قـــررت وزارة الـــتـعـليـــم تـدريـــس
هـــذا الـكـتـاب وطـبـعـه عـلـى نفقتها

وزارة التـعـــليم
Ministry of Education

المملكة العربية السعودية

Business Decision Making

Secondary Stage – Pathways System
Second Year

The book is distributed freely and cannot be sold.

1448-2026 Edition

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Introduction

The progress and development of countries can be measured by their ability to invest in education and by the extent to which their educational system responds to the requirements and changes of the age. It is the responsibility of the Ministry of Education to sustain the development of its educational systems. In response to the concept of Saudi Arabia's Vision 2030 policy, the Ministry has taken the initiative in adopting the Secondary Education Pathways system with the aim of bringing about effective and comprehensive reform at the secondary stage.

The Secondary Education Pathways system provides a distinguished and modern educational model for secondary education in Saudi Arabia, which efficiently contributes to:

- Strengthening the values associated with belonging to our homeland, the Kingdom of Saudi Arabia, and of loyalty to its wise leaders, may Allah protect them, based on pure belief founded on tolerant Islamic teachings.
- Strengthening the values of citizenship by focusing on them in the school curriculum and in class activities, in line with the demands of sustainable development and the development plans of Saudi Arabia, which emphasize the consolidation of the duality of values and identity, founded on the teachings of Islam and moderation.
- Offering qualifications to students that are in line with future specializations in universities and colleges or the required professions, and ensuring that educational outputs are consistent with the requirements of the labor market.
- Enabling students to pursue education along their preferred track at an early stage, according to their inclinations and abilities.
- Enabling students to enrol in specific scientific and administrative disciplines related to the labor market and future jobs.
- Integrating students into an enjoyable and stimulating learning environment within the school, based on a constructive philosophy and applied practices within an active learning environment.
- Guiding students on an integrated educational journey from the primary stage to the end of secondary stage, and facilitating the process of their transition to the post-general education stage.
- Providing students with the technical and personal skills which will help them to deal with life and to respond to the requirements of the stage they are at.
- Expanding opportunities for graduate secondary school students through various options in addition to universities, such as by obtaining professional certificates, joining applied colleges, and obtaining job diplomas.

The Pathways system consists of six semesters taught over three years, including a common first year in which students receive lessons in various scientific and human fields, followed by two specialized years during which students follow a general pathway as well as four specialized pathways consistent with their inclinations and abilities. These are: the Legal Pathway, the Business Administration Pathway, the Computer Science and Engineering Pathway, and the Health and Life Pathway. This makes this system the best option for students in terms of:

- The existence of new study materials that comply with the requirements of the so-called Fourth Industrial Revolution and its associated development plans, as well as the Saudi Vision 2030 policy which aims to develop higher-order thinking, problem solving, and research skills.
- Elective field programs which are consistent with the needs of the labor market and the students' own preferences. This enables students to enrol in a specific elective field according to a specific job skills matrix.
- An "inclination" scale that ensures the attainment of students' efficiency levels and effectiveness, and helps them to determine their own tendencies, predispositions, and strengths—all of which enhances their chances of success in the future.
- Volunteer work designed specifically for students in line with the philosophy of activities in schools, which is also one of the graduation requirements. This helps to promote humane values, build up society, and ensures its development and cohesion.
- A transfer procedure that enables students to move from one pathway to another according to specific mechanisms.
- Proficiency classes in which skills are developed and achievement levels improved, by providing intensive and remedial lessons.

- Options for combining education with e-learning and blended learning/teaching, which are built into the Pathways system for reasons of flexibility, convenience, interaction, and effectiveness.
- A graduation project that helps students to integrate theoretical experiences with applied practices.
- Professional and skill-based certificates that are awarded to students after completing specific tasks and certain tests in partnership with specialized bodies.

The Business Administration Pathway is one of the paths developed at the secondary level. It contributes to achieving best practices by investing in human capital and providing students with the knowledge, experience, and skills that will allow them to keep pace with the Fourth Industrial Revolution and the challenges of the 21st century. This pathway also seeks to provide students with the necessary skills to deal with the administrative and financial challenges of the digital economy era in order to ensure a stable economic future. This is driven and supported by: 1) the contents of the Saudi Vision 2030 policy, 2) the two associated programs for developing human capabilities and the quality of life, and 3) the labor market's need for qualified personnel to work in future jobs. The pathway is also intended to promote the values of hard work, discipline, determination, perseverance, positivity, flexibility, national values, enhanced national identity, support for a culture of innovation and entrepreneurship, support for the value of volunteer work—all to prepare students for the labor market and to expand educational opportunities for them. It may also contribute to preparing students to continue their studies at university level, or to obtain professional certificates in one of the related disciplines.

"Business Decision Making" is one of the main subjects in the Business Administration Pathway. It helps students to:

- Become familiar with and grasp the most important basic concepts of decision making.
- Understand business problems, find appropriate solutions, and then use these to fully comprehend the reality and make good decisions for the future.
- Appreciate the importance of identifying problems and finding the most important methods for resolving them.
- Develop an awareness of the alternative solutions available and how to choose the optimal alternative using intuitive or methodological and critical-thinking methods.
- Similarly, develop an awareness of how these methods can be beneficial in solving life and practical problems, and making decisions at the personal, societal, and professional levels.

The subject emphasizes the importance of using quantitative methods in decision making and includes practical and technical exercises to practice what the students have learnt, in order to assist them in solving realistic problems that develop their cognitive skills, under the guidance and supervision of the teacher.

This book "Business Decision Making" is characterized by promoting creative thinking and innovation using technical tools that support the modern decision-making methodology. The book emphasizes important aspects represented by:

- The close connection between the content and real-life situations and problems.
- Presenting the content in diverse, attractive, and interesting ways.
- Highlighting the role of the student in the teaching and learning processes.
- Paying attention to the coherence of its content, which forms an integrated whole.
- Encouraging interest in employing technology in different situations.
- Encouraging Interest in employing a variety of methods in evaluating the students, taking into account the individual differences between them.

In order to keep pace with global developments in this field, the book "Business Decision Making" provides the teacher with an integrated set of diverse educational materials that take into account the individual differences between students. Furthermore, it gives references to educational software and websites, all of which provide students with the opportunity to employ modern technologies and practice-based communication that serve to further confirm the book's role in the teaching and learning process.

Finally, we ask Allah the Almighty to grant that this book may contribute to preparing and qualifying our sons and daughters as students for the world of work and business, and that it may act as an incentive to invest their energies wisely, to build their future, and to contribute to the development of their country.

It is Allah who grants success!

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Foreword

On a cold January morning in 1986, the Space Shuttle Challenger was launched from the Atlantic coast of the United States on its tenth mission. The flight was broadcast live throughout the world, and millions watched as the rockets ignited and carried the shuttle up into the sky. 73 seconds into the flight, one of the solid rocket booster engines exploded, destroying the shuttle and causing the death of its seven crew members. It was one of the most tragic disasters in the history of the American space program. The explosion was blamed on the failure of two O-ring seals in the booster rocket, but the real cause of the disaster was later found to be a case of bad decision making.

The freezing temperatures that day reduced the elasticity of the rubber O-rings which caused them to fail and leak fuel. Engineers were concerned about the effects that the cold weather would have on the integrity of these systems, voiced their reservations, and recommended that the launch be delayed until a day when the temperatures were warmer. However, managers and NASA officials ignored these warnings and made the decision to proceed with the launch. By giving in to what was most certainly enormous pressure to carry on with the mission, their poor decision had catastrophic results.

Life is all about making decisions. From the moment you wake up in the morning until you fall asleep that night, you are constantly making choices and decisions. How many decisions do we make? The number of daily decisions could exceed 100. Whether these are part of your personal or professional life, you are defined by your decisions. If you want your life to follow a particular path, be sure to make decisions carefully, and make the right choices.

Many of the decisions we make each day are routine, and we barely give them a thought. You probably don't spend much time each day thinking about which route you'll take to go to school. You have a routine and the decision becomes automatic. The more challenging decisions are the ones we don't make regularly. This is especially true when the decision is important and has broader implications. Some of the important decisions that many students face include:

- Shall I go on to study at college?
- Which field should I study?
- What profession would I like to go into?
- Where do I want to live and work after finishing school?

Each of these choices will have a major impact on our life's direction. Imagine the outcome if we made important decisions like these randomly or without careful thought?

Important decisions are also a large part of professional life. Consider these examples:

- A manager deciding which job applicant to hire
- A banker deciding whether or not to approve a business loan
- A doctor making decisions about how best to treat a critically-ill patient

In each of these situations, making a thoughtful and informed decision will improve the likelihood of a positive outcome (for example, hiring a good employee, making a productive loan, helping a patient to recover). If these decisions aren't made carefully, we can imagine the negative outcomes that might follow.

Being able to effectively make decisions in the workplace can make you a better employee, manager, and leader. Good decisions have many positive benefits for you and the organization you will work for. Everyone makes numerous decisions every day,

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so knowing why decision making is important, and always improving your decision-making skills, will enhance your performance and work productivity.

On the job, decision-making skills can distinguish you from others and contribute to your professional growth and career development. Depending on your position in the organization, your decisions and choices may also impact other employees and affect their performance as well. The better you are at making decisions, the more success you will experience in your position. Demonstrating your decision-making skills at work can be beneficial when seeking promotions and managerial positions.

Complex decisions aren't only made by individuals. Schools, businesses, public agencies, and even nations must make operational and strategic decisions as they seek to move forward. These are often challenging as the decisions typically affect many people, each of whom may have a different idea about how best to act. Consider the example of Saudi Vision 2030. This was launched with the support of the Custodian of the Two Holy Mosques, may God protect him, and it is the vision of His Royal Highness Crown Prince Mohammad Bin Salman, for the future of this great country. Since the development of Saudi Vision 2030 in 2016, the Kingdom has witnessed changes and development on different levels in the Saudi community. This vision is a wise example of the power and importance of making complex decisions.

Saudi Arabia's economy is heavily reliant on oil exports and has been since the discovery of oil in 1938. Oil is thought to make up 30–50% of Saudi GDP. (GDP, gross domestic product, is a measure of a country's economic output.) Its leaders recognize that the country would benefit from change, but how best to accomplish this? Many important and difficult decisions were made about different aspects of Saudi life, culture, and society. These decisions culminated in the Saudi Vision 2030 plan, a strategic framework designed to:

- Reduce dependence on oil
- Diversify the country's economy
- Develop public-service sectors including: Healthcare, Education, Infrastructure, Recreation/Entertainment, and Tourism

Saudi Vision 2030 is translated into strategic goals to empower effective execution through programs that aim to implement the vision through three main pillars:

1. A resilient society
2. A prosperous economy
3. An ambitious country

Saudi Vision 2030 is based on the following competitive benefits for Saudi Arabia:

- To become the heart of the Arab-Islamic world
- To become a powerful global investor
- To become a hub connecting Africa, Asia, and Europe

Saudi Vision 2030 represents the combined efforts of many people under the leadership of Crown Prince Mohammed bin Salman. Since its introduction in 2016, the country has seen changes and developments throughout society. Saudi Vision 2030 is an example of the power and significance of complex decision making.

Making good decisions is easier when we understand and follow sound decision-making practices. In this book, you will learn about this important process and how to approach problems logically and rationally. You will learn powerful decision-making strategies that you will use throughout your personal and professional life.

This book is written in a way that makes learning simple and enjoyable. Important concepts are broken up into short lessons. Each of these can be quickly read and understood. The lessons are colorfully illustrated to help reinforce each concept. In addition, your teacher may assign learning activities to give you an opportunity to practice these new skills. The structure and features of each lesson are detailed in the Preface of this book.

Good decision making is an important personal and professional skill; one that you'll develop and improve throughout your life.

Preface

Welcome to *Business Decision Making*. This book is divided into 15 chapters. See the illustrations on the right to learn more about the pedagogical and design elements of a typical lesson.

Chapters 1–9 present only the most important information about the featured skill. Absorbing and retaining a limited number of key ideas makes it more likely that students will retain and apply the skill in a real-life situation.

Chapters 10–15 build upon the students' prior experience with spreadsheets by focusing on how Microsoft Excel is used for data modeling, decision-making, and analysis. Students will build upon their existing skills and develop new ones, before working on four exciting projects that focus on how business decisions are modeled and analysed.

Hands-on Activities

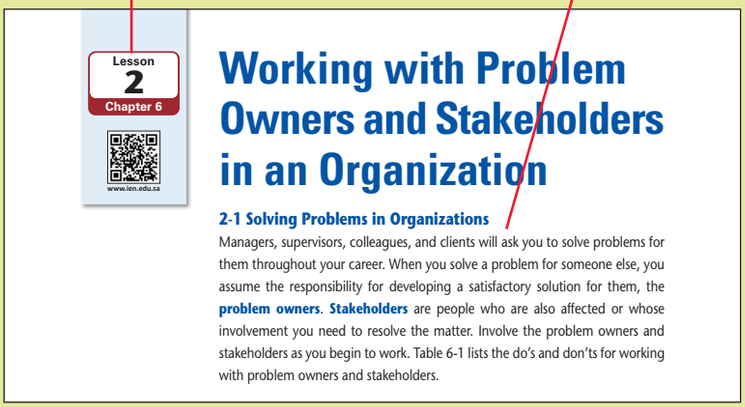
Every lesson in Chapters 1–9 contains a You Try It exercise, where students demonstrate their understanding of the lesson skill by completing a task that relates to it. The steps in the You Try It exercises are often general, requiring that students use critical thinking to complete the task.

Real-world Advice and Examples

To help put lesson skills in context, many lessons contain yellow shaded boxes that present real-world stories pulled from today's workplace. Some lessons also contain Do's and Don'ts tables, featuring key guidelines on what to do and not do in certain workplace situations relating to the lesson skill. The Technology @ Work lesson at the end of every chapter covers the Internet and other technologies relating to the chapter.

Each lesson focuses on a single learning objective.

Short introduction reviews key lesson points and presents a real-world case study to engage students.



Lesson 2
Chapter 6
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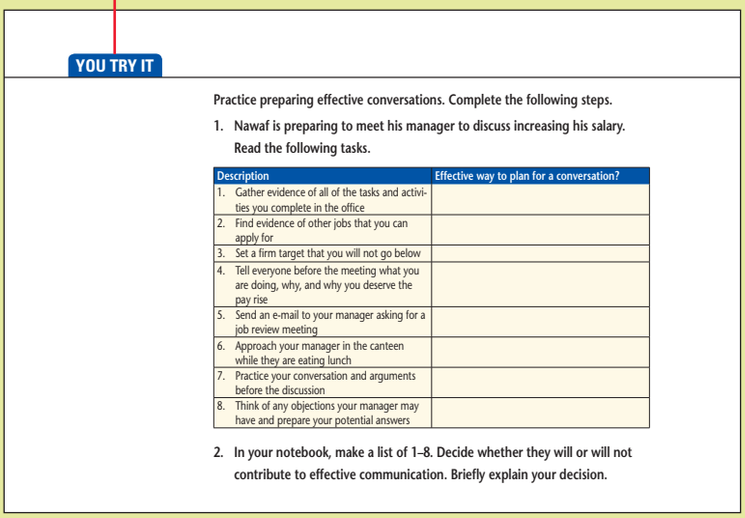
Working with Problem Owners and Stakeholders in an Organization

2-1 Solving Problems in Organizations

Managers, supervisors, colleagues, and clients will ask you to solve problems for them throughout your career. When you solve a problem for someone else, you assume the responsibility for developing a satisfactory solution for them, the **problem owners**. **Stakeholders** are people who are also affected or whose involvement you need to resolve the matter. Involve the problem owners and stakeholders as you begin to work. Table 6-1 lists the do's and don'ts for working with problem owners and stakeholders.

You Try It activities let students perform tasks to demonstrate their understanding of the lesson objective.



YOU TRY IT

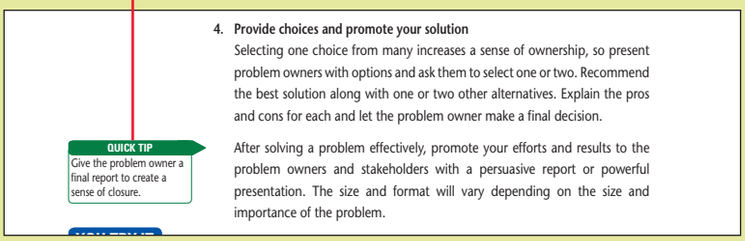
Practice preparing effective conversations. Complete the following steps.

1. **Nawaf is preparing to meet his manager to discuss increasing his salary. Read the following tasks.**

Description	Effective way to plan for a conversation?
1. Gather evidence of all of the tasks and activities you complete in the office	
2. Find evidence of other jobs that you can apply for	
3. Set a firm target that you will not go below	
4. Tell everyone before the meeting what you are doing, why, and why you deserve the pay rise	
5. Send an e-mail to your manager asking for a job review meeting	
6. Approach your manager in the canteen while they are eating lunch	
7. Practice your conversation and arguments before the discussion	
8. Think of any objections your manager may have and prepare your potential answers	

2. **In your notebook, make a list of 1–8. Decide whether they will or will not contribute to effective communication. Briefly explain your decision.**

Quick Tip boxes give students short pieces of practical advice on how to put skills successfully into practice.



4. **Provide choices and promote your solution**
   Selecting one choice from many increases a sense of ownership, so present problem owners with options and ask them to select one or two. Recommend the best solution along with one or two other alternatives. Explain the pros and cons for each and let the problem owner make a final decision.

   After solving a problem effectively, promote your efforts and results to the problem owners and stakeholders with a persuasive report or powerful presentation. The size and format will vary depending on the size and importance of the problem.

QUICK TIP
Give the problem owner a final report to create a sense of closure.

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TABLE 6-1: Working with problem owners do's and don'ts

Guidelines	Do	Don't
Initial discussion	• Discuss the problem with the stakeholder • Ask questions to define the problem • Ask for suggested solutions • Make sure you include all the details • See the problem from the stakeholder's perspective • Separate opinions from facts	• **Don't** accept the stakeholder's solution as the only one • **Don't** confuse the stakeholder's opinion with substantiated facts
Progress	• Communicate the progress you make toward solving the problem • Use e-mail and memos to document your progress • Recommend an ideal solution and one or two alternatives • Demonstrate why you suggest one solution over another	• **Don't** overwhelm others with communication • **Don't** surprise the stakeholder by trying a solution without their participation or approval • **Don't** present only one possible solution • **Don't** fail to do your homework
Solution	• Promote effective solutions • Present the solution in a report or presentation	• **Don't** overpromote yourself, but don't let the credit for the solution go to someone else either

Do's & Don'ts tables present key tips for what to do and not do.

How are these two team members working together effectively?

Certain lessons feature illustrations of examples discussed in the lesson, and act as prompts for discussion and further thought.

REVIEW QUESTIONS

1. **An organizational structure where every worker is equal is sometimes described as:**
   a. equal
   b. long
   c. flat
   d. a pyramid
2. **Which of the following is *not* a way for a company to measure your performance:**
   a. KPIs
   b. job interview
   c. appraisal
   d. statistical data

Review Questions provide multiple-choice questions that test students' understanding of the lesson material.

Blogging is writing

More than other forms of electronic communication such as e-mail, blogs are crafted pieces of writing that people can access long after they are first published on a Web site. If you are writing a blog, at a minimum, make sure you are using clear sentences and a logical organization for your ideas. Build on these fundamentals with the following techniques to devise an appealing and useful blog:

- *Include descriptive titles and headings:* Your titles and headings tell potential visitors what you are writing about. Make sure these elements use concrete details and active verbs.
- *Get to the point:* People read content on the Web more quickly than they do printed material. Make your point quickly—in the first sentence, if possible. Write economically throughout the post so people keep reading.
- *Stick to one topic:* A blog post can be long or short, but it should cover a single topic. An effective strategy is to present a single problem, discuss a solution, and then describe the results. Support your ideas with facts and references. Come to conclusions based on evidence rather than unsupported opinions.
- *Make it worth your reader's time:* Share knowledge and experiences to teach your readers or stimulate them to think. Write with energy and conviction, and show readers something in a new way to make your post worthwhile.
- *Edit and revise before publishing:* You can write quickly to put your words on the page, but those ideas are likely to remain fuzzy unless you edit them. Professional writers spend more time editing and revising than writing first drafts. Make sure the words you post on a blog today will be valuable and clear in the future.

News to Use boxes provide real-world stories related to the lesson topic.

Definition Boxes

Each chapter includes key terms which are highlighted in blue throughout the main text and are accompanied by definitions in boxes which explain the meaning of these terms. These are useful for revision and reference after reading a chapter, to reinforce the concepts discussed. All key terms and their definitions are collated in the Glossary at the back of the book.

Lessons and Exercises

Each chapter contains a series of lessons, or learning objectives. Chapters 1–5 use a fictional adventure travel company as the case study. The assignments in the Extra Practice section at the end of Chapters 1–11 increase in difficulty. The exercises and case studies provide a variety of interesting and relevant business applications. Assignments include:

- **Real Life Independent Challenges** are practical exercises where students can apply the skills they learned in an activity that will help their own lives. For instance, they might create a resume, write a business letter to a company, or research a potential employer and prepare a report on their findings.
- **Team Challenges** are practical projects that require working together in a team to solve a problem.
- **Be the Critic Exercises** are activities that require students to evaluate a flawed example and provide ideas for improving it.
- **Critical Thinking Questions** pose topics for discussion that require analysis and evaluation. Many also challenge students to consider and react to realistic critical thinking and application of the skills taught in the relevant chapter.

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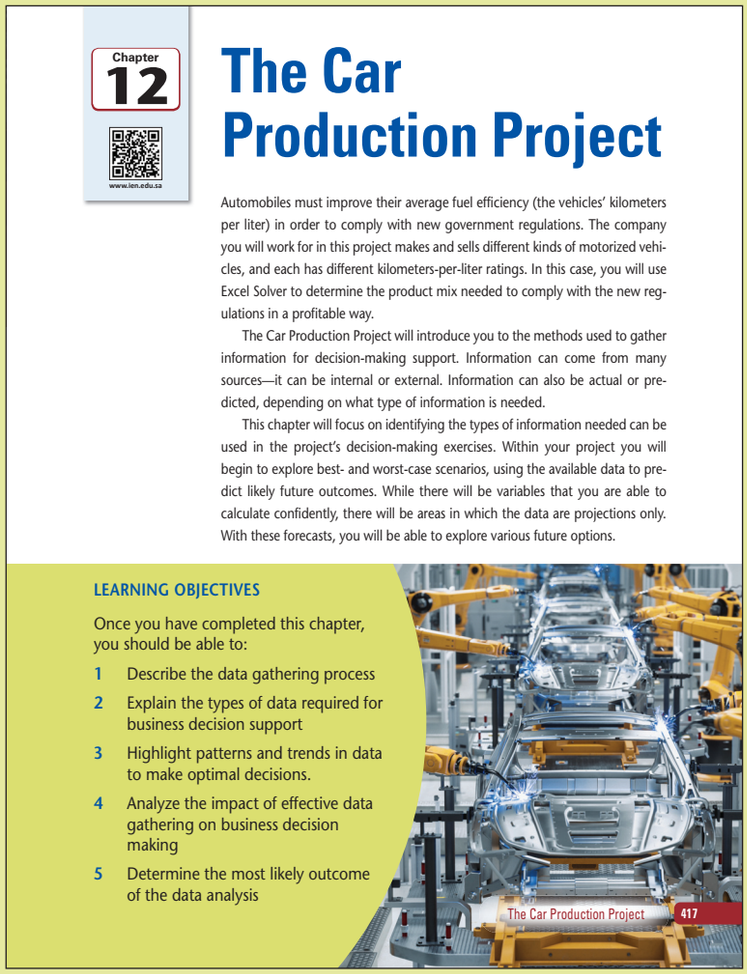
Hard Skills

Chapter 9 explores the fundamentals of data analysis to support the decision-making process. In the final lesson of this chapter, Q&A features provide additional step-by-step hints.

Project-based Learning

Chapters 12–15 focus on project-based learning which engages students in completing cases where they model and analyze data, and solve realistic problems for businesses in the fields of production, environment, and finance. Students are guided through the process of using spreadsheets to make data-driven decisions.



Chapter 12

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The Car Production Project

Automobiles must improve their average fuel efficiency (the vehicles' kilometers per liter) in order to comply with new government regulations. The company you will work for in this project makes and sells different kinds of motorized vehicles, and each has different kilometers-per-liter ratings. In this case, you will use Excel Solver to determine the product mix needed to comply with the new regulations in a profitable way.

The Car Production Project will introduce you to the methods used to gather information for decision-making support. Information can come from many sources—it can be internal or external. Information can also be actual or predicted, depending on what type of information is needed.

This chapter will focus on identifying the types of information needed can be used in the project's decision-making exercises. Within your project you will begin to explore best- and worst-case scenarios, using the available data to predict likely future outcomes. While there will be variables that you are able to calculate confidently, there will be areas in which the data are projections only. With these forecasts, you will be able to explore various future options.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Describe the data gathering process
2. Explain the types of data required for business decision support
3. Highlight patterns and trends in data to make optimal decisions.
4. Analyze the impact of effective data gathering on business decision making
5. Determine the most likely outcome of the data analysis

The Car Production Project 417

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Airline Deliverables

You have built a series of worksheets to determine the best plane assignments with which to maximize profits and minimize costs.

1. As you have done with the other cases in this book, you now need to present your findings to Airline Company's executives in the form of a short report. Scan the QR code to access the report template (**Report template.dotx**).

   You should now be familiar with how to fill out the report, and the kind of information you need to include.

2. In the Results section, you will need to explain whether you think the current plane assignment method is still profitable, providing evidence to support your decision.

3. In the Analysis section, look again at your Airline Company Guess and your Airline Company Solver worksheets. Write a paragraph comparing the results in each, discussing how accurate your guess was at predicting the results found in Solver. Consider the following questions:

   What can you learn from this difference?

   How important is the use of DSS in the process of optimization?

4. When your report is complete, save it by selecting Save from the file menu, and use the file name format: **YourName - Airline - Report.docx**.

5. Summarize your report in an oral presentation to your class.

   Prepare a 5-minute presentation for your class explaining your findings.

   You might want to use PowerPoint slides, and perhaps even print out copies of your report to distribute to your class. Be prepared to take questions at the end.

   Your role as a presenter is to provide clear and accurate information, and explain your analysis and recommendations. Your role as an audience member is to imagine you are one of Airline Company's executives, and to ask the presenter about anything you think they need to explain further.

6. Congratulations! You have completed this semester's work on Business Decision Making.

The Airline Project 507

Deliverables

Chapters 12–15 conclude with an opportunity for students to complete the process of modeling and analyzing the data they have been gathering for each project. They will be guided to complete a report that could be presented to the company's CEO, managers, or board of directors that clearly explains and analyzes their options—backed up by the data—and helps them to reach an informed business decision.

In Chapter 15, students are encouraged to take this process a step further, with the challenge to present their findings to their teacher and class, as if presenting to the company's board. Presenters will need to think about how they will communicate their ideas clearly and persuasively, while the listening students must demonstrate their engagement by asking thoughtful questions informed by their own experience of the project and the critical thinking exercises completed at the end of Chapters 10 and 11.

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What decisions have you made today?

What decisions will you have to make about going to university or college?

What decisions will you have to make about deciding on a career?

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Think back to an important decision you made, either recently or in the past, and answer the following questions:

1. **What decision did you make?**

2. **What were the main factors that affected your decision?**

3. **What was the outcome of your decision? Would you make the same decision again? Explain your answer.**

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4. **Were there any solutions you overlooked? If so, what were they?**

5. **Were there any unforeseen outcomes? If so, what were they?**

6. **Did this decision have a positive or negative effect on you?**

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Part 1

Chapter 1: Identifying and Defining Problems

Chapter 2: Solving the Problem

Chapter 3: Thinking Critically

Chapter 4: Group Decision Making and Problem Solving

Chapter 5: Decision Support Tools

Chapter 6: Decision-Making Processes in Organizations

Chapter 7: Managing Teams to Support Decisions in Organizations

Chapter 8: Organizational Communication and Decision Making

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Chapter 1

Identifying and Defining Problems

Whether you are working in a large or small company, or preparing to start a career, you are likely to spend time making decisions and solving problems. Although problems can cause frustration and substantial difficulties, creative thinkers and successful professionals learn to view them as opportunities for improving a business, service, or task because they compel you to recognize and confirm your goals. This chapter outlines the process of solving problems, discusses how to analyze problems and their causes, and identifies common problem-solving pitfalls. case You are working at an adventure travel company as an assistant to Omar, the vice president of finance. Tour sales at the company have not increased in many months, even during the height of the summer travel season. Omar is in charge of a new project called 12 by 12 that is looking for a solution to this problem. The goal of the project is to increase sales by 12%. As an assistant, you are helping him identify problems customers have with the company's tours and with traveling overall. Omar asks you to learn more about creative thinking and problem solving to contribute productively to the 12 by 12 project.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Understand problem solving
2. Analyze problems
3. Develop effective problem statements
4. Identify and manage risks

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Lesson
1
Chapter 1

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Understanding Problem Solving

To be an effective business decision maker, every professional should be a problem solver. You can learn and develop the skill of solving problems over time to help support successful decision making. People who can identify, define, and solve problems are valued members of an organization. Developing this ability will contribute to the success of your career as you seek positions with greater responsibility. Table 1-1 compares the do's and don'ts of effective problem solving. case To prepare for an upcoming 12 by 12 project meeting to discuss goals and assign tasks, Omar asks you to develop a list of problem solving guidelines to guide decision making.

TABLE 1-1: Problem solving do's and don'ts

Guideline	Do	Don't
Identify yourself as a problem solver	• Feel confident you can solve the problem	• **Don't** give up easily if one idea does not work
Recognize problems	• Consider problems as opportunities to find innovative solutions • Define and then redefine the problem	• **Don't** ignore problems until they are too big to solve easily • **Don't** stick to your original conception of the problem if you are having trouble finding a solution
Select an approach	• Use your intuition for simple problems • Follow a systematic process for complex problems • Review and reconsider the problem, your goals, and possible solutions • Consider the problem from different perspectives	• **Don't** create a detailed procedure that is difficult to complete or duplicate • **Don't** jump to conclusions
Make decisions	• Consider all the alternatives before selecting one • Trust your intuition, but make sure the facts support your decision	• **Don't** make rash decisions • **Don't** second guess yourself if you feel you made the right choice

Details

Consider these guidelines as you begin solving problems to guide decision making:

- **Identify yourself as a problem solver**

  One day, you are likely to enter employment. Whether you are a member of staff or management, much of what you do every day is solve problems and make decisions. In fact, the role of a problem solver is one that distinguishes the professional from the line worker. People who are new to the workforce

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often solve problems by reacting to them. However, you are more effective if you use an organized approach to problem solving.

QUICK TIP
Variations on problems include dilemmas, paradoxes, and difficulties, such as trouble performing tasks.

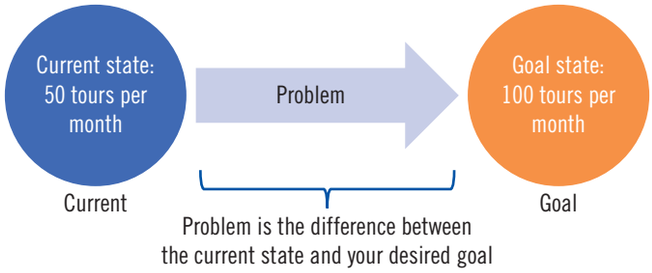
- **Recognize problems**

Learn to recognize problems so that you see them developing and can act quickly to solve them. A dictionary defines a problem as an unsettled question or the source of distress or difficulty. In an organization, a **problem** is an obstacle that stands in the way of achieving a desired goal. In short, a problem is the difference between the current state and where you want to be. For example, if you expect to sell 100 tours each month, but are only selling 50, then you have a problem. See Figure 1-1.

DEFINITION

Problem: In an organization, an obstacle that stands in the way of achieving a desired goal. In short, a problem is the difference between the current state and where you want to be.

FIGURE 1-1: Defining a problem



QUICK TIP
No single or simple set of steps solves every type of problem. Most solutions involve creative thinking and logical exploration.

- **Select an intuitive approach for solving problems**

People usually solve problems in one of two ways: intuitively or systematically. **Intuition** is your knowledge of something without having to discover or learn it, and it is typically your first reaction to a problem or question. When you solve a problem intuitively, you react immediately and instinctively, without following a particular procedure. This reactive approach is well suited to situations where you need to make a quick decision or solve a routine problem. In those cases, you can often use your common sense to decide on a solution. For example, if the problem is that customers often have to wait to receive brochures for the popular Al Wahbah crater tour, you can solve the problem by printing additional brochures.

DEFINITION

Intuition: Your knowledge of something without having to discover or learn it; typically your first reaction to a problem or question. When you solve a problem intuitively, you react immediately and instinctively, without following a particular procedure.

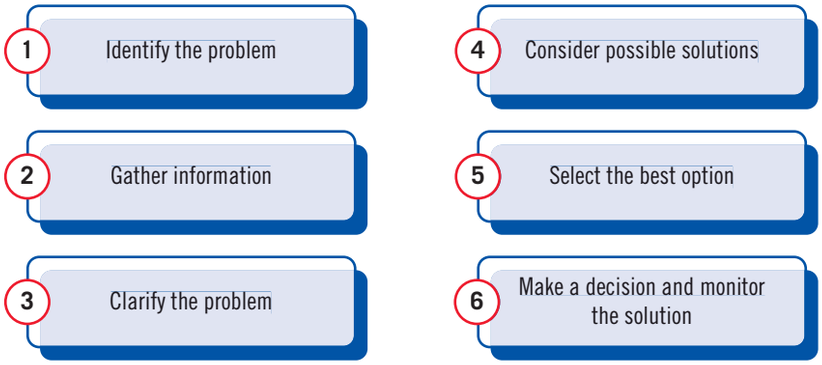
- **Select a systematic approach for solving problems**

When you are **systematic**, you solve a problem in a methodical and organized manner. Systematic problem solving takes a reasoned, rational approach and is appropriate for larger, more complicated problems or situations that involve a lot of risk. One systematic problem-solving method is to adapt a solution from a prior problem and apply it to your current situation. For example, one way to begin solving the problem of declining sales at the travel company you're working at is to examine advertising campaigns that increased sales in the past. Figure 1-2 lists the basic problem-solving steps.

DEFINITION

Systematic: Doing something such as solving a problem in a methodical and organized manner. Systematic problem solving takes a reasoned, rational approach and is appropriate for larger, more complicated problems or situations that involve a lot of risk.

FIGURE 1-2: Basic problem-solving steps



- **Make decisions**

A major part of problem solving involves making effective decisions. **Decisions** are choices you make when faced with a set of options or alternatives. You can also think of decisions as tiny problems you need to solve, and

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then apply problem-solving techniques to guide your choices. As you improve your problem-solving skills, you will naturally develop your decision-making ability as well.

DEFINITION

Decision: A choice you make when faced with a set of options or alternatives.

REVIEW QUESTIONS

1. **What is a problem for an organization?**
   - **a.** Choice made when faced with a set of alternatives
   - **b.** Difference between a professional and line worker
   - **c.** Set of objectives or goals
   - **d.** Difference between current state and goal state
2. **Which of the following should you not do when solving problems?**
   - **a.** Define the problem
   - **b.** Accept the first solution
   - **c.** Gather information
   - **d.** Make a decision

Lesson
2
Chapter 1

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Analyzing Problems

Many companies around the world rely on their employees to identify problems and solve them. That is why people who can effectively solve problems are valuable members of an organization. Much of the effort in problem solving involves understanding what the underlying issues really are. Look for the root causes, related information, ideas, risks, costs, and benefits associated with problems. Defining the real problem is the first major milestone on the way to a solution. It frequently takes as much time to identify and understand the problem as it does to solve it. Table 1-2 summarizes the do's and don'ts for analyzing problems. case Omar asks you to determine whether the decline in sales is part of a trend for the entire travel industry or if it is unique to the company.

TABLE 1-2: Analyzing problems do's and don'ts

Guidelines	Do	Don't
Identification	• Look for possible deficiencies, shortcomings, and other types of problems • Ask questions of people involved to find out why goals are not met • Gather data from other sources	• **Don't** overlook or ignore possible problems • **Don't** limit yourself to a single type of information
Observation	• Observe where and how the problem occurs, if possible • Ask "what," not "who" • Assure people that you respect their ideas, opinions, and suggestions	• **Don't** intimidate people involved with the problem; ask for their cooperation • **Don't** threaten others so that they undermine the solution
Confirmation	• Review the data you gathered to confirm that you've correctly identified a problem	• **Don't** start solving the problem unless you are confident you identified it thoroughly

Essential Elements

1. **Look for deficiencies**

   A problem is only a problem when you are aware of it. Most organizations have a constant stream of difficulties, though they frequently overlook or ignore many because of time or other constraints. The first step in the problem-solving process is to identify shortcomings, deficiencies, or dissatisfactions. Be observant, ask questions, and develop sensitivity for subtle problems.

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2. **Interview and gather data**

Talk to people who are involved with the problem, work in the area, or may be affected by your solution. Learn all that you can about the problem and possible solutions. The best insights often come from the least obvious people and sources. Gather enough information to develop a representative sample. Figure 1-3 outlines ways to gather information.

FIGURE 1-3: Gathering information

Resource	Type of information
Electronic	General information on Web sites, databases, or USB drives
Print	Background information available in books, newspapers, and periodicals
Primary	Direct observations, interviews, questionnaires
Informal	Organization files, conversations with colleagues, informal surveys

QUICK TIP

As you observe and discover information, you might have to redefine the problem.

3. **Observe as much as you can**

You often learn the most about a problem through observation. You can observe a problem directly by watching an interaction, for example, or experiencing the problem yourself. You can also rely on the direct observations of others to describe current or past difficulties. When you use observed data, be sure to document details such as the date, time, and other factual information about the observation and the problem.

4. **Ask what, not who**

   When gathering information, focus on objective facts. Ask "what?" not "who?". Investigating problems can make people apprehensive, and they might withdraw as a consequence. Assure everyone that you are seeking their help and that you value and respect their ideas, opinions, and suggestions.

5. **Have a reality check**

   When you identify a suspected problem, ask yourself if it makes sense in light of the data you've collected. Trust your instinct and wait to start solving the problem until you are comfortable with your conclusion. If you are not satisfied, take more time to redefine the problem. Ask other people for opinions and advice.

YOU TRY IT

Practice analyzing problems by listing the steps you would take to analyze a problem. Complete the following steps.

1. **Get ready**

   Read the following descriptions of the travel company you're working at and its problem.

   Company description: A tour company based in Riyadh that organizes adventure, cultural, and educational tours in Saudi Arabia. The company's travelers enjoy activities ranging from hiking to wildlife spotting, while becoming familiar with the culture of the region—the food, the people, and the history.

   The company sponsors tours to the various provinces of Saudi Arabia. Customers are usually traveling for pleasure, though the company occasionally organizes business trips.

   Problem: Typically, the late spring and summer months are the most popular times for personal travel. For the last five years, the top sales months have been April–August. This year, however, sales did not increase during these months. For the first time in five years, the company's annual sales are declining—they now expect to make less this year than last year.

2. **Now you try it**

   Based on the information available, list the next steps you would take to analyze this problem. Tip: Note that this question is about nurturing your analytical skills. Is there enough background information to solve the problem?

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If not, how would go about gathering the information needed? You may wish to revisit the steps provided in Lesson 2 of Chapter 1.

REVIEW QUESTIONS

1. **The first step in problem solving is to:**
   - **a.** make a decision
   - **b.** describe the problem-solving traps
   - **c.** identify shortcomings
   - **d.** communicate your progress
2. **Which of the following is a primary resource of information about a problem?**
   - **a.** Observation
   - **b.** Web site
   - **c.** Magazine article
   - **d.** Organization files

Lesson 3
Chapter 1

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Developing Effective Problem Statements

As you solve problems, communicate clearly and succinctly about what you are doing and the progress you are making. Start by providing a statement of the problem. A **problem statement** is a clear, concise description of the problem and the effect you expect from the solution. Its purpose is to describe a single problem objectively, not to find a cause, assign blame, or define the solution. Include the problem statement in your proposals, progress reports, and discussions with stakeholders. Table 1-3 outlines the do's and don'ts of developing a problem statement. case After gathering data about the problem of the company's declining tour sales, you are ready to summarize your understanding of the problem in a problem statement you include in a progress report for Omar.

DEFINITION

Problem statement: A clear, concise description of the problem and the effect you expect from the solution.

TABLE 1-3: Problem statement do's and don'ts

Guidelines	Do	Don't
Purpose	• Describe a single problem • Use objective measures	• **Don't** address more than one problem • **Don't** identify causes • **Don't** assign blame • **Don't** describe the solution
Audience	• Provide the problem statement to the person who is supervising or approving your problem-solving activities • Involve others who are helping to solve the problem	• **Don't** give the problem statement to everyone in the organization
Content	• Identify the ideal situation from the point of view of your audience • Describe the condition that prevents the ideal situation • Identify symptoms • Describe the size and scope of the problem objectively • Identify consequences	• **Don't** list every condition or symptom; focus on the most important ones • **Don't** offer opinions about possible consequences

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Essential Elements

1. **Describe the ideal situation**

   Frame the problem for your audience by starting with a brief description of the ideal situation. A problem represents a deviation from the norm. By describing the desired state, you help others understand the current situation. Use terms and comparisons that your audience considers important.

2. **Briefly summarize the problem**

   Contrast the ideal situation with the current state. Identify the condition that is preventing the goal, outcome, or state from being achieved.

QUICK TIP
Describe objective symptoms of the problem that others can observe.

3. **Identify symptoms of the problem**

   Let your audience know where the problem is manifesting itself. Describe the symptoms of the problem that others can see or detect so they understand the problem you are working on.

QUICK TIP
Use numbers and other specific, concrete details to describe the problem.

4. **Describe the size and scope of the problem**

   Stakeholders and other interested people will try to assess how significant the problem is. Help them to do this by providing information about the size and scope of the matter.

How would you describe the size and scope of the problem?

5. **Identify the consequences**

   Use specific detail to describe how the problem affects your audience and the organization. Identify any direct and indirect costs associated with the problem. Emphasize the benefits of your work by outlining the consequences of a solution.

6. **Explain any other research or investigation that you may pursue**

   Your problem statement is likely to be a work in progress. If you are still collecting data, interviewing affected parties, or developing alternative solu-

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tions, let your audience know. Your understanding of the problem may change as new information becomes available. See Figure 1-4.

FIGURE 1-4: Parts of a problem statement

Ideal situation:
Based on previous years, tour sales overall should be steady, with an increase in trips to adventure travel destinations.

Problem summary:
Customers report that worries about the global economy and international airline services are preventing them from traveling.

Consequences:
Plans to add tours, develop our Web site, and expand staff are now on hold until we can solve this problem.

Symptom:
Tour sales in all areas have decreased by 8%, with no increase in adventure travel.

Size and scope:
Even our most popular Saudi Arabian tours show no increase in enrollment, despite heavy promotion.

Research:
50% of tour companies reported significant loss of revenue last year.

YOU TRY IT

Practice developing effective problem statements by writing a problem statement. Complete the following steps.

1. **Get ready**

   Read the following description of a problem.

   Problem: Typically, the late spring and summer months are the most popular times for personal travel. For the last five years, the top sales months have been April–August. This year, however, sales did not increase during these months. In fact, tours overall have decreased by 8% compared to last year.

   This is true for most travel companies. Only 5% said they sold more tours, 10% said sales were the same, 35% said sales were somewhat lower, and 50% said they were significantly lower.

   The travel company you're working at expected adventure travel to increase substantially, but it remained steady compared to last year. Adventure travel includes exploring remote or exotic areas and engaging in activities such as hiking, sightseeing, and outdoor exploring.

   Although the company promoted popular cultural tours, sales for those tours are also flat. Two of the most popular destinations are Abha and Dammam. Another problem is that tour operators in these regions are charging more for their services.

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The company also expected tour sales overall to increase by 5% more than it has in previous years. The company surveyed its customers and found that they are delaying travel plans because of concerns about international airline prices.

This means that plans to expand tours, staff, and the company Web site should be put on hold. Other expenses might need to be cut.

2. **Now you try it**

   Revise the problem description to create a complete but concise problem statement.

REVIEW QUESTIONS

1. **The purpose of a problem statement is to:**
   - **a.** determine the cause
   - **b.** assign responsibility
   - **c.** define the solution
   - **d.** describe a single problem objectively
2. **A statement such as "Plans to add tours, develop our Web site, and expand staff are now on hold until we can solve this problem," is an example of:**
   - **a.** defining the ideal situation
   - **b.** identifying the consequences
   - **c.** describing the symptoms of the problem
   - **d.** describing the size and scope of the problem

Lesson
4
Chapter 1

Identifying and Managing Risks

Any decision you make or solution you implement involves some **risk**, which is an exposure to a chance of loss or damage. Although the solution you develop might succeed or fail, you are risking time, money, and effort with each decision you make. Risk is an inevitable part of business, especially when you are introducing creative changes. With careful planning, you can often avoid many of these risks or reduce their drawbacks. If the potential risk is significant enough, you might need to take a different approach altogether (which is called risk avoidance). case One of the smaller problems you identified for the travel company you're working at involves tour frequency—customers would like to take popular tours more often. Omar encourages you to identify the risks associated with this problem and solution before introducing it to managers at the company.

DEFINITION

Risk: An exposure to a chance of loss or damage.

TABLE 1-4: Problem risks do's and don'ts

Elements	Do	Don't
Risk	• Identify all risks before making a decision • Identify the costs of each risk • Recognize the potential rewards • Seek solutions that are low risk and high reward	• **Don't** disregard the consequences of taking a risk • **Don't** minimize the risk or the reward • **Don't** choose solutions that are high risk and low reward
Testing	• Try out a solution on a limited basis • Make sure a test reveals strengths and weaknesses • Communicate the results of the test to everyone involved	• **Don't** ignore unpopular or unwelcome test results • **Don't** forget to test your backup plan of a solution • **Don't** avoid communicating bad news

Essential Elements

1. **Be aware of potential risks**

   As you consider alternatives and possible solutions, ask what might go wrong with each. What is the likelihood that a particular solution will succeed or fail? What would the costs be if a solution didn't work out? Would failure complicate the problem further, or could you easily try a different solution? Consider the answers to these questions when making decisions and assessing your options.

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2. **Assess your risk/reward ratio**

   While risks are a part of any decision you make, rewards are associated with successful problem solutions. Consider both outcomes. Avoid solutions that carry significant risk, but minimal reward. If your recommended solution does not solve the main problem, much of the cost will come at the expense of your credibility. Solutions that are low risk and high reward are ideal. See Figure 1-5.

FIGURE 1-5: Assessing risks and rewards

Option	Potential Reward	Potential Risk
A	High	High
B	Moderate	Low
C	Low	Moderate

Option A has the highest potential reward, but high risk

Option B might be the preferred alternative because of its risk/reward ratio

3. **Reduce your risk by testing**

   Testing a solution involves trying it on a small or limited basis. A well-designed test shows the strengths and weaknesses of an idea while limiting your exposure and expense. If the test is unsuccessful, you can try another alternative with minimal cost. When your tests are successful, they often give you insight into ways you can refine and improve your solution before you implement it on a wider scale. For example, the travel company you're working at could reduce its tour costs by switching to a no-frills airline. However, your customers might react negatively to the change. You could test this solution by using a low-cost carrier for a few select tours and then carefully surveying your clients about their perceptions.

4. **Develop a fall-back position or a backup plan**

   Sometimes even well-conceived ideas fail. What will you do in response? The point of failure is a poor time to begin considering alternatives. The greater the potential effect of your decision, the more important it is to have a backup plan in place.

QUICK TIP

Be sure to communicate your plans to others who may be affected or whose help you will need.

5. **Keep everyone informed**

   Being surprised by something going wrong is often worse than the drawback itself. Avoid surprising your supervisor, problem owner, and other stakeholders by something you do. Keep them informed and communicate your

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intentions and actions. They can sometimes see a problem before it happens and provide you with an early warning. If something does go wrong, keeping them in the loop will help to reduce the damage.

Why is it important to keep everyone informed?

Crisis management

Some problems are bigger than others and can affect the well-being of an entire organization. These are true crises and demand thoughtful, ethical responses. As the global COVID-19 pandemic has highlighted, major crises can occasionally occur on a truly global scale. The pandemic has affected the majority of the world's population in some shape or form. Governments around the world, including Saudi Arabia, have responded with crisis management initiatives to help contain the spread and minimize the impact, such as temporary travel limitations and social-distancing measures to safeguard travelers participating in the Hajj to Makkah al-Mukarramah. Measures including the roll-out of vaccination programs have helped businesses and services to resume daily operations. While the specific global COVID-19 pandemic was unforeseen, organizations and governments nevertheless prepare for pandemics, and other health-related or economic challenges. In light of the global SARS outbreak of 2002–2004, for example, Saudi Arabia was one of the many signatories of the World Health Organization's International Health Regulations of 2005 to help prevent and control infections, and prepare for pandemics. Although the worst crises have a low probability, they usually have a high cost. Preparing for the worst can obviously help you avoid it or minimize its impact.

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YOU TRY IT

Practice identifying and managing risks by ranking possible solutions to a problem. Complete the following steps.

1. **Get ready**

   Read the following description of a problem.

   Problem: Sales at the travel company so far this year are weak. What can the company do to increase sales?

2. **Now you try it**

   In your notebook, or using a word processor, complete the following risk/reward table to score each solution according to the risks and rewards it presents. Assign a score of High, Moderate, or Low to each option. Identify the preferred alternative.

Option	Potential Reward	Potential Risk
Increase tour prices		
Offer popular tours more often		
Cut expenses, including staff		

   Explain why you assigned the scores you did.

REVIEW QUESTIONS

1. **What is risk?**
   - **a.** A random form of success
   - **b.** Exposure to the possibility of loss or damage
   - **c.** A way to react to a problem
   - **d.** A way to solve a problem
2. **What type of solution should you seek when solving problems?**
   - **a.** One with low risk and high reward
   - **b.** One with low risk and low reward
   - **c.** One with high risk and high reward
   - **d.** One with high risk and low reward

Technology @ Work: Crowdsourcing

Crowdsourcing is a term to characterize a way of using groups to solve problems. The groups are usually online communities called a crowd. An organization broadcasts a problem to the crowd as an open call for solutions. The crowd submits solutions, and then the organization selects and owns the best solution. It sometimes rewards members of the crowd. The Royal Commission for Riyadh City is consulting consumers' opinions through crowdsourcing to help transform the city and improve its services. The National Competitiveness Center's Public Consultation Platform enables individuals and businesses to share insights on proposed economic and development projects (https://istitlaa.ncc.gov.sa/ar/Pages/default.aspx). Through crowdsourcing, a company can investigate problems at low cost and might produce innovative solutions from a wider range of people than it employs. The risks to the company are that it might waste time looking for a solution from the crowd, who is not committed to helping the company solve the problem. case Because the problem at the travel company you're working for is common to the travel industry, Omar is considering working with other travel companies to solve the problem and asks you to learn more about crowdsourcing.

DEFINITION

Crowdsourcing: A way of using groups to solve problems. The groups are usually online communities, such as members of a blog or visitors to a Web site, called a crowd. An organization broadcasts a problem to the crowd as an open call for solutions. The crowd submits solutions, and then the organization sorts through them, finding the best ones. The organization selects and owns the ultimate solution, and sometimes rewards members of the crowd.

Essential Elements

QUICK TIP
Open-science problem solving is a form of crowdsourcing.

1. **Strength in numbers**

   The value of crowdsourcing comes from the thousands or millions of people participating. Successful Web sites such as the National Business Innovation Portal Fikra (https://fikra.monshaat.gov.sa) use crowdsourcing, by drawing upon over 60 government and private agencies to offer services that promote and support the development of small and medium enterprises.

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2. **Collaboration matters**

   Crowdsourcing can provide valuable feedback for companies about their products. More than feedback, however, customers often want to collaborate. For example, a furniture company might invite its customers to submit designs for chairs, helping to develop the crowd into a loyal and enthusiastic customer base.

3. **Different, not necessarily better**

   Crowdsourcing is not designed for every business. A crowd's decisions can determine the direction of a company or product. Crowdsourcing works well for businesses such as video Web sites, which are popular and draw enough numbers to provide a representative sample. Other products or businesses that have less appeal, such as household cleaners, are unlikely to attract enough of a crowd to solve problems.

YOU TRY IT

Explore crowdsourcing sites. Complete the following steps.

1. **Get ready**

   1. Open a Web browser such as Internet Explorer or Firefox, and go to a Web site that relies on crowdsourcing:
      Public Consultation Platform: https://istitlaa.ncc.gov.sa/ar/About/Pages/default.aspx
      Project Gutenberg: http://www.gutenberg.org
      National Business Innovation Portal: https://fikra.monshaat.gov.sa
   2. Explore the Web site and learn how to participate; sign up and participate, if possible.
   3. Take at least three screenshots of your activities on the Web site.

2. **Now you try it**

   Using a word processor, paste at least three screenshots of your activities on a crowdsourcing Web site into a new document. Alternatively, describe your activities in your notebook.

REVIEW QUESTIONS

1. **Crowdsourcing is a way to:**
   - **a.** employ staff
   - **b.** reduce risk and increase rewards
   - **c.** use many overseas workers to perform tasks
   - **d.** use groups to solve problems
2. **The most successful crowdsourcing examples involve:**
   - **a.** volunteer efforts where the results are provided for the common good
   - **b.** persuading customers to purchase services
   - **c.** products that have specific, limited appeal
   - **d.** high company profits with low crowd compensation

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Extra Practice

Real Life Independent Challenge

You can apply the problem-solving techniques you learned in this chapter to challenges, difficulties, and other problems in other parts of your life.

Start by selecting a problem you want to solve. Next, using the template below, construct a problem statement, following the steps in Lesson 3 and the example model provided in Figure 1-4.

Ideal situation:	**Problem summary:**
Symptom:	**Size and scope:**
Consequences:	**Research:**

Team Challenge

You have just been hired by Qassim Builders, a company in Buraydah, Al-Qassim Province, specializing in sustainable building. In line with Saudi Vision 2030, the goals of your company are to design and build structures that use energy, resources, and materials efficiently. For your first project, you are assigned to a newly formed team that will communicate with clients and solve their problems. However, your new team itself is having problems: the team has only met once and one person dominated the discussion. Everyone else was silent or quietly responded to text messages. Your manager learned about the ineffective meeting and suggested that you start by creating a team charter, which spells out the rules for conduct for the team and its members. The following Web site can be used for free for this purpose: https://mural.co (team charter template: https://mural.co/templates/team-charter)

a. Meet as a group to begin creating a team charter. Identify the goals of the Qassim Builders team. Discuss how often the team should meet, and what happens if a team member skips meetings or doesn't do their share of the work.

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b. Identify the strengths of each member of the team. Discuss how to resolve conflicts and other team problems.

c. On your own, summarize the conclusions of your team. Be sure to include suggestions for resolving conflicts and handling team problems.

d. Meet again as a team and compile a single charter for your team.

Be the Critic

You are working for Asif Insurance, an insurance agency in Riyadh. Asif Insurance often contributes to local nonprofit organizations, and provides major support to one organization each year. You are a member of a committee that is selecting this year's organization. Figure 1-6 describes the meeting. Analyze the problem-solving discussion, noting its weaknesses, and send a list of the weaknesses to your instructor.

FIGURE 1-6

Yousef (committee chair):
Let's support the food pantry.

Khalil:
That sounds like a good idea.

Farah:
I like any idea that helps people in need.

Tahir:
I have to leave in 10 minutes.

Jamal:
What about something else, such as the electronics recycling program?

Yousef:
Electronics recycling doesn't seem as helpful as the food pantry.

Khalil:
I agree.

Tahir:
So we've settled on the food pantry?

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Chapter 2

Solving the Problem

After you identify a problem and explore its causes and related issues, it is time to develop a solution. The activities associated with solving a problem are different from the steps you have followed to this point. When you define a problem, you should be open-minded and flexible as you explore, research, and communicate with others. Developing and implementing a solution demands greater focus and deliberation. Planning tasks and managing your time become your most distinguishing skills. This chapter introduces you to solving problems methodically and then managing the solution to verify you made the right decision. case As an assistant to Omar, the vice president of finance at the adventure travel company you both work for, you have been working on a project called 12 by 12 that aims to increase sales by 12%. After identifying problems customers have with the company's tours and with traveling overall, Omar is ready to assemble all the data you and others have collected, discuss alternatives, and make decisions about the future of the company. He asks you to work with him to solve the problem of declining tour sales.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Gather and analyze data
2. Develop alternatives
3. Evaluate options
4. Implement the solution
5. Monitor and manage the solution
6. Verify the solution

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Gathering and Analyzing Data

Before you solve a business problem, gather relevant data and then analyze it to find trends, indicators, and other useful information. Successful business decisions are based on sound information. Use the data you collect to prepare possible solutions and alternatives. To systematically gather and analyze the data related to your problem, start by identifying your goal and looking for information related to it. If you want to increase sales, for example, you should gather recent sales data. Then use tools to view that data in different ways, such as by product, region, or quarter, as shown in Figure 2-1. Keep one eye on your desired outcome to be sure the information you collect is helping you to reach your goals. Table 2-1 outlines the types of data you can collect. case Before you meet with Omar to discuss solutions, he advises you to review the fundamentals of gathering and analyzing data.

FIGURE 2-1: Viewing data in different ways

Specialty Travel

Tour	Qtr 1		Qtr 2	
Farasan Islands	SAR	23,600	SAR	5,900
Jabal Qarah caves	SAR	51,540	SAR	-
Al Wahbah crater	SAR	26,970	SAR	-
Qaisariyah Souq	SAR	31,425	SAR	6,285
Al-Masmak	SAR	18,360	SAR	-
Al-'Ula	SAR	39,950	SAR	-
Diriyah	SAR	26,340	SAR	-
Wonders of Saudi Arabia	SAR	218,185	SAR	-

Spreadsheet of sales data

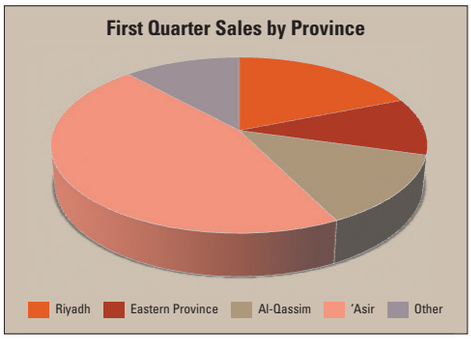

Chart showing sales by Province

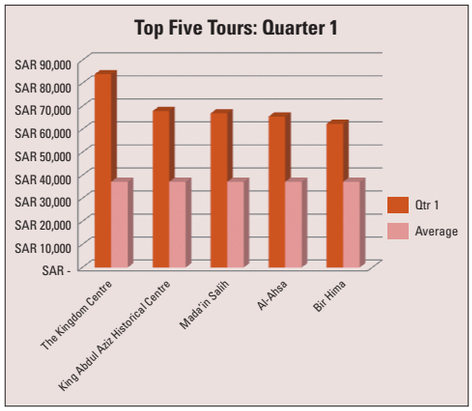

Chart comparing top five tours in Quarter 1

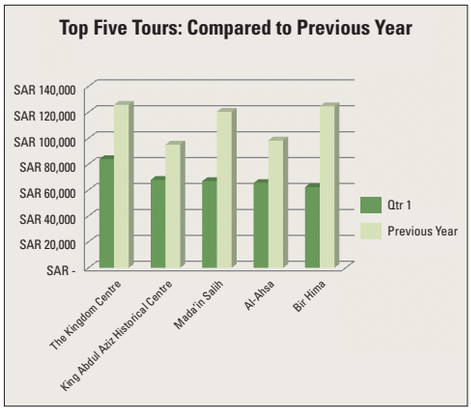

Chart comparing top five tours to previous year

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TABLE 2-1: Types of data to collect

Type of data	Resource	Applies to
Financial	Organization records, trade associations, and business databases	Financial problems, such as increasing revenue, decreasing expenses, and setting prices
Task or process	Employee reports and logs	Inefficient processes, such as late orders, missed deadlines, and low production
Product or service	Customer surveys and comments	Decreasing sales, high inventory, and customer dissatisfaction
General advice	Experts, experienced colleagues and managers, outsiders, and secondary sources, such as books and Web sites	Comprehensive problems, such as business mission and focus, and social or interpersonal problems

Details

Consider the following guidelines as you gather data:

- **Define your data needs**

  What information do you need to reach an informed decision? A thoughtful answer to this question helps guide your research. Make a list of important data and where you can find it. Consider the costs of acquiring this information (such as money and time), and plan to pursue the data that provides the best return on your efforts.

- **Do not overestimate what you know about the problem**

  The information you gather might contradict your assumptions. Be scientific and objective in your research. Let the data stand on its own and keep an open mind about interpreting it. Apply intellectual humility, and assume your research will reveal more than you already know about the problem.

QUICK TIP
Documenting your data and sources of information also supports your decision in case something goes wrong with your solution.

- **Document the data and its sources**

  As you talk with people, review documents, and make observations, take time to record basic information such as title, author, and location. Your records will be useful when you need to retrace your steps. As other people become involved, they might also need to review your work.

- **Examine existing information first**

  Acquiring information costs you and others time and effort. Before you start to collect new information through observations or studies, look for sources of existing information. Talk to others who already observed the problem and can quickly provide you with details. Company documents and records can reveal information with a quick search and review. Start to gather new data after you examine the available material.

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- **Rely on people as your most important resource**

  Much of the information you need might be available only from other people in your organization. They often have insights or experience that is not available anywhere else. Even if they do not know about the problem directly or do not think they could contribute to the solution, identify and approach people who might be able to share data with you.

QUICK TIP
Use software tools such as spreadsheets, databases, and diagramming programs for flowcharts to help you see how one set of data relates to another.

- **Consider interrelationships**

  Most of the data you collect is interrelated because it is connected to the same problem. Examine all of the information together to see how it is connected. Does one factor or process show up repeatedly? Do you see a trend or pattern? What do the relationships tell you about the nature of the problem?

REVIEW QUESTIONS

1. **Before you start collecting new information through observations or experiments, you should:**
   a. analyze the alternatives
   b. look for sources of existing information
   c. make quick decisions
   d. subscribe to new sources of information
2. **What kind of data should you collect to solve a problem of customer dissatisfaction with a product or service?**
   a. Employee reports and logs
   b. Secondary sources, such as books and Web sites
   c. Customer surveys and comments
   d. Organization records, trade associations, and business databases

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Developing Alternatives

After you research a problem and collect data, start to consider alternatives and solutions. This creative phase of the problem-solving process requires imagination and intuition. Identify as many alternatives and ideas as you can—your eventual solution is only as good as the set of options that you generate. Continue working with other people, especially those who are close to the problem, because they often suggest solutions that might not occur to you. Table 2-2 outlines the do's and don'ts for developing alternatives. case Now that the 12 by 12 project team has gathered data about sales at the company you're working at and throughout the travel industry, Omar is ready to meet with you and other members of the team to explore alternative solutions.

TABLE 2-2: Developing alternatives do's and don'ts

Guidelines	Do	Don't
Think creatively	• Generate as many ideas as possible • Break your assumptions to uncover original ideas • Brainstorm new approaches and uncommon ideas • Develop a mind map to see how problems, solutions, and alternatives are connected	• **Don't** get too attached to your own ideas • **Don't** settle for the standard approach • **Don't** rely on your preconceived assumptions • **Don't** evaluate the ideas you generate yet
Ask others	• Take advantage of the collective wisdom of your colleagues • Consider the opinions and advice of experts and nonexperts	• **Don't** think you must solve the problem yourself • **Don't** work on the problem alone
Document ideas	• Keep track of your ideas and those offered by others • Refer to the ideas you documented later	• **Don't** risk forgetting a great idea by failing to write it down • **Don't** limit the number or type of ideas you document

Essential Elements

QUICK TIP
Innovative ideas often come when you don't expect them, so carry a pad of paper, notebook, or journal with you and record ideas as you think of them.

1. **Think creatively**

   The desire to solve a problem often anchors people to their initial ideas, though this limits the possibilities they consider and detracts from the quality of the final solution. Instead, use your creativity to explore as many ideas as you can. Think of creativity as an exercise in breaking your assumptions. Your goal is to identify new approaches and uncommon ideas.

2. **Brainstorm ideas**

   Brainstorming is a powerful creativity tool you can use to generate ideas and alternatives. Start by defining your problem—write it on a pad of paper,

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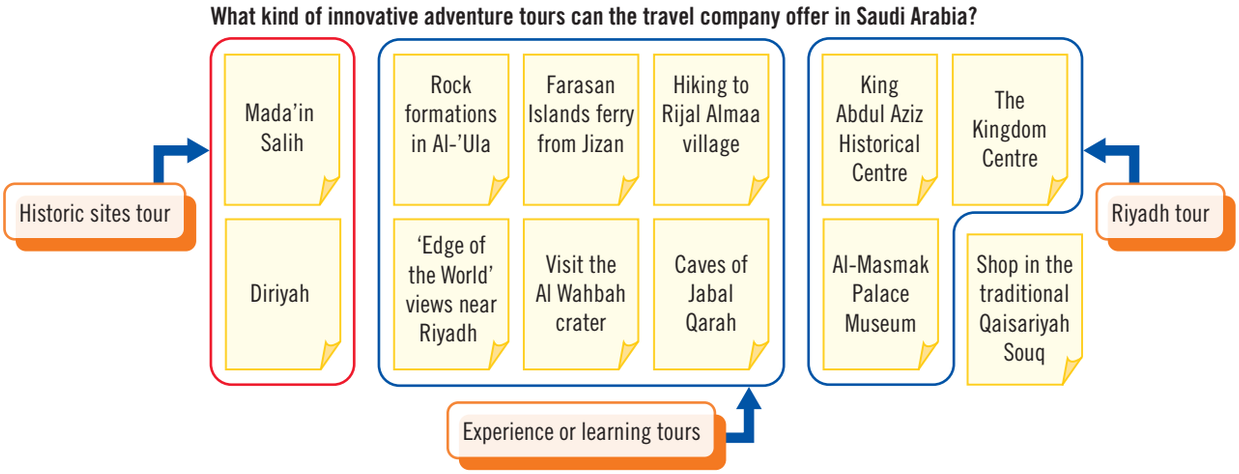
flip chart, whiteboard, or electronic document. List possible solutions as they occur to you, whether they are obvious, impractical, or far-fetched. The goal is quantity, not quality. Work quickly to suppress the tendency to edit and critique. When you run out of ideas, review your list to refine, combine, and edit alternatives. For example, one suggestion for increasing sales at the travel company you're working at is to offer a wider range of adventure tours showcasing stunning natural and historic wonders of Saudi Arabia. The 12 by 12 project team brainstormed to identify the alternatives shown in Figure 2-2.

FIGURE 2-2: Brainstorming



QUICK TIP
Remember that you are asking for opinions, not inviting people to assume control of your project.

3. Ask others for advice

Even if you are responsible for solving the problem, you do not have to work alone. Instead, take advantage of the **collective wisdom** of your colleagues, which is the shared knowledge and experience a group of people can apply to a problem. By involving others, you can take advantage of their diverse opinions, experiences, and perspectives.

DEFINITIONS

Brainstorming: A creativity tool for generating ideas and alternatives. A brainstorming session usually starts by defining a problem, and then listing possible solutions as they occur to you, whether they are obvious, impractical, or far-fetched. The goal is quantity, not quality.

Collective wisdom: The shared knowledge and experience a group of people can apply to a problem.

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QUICK TIP
Mapping your ideas visually helps you see relationships, understand and remember your ideas, and avoid the limitations of a traditional outline or list.

4. **Develop a mind map**

   Mind maps are diagrams that represent your ideas and stimulate your creativity. Start a mind map by writing the problem in the center of a physical or digital sheet of paper. As you think of ideas, draw them as branches that project from the problem description. See Figure 2-3. Do this quickly, without pausing to reflect on the ideas, as you do when brainstorming. Add words or concepts that you associate with each idea. Continue to add branches radiating out from the central idea.

FIGURE 2-3: Mind map

YOU TRY IT

Practice developing alternatives by generating a list of alternatives. Complete the following steps.

1. **Get ready**

   Read the following description of a problem.

   Problem: The main problem is that the travel company you're working at needs to increase its revenue. It also needs to improve its educational tours, which customers report are not very interesting. (An educational tour involves some type of instruction, such as on-site lectures about the history of a place, cooking classes, or art workshops.)

2. **Now you try it**

   Use a technique discussed in the "Developing Alternatives" lesson to generate a list of six ways the company can improve its educational tours.

REVIEW QUESTIONS

1. **Why should you use your creativity when developing alternatives?**
   - **a.** To identify as many ideas as possible
   - **b.** To enjoy the experience
   - **c.** To stay anchored to your initial ideas
   - **d.** To delay a decision
2. **Which of the following is a useful creativity tool for generating ideas?**
   - **a.** Mind map
   - **b.** Mindstorm
   - **c.** Brain wave
   - **d.** Mashup

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Evaluating Options

As you search for solutions, analyze the trade-offs among competing needs and options. Instead of trying to find the one best solution, your goal should be to develop a good solution by evaluating, modifying, and improving on your ideas. After generating as many alternatives as you can, evaluate each one carefully. Using objective criteria helps you avoid making decisions based on emotion or snap judgments. Table 2-3 summarizes the do's and don'ts for evaluating options. case The 12 by 12 project team generated many ideas for solving the problem of declining sales at the travel company you're working at, and you recorded them on an electronic whiteboard. Now the team is meeting again to evaluate the options.

TABLE 2-3: Evaluating options do's and don'ts

Guidelines	Do	Don't
Examine criteria	• Identify the criteria for your decision, such as cost, time, and usefulness • Choose more than one criteria • Assign weights to each criterion	• **Don't** settle on only one criterion • **Don't** assign the same weight to the criteria
Rate alternatives	• Rank alternatives based on the criteria and assigned weights • Compare each alternative to the others • Reevaluate if you have different outcomes using different techniques	• **Don't** use a single evaluation method for complex problems
Make a decision	• Choose the best alternative and use it to develop a solution to the problem • Select a good alternative instead of waiting for the ideal solution	• **Don't** be concerned if the selected alternative is not perfect • **Don't** make a decision you are not comfortable with

Essential Elements

1. **Choose an evaluation method**

   To select a solution from the alternatives you developed, adopt an appropriate way to evaluate them. Is the decision small enough that you can choose intuitively? If not, consider the pros and cons of each alternative and how you can objectively measure them.

QUICK TIP
Decisions based on a single criterion are often unsatisfactory.

2. **Select the criteria**

   Evaluation criteria are the variables that drive your decisions. What do you need to know about each alternative to make an informed choice? Popular criteria include cost, time, feasibility, usefulness, and appropriateness for the organization. Use more than one of these when evaluating alternatives.

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DEFINITION

Evaluation criteria: The variables that drive your decisions.

3. **Weigh your criteria**

   If your problem is complex, consider all of its dimensions as you evaluate alternatives. However, not all criteria are equally important. To take the differences into account, assign weights to each option. For example, you might be evaluating locations for a customer appreciation event for the travel company you're working at. Two criteria are overall cost and the availability of an event planner at the hotel. Because cost is more significant, you could assign 80% of the decision to cost and 20% to the event planner. The weights you assign to each criterion determine how much influence each has on the final outcome.

QUICK TIP

Have a reality check. Don't assume that the rating is the absolute answer.

4. **Rate the alternatives**

   You can rate the alternatives by ranking each one based on your criteria and the weight you assigned. See Figure 2-4. Another method is to compare each alternative to the others and determine which is superior. You can use an analytical hierarchy matrix to rate alternatives based on these comparisons. See Figure 2-5. When making important decisions, use more than one rating technique. The outcomes might not be identical, but they should be very similar. If not, reevaluate your work.

FIGURE 2-4: Ranking and weighting alternatives

Evaluating Alternatives

Each alternative = 25%	Easy to do		Popular with customers		Compared to competition		Amount of revenue		
	Points	Score	Points	Score	Points	Score	Points	Score	Total Score
Raise tour prices	5	125	1	25	4	100	5	125	375
Drop unprofitable tours	3	75	5	125	5	125	4	100	425
Offer popular tours more often	3	75	5	125	5	125	5	125	450
Cut tour features	1	25	1	25	2	50	5	125	225

Assign points on a scale, such as 1–5

Multiply points by percentage for each alternative (5 × 25 = 125)

Highest total is the best alternative

Total the scores

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FIGURE 2-5: Analytical hierarchy matrix

Options for Increasing Sales						
	A	B	C	D	Row Sum	Rank
A. Raise tour prices		0	0	1	1	3rd
B. Drop unprofitable tours	1		0	1	2	2nd
C. Offer popular tours more often	1	1		1	3	1st
D. Cut tour features	0	0	0		0	4th

Add the sum of the ratings in the row

Is option A (raise tour prices) preferable to option B (drop unprofitable tours)? If yes, rate this 1. If no, rate it 0.

Is option A preferable to option C (offer popular tours more often)? If yes, rate this 1. If no, rate it 0.

Is option A preferable to option D (cut tour features)? If yes, rate this 1. If no, rate it 0.

Rank the row sums

QUICK TIP

Ask trusted colleagues for their opinions; they might see something you overlooked.

5. **Make a decision**

   Choose the best alternative and use it to develop a solution to the problem. Do not be concerned if the selected alternative is not perfect. Complex problems rarely have ideal solutions. Make sure you feel comfortable with the alternative you choose.

YOU TRY IT

Practice evaluating options by selecting an option and then explaining why you selected it. Complete the following steps.

1. **Get ready**

   Read the following description of a problem and possible solutions.

   Problem: One of the subproblems for the travel company you're working at is that its educational tours are not very popular.

   Possible solutions:

   - Create a partnership with an established educational tour company.
   - Focus on one type of educational tour, such as cooking classes.
   - Add a class or workshop to every cultural and adventure tour.
   - Coordinate with on-site schools.

2. **Now you try it**

   Review the list of possible solutions to the problem of unpopular educational tours and then complete Table 1 or Table 2 according to the guidelines in the "Evaluating Options" lesson.

TABLE 1: Comparing options

Options for improving educational tours						
	A	B	C	D	Row Sum	Rank
A. Create a partnership						
B. Focus on one type						
C. Add class/workshop to each tour						
D. Coordinate with schools						

1 = This option is better than the other option

0 = This option is not better than the other option

TABLE 2: Ranking and weighting options

Improving educational tours									
Each alternative = 25%	Easy to do		Popular with customers		Compared to competition		Amount of revenue		
	Points	Score	Points	Score	Points	Score	Points	Score	Total Score
Partnership									
One type									
Add class/workshop to tour									
On-site schools									

Points: Rank each option by assigning 1–5 points for each criterion

Score: Multiply the points by 25 for each option

REVIEW QUESTIONS

1. **Cost, time, and usefulness are examples of:**
   - **a.** primary resources
   - **b.** common problems
   - **c.** adaptive techniques
   - **d.** evaluation criteria
2. **Which of the following should you not do before making a decision?**
   - **a.** Weigh the criteria
   - **b.** Wait for the ideal solution
   - **c.** Rate the alternatives
   - **d.** Select an evaluation method

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Developing Effective Problem Statements

Moving from planning to implementation is a significant milestone when you are solving a problem. This is when you begin to make decisions, take actions, and put your plans into practice. Keep everyone informed of your intentions as you move ahead by communicating clearly and frequently. Take action and remember that in most cases, it is better to act decisively with a good solution than it is to plan endlessly looking for the perfect one. Table 2-4 offers do's and don'ts for putting solutions into practice. case Based on the results of the 12 by 12 team's work, Omar has decided to offer popular tours more often in an effort to increase sales for the company.

TABLE 2-4: Implementing the solution do's and don'ts

Guidelines	Do	Don't
Communicate with others	• Involve the problem owner in the decision • Describe the steps you followed to make a decision • Communicate clearly and frequently • Notify staff and managers	• **Don't** go forward with the solution if the problem owner is uncomfortable • **Don't** withhold information in the hopes of having everyone agree
Develop a plan	• Outline the steps to take to put the solution into place • Identify the resources you need • Draft a realistic schedule • Reconsider your goals	• **Don't** underestimate the amount of time you need to complete each step of the plan • **Don't** move forward if your plan doesn't meet your goals
Anticipate opposition	• Build support for your solution • Continue to communicate about your plans and progress	• **Don't** ignore the opposition • **Don't** block out opposing points of view, but don't abandon the solution either
Take action	• Start following your plan soon after making a decision	• **Don't** let inaction end your efforts to solve the problem

Essential Elements

1. **Get approval from the problem owner**

   Before you implement a solution, consult with the problem owners and make sure they support your idea. Discuss the process you followed, explain the options you considered, and make your case for the solution you chose. If a problem owner is uncomfortable with the solution you recommend, work together to identify an acceptable option.

QUICK TIP
Make sure that your plan leads you to this desired end state.

2. **Develop a plan**

   Outline the steps to apply your chosen alternative. List the resources you need, including people, money, facilities, and influence. Estimate how much time the solution will take, and develop a schedule. Define the expected outcome, and consider what the situation should look like when the problem is solved. Work with other people in your team, if necessary, to identify all parts of the plan.

What factors should be considered when developing a plan?

3. **Notify stakeholders**

   How you communicate your decisions significantly affects how others accept your proposed solution. Internal staff and managers need to understand how each decision relates to their jobs and missions. As you begin to implement your solution, let people know what you are doing so they can take action. Your communication should include the elements shown in Figure 2-6.

FIGURE 2-6: Communicate with stakeholders

Topics to discuss with stakeholders:

What the decision is
How the solution will be put into place
How it will be monitored and evaluated
How changes will be decided on and made

4. **Anticipate opposition**

   Decisions that cause change can upset or threaten others in the organization. To avoid this, build support for your solution before you put it into practice. Preview your plan to reassure people who resist change. Clearly

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explain the nature of the problem, and show why your solution is the most responsible way to deal with it.

5. **Take action**

   Until the solution takes effect, your decision is little more than a good intention. After making decisions and securing approvals, start to take specific actions. Projects suffer from inertia, so it usually requires extra effort to keep your plan moving. However, once you start, it becomes easier to manage.

Unintended consequences: when solving one problem spurs new ones

All business owners and managers need to be good problem-solvers. This is not always easy, because in solving one problem it is possible to create another. The law of unintended consequences maintains that any purposeful activity can produce some unintended consequences. In 2008, for example, authorities in the United States attempted to crack down on spam (junk e-mail sent out in bulk to clog your inbox). However, their actions had unintended consequences; and as a result, a group of servers in California (U.S.), considered to be the source of 40% of the world's spam, were disconnected from the Internet, leading to a sudden decrease in nuisance emails. Shortly after, researchers discovered a significant increase in activity of `botnets' (software robots that secretly gather e-mail addresses and, use them to spam). As you consider solutions, keep in mind that at least one of them is likely to produce an unintended side effect.

In line with Saudi Vision 2030, a number of electronic services have been offered to residents, who were then encourage to implement them in both the private and public sectors. The goal was to provide quality services and improve the workflow in different organizations. However, since the tech world was still new, people were unaware of the importance of keeping your data private; and this lack of understanding led them to receive phony advertisements for fraudulent products. These scams would often be disguised as emails from supposedly legitimate sources, asking people for their banking information. They would even pose as real "Absher" accounts to swindle funds from people's accounts without them noticing. As a result, the Saudi Commerce Ministry and the Central Bank warned consumers to be vigilant against online scams, putting measures in place to protect shoppers and for reporting violations.

YOU TRY IT

Practice implementing solutions by identifying why a solution was not successful. Complete the following steps.

1. **Get ready**

   Read the following description of the events leading to a solution for the problem of improving educational tours at the travel company you're working for.

   1. Asma, vice president of operations at the company, asked Rasheed to look into the problem of improving the educational tours and to help her implement a solution.

2. Rasheed gathered and analyzed some data, developed alternatives, and evaluated the options. He decided that adding a class, workshop, or other learning experience to each tour was the best way to solve the problem because that solution was the most popular with customers.
3. Rasheed talked to the tour developers and asked them to add an educational experience to each of their tours. When a few tour developers objected, saying specialized classes required too much effort and expense, Rasheed said they should start by adding just one class to one tour.
4. When Asma received reports from the tour developers requesting extra funds for the classes, she was not pleased. In fact, she told the tour developers to stop planning the classes until further notice.
5. Rasheed was very disappointed. He wanted to surprise Asma with a complete, successful program, and thought Asma would be delighted by his initiative.

2. **Now you try it**

List the reasons the solution was not successful.

REVIEW QUESTIONS

1. **An effective plan for implementing a solution includes a(n):**
   a. analytical hierarchy matrix
   b. collective wisdom indicator
   c. schedule
   d. mind map
2. **Communication about your proposed solution should include:**
   a. a notice that you have a limited amount of time
   b. a code of ethics
   c. a worst-case scenario
   d. details about how the solution will be put in place

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Chapter 2

Monitoring and Managing the Solution

Complicated problems are seldom solved by making a simple decision. Most solutions involve related choices, tasks, and the participation of others. Monitor and manage these activities to ensure a successful outcome. Managers, coworkers, and other stakeholders expect you to deal professionally and competently with interruptions, delays, and unexpected events. Planning for and identifying trouble quickly helps you minimize the disruption and problems it causes. Table 2-5 summarizes the do's and don'ts of managing solutions. case Under Omar's management, the 12 by 12 project team has started to rework schedules and develop promotional materials to offer the travel company's most popular tours more often. Omar asks you to help monitor this solution.

TABLE 2-5: Managing solution do's and don'ts

Guidelines	Do	Don't
Identify variables	• Identify signs that your plan is working • Track objective measures of the solution's success • Watch for symptoms of the original problem	• **Don't** assume your plan is solving the problem; make sure it is by measuring the results
Select a level of monitoring	• Monitor complicated solutions closely • Monitor simple problems occasionally • Spend at least some time every day monitoring, managing, and working on the problem • Continue to put your solution into place as you planned	• **Don't** forget to budget for monitoring time in your work schedule • **Don't** monitor the solution only one day a week
Involve others	• Ask stakeholders and others to help you monitor changes • Let people know what you changed and the outcomes you expect	• **Don't** let yourself be the only one monitoring the solution • **Don't** forget to let others know what to do if they detect a problem
Correct problems	• Make adjustments as soon as possible • Communicate the changes to everyone involved	• **Don't** overlook signs that the solution is not working or the problem is returning

Essential Elements

1. **Identify key variables**

   Solutions to problems are abstract ideas, not tangible objects you can pick up, hold, and inspect, which makes them difficult to monitor. Instead, identify the key variables or observable indicators that show whether your solution is succeeding or failing. These are often symptoms of the problem itself, such as tour enrollment, and are factors that should improve. Decide which

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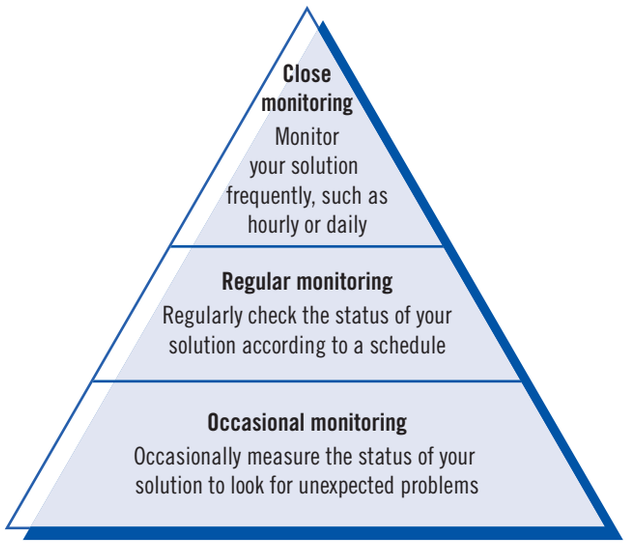
variables are appropriate for your solution and monitor them. For example, you might track weekly tour enrollment in the travel company's most popular tours.

QUICK TIP
Typically, the necessary amount of management and control decreases over time.

2. **Select an appropriate level of monitoring**
   The level of monitoring, follow-up, and control varies for each problem. See Figure 2-7. Complicated solutions require close contact, while simpler problems need less attention. Budget time for monitoring by asking yourself if the solution requires a full-time commitment, daily activity, or only occasional monitoring.

FIGURE 2-7: Levels of monitoring



3. **Involve others with the process**
   Engage others to help with your solution. Ask stakeholders and others to monitor changes and watch for problems. Let people know what you changed and the outcomes you expect so they can observe the right indicators. Also advise them about what action to take if something seems out of place. Follow up with these observers to keep them aware and interested.

QUICK TIP
Stay connected with the issues because much can change in a short time.

4. **Be persistent**
   Spend some time every day monitoring, managing, and working on the problem. In most cases, it is better to spend an hour or two every day managing your project than devoting a full day once a week. Consistency and persistence will contribute to a successful conclusion.

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Why is it important to involve others with your solution?

5. **Make corrections promptly**

   Unforeseen complications or issues can cause your solution to go off track. If you detect a problem, it is usually best to make adjustments promptly. Problems tend to grow bigger with time and harder to tame. If you need to change your plans, be sure to communicate them clearly to everyone involved. Then monitor indicators very closely to ensure that the correction is working.

YOU TRY IT

Practice monitoring and managing the solution by describing how you would monitor a problem and solution. Complete the following steps.

1. **Get ready**

   Read the following description of a problem and solution.

   Problem and solution: The problem is the main one the travel company you're working at have been working on: to increase sales of their tours. The solution they selected is to offer the company's most popular tours more often. Three of the most popular tours are to Dammam, Abha, and Ha'il.

2. **Now you try it**

   List the general steps the company should follow to monitor the solution they selected. Give specific examples about the kinds of activities they can perform.

REVIEW QUESTIONS

1. **Which of the following is not a variable you might track when monitoring a solution?**
   - **a.** Expert advice
   - **b.** Daily sales data
   - **c.** Production logs
   - **d.** Customer surveys
2. **What should you do if your solution is not causing expected improvements?**
   - **a.** Wait for the problem to solve itself
   - **b.** Adjust the solution promptly
   - **c.** Abandon the solution
   - **d.** Stop monitoring efforts

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Lesson
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Chapter 2

Verifying the Solution

Expect surprises when you implement a solution. Part of being an effective professional is staying involved with a project until it is completed and making necessary corrections along the way. Ask yourself and others how well the solution is working, how realistic your objectives are, and what is not working as expected. When you identify a deficiency, take the responsibility for making a correction. Table 2-6 outlines the do's and don'ts of verifying the solution. case You have been tracking tour enrollments for the most popular tours at the travel company you're working at. Omar asks you to develop a presentation that describes the progress of the project and its success. See Figure 2-8.

TABLE 2-6: Verifying solutions do's and don'ts

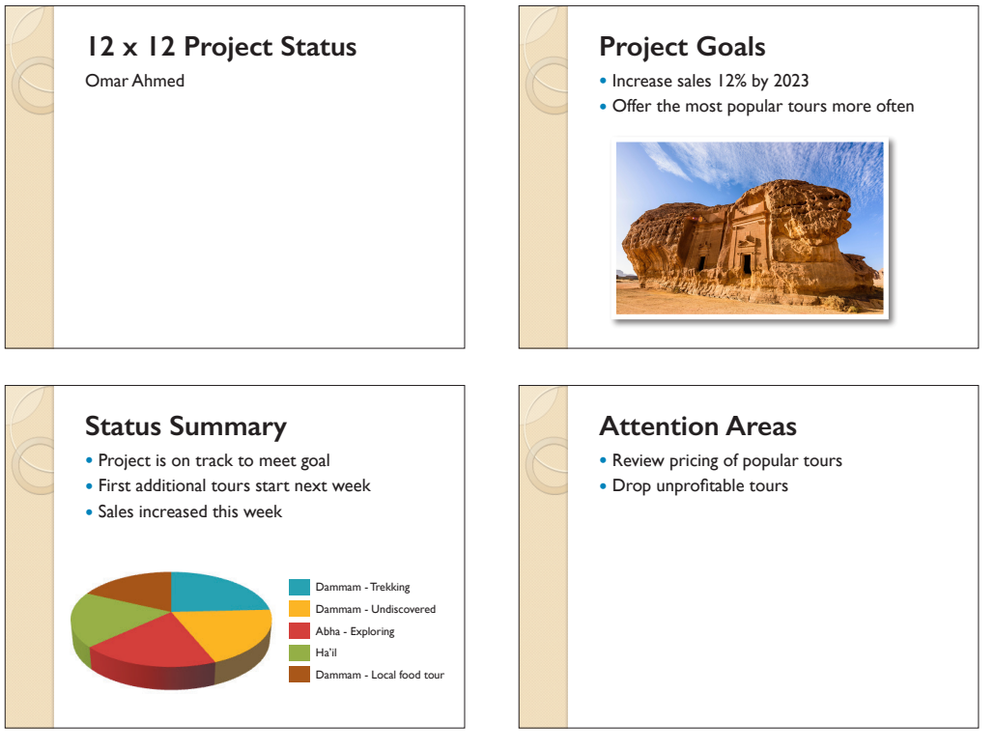
Guidelines	Do	Don't
Define success	• Compare the current state to the goal state • Measure the changes that determine your success • Define success with the stakeholders and problem owner	• **Don't** forget to define success for the problems you solve • **Don't** consider the problem solved because major symptoms disappear
Test solution	• Test the solution by considering the worst-case scenario • Stress the system and see if you still have the desired results	• **Don't** look at superficial parts of the solution only • **Don't** create a dangerous or problematic test
Avoid problems	• Consider how long your decisions will affect the organization • Train someone else to monitor the solution as necessary	• **Don't** overlook long-term effects • **Don't** hold yourself back by making yourself the only person who knows how to manage the problem and solution
Learn from success	• Make sure you and the organization learn from the success • Document your results	• **Don't** fail to take credit for your contributions to the success

Essential Elements

1. **Define success**

   Define a successful solution using objective measures, if possible. For example, the travel company you're working at wants to increase sales by 12%. In other cases, success means that major symptoms disappear. Discuss your definition of success with the problem owner and other stakeholders, and use the definition when you verify your work.

FIGURE 2-8: Communicating progress



2. **Test your solution**

   Though a solution seems to be working superficially, it might break down under stress. Test your solution to make sure it is successful. Determine a **worst-case scenario** and try to simulate it. However, avoid introducing hazards or additional problems. Does increasing sales by 12% really solve the travel company's income problems? Or do the extra expenses offset the gains? Play *"what-if"* to make sure your solution is robust.

DEFINITION

Worst-case scenario: A situation or conclusion that could not be any worse; the worst possible outcome.

3. **Avoid the problem in the future**

   Consider how well your solution holds up over time. What short- and long-term effects do your decisions have on the organization? What else can you do to improve the longevity of your solutions? Who can monitor and maintain the solution in the future? Document the problem so that the organization does not make the same mistakes again.

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QUICK TIP
Identify how you would conduct the same project if you had to redo it.

4. **Learn from the process**

   When you solve a problem, you and the organization should learn from the experience. Identify what you did correctly and what you might have done differently. You can apply many of the lessons you learn in other situations. Your company should also benefit from your efforts. Take the time to document your results and make them available to others to reference in the future.

QUICK TIP
Take credit for your success and share it with others who helped you.

5. **Take credit for your success**

   Your abilities to solve problems and make decisions are among your most valuable professional skills. When you successfully complete a project, let others know what you and your team accomplished. The problem owner, stakeholders, or your direct supervisor might not be aware of all that you have done. Communicate your success with them professionally through a written report, oral presentation, or combination of the two.

YOU TRY IT

Practice verifying the solution by testing a solution with a worst-case scenario. Complete the following steps.

1. **Get ready**

   Read the following description of a problem and solution.

   Problem and solution: The travel company you're working at needs to increase sales of its tours. The solution is to offer the company's most popular tours more often. Three of the most popular tours are to Dammam, Abha, and Ha'il. The solution will be successful if sales to all tours increase by 12% in a year. That means enrollment in these three tours must increase by 20%.

2. **Now you try it**

   1. Describe the worst-case scenario for this problem.
   2. List at least two ideas to avoid the scenario.

REVIEW QUESTIONS

1.When testing a solution, you should:

a. create the most stressful test possible, even if it is dangerous

b. stick to the superficial part of the solution

c. consider the worst-case scenario

d. make the results confidential

2. Why might you give a presentation after verifying a solution?

a. To communicate your progress

b. To entertain your colleagues

c. To provide an opportunity for brainstorming

d. To defer a decision

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Technology @ Work: Mashups

A **mashup** is a Web application that combines features or information from more than one source. A popular example is the integration of open-source mapping software (such as Google Maps) with company-specific data, to create an interactive map to promote the company's services. For example, the map might show branch locations of a particular bank or Panda grocery store in the region. Clicking on a locator might provide the address or opening hours of that branch. Businesses like Al-Rajhi Bank are using mashups to develop views of information that aid in decision making. Business mashups typically combine data from internal and public sources, and publish the results within the company for employees to use. case Omar wonders if the company could develop an in-house mashup that uses mapping Web sites and local data about weather, events, and travel information. He asks you to learn the basics of mashups and their benefits to business.

DEFINITION

Mashup: A Web application that combines features or information from more than one source.

Essential Elements

1. **Use the best of the Web**

   Mashups are created from parts of Web applications and services and result in innovative resources. Because they present information in new ways, they can help you to make quick decisions that depend on factors such as weather and traffic. For example, if your company does business overseas, it could create a mashup between a translation service such as Google Translate and local business news so you can find up-to-date market information in your native language.

2. **Find mashups by type**

   The two main types of mashups are consumer and business, and the two types overlap. Consumer mashups include mapping, photo and video, search, shopping, and news. News mashups use sources such as the Arab News and syndication technologies such as Really Simple Syndication (RSS)

QUICK TIP

Like automobile dashboards, business dashboards display current information about an organization's performance or other indicators. See, for example, https://covid19.moh.gov.sa/.

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to provide personalized news summaries on your desktop. Government departments such as the Ministry of Health use RSS feeds to share important information and announcements about their services.

Business mashups generally help employees process information or decision makers view information in new ways. For example, online retailers can combine customer orders with credit card approval and protection systems from banks to offer secure online payment for orders. Managers can view mashups called **dashboards**, windows that graphically summarize information about how a business is operating.

DEFINITION

Dashboard: A window that graphically summarizes information about how a business is operating.

YOU TRY IT

Explore online mashups and RSS feeds. Complete the following steps.

1. **Get ready**
   1. Open a Web browser such as Internet Explorer or Firefox, and go to a Web site that provides mashups or uses RSS feeds:
      Saudi Ministry of Health: https://www.moh.gov.sa/en/Pages/default.aspx
   2. Explore the Web site to discover how it uses RSS and mashup technology (for example, the interactive map).
   3. Take at least three screenshots of your activities on the Web site.
2. **Now you try it**

   Using a word processor, paste at least three screenshots of your activities into a new document. Alternatively, write down a description of your activities in your notebook.

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REVIEW QUESTIONS

1. **What is a mashup?**
   - **a.** A matrix for making decisions
   - **b.** A way to use groups to solve problems
   - **c.** A way to make decisions based on intuition
   - **d.** A Web application that combines features or information from more than one source
2. **A business might create a mashup to:**
   - **a.** develop views of information that aid in decision making
   - **b.** learn how to manage by exception
   - **c.** test solutions using worst-case scenarios
   - **d.** schedule Web conferences

Extra Practice

Real Life Independent Challenge

You can apply the decision-making techniques you learned in this chapter to the decisions you need to make in other parts of your life, such as what job to accept, whether to buy or rent a house or apartment, and whether to continue your formal education. Select a decision you need to make, and then identify possible solutions.

a. Select a decision you need to make. Choose one that demands careful consideration and analysis.

b. Use one of the tools presented in this lesson to generate possible alternatives. For example, brainstorm a list of alternatives or create a mind map.

c. Use a tool such as a decision table to rate the alternatives.

d. Use a different tool to rate the alternatives, and then compare the results.

e. Now that you've applied logic to your decision, do you intuitively agree with the results?

Team Challenge

You are working for Qassim Builders, a company in Buraydah, Al-Qassim Province, specializing in sustainable building. In line with the Saudi Vision 2030, the goal of your company is to design and build structures that use energy, resources, and materials efficiently, protect the health of occupants, improve the productivity of employees, and reduce waste, pollution, and environmental degradation. Your manager, Nora, asks you and your team to consider whether Qassim Builders should accept a new project. The project involves building an information center in Buraydah. The building will be "off the grid," meaning that the building will be self-sufficient and will not rely on public utilities for power or water. Nora suggests you follow the steps below to make your recommendations:

a. Individually, learn what is involved in green building and creating off-the-grid structures. Outline a plan of up to six steps for building the information center.

b. Meet as a group to discuss what would happen if the project fails miserably. Compile a list of the reasons for the failure.

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c. Sort the list into categories, such as technology obstacles, community opposition, and lack of knowledge.

d. Revise your plan to correct its flaws and to avoid the potential problems.

e. Submit the plan to your instructor as requested.

Be the Critic

You are working for Salman Software, a company that designs useful desktop gadgets for computer users. Your boss, Abdullah Salman, is planning a major overhaul of the company Web site. Abdullah is trying to decide whether to hire an outside Web design firm to create the Web site or do it in house using company programmers. To help make the decision, Abdullah listed the pros and cons of his two alternatives, as shown in Figure 2-9. In the end, Abdullah made a gut decision and now plans to revise the Web site in house. Analyze Abdullah's decision, noting its weaknesses, and send a list of the weaknesses to your instructor.

FIGURE 2-9

Hire an Outside Web Design Agency?	
Pros	**Cons**
Quality of work	High cost
Expertise	Don't know our products
Work more quickly	Not as flexible
Have graphical resources	Loss of control

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Chapter 3

Thinking Critically

Suppose as part of the Saudi Vision 2030 initiative to develop Al Widyan as the world's largest shopping and entertainment destination, you were building a new shopping mall complex. You would determine how many stores, staff, and customers would need to be accommodated, where precisely to locate the site, and assess transport links. You might consider a few styles of buildings. You would draw designs and build at least one model to make sure the layout was suitable for all needs. Finally, after creating schedules and enlisting help from experts, you would dig the first foundations. All of these activities involve analyzing, evaluating, and making objective decisions to make sure the result is sound and successful. The same is true for critical thinking. In this chapter, you explore what it means to think critically and how to become a critical thinker. case At the travel company, you have been working with Omar, the vice president of finance, to solve the problem of declining sales. Your project team is now tracking the progress of the solution: increasing the enrollment of the company's most popular tours. These tours include trips to Dammam, Abha, and Ha'il. So far, the enrollment for the Abha and Ha'il tours have improved steadily. In fact, the Al-Qishlah Palace tour in Ha'il is now one of the top five all-time best sellers. However, sales for the active tours in Dammam remain flat, despite the region's popularity. Omar asks you to help him determine the reasons for the flat sales.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Understand critical thinking
2. Overcome obstacles to critical thinking
3. Become a critical thinker

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Chapter 3

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Understanding Critical Thinking

One characteristic that differentiates humans from other animal species is the ability to think, reason, and make informed judgments about observations and facts. Thought and thinking are natural, sometimes automatic mental processes that include reasoning, remembering, imagining, and reflecting, for example. **Critical thinking** generally requires more analysis, evaluation, discipline, and rigor. The goal of critical thinking is often to improve choices and reduce the risk of adopting or acting on a flawed assumption. case Omar says that investigating the reasons for the flat sales of Dammam tours requires critical thinking. He advises you to learn more about critical thinking to help him solve the sales problem.

DEFINITION

Critical thinking: The thoughtful, deliberate process of deciding whether you should accept, reject, or reserve judgment about a particular idea. The goal of critical thinking is often to improve choices and reduce the risk of adopting or acting on a flawed assumption.

Details

Ask yourself the following questions as you prepare to improve your critical thinking:

- **What is critical thinking?**

  Critical thinking is the thoughtful, deliberate process of deciding whether you should accept, reject, or reserve judgment about a particular idea. It is also a measure of your confidence in the idea itself. Use critical thinking whenever you make a decision, solve a problem, take an action, or decide what to believe. Although the word *critical* can mean to find fault or to criticize, critical thinking is not a negative activity. Rather, it is a process where you ask questions, challenge assumptions, examine claims, and identify alternatives or answers. See Figure 3-1.

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FIGURE 3-1: Steps in critical thinking

- **What is a claim?**

  A **claim** is a statement that someone says or writes about a topic. The claim can be true or false. Many statements are not claims. For example, when you greet someone or ask a question, the statements are generally not either true or false. In contrast, you can measure the amount of truth in a claim. For example, if a colleague claims that the company tours to Dammam are the most popular, you can refer to tour sales to determine if that claim is true. When you are presented with a claim, you decide whether to accept, reject, or investigate it.

DEFINITION

Claim: A statement that someone says or writes about a topic.

- **What is an issue?**

  When you are solving problems or engaged in other activities that demand critical thinking, you are examining and thinking about an issue. In general terms, an **issue** is any controversial subject that you discuss, dispute, or review. An issue is different from a simple topic of conversation because it raises questions or concerns. For example, the Dammam tours at the travel

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company are an issue—their sales should be increasing, but they are not, which raises concerns about the tours.

DEFINITION

Issue: Any challenging subject that you discuss, dispute, or review. An issue is different from a simple topic of conversation because it raises questions or concerns.

- **What is an argument?**

In common usage, *argument* means a heated discussion between people. In the context of critical thinking, an **argument** is a set of one or more claims that support a particular conclusion. The claims are sometimes called *premises*. When you try to persuade someone to adopt your point of view, you typically make an argument and offer evidence that helps prove your claim as true. You should also evaluate other peoples' claims carefully and decide whether you accept their arguments.

DEFINITION

Argument: (1) A set of one or more claims that supports a particular conclusion. (2) A value or cell reference that a function uses in its calculations.

- **What is the difference between facts, opinions and factual matter?**

Thinking critically demands that you distinguish between fact and opinion. Typically, a **fact** is a claim that is considered to be true. An **opinion** is a claim that someone believes is true. Opinions may or may not be factual, even though people often assert their opinions as facts. Figure 3-2 compares facts and opinions. If you can collect data about and analyze a claim, it is said to be a **factual matter**. This term suggests that you are not certain the claim is a fact, but could prove or disprove if necessary.

DEFINITIONS

Fact: A claim that is considered to be true.

Opinion: A claim that someone believes is true.

Factual matter: A claim about which you can collect and analyze data. This term suggests that you are not certain the claim is a fact, but could prove or disprove if necessary.

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FIGURE 3-2: Facts and opinions

Facts	Opinions
Enrollment for the Dammam tours has not increased in six months.	Dammam just doesn't appeal to our customers anymore.
Air travel has declined by 3% since last year.	Air travel is considered a luxury in a recession.
Dammam accommodates a wide range of budgets.	Dammam is too expensive.

REVIEW QUESTIONS

1. **A(n) _____ is a written or spoken statement that someone makes about a particular topic that is either true or false.**
   - **a.** opinion
   - **b.** hasty generalization
   - **c.** claim
   - **d.** fallacy
2. **What is an argument?**
   - **a.** Claims that support a particular conclusion
   - **b.** An act based on a flawed assumption
   - **c.** Any subject of controversy
   - **d.** The limit of your own knowledge

Lesson
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Chapter 3

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Overcoming Obstacles to Critical Thinking

You develop critical thinking as a skill over time through practice and repeated application. Learn to recognize typical obstacles to critical thinking so you can anticipate and work through them. Table 3-1 lists the do's and don'ts for overcoming obstacles to critical thinking. case Omar is not convinced that the travel company you're both working at needs to promote the Dammam tours more aggressively. When he checked the advertising expenses, he found the Dammam tours are already being promoted heavily. He asks you to help him find the root of the problem, which will require additional critical thinking. You prepare to overcome typical obstacles so you can help Omar find a solution.

TABLE 3-1: Overcoming obstacles do's and don'ts

Guidelines	Do	Don't
Avoid egocentric thinking	• Be aware of your own point of view	• **Don't** assume your point of view is the norm or exclusively right
Recognize social conditioning	• Challenge yourself to move beyond your social conditioning and consider alternative ways of thinking and interpreting	• **Don't** let social conditioning prevent you from considering unpopular alternatives
Understand outliers	• Understand that past extreme experiences can bias future behavior	• **Don't** let past experience necessarily determine your reactions to similar experiences in the future
Avoid normalization	• Look past the tendency to normalize ideas • Question and challenge thoughts and beliefs when appropriate	• **Don't** keep critical thinking separate from creative thinking
Respect emotions	• Respect your emotional reactions to arguments	• **Don't** give emotion more weight than logic and reason

Essential Elements

QUICK TIP
Being flexible, adaptable, and open minded when working with others helps you avoid egocentric thinking.

1. **Avoid egocentric thinking**

   Being egocentric means seeing the world from your own point of view, assuming you are the norm or center. This thinking limits your ability to appreciate other points of view or see past your limitations.

2. **Be aware of your social conditioning**

   Social conditioning encourages you to accept the beliefs, traditions, and values of your social group. Social conditioning helps you feel part of the greater whole, but it can also prevent you from considering unpopular alter-

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natives. Challenge yourself to move beyond your social conditioning and consider other ways of thinking and interpreting.

DEFINITION

Social conditioning: Conditioning that encourages you to accept the traditions and values of your social group. Social conditioning helps you feel part of the greater whole, but it can also prevent you from considering unpopular alternatives.

3. Identify outliers

Past experiences with other people, places, and situations that are extremely good or bad are **outliers**. They can bias your expectations in the future. For example, if your first experience flying in a commercial jet involved stormy weather, turbulence, and rough landings, you might not want to fly again. However, that flight was an outlier, so you should not expect future flights to be similar.

DEFINITION

Outlier: A piece of data in a set that is much larger or smaller than the other values in the data set, or an experience that is extremely good or bad.

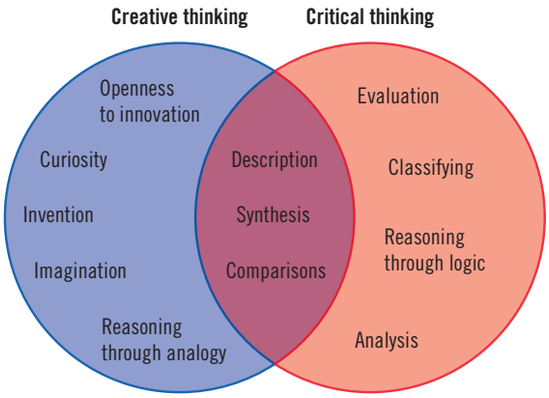
QUICK TIP

If you notice yourself accepting a common idea without much consideration, you have likely normalized it in your mind.

4. Avoid normalization

People who assume that their ideas are normal because they have been exposed to them repeatedly are normalizing the ideas. Critical thinking looks past the tendency to normalize and requires you to question your own thoughts and beliefs. Critical thinking, like creative thinking, demands that you see problems with a fresh perspective. In fact, keeping critical thinking separate from creative thinking can be an obstacle to solving problems. See Figure 3-3.

FIGURE 3-3: Creative and critical thinking



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5. **Respect your emotions**

   Respect your emotions, but consider their logic and appropriateness for the decisions that you are trying to make. Avoid emotional thinking, which makes it difficult to distinguish between emotions and thoughts.

Critical thinking and feeling

Pioneering research at King Abdullah University of Science and Technology (KAUST) is using 3D visualization to help provide a better understanding of how brains function. Interest in the field of neuroscience has soared in Saudi Arabia in recent years, with facilities including KAUST's Visualization Core Lab leading the way in new research and scientific publications. These research projects are part of a wider international effort to understand the human mind. Rational thoughts and emotional feelings are usually considered as separate mental processes, perhaps even occurring in opposite sides of the brain. In early brain studies, scientists said that the rational mind is like a computer, and computers do not have feelings. Recently, however, researchers have discovered that we cannot understand how we think without understanding how we feel. Neuroscientists studying people with brain injuries that prevent them from perceiving their emotions have found that they cannot make effective decisions. Researchers, using sophisticated imaging techniques to monitor brain activities, find that decisions involve emotional reactions as well as logical thought.

YOU TRY IT

Practice overcoming obstacles to critical thinking by reacting to a scenario. Complete the following steps.

1. **Get ready**

   Read the following statement and the reactions to it. Each reaction includes an obstacle to critical thinking.

   Statement: The travel company you're working at can increase tour sales by promoting Dammam tours more aggressively.

   Reactions:

   1. I really think promoting Dammam tours is the right solution to the company's problem. And I am usually right.
   2. Everyone in the travel business believes that increasing promotion results in increased sales.

2. **Now you try it**

   Identify the obstacle in each reaction.

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REVIEW QUESTIONS

1. **Which of the following is *not* an obstacle to critical thinking?**
   - **a.** Normalization
   - **b.** Creative thinking
   - **c.** Social conditioning
   - **d.** Being egocentric
2. **What is an outlier?**
   - **a.** An extreme experience in the past
   - **b.** Someone far outside the norm
   - **c.** An emotional reaction to a logical problem
   - **d.** A goal in critical thinking

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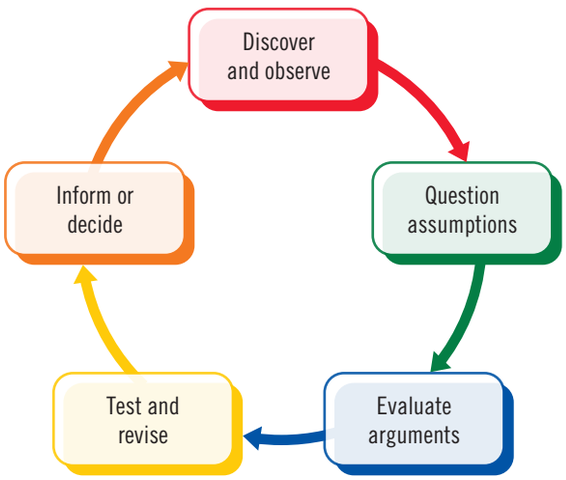
Becoming a Critical Thinker

Developing your thinking and problem-solving skills is a gradual process that requires conscious effort on your part. Changing your thinking habits and practices is a long-range project and something you should commit to throughout your life. Table 3-2 identifies the do's and don'ts for becoming a critical thinker. Figure 3-4 illustrates the habits of critical thinkers. case After analyzing your premises and data, you conclude that the new tour assistant for Dammam tours needs training to improve her time and customer management skills. This should result in greater enrollments on the tours. You meet with Omar to make your argument, confident in your critical-thinking abilities.

TABLE 3-2: Becoming a critical thinker do's and don'ts

Guidelines	Do	Don't
Develop intellectual humility	• Recognize the limits of your own knowledge and understanding • Be aware of your biases and limitations	• **Don't** grow overconfident about your habits or conclusions
Be critical	• Be inquisitive and open minded while also being empathetic and respectful of other people • Challenge your own assumptions, ideas, and beliefs	• **Don't** be cynical when you should be critical • **Don't** be negative or distrustful
Have confidence in your critical thinking	• Practice critical thinking • Accept solutions that are good enough instead of perfect	• **Don't** be intolerant of uncertainty

FIGURE 3-4: Critical-thinking habits



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Essential Elements

1. **Develop intellectual humility**

   Intellectual humility is defined as recognizing the limits of your knowledge and understanding of a situation. It includes an awareness of your biases and limitations in your thinking. When you are intellectually humble you become more open to other ideas, different viewpoints, and potential solutions to problems. You are also better able to avoid the effects that false beliefs and habits of mind tend to have.

2. **Be a critic, not a cynic**

   Becoming a critical thinker is not the same thing as being a cynic or critical person. A cynic is generally negative, scornful, and distrusting of other people. Cynics are often self-righteous and quick to point out flaws in other people's arguments. It is because of this that cynicism and critical thinking are sometimes confused. A critical thinker is neither negative nor distrustful. Rather, you should be inquisitive, questioning, and open minded in your thinking while also being empathetic and respectful of other people.

3. **Challenge your assumptions and beliefs**

   Sometimes we put our own blinders on and limit our ability to think critically. You can overcome this by not only challenging other peoples' arguments, but your own assumptions, ideas, and beliefs as well. Don't always believe and accept everything you see for the first time. Ask yourself what you want to see or hear and how that influences any incoming information. Hold yourself to the same intellectual standards that you have for other people.

4. **Work through complex issues and problems**

   Critical thinking is certainly hard work; however, it is also an important part of being a professional. There are no simplistic solutions to complex human problems, and you need to be prepared to work through complex issues. Don't become comfortable with the easy answers or give up when you become frustrated.

5. **Have confidence in your reasoning ability**

   Know that you can learn to be a critical thinker and that your reasoning and decision-making abilities can improve with practice. Trust yourself and give yourself permission to think openly and honestly. Know that your ideas and solutions may not always be optimal, but in most cases they will be "good enough" and better than they would otherwise have been.

Guesstimating is critical thinking

One way to become a critical thinker is to 'guesstimate'—giving approximate answers to mathematical questions such as the amount of space required to gather all the people in the world in one place. In fact, you could fit the entire world's population into an area the size of Riyadh with plenty of room to spare! While, by nature, it is imprecise and involves some degree of speculation, the ability to guesstimate is an invaluable skill for any critical thinker. According to the traditional Arabic proverb, "Ask the experienced, not the learned." Guesstimating can be viewed as a technique that bridges the gap between what one has learned (the known facts) and what one has experienced (one's intuition and ability to make a judgment based on their practical interactions in the real world). Guesstimating should not be relied upon for making big decisions that will have a significant impact on the final outcome of a result, especially when there is sufficient time in the schedule for collecting and interpreting all the relevant information. However, it is particularly useful in situations such as business meetings, when a quick judgment is needed to 'get a sense' of the current state of play in the short-term before the full facts are established.

YOU TRY IT

Practice becoming a critical thinker by identifying the habits of critical thinkers. Complete the following steps.

1. **Get ready**

   Read the following statements and consider whether each one describes a critical thinker.

   1. It is unlikely that any overseas tour assistant will ever develop good customer service skills.
   2. I assumed that the new tour assistant does not value promptness, but after talking to her, I think that assumption is wrong.
   3. Based on my limited knowledge of business management, I recommend additional training for the new tour assistant.
   4. I'll try to help the new tour assistant improve her time and customer management skills. But if that doesn't increase tour enrollments, I give up. Someone else can tackle this problem.

2. **Now you try it**

   Decide whether each statement describes a critical thinker. Identify which habit each critical-thinking statement demonstrates.

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REVIEW QUESTIONS

1. **Which one of the following is *not* a habit of critical thinkers?**
   - **a.** Intellectual humility
   - **b.** Methodical reasoning
   - **c.** Cynicism
   - **d.** Questioning assumptions
2. **What quality do you have when you understand the limits of your own knowledge?**
   - **a.** Intellectual humility
   - **b.** Scientific reasoning
   - **c.** Valid arguments
   - **d.** Social conditioning

Technology @ Work: Electronic Books

In Saudi Arabia, many readers enjoy the tactile pleasure of flicking through the pages of a traditional paper book. However, there is a growing market for electronic books (e-books) used on hand-held devices, such as a tablet or smartphone, with an app for downloading books. Thousands of titles can be stored on one device, and e-books can increase the distribution of useful information from businesses. case Omar wonders if the travel company you're both working at should enter the business of electronic tour guides that travelers could take with them on trips. He asks you to learn the advantages and disadvantages of e-books.

Essential Elements

1. **Enhance research and thinking**
   Unlike conventional, printed books, you can search e-books electronically using hyperlinks, similar to the way you use the Web. That could make it easier to do research and find the connections among ideas, evidence, and arguments, which enhances thinking.
2. **Provide a more engaging medium**
   E-books can include multimedia such as sound, video, and more vivid graphics than are usually produced in printed books. Readers can annotate and

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highlight e-texts without permanently marking the book. They can also adjust font size, lighting, and other settings to create a more comfortable and engaging reading experience.

3. **Require electronic device and software**

   Even if you read e-books on a laptop computer or mobile phone, you need special software to do so, whereas traditional books do not need special equipment or software. Traditional books are also easier to carry and transport than e-book devices, which require a source of power, although many titles can be stored on one device. Furthermore, e-books are susceptible to physical damage.

4. **Change the reading experience**

   Traditional books enhance the tactile and visual experience. Scanning and quickly paging through a book can be a more effective way to learn new information than searching electronically. Unlike glancing at the front or back cover of a book, it is difficult to gain a sense of an e-book by viewing its first page or promotional material.

YOU TRY IT

Explore electronic books. Complete the following steps.

1. **Get ready**
   1. Open a Web browser such as Internet Explorer or Firefox, and go to the Amazon Web site at amazon.com.
   2. Search for information about the Kindle.
   3. Find a video or other explanation of how the Kindle works.
   4. Find other sources of reading materials available for the Kindle, such as online reviews and articles.
   5. Take at least three screenshots of your activities researching the Kindle.
2. **Now you try it**

   Using a word processor, paste at least three screenshots of your research activities into a new document. Alternatively, describe your research activities in your notebook.

REVIEW QUESTIONS

1. **Which of the following is an advantage e-books offer over conventional books?**
   - **a.** Can transport without a power source
   - **b.** Can search electronically using hyperlinks
   - **c.** Can absorb greater physical damage
   - **d.** Can judge an e-book by its cover
2. **Which of the following is an advantage traditional books offer over e-books?**
   - **a.** Include multimedia
   - **b.** Can annotate without making permanent marks
   - **c.** Can adjust font size
   - **d.** Do not need special equipment or software

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Extra Practice

Real Life Independent Challenge

You can apply the critical-thinking techniques you learned in this chapter to develop your leadership skills. Develop your self-awareness by completing the following exercise.

a. Create a timeline of your life history. What are the major events in your life?

b. Identify your role models. Are these people in your current or past life? What did you learn from them?

c. Describe your strengths and weaknesses.

d. Describe the way you typically solve problems

e. Identify at least three of your core values. How do they shape the decisions you make?

Team Challenge

You are working for Qassim Builders, a company in Buraydah, Al-Qassim Province, specializing in sustainable building. In line with the Saudi Vision 2030, the goal of your company is to design and build structures that use energy, resources, and materials efficiently, protecting the health of occupants and improving the productivity of employees while reducing waste, pollution, and environmental degradation. Your top competitor is a company named Tameer Environments, and you are both submitting bids on three lucrative contracts. Your manager, Nora, asks your team to find a way to win the contract. Which of the following motivating actions should your team choose and why? Select your responses individually and then discuss them in your team.

a. Offer your team data from the green building trade association showing how Qassim Builders uses more environmentally friendly methods and products than Tameer Environments.

b. Offer a whitewater rafting adventure tour for any team member who wins a contract.

c. Announce that Qassim Builders is downsizing. The team member who does not contribute to a winning bid will be fired.

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d. Hold a team meeting to brainstorm how to win the contracts. What has anyone learned from customers recently? Do they like the buildings and structures from Qassim Builders? What can be improved and how?

Be the Critic

You are working on a Saudi Vision 2030 project to build a new community center in Riyadh, which will provide a state-of-the-art events space and other facilities for the public and local businesses to use. However, one of the members of the board wants to change the location of the proposed building. He has provided his argument for moving the location in the series of statements below.

Considering the critical-thinking processes discussed in this chapter, analyze the argument in each statement, noting its weaknesses, and send a list of the weaknesses to your instructor.

"We should change the location of the community center because it would better to build a new shopping center in this location instead."

"We should change the location of the community center because some people think we don't need one here anyway."

"We should change the location of the community center because I'm selling my own piece of land and I think it would be much better to build it there."

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Chapter 4

Group Decision Making and Problem Solving

When confronted with a complex problem or one that affects many people, organizations usually form a group to study the problem and make decisions that lead to a solution. Group decision making and participatory management are key facets of the Saudi Vision 2030. Today, many companies use team-based approaches for organizational tasks. Your task can be complicated or enhanced by group dynamics. This unit introduces you to the basics of group dynamics and the ways teams can work together effectively to solve problems. case You have been working with Omar, the vice president of finance at a travel company, to solve business problems for the company. Omar suspects that the company's future financial health depends on expanding its services to corporate travelers. He talks to company employees who were members of other problem-solving groups and asks them to join a new team exploring business travel services. Omar asks you to be a member of the new team.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Explain group dynamics
2. Evolve from a group to a team
3. Use divergent thinking
4. Use convergent thinking
5. Reach closure
6. Build sustainable agreements

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Understanding Group Dynamics

When working on complex tasks, you cannot do them all yourself. Organizations use groups and teams to make decisions, solve problems, and accomplish goals. A **group** is made up of two or more people who interact with each other, share expectations and obligations, and develop a common identity as a group. Real groups, as opposed to random collections of individuals, also have social or professional bonds and common interests, values, or backgrounds. The way that people work and interact with each other is known as **group dynamics**. Other terms used to describe groups include "teams," "clubs," and "committees." case Before the new company group meets for the first time, Omar suggests that you learn about the benefits of successful groups.

DEFINITIONS

Group: Two or more people who interact with each other, share expectations and obligations, and develop a common identity as a group.

Group dynamics: The way that people work and interact with each other.

Details

Organizations are embracing group projects and teamwork for the following reasons:

- **Diversity**

  A group of people can bring a rich diversity of culture, age groups, and other variables to a common table. This diversity gives a group a more varied perspective and appreciation for different ideas and enhances the types of solutions it can come up with. Figure 4-1 illustrates the types of expertise group members can offer when discussing a topic or solving a problem.

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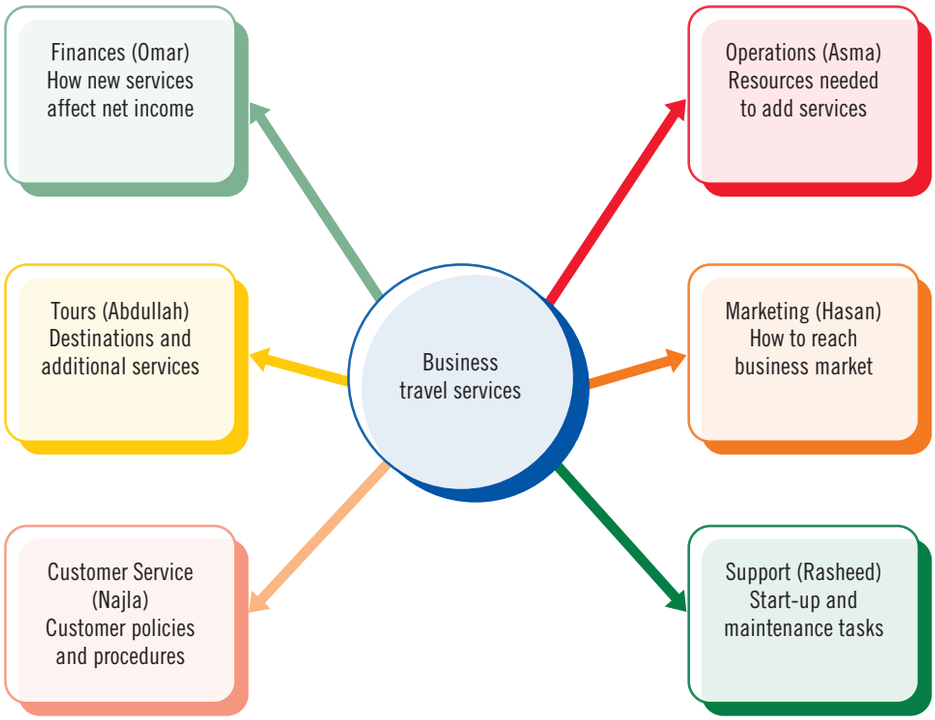
FIGURE 4-1: Using a group's expertise to explore a topic



- **Rich experience base**

  Each member of a group brings unique experiences with them. This includes differences in formal and informal education, work experience, responsibilities, and exposure to ideas from outside of the organization. Bringing together a group of people with a rich set of experiences can be very powerful.

QUICK TIP
Organizational memory can include an organization's physical archives, electronic databases, and members' knowledge.

- **Enhanced organizational memory**

  Organizations have a unique history and culture that a group must function in. People who have worked for a company for some time develop an **organizational memory** as they learn about the various processes, personalities, and subtleties of how the organization operates. When a group is formed, it can take advantage of its rich organizational memory. Someone on the team is likely to know who to talk with, what resources are available, or how to get something done. See Figure 4-2.

DEFINITION

Organizational memory: The history and culture that a group must function in, including the various processes, personalities, and subtleties of how the organization operates.

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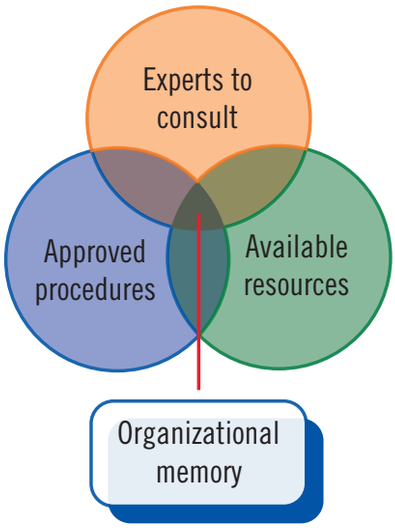
FIGURE 4-2: Organizational memory



- **Error detection**

  When you bring people together to work on a common task, you introduce multiple levels of error checking. Mistakes and omissions that may have otherwise gone unnoticed are more likely to be caught by other team members.

- **More creative solutions**

  Each individual in a group will approach a problem differently than everyone else. This leads to a larger number of unique and creative solutions. Functional teams can be an excellent source of ideas.

- **Greater acceptance of decisions and outcomes**

  When someone is involved in a decision-making process, they are more likely to accept and support its outcome. Committees are often formed when broad acceptance of an outcome is necessary. Even those who are not part of the group will be more accepting if someone from their department or work unit is involved in the decision process.

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Star power or team effectiveness?

Managers of business teams can learn a lot from how successful sports teams are managed. Using a popular management approach, many managers assign tasks to staff members according to their skills, personalities, and experience. This style of leadership, called a differentiated style, is used by coaches who treat their superstars differently from other players. Some coaches might award star players special privileges like more time with the trainer. In contrast, team-focused leadership treats a staff or other group as a whole.

A recent study compared the two styles and reached a surprising conclusion. "Most managers believe that you should treat everybody differently," says researcher Angelo Kinicki. "But our results reveal that...in a team setting, [singling out a star] can actually lead to negative effects." The results of the research show that teams in organizations work the same way. Treating all team members the same way can make them work more effectively in the group.

Source: Staff, "Successful Small Team Leadership: Manage the Group, Not the Individuals," Knowledge@W.P. Carey, May 27, 2009.

REVIEW QUESTIONS

1. **What are group dynamics?**
   - **a.** Changes noted in the action plan
   - **b.** How people work and interact with each other
   - **c.** Ways to organize an idea's costs and benefits
   - **d.** How resources are provided where they are needed
2. **Knowing about the processes, personalities, and subtleties of how a company operates is called:**
   - **a.** organizational memory
   - **b.** logistics
   - **c.** groupthink
   - **d.** consensus

Lesson
2
Chapter 4

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Evolving from a Group to a Team

People often form themselves into groups, but they may or may not work well together. If they do, the group is said to be functioning as a **team**—a group of people who organize themselves to work cooperatively on a common objective. Effective teams are not created automatically. Most groups of people pass through stages of cohesion and understanding before they can do useful work. Understanding how groups develop will help you when working with other people. Table 4-1 lists the do's and don'ts for evolving from a group to a team. case You meet with the new company group so each member can get acquainted before discussing how to improve sales to business travelers.

DEFINITION

Team: Unit of two or more people who interact and coordinate their work to accomplish a goal to which they are committed and hold themselves mutually accountable.

TABLE 4-1: Evolving to a team do's and don'ts

Guidelines	Do	Don't
Phase 1: Socialize	• Allow time for a new group to get acquainted • Develop the personal connections that make teams successful	• **Don't** skip this phase because you think it wastes time
Phase 2: Organize	• Agree on a shared mission and purpose • Reach an understanding about how to run and participate in group meetings • Set a schedule	• **Don't** let a power struggle over the group's leadership get in the way of the group's mission • **Don't** rush this preliminary phase • **Don't** make important decisions during this phase
Phase 3: Share	• Share information with other group members • Respond openly to others in the group • Provide feedback • Schedule work sessions and meetings	• **Don't** disregard the pecking order the group has established
Phase 4: Solve problems	• Collaborate on tasks • Work on solving complex problems • Make shared decisions • Encourage respect and cooperation	• **Don't** be discouraged if your group does not reach this level of teamwork

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Essential Elements

1. **Expect socializing**

   During the first meetings, groups of people typically take time to get to know one another. This phase involves introductions, social interaction, and personal sharing through polite conversations. Some group members think that the socialization phase wastes time, but a group needs personal connections to develop into an effective team.

2. **Encourage organizing and forming**

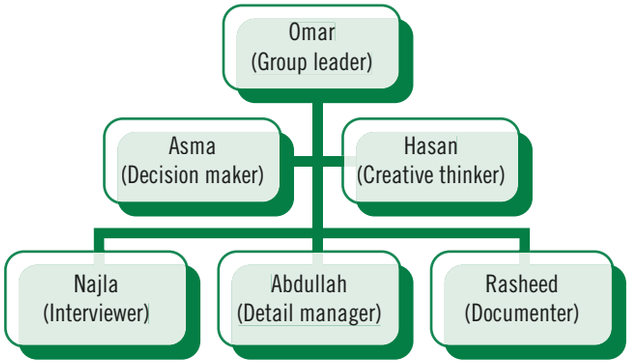
   During the second phase, the group develops a shared understanding of its mission and purpose. People also begin to assume group roles, including asserting their dominance and competing for influence over the group's direction. This power struggle often occurs even if the group has a formal leader or chair. In time, the group comes to an understanding about how it operates and makes decisions, what the expectations for participation are, and how often it meets. Members begin to identify with the group during this phase and develop a sense of belonging.

QUICK TIP
Avoid making important decisions before the group works out a pecking order. Priorities can change as informal leaders emerge.

3. **Facilitate information sharing and processing**

   After group members get acquainted and work out their **pecking order**, as shown in Figure 4-3, they feel comfortable sharing information with each other. This includes disclosing sensitive material, responding openly to one another, and providing feedback. At this point, the group can begin to schedule meetings, work sessions, and other collaborative time. The group also starts to work on its assigned tasks and looks more like a team to an outside observer.

FIGURE 4-3: Pecking order and assumed roles



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DEFINITION

Pecking order: A hierarchy; the organization of people at different ranks in an administrative body.

4. **Collaborate to solve problems**

   Assuming a group successfully completes earlier phases, it eventually develops teamwork and **synergy**, which is achieved when two or more people work together to produce something greater than the sum of their individual efforts. During the collaboration phase, group members can complete tasks efficiently, work together on complex problems, and make shared decisions. They respect each other, develop a desire to cooperate, and take pride in the group's accomplishments instead of only their own. Not all groups evolve to the collaboration phase, but those that do are usually very productive and effective.

DEFINITION

Synergy: When two or more people work together to produce something greater than the sum of their individual efforts.

Critical thinking and feeling

If your group is discussing a change that directly affects most people in the organization or a solution that requires cooperation and unity, consensus decision making can be invaluable. Collaboration and consensus are two key themes of Saudi Vision 2030, which encourages citizens to play an active role in ensuring collective success, while simultaneously promoting and empowering individuals to nurture "resilient and independent characters". According to Saudi Vision 2030: "The nation we aspire to build will not be realized without a grand collective national effort where everyone contributes..." One specific example of a new collaborative approach is the 'Irtiqaa' program in children's education. This initiative encourages parents to become more actively involved in their children's education, through developments including parent-led school boards and open discussion forums. Equally, innovative educational programs (drawing upon collaboration with both nonprofit and private sectors) and teacher training will help to foster this relationship between families and educators. Collaborative initiatives can prove to be very effective when everyone involved stands to benefit from their success.

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YOU TRY IT

Practice evolving from a group to a team by analyzing descriptions of group meetings. Complete the following steps.

1. **Get ready**

   For each description of a meeting listed in Step 2, consider which team-building phase each meeting represents.

   Phase 1: Socialize
   Phase 2: Organize
   Phase 3: Share
   Phase 4: Solve problems

2. **Now you try it**

   1. Omar meets with other company employees to discuss the mission and purpose of exploring business travel services.

   Phase:

   2. Employees meet to collaborate on materials that promote the company's business travel services.

   Phase:

   3. Ebtesam meets with other employees to get acquainted before dealing with the new business travel project.

   Phase:

   4. Omar organizes a lunch meeting so that members of the new business travel team can develop personal connections.

   Phase:

   5. During a meeting of the business travel team, Ebtesam schedules a work session for identifying tours that appeal to business travelers.

   Phase:

   6. At the beginning of a meeting of the business travel team, Omar sets a schedule so that everyone on the team can meet once a week.

REVIEW QUESTIONS

1. **In business, a team is:**
   - **a.** two or more people attending a meeting
   - **b.** a group of people who work together cooperatively
   - **c.** a group of people that meet regularly
   - **d.** two or more people who share expectations
2. **What do successful teams allow time for when the group first starts to meet?**
   - **a.** Online scheduling
   - **b.** Convergent thinking
   - **c.** Creating action plans
   - **d.** Socializing

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Chapter 4

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Using Divergent Thinking

Groups can develop creative ideas and solutions to problems because their collective knowledge is greater than that of a single person. However, groups seldom behave creatively on their own. The team leader or other facilitator needs to engage the group in activities that foster creativity and collaboration. **Divergent thinking** describes thought processes or methods used to generate ideas. As the name suggests, divergent thinking techniques generate many ideas that are often not related to one another. Divergent thinking is usually spontaneous, free flowing, and unorganized. Later, the group can organize the ideas and apply them to solving the problem. Table 4-2 describes the do's and don'ts of divergent thinking. case After meeting with Omar and the new corporate travel team, you are ready to generate ideas about how to increase the amount of tours designed for business travelers.

DEFINITION

Divergent thinking: Thought processes or methods used to generate ideas.

TABLE 4-2: Divergent thinking do's and don'ts

Guidelines	Do	Don't
Brainstorming	• Generate ideas and solutions as a group • Record ideas	• **Don't** disregard, analyze, or reject an idea during brainstorming
Mind map	• Visualize and organize creative ideas as a group • Draw ideas as a tree or spoke-wheel diagram • Retain the mind map as a record of the group's ideas and decisions	• **Don't** get bogged down in the mechanics of drawing a mind map • **Don't** evaluate ideas until you are finished
Free writing	• Use to stimulate individual creativity • Write thoughts about a subject nonstop for a short time • Follow up with a group brainstorming or mind mapping session	• **Don't** pause to edit, proofread, or review as you are writing
Journal writing	• Use to record spontaneous thoughts and ideas • Share journal contents with the group	• **Don't** expect to generate as many ideas with a journal as with brainstorming or mind maps

Essential Elements

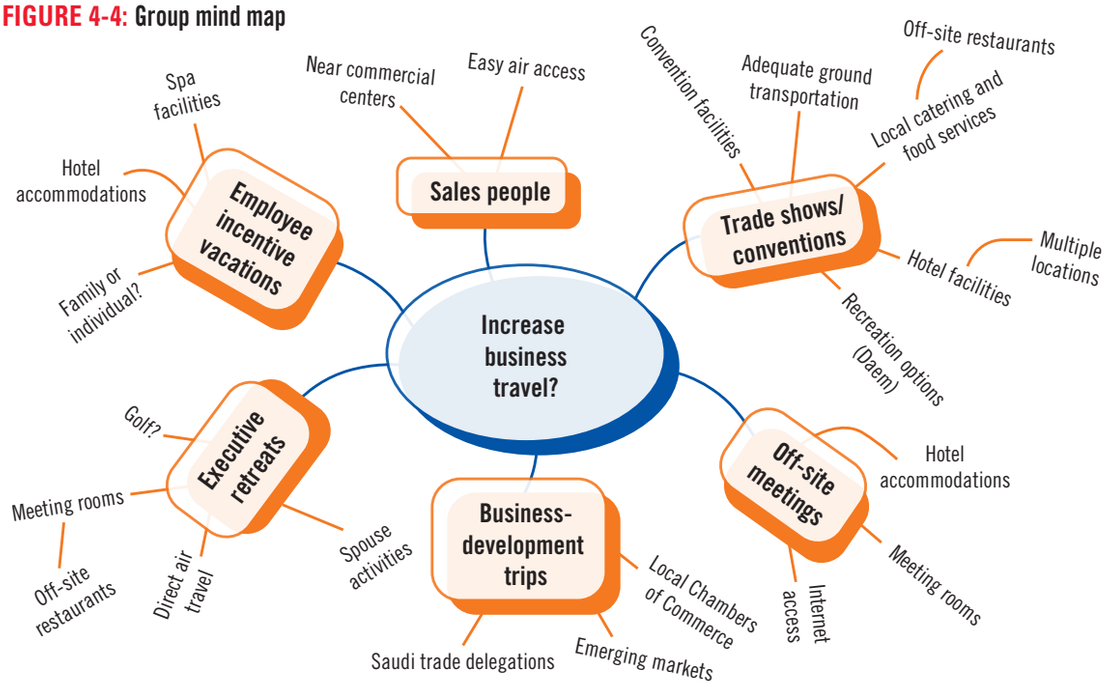
1. **Brainstorming**

   One of the most popular and well-known techniques for divergent thinking is brainstorming. Groups use brainstorming to generate ideas and solutions to problems. The group considers a question, task, or project, and then generates as many ideas as possible, usually in a short period of time. Every idea is recorded, and no idea is disregarded, criticized, or analyzed. As ideas are suggested, they often stimulate others. The group continues to contribute ideas until everyone has exhausted their creativity.

2. **Group mind mapping**

   Mind mapping uses simple graphics to generate, visualize, and organize creative ideas. A group member lists a main idea or problem at the center of a page, white board, or flip chart. Each participant is invited to share reactions and ideas. These are drawn as radial lines or spokes. When someone's idea builds, or piggybacks, on another, it is drawn as a branch in a tree structure. The visual nature of a mind map helps some people to think about a problem more creatively and may yield different results than traditional brainstorming. The map itself is a useful record of the group's contributions. See Figure 4-4.

FIGURE 4-4: Group mind map



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3. **Free writing**

   Free writing is a form of brainstorming where group members focus on a subject and then write about it nonstop for a short period of time. Participants write any idea that occurs to them without pausing to consider the value of the idea or to proofread or edit their writing. This exercise is designed to encourage creativity and explore alternatives. When done as a group, free writing can be followed by a brainstorming or mind mapping session to collect ideas for the group.

QUICK TIP
Allow people to submit their entries anonymously to encourage free thought.

4. **Journaling**

   People often think of creative ideas spontaneously and can easily forget them if they do not act on them or record them. Distribute journals to members of a group and ask each to write down thoughts and ideas. A journal can be an inexpensive spiral notebook or specialty blank book. Team members can keep the journal at their desks to note ideas when they occur to them. They can share the ideas with the group at a later meeting or submit them directly to a team leader. The quantity of ideas generated through journal writing is not as great as some other techniques, but the quality and range of the ideas are often superior.

Mind mapping software

You can use digital tools to boost your divergent thinking. Bubbl.us (*www.bubbl.us*) is a free Web application that lets you conduct brainstorming sessions online. You write your thoughts in graphical bubbles and connect those to other bubbles without the distraction of drawing and formatting. Bubbl.us helps you brainstorm quickly instead of getting bogged down in the mechanics of creating and linking bubbles. MindMeister (*www.mindmeister.com*) is a simple, free tool that lets you quickly create mind maps just by pressing the directional arrow keys on your keyboard. XMind (*www.xmind.net*) is also free, but lets you create fishbone, organizational, tree, and logic charts in addition to mind maps.

YOU TRY IT

Practice using divergent thinking by generating solutions to a problem. Complete the following steps.

1. **Get ready**

   The travel company you're working at wants to offer new types of tours that will appeal to business travelers. Prepare to use the free writing technique to generate tour ideas.

2. **Now you try it**

   Use the free writing technique to generate tour ideas as follows:

   1. For one minute, think of the types of tours and destinations that would appeal to various business travelers, including salespeople, managers, owners, and staff members.
   2. For five minutes, write down any ideas you have for increasing business travel. Write nonstop during this period without pausing to read or edit your work.

REVIEW QUESTIONS

1. **Divergent thinking describes thought processes or methods used to:**
   - **a.** design credible arguments
   - **b.** generate ideas
   - **c.** select the best alternative
   - **d.** overcome resistance to change
2. **Which of the following is not an exercise in divergent thinking?**
   - **a.** Brainstorming
   - **b.** Free writing
   - **c.** Outlining
   - **d.** Mind mapping

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Using Convergent Thinking

In the early stages of solving a problem, you use divergent thinking to develop as many creative ideas and potential solutions as possible. At some point, however, the group needs to review and evaluate the ideas in an organized, understandable, and structured format. **Convergent thinking** techniques narrow the options to a manageable set. The decisions and solutions that the group eventually makes will be based on these organized ideas. Table 4-3 lists the do's and don'ts for convergent thinking. case Now that the corporate travel team met to generate ideas, Omar plans a meeting to organize and evaluate the ideas. He asks you to learn about techniques for structuring group ideas and solutions.

DEFINITION

Convergent thinking: Thought processes or methods that narrow options to a manageable set.

TABLE 4-3: Convergent thinking do's and don'ts

Guidelines	Do	Don't
Review ideas	• Review ideas and eliminate some • Reduce number of ideas to a manageable amount • Use three-pile method to vote on each idea	• **Don't** reject ideas arbitrarily; use criteria the group agrees on
Analyze ideas	• List the pros and cons of each idea • Perform a cost-benefit analysis • Create a decision balance sheet • Create an impact analysis • List the consequences of each idea • Use reverse brainstorming to identify weaknesses and avoid groupthink	• **Don't** overlook the fatal flaw in an idea • **Don't** focus on one type of cost or benefit—consider different forms • **Don't** consider ideas, options, and potential solutions on their own—consider related factors • **Don't** introduce new ideas

Essential Elements

1. **Review your ideas**

   If your group's divergent thinking has gone well, you should have a sizable set of ideas, options, and possibilities to consider. One of the first tasks for the group is to carefully review these ideas and cull, or remove, the impractical ones. A popular culling approach is the **three-pile method**. Review

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each option and have the group vote to put the idea into either a Yes, No, or Maybe pile (or category). A simple plurality of votes is needed for each. The No pile is eliminated from further consideration. The Maybe pile is held in reserve and may be revisited if necessary.

DEFINITION

Three-pile method: A technique for reducing ideas to a manageable number.

QUICK TIP

Identify pros and cons in an informal discussion, or more formally with someone recording the feedback for all to see.

2. **Identify the pros and cons**

Have the group consider each option or idea one at a time and identify the associated pros and cons. The objective is to have the group consider each option in an objective manner. Ask the group if there is a **fatal flaw** inherent in any of the ideas. A fatal flaw is some aspect of an idea that would make it unacceptable.

DEFINITION

Fatal flaw: An aspect of an idea that would make it unacceptable for some reason.

3. **Perform a cost-benefit analysis**

Each idea that is proposed will have some benefit to the group or organization. It will also have some associated costs. Good ideas typically have benefits that outweigh their costs. Costs and benefits may take different forms such as monetary return, cost savings, improved efficiency, reduced problems, and others, and comparing one to another may be tricky. A **decision balance sheet** is a formal way of organizing an idea's costs and benefits. See Figure 4-5.

FIGURE 4-5: Decision balance sheet

Should the travel company expand to provide tours and services for the business traveler?

	Gains	Losses
The company	Add to customer base	Detract from current customers
	Develop new sources of revenue	Increase expenses
	Build on current tours	Manage conflicts
	Create stability	Manage change
	Increase sales to both sets of customers	Dilute current services
Customers	Can select from a full range of services	Might be confused about company focus
	Can combine business and personal travel	Might not be willing to pay higher prices for business services

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DEFINITION

Decision balance sheet: A formal way of organizing an idea's costs and benefits.

QUICK TIP

An impact analysis alone should not drive the final decision, but can help to better differentiate between alternatives.

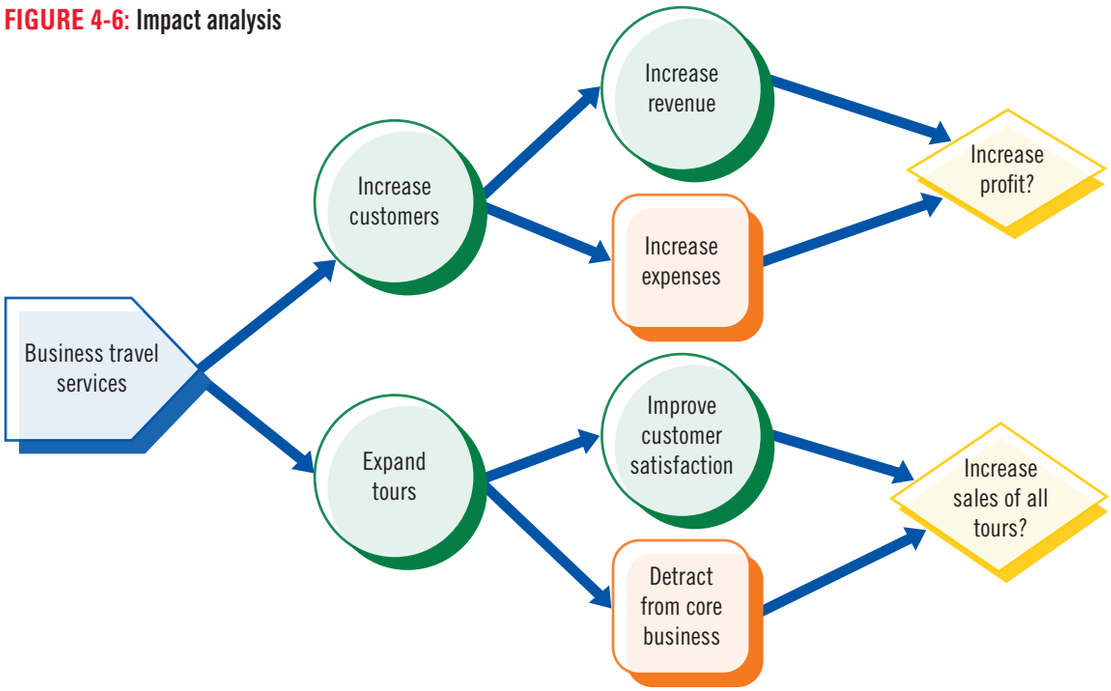
4. **Create an impact analysis**

It is easy to consider ideas, options, and potential solutions by themselves and not consider other related factors. Use an **impact analysis** to broaden your view. Have the group list the consequences of each idea. Who or what would each option affect? Would the consequences be minimal or manageable? Which idea would cause the least amount of loss or harm? See Figure 4-6.

DEFINITION

Impact analysis: A way of evaluating the effects of an idea or alternative.

FIGURE 4-6: Impact analysis



5. **Use reverse brainstorming**

Brainstorming is usually thought of as a divergent thinking technique. However, when used in reverse it can be a helpful convergent tool. Present each idea or option to the group and ask everyone to identify possible weaknesses or problems. The goal is not to come up with new ideas, but to gen-

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erate criticisms instead. This exercise forces people to take a hard look at each option and helps minimize problems associated with groupthink. The group can reexamine the ideas to generate possible solutions for each of the weaknesses identified.

YOU TRY IT

Practice using convergent thinking by generating solutions to a problem. Complete the following steps.

1. **Get ready**

   At the travel company you're working at, one idea generated during divergent thinking activities was to expand the company Web site to provide general services for business travelers. The Web site would let business travelers do the following:

   - Find information about destinations.
   - Request services from the travel company staff, such as group accommodation, travel reservations, and event planning.
   - Look up information about flights, tours, excursions, and reservations.

2. **Now you try it**

   Use a convergent thinking technique to evaluate the problem of whether the company should expand its Web site to include services for business travelers.

REVIEW QUESTIONS

1. **The goal of convergent thinking is to:**
   a. narrow possible options to a manageable set
   b. avoid groupthink
   c. identify tasks, resources, and expenses
   d. reach a group consensus
2. **Which of the following tools helps to perform a cost-benefit analysis?**
   a. Three-pile analysis
   b. SWOT analysis
   c. Online communication channel
   d. Decision balance sheet

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Reaching Closure

Some groups and teams are designed to be ongoing concerns that continue to work together and move from one issue or project to another. Other groups address a particular concern and are disbanded when that problem is solved. In both cases, it is common for the group to artificially prolong a process and not reach closure as efficiently as it could. A team leader needs to provide direction and help the group to develop closure and make necessary decisions. Table 4-4 lists common approaches for groups to make final decisions. case The corporate travel team has met a few times and generated detailed suggestions for providing tours to the business traveler. For the next meeting, you and the other members plan to decide whether to pursue the new business and if so, what approach to take.

TABLE 4-4: Group decision methods

Method	Description	Purpose
Range voting	• Members assign scores to multiple options rather than voting for a single choice • Scores indicate level of preference • Option with the highest overall average is selected	• Allows people to better express their preferences • Appropriate when group members support several options
Majority rule	• Common decision technique • Selects an alternative based on which one has more than half of the votes	• Efficient technique when choosing between two alternatives • Less efficient with more than two options; another approach might be more practical
Plurality	• The largest block in the group decides the issue • A plurality can be a percentage less than 50%	• This technique is useful when a choice is made from multiple alternatives • Because a decision can be made by a relatively small percentage of a group, people may be less accepting of the outcome

Essential Elements

1. **Use a command style**

   In some settings, a group may examine an issue and develop ideas for it, but the final decisions are left up to a single person. In most cases, this decision maker is a manager, executive, or other administrator. The command approach is the most efficient way to reach closure as there is only one decision maker. However, it is often unpopular with the other participants. People who feel as though their opinions and ideas have little consideration are less committed to the outcome and may harbor negative feelings about the process.

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2. **Use a consultative approach**

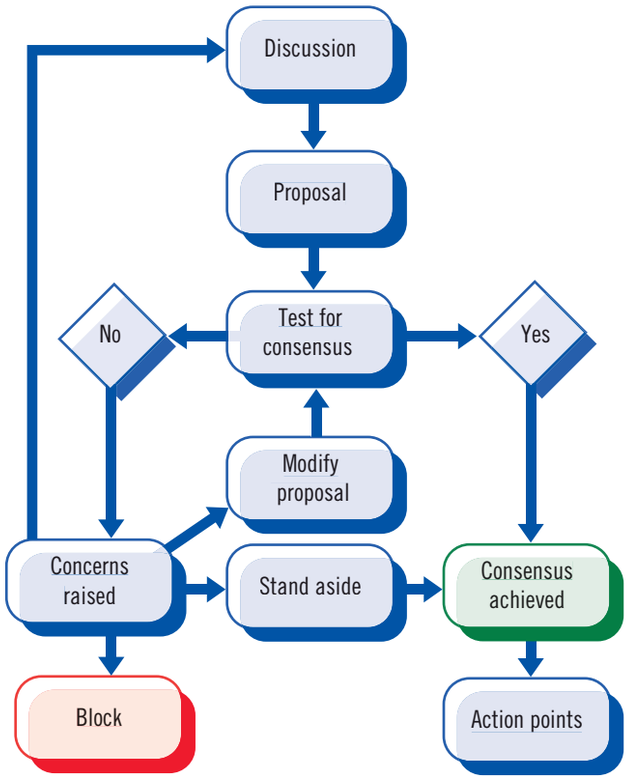
The consultative approach is similar to a command style in that a leader still makes the final decisions. However, the process is more democratic because the leader actively seeks input and advice from the group before making the decision. Because there is more communication between the leader and the group, ideally the solution reflects contributions from everyone.

QUICK TIP
Consensus doesn't mean allowing someone to set the agenda with an unreasonable demand.

3. **Use consensus decision making**

Consensus decision making seeks a solution that most of the group can agree to while trying to resolve any concerns or objections that the minority has. Consensus-based approaches require more time for closure, but tend to have a higher level of commitment from the participants. This is achieved by seeking solutions that the majority can agree to while also taking steps to modify or remove objectionable features of any decisions. See Figure 4-7.

FIGURE 4-7: Reaching closure through consensus



QUICK TIP
Strengthen a plurality vote by using several rounds. Eliminate options with the least support and vote again.

4. **Select appropriate voting methods**

In all but the most authoritative groups, members signal their intent and preferences for different options through some form of voting. A group can select one of several voting methods according to what is most appropriate for the problem or project. See Table 4-4.

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YOU TRY IT

Practice reaching closure by reviewing a decision and choosing how to reach closure. Complete the following steps.

1. **Get ready**

   The travel company you're working at is deciding whether to open a new department dedicated to business travel. This department would coordinate travel arrangements for corporate travelers, focusing on special tours such as employee incentive trips, executive retreats, and conference and event tours.

   During a meeting, the company corporate travel team will determine whether to recommend creating the new business travel department or not. Some members of the team want to create the new department, others do not want to create the new department, and a few are undecided.

2. **Now you try it**

   Describe how you would reach closure during the meeting.

REVIEW QUESTIONS

1. **A team leader who actively seeks advice from the group before making a decision is using:**
   - **a.** a consultative approach
   - **b.** a command style
   - **c.** consensus decision making
   - **d.** an active advice approach
2. **When is majority rule an efficient decision-making technique?**
   - **a.** When using a command style
   - **b.** When group members support several options
   - **c.** When choosing between two alternatives
   - **d.** With small groups

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Building Sustainable Agreements

The final step a problem-solving group performs is developing an implementation plan, also called an **action plan**, to guide changes, product or service introductions, and complex projects. The action plan summarizes the activities the group and other members of the organization agree to perform to make sure the project succeeds. See Figure 4-8. Recognize that the action plan represents change, and people and organizations tend to resist change. Involve members of the team and others in the organization to build an agreement that can be sustained as the problem is solved. Table 4-5 describes the do's and don'ts for building agreements. case A few days after meeting to discuss the travel company's new business travel services with the Riyadh office and partners around the world, you and the rest of the corporate travel team in Tabuk meet again to create an action plan.

DEFINITION

Action plan: A plan that summarizes the activities the group and other members of the organization agree to perform to make sure the project succeeds.

TABLE 4-5: Building agreements do's and don'ts

Guidelines	Do	Don't
Overcome fear	• Recognize that team members and others in the organization might resist change • Discuss the benefits of the change	• **Don't** change tasks, project goals, or parts of the team without discussing them first • **Don't** discourage members of your group from discussing their concerns about the project • **Don't** avoid identifying fears and objections
Communicate openly	• Share team ideas with a larger audience, such as a department or company • Communicate frequently with decision makers • Hold open meetings and forums, and provide memos, newsletters, and presentations to keep in touch with others outside the team	• **Don't** assume a single communication or tool is sufficient • **Don't** overwhelm the larger audience with too much or too frequent news • **Don't** introduce a new solution during a period that is usually busy for your organization

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FIGURE 4-8: Sample action plan

Action Plan: Expand business travel market				
Objectives: To contact 2000 potential business customers and sign 40 of those customers to a tour in one year **Budget:** SAR 1500 start-up budget plus SAR 1000/month				
Action	**Cost**	**Time**	**Schedule**	**Assigned to**
• Add or expand five tours for business travelers	SAR 1000	24 hours	June 20–July 20	Asma Hasan Abdullah
• Join Saudi Arabian Voyagers Association (Meetings and networking)	SAR 250/yr	4 hrs/month	June, September	Hasan
• Create new brochure	SAR 600	15 hrs	June 20–30	Asma Rasheed
• Select and hire a telemarketing firm	SAR 300/month	5 hrs/month	June 1–July 1	Hasan
• Advertising (Direct mail and Web)	SAR 550 plus SAR 120/month	9 hrs plus 3 hrs/month	June 16–August 15	Asma Omar Hasan
• Develop sales presentation	SAR 360	20 hrs	June 20–30	Abdullah Omar
• Train customer service staff	SAR 150	20 hrs	June 16–30	Najla Ebtesam
Start-up expenses	**SAR 2910**	**88 hrs**		
Monthly expenses	**SAR 420**	**12 hrs**		

Essential Elements

QUICK TIP
If the group's solution might be threatening to a decision maker, invite that person to a team meeting to encourage their support.

1. **Overcome fear**

   An action plan represents change, which can threaten someone's job, status, position, budget, or power. Resistance to change increases as a solution becomes more creative and less like habitual activities. Members of your group should discuss their concerns about the plan and understand its benefits before agreeing to it. The group can also work together to identify fears and objections others in the organization might have.

2. **Communicate openly**

   Groups tend to communicate among themselves, forgetting to share their ideas with a larger audience. This is especially true of teams that have worked together in the same location for some time. As your group starts to develop its action plan, take extra steps to share your ideas and progress with stakeholders and decision makers. Use a variety of open meetings, forums, memos, newsletters, and presentations to communicate across the organization.

3. **Manage the pace**

People are more accepting of change when they have sufficient time to adjust to it. Your group should share ideas and conclusions gradually, allowing time between each new step the group introduces. Welcome discussions about the action plan and its steps, but avoid overwhelming people with major new initiatives all at once.

QUICK TIP
Look at the company calendar and ask people what activities are scheduled for the organization.

4. **Avoid inappropriate times**

Be aware of the periods when your organization is typically busy, and avoid starting the steps in the action plan at that time. For example, trying to launch a new project a day before the weekend, when employees are focusing on completing their existing tasks, may not be advisable. However, that same initiative introduced at another time might have a warm reception.

YOU TRY IT

Practice building sustainable agreements by creating an action plan for a project. Complete the following steps.

1. **Get ready**

Read the following details for a project to expand the Web site at the travel company you're working at to offer business travel services.

Expanding the company Web site to provide business travel services:

- Hasan can design the Web pages. He estimates he needs about 5 hours and SAR 250 to do this.
- The Web pages should be designed June 1–5.
- Overall budget is SAR 2000.
- The tour database also needs to be expanded. Asma is in charge of this task. She needs SAR 150 and 8 hours per week during June 1–15 to complete this task.
- Hasan and Ebtesam can work together to create and test the Web pages from June 8–22. This will cost SAR 500 and take 10 hours to complete.
- Ebtesam can also work with Asma to add the new Web pages to the Web site and then maintain them. Starting June 24, this will take SAR 20 and 2 hours per week.
- The Web site needs to be promoted starting June 24. Hasan is in charge of this task. He needs SAR 500 plus SAR 50 per week. He estimates he'll also need 10 hours per week to promote the Web site.

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2. **Now you try it**

Use the following form to complete the action plan in your notebook or using a word processor.

Action Plan:				
Objective: **Budget:**				
Action	**Cost**	**Time**	**Schedule**	**Assigned to**
•				
•				
•				
•				
•				
Start-up expenses				
Weekly expenses				

REVIEW QUESTIONS

1. **What is the purpose of an action plan?**
   - **a.** To identify the consequences of each idea
   - **b.** To review ideas and reduce them to a manageable number
   - **c.** To document meeting activities
   - **d.** To summarize the activities the group agrees
2. **Which of the following is not a way to build a sustainable agreement?**
   - **a.** Introduce all changes at the same time
   - **b.** Overcome fears
   - **c.** Communicate openly
   - **d.** Manage the pace

Technology @ Work: Online Scheduling Tools

Finding time for team meetings or scheduling appointments with another professional can result in dozens of exchanged e-mail messages that are hard to track. A growing range of online scheduling tools, which includes Doodle and Google Calendar, can simplify this time-consuming task. In typical online scheduling tools, the meeting organizer uses an online calendar to select times for the meeting. The organizer uses e-mail to notify everyone who needs or wants to attend the meeting. Participants respond by selecting times that are most convenient for them. The organizer can select the time, usually the one that works for most people, or the tool can recommend a time. Using Doodle, you can conduct polls to schedule events. Google Calendar lets you organize your schedule and share it with others. case Omar wants to offer services such as destination planning and trip coordination to corporate customers. He asks you to learn about online scheduling tools to find out if they would support these services and appeal to the company's business customers.

Essential Elements

QUICK TIP
If you are setting up many dates and times in Doodle, you can copy and paste the times from one date to the next.

1. **Schedule events**
   If you are organizing a meeting or hosting an event, you can use Doodle or Google Calendar to enter the event on an online calendar. With Doodle, you select more than one day or time convenient for you and other participants. With Google Calendar, you enter the event on a personal calendar.
2. **Invite others to review the schedule**
   After you schedule an event, invite others to attend. Doodle sends participants a link to a poll that lists the dates and times you selected. With Google Calendar, you send e-mail invitations to participants.
3. **Reserve the best time**
   Based on the responses from participants, reserve the best time for the event. Doodle takes care of this in an innovative way: as each person responds to the poll by voting for scheduled time, Doodle tabulates the votes and reports the results. You can then reserve a time for the event considering those results. With Google Calendar, the people you invite can RSVP using e-mail or the calendar itself. Let everyone know the event has been scheduled by sharing your calendar online.

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QUICK TIP
In Google Calendar, you can set up a calendar for a conference room so you can reserve a meeting space.

4. **Send reminders**

   To notify participants about an upcoming event, you send them an e-mail or text message. You can set Google Calendar to automatically remind others about upcoming events or let them know if event details have changed. If you sign up for a free Google account, you can receive a daily agenda listing your schedule.

YOU TRY IT

Explore online scheduling tools. Complete the following steps.

1. **Get ready**
   1. Open a Web browser such as Internet Explorer or Firefox, and go to the Doodle Web site at doodle.com.
   2. Follow the steps to schedule an event, inviting yourself, your instructor, and at least one classmate.
   3. Follow the poll results as you receive them.
   4. Take a screenshot of the results.
2. **Now you try it**

   Using a word processor, paste the screenshot of your results into a new document. Alternatively, describe your results in your notebook.

REVIEW QUESTIONS

1. **In most online scheduling tools, the meeting organizer uses an online calendar to:**
   a. vote for meeting locations
   b. select times for a meeting
   c. schedule range voting
   d. distribute documents electronically
2. **After participants respond to a meeting invitation, how does Doodle help you select the best time?**
   a. It reserves a conference room
   b. It publishes a group calendar online
   c. It sends electronic RSVPs
   d. It tabulates responses and reports the results

Extra Practice

Real Life Independent Challenge

You can apply the group decision-making techniques you learned in this chapter to develop your group participation and decision-making skills. Most jobs require a variety of skills in these categories. Develop these skills by completing the following exercise.

a. Identify your life and study skills. List the types of activities you have performed in the past six months in life or school. For example, have you worked on a team? Written reports? Attended group workshops? Then list the skills required to complete these activities.

b. Identify your experiences in life outside of school. List these experiences and the skills required to perform them.

c. Review the lists you created and identify interpersonal and group skills, such as motivating others, learning to negotiate or network, or organizing a meeting.

d. Which skills do you want to continue to develop and be central parts of your future jobs?

Team Challenge

You are working for Qassim Builders, a company in Buraydah, Al-Qassim Province, specializing in sustainable building. You are part of a project team that is supervising the design and construction of a visitor's center in Buraydah. In line with the Saudi Vision 2030, the goal is to build the visitor's center so that it is self-sufficient. That means it should use no outside resources, if possible, including energy, water, and waste systems. Your manager, Nora, suggests that you meet with your team to plan this project.

a. Meet as a team and brainstorm the general categories of resources you need to build the visitor's center so that it is self-sufficient. Consider everything typically found in a public building.

b. Review the resource categories and create a master list.

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c. For each category, brainstorm ways to provide the resource without depending on outside systems. For example, if you have a food category, you could create a garden and greenhouse to provide fruits and vegetables without depending on outside suppliers.

d. Review the ideas your team generated, and then use convergent thinking techniques to edit the list. Your goal is to identify all the resources a visitor's center needs using systems that are fairly easy to set up and maintain and are not too expensive.

e. Submit the list to your instructor as requested.

Be the Critic

You are working part-time for a landscaping company planting trees and shrubs in a new neighborhood full of recently built homes. A large warehouse is located near a wadi at the edge of the neighborhood. When you enter the warehouse, you discover it houses old pesticides, some of which are now outlawed. Concerned that the pesticides could pose a danger to the new neighborhood, you introduced the topic of the pesticides at a staff meeting and asked what you should do. Figure 4-9 shows how people answered your question. Analyze the solutions offered, noting their weaknesses, and send a list of the weaknesses to your instructor.

FIGURE 4-9

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Chapter 5

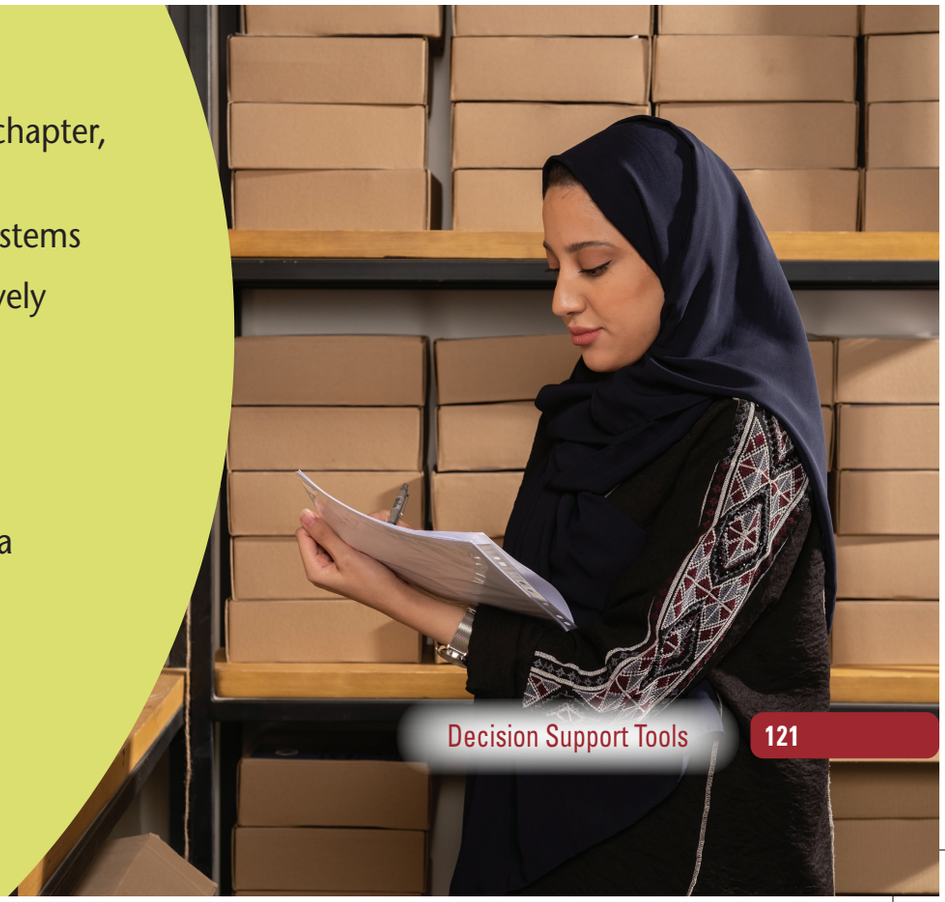
Decision Support Tools

One of the earliest uses of computer technology was to support people making complex decisions. The term decision support system (DSS) describes any information system that aids in decision making, such as spreadsheets that compare weekly sales data or software that summarizes data on a so-called dashboard to highlight positive and negative trends. Today, decision makers use spreadsheets, communication tools, and graphics software to analyze data and options. This chapter introduces the basic concepts of decision support tools and shows how you can use software to make objective decisions. case You have been working with Omar, the vice president of finance at a travel company, to help expand the company's services to corporate travelers. The new project is a success so far, though it has introduced some unexpected questions and decisions. Omar asks you to help him organize information and learn to use decision support tools so that he and others can make effective decisions.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Explain decision support systems
2. Model decisions quantitatively
3. Describe data objectively
4. Weigh factors
5. Create decision trees
6. Use graphics to display data



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Understanding Decision Support Systems

A **decision support system (DSS)** is interactive software designed to help you compile useful information from raw data, documents, and business knowledge. You then use this information to identify and solve problems and make decisions. A DSS is ideal for analyzing complex problems that involve sets of data and demand a systematic decision-making approach. case Before you start assisting Omar, he asks you to learn about decision support systems and their benefits.

DEFINITION

Decision support system (DSS): Interactive software designed to help you compile useful information from raw data, documents, and business knowledge.

Details

Decision support systems offer the following benefits for decision makers:

- **Add objectivity to making decisions**

  Decision support software requires you to clearly define the issues, identify relevant information, determine how factors are related, and analyze the results. When you are making a decision, a DSS helps you evaluate all parts of the decision objectively. For example, the travel company you're working at can use a graphic such as the one shown in Figure 5-1 to determine which tour to offer first to corporate customers.

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FIGURE 5-1: Decision diagram

- **Improve efficiency for complex decisions**

  Complex decisions typically involve gathering lots of detailed information and then ranking or assigning weights to each factor. A computer can store information and make complex calculations much more efficiently than people can. You use decision support software to maintain, process, and report on the detailed information involved in complex decisions. For example, the travel company you're working at is considering opening a branch office in Jeddah or Khobar to serve corporate customers. It can use decision support software to compare expenses such as rent, travel, and employees and weigh factors such as proximity to clients, staff preference, and local attractions.

- **Encourage exploration and discovery**

  Decision support systems help you visualize data, illustrate problems, and graphically represent options and solutions. You can easily adjust variables and model scenarios. For example, the travel company's employees can use a spreadsheet to compare the income and expenses they have now with those they expect to have with a separate business travel department.

QUICK TIP
When you solve a problem intuitively, you react immediately and instinctively, without following a particular procedure.

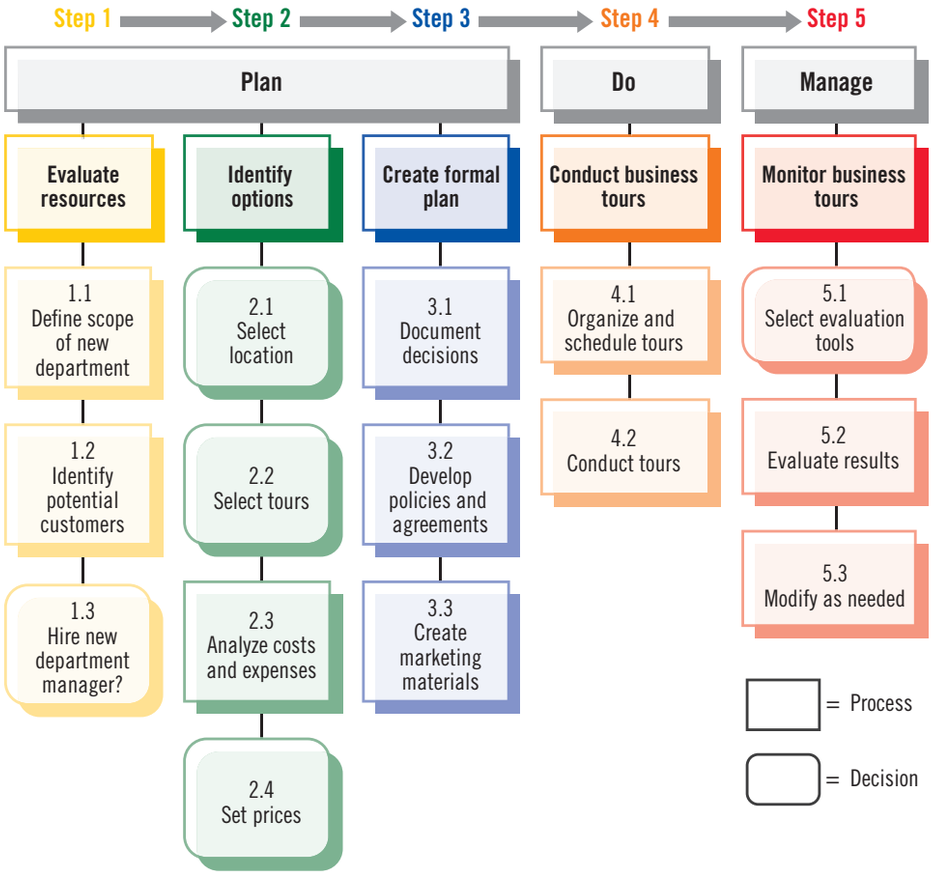
- **Provide support for particular decisions**

  As a member of an organization, you must always be prepared to support the decisions you make. Intuitive decisions can be difficult to defend. When you approach a decision objectively and analyze it, you can demonstrate that you handled the matter professionally. For example, a decision support system can help to compare the cost and volume of trips to find the best price.

- **Help communicate decisions to other interested people**

  Describing the thought processes that go into making a complex decision or solving an involved problem can be difficult. Decision support systems and their models can help you more effectively communicate your ideas to interested stakeholders. Figure 5-2 shows the steps, processes, and decisions involved in creating a new corporate travel department at the travel company you're working at.

FIGURE 5-2: Comparing cost and volume of trips



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REVIEW QUESTIONS

1. **A decision support system helps you:**
   - **a.** generate ideas
   - **b.** communicate with colleagues
   - **c.** identify and solve problems and make decisions
   - **d.** prepare for presentations
2. **Which of the following is not a benefit of using a decision support system?**
   - **a.** Provides better logistics
   - **b.** Adds objectivity
   - **c.** Improves efficiency in making complex decisions
   - **d.** Helps to communicate decisions

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Modeling Decisions Quantitatively

When solving complex problems, gather all the data you can related to the problem. Then you can **model** your decisions quantitatively, which means you represent the decision and its factors using numbers. Modeling decisions can help you see patterns in the data, make objective choices—especially among competing options—and provide substantiation for your decisions. case One of the new corporate clients at the travel company you're working for has headquarters in Jeddah, Makkah Province, and wants the company to open a branch office on its corporate campus. Some managers at the company want to open an office in the Eastern Province. Omar asks you to help him gather data and model the decision quantitatively.

DEFINITION

Model: (*n.*) A collection of information that shows how an organisation is working, or could be working in the future; (*v.*) to produce such a collection of information.

Essential Elements

QUICK TIP
Be sure to enter numbers carefully—a typo can ruin an otherwise useful model.

1. **Assign numeric values to your data**
   Gather data you can measure, which includes numeric variables such as price, weight, temperature, square footage, and sales per week. Make sure you collect accurate information, and then enter the data in a tool designed for numeric analysis, such as a spreadsheet.

2. **Compare apples to apples**
   The data you collect is not always available in the same format. For example, to compare salary data, convert an hourly or monthly wage to an annual salary or vice versa. See Figure 5-3. Make similar adjustments for quantities (single units vs. bulk quantities), monetary units (riyals vs. dollars), and other measures that describe the same item, but express it in different ways.

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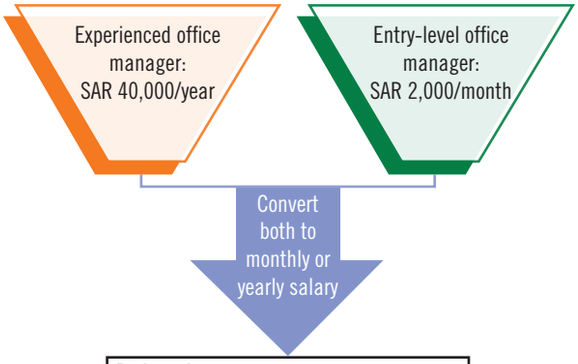
FIGURE 5-3: **Comparing data**

Problem: How much should the company budget for an office manager in the new Jeddah office?



Projected expenses		
	Experienced	Entry-level
Monthly salary for office manager	SAR 3,333	SAR 2,000

QUICK TIP

Survey designers recommend five-point scales as the most accurate; fewer points don't offer enough options, and more points create confusion.

3. Rate subjective variables

In addition to gathering objective data, you can collect subjective data. For example, you might want to poll the staff at the travel company you're working at to determine their preferences for opening a new office in Jeddah or other sites. To use this information in a quantitative model, you must first convert it to numbers. Ask people to rate or evaluate options and assign numeric values to their responses. You can use a five-point response scale similar to the one shown in Figure 5-4.

FIGURE 5-4: **Rating subjective data**

Answer the following questions according to the scale.				
• Do you think the company should open a branch office in Jeddah?				
Strongly agree	Agree	Neutral	Disagree	Strongly disagree
5	4	3	2	1
• Should the Jeddah branch be on a client's corporate campus?				
Strongly agree	Agree	Neutral	Disagree	Strongly disagree
5	4	3	2	1
• Do you think the company should open a branch office in Khobar?				
Strongly agree	Agree	Neutral	Disagree	Strongly disagree
5	4	3	2	1

4. **Use a decision model**

To make numeric data useful, organize it in a **decision model**, which is one or more formulas that includes all of the relevant variables and calculates a result. For example, to choose between a Jeddah and Khobar branch office, you could rate staff preference, proximity to your clients, and building features and amenities for each location and calculate the sum of the ratings. Also calculate the sum of variables such as monthly office rent, taxes, utility costs, and salary. Determining these totals for each location provides a ranked listing of the options. See Figure 5-5.

DEFINITION

Decision model: One or more formulas that includes all of the relevant variables and calculates a result.

FIGURE 5-5: Decision model

	A	B	C	D
1	**Decision Model: Company Branch Office**			
2		**Jeddah**	**Khobar**	
3	Staff preference	45	38	
4	Proximity to clients	40	40	
5	Building features	35	42	
6	Amenities	30	42	
7	**Total**	**150**	**162**	
8				
9	Rent per month	SAR 2,200.00	SAR 1,800.00	
10	Taxes	SAR 448.00	SAR 725.00	
11	Utilities	SAR 500.00	SAR 450.00	
12	Salary	SAR 800.00	SAR 650.00	
13	**Total**	**SAR 3,948.00**	**SAR 3,625.00**	
14				

Sums for each questionnaire rating

Ratings for Khobar branch office are the highest

Expenses for Khobar branch office are the lowest

YOU TRY IT

Practice modeling decisions quantitatively by selecting a solution. Complete the following steps.

1. **Get ready**

Review the responses to the following questions, which are related to whether the travel company you're working at should open a branch office.

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Do you think the company should open a branch office?

Rating	Number of responses
5 – Strongly agree	8
4 – Agree	8
3 – Neutral	2
2 – Disagree	2
1 – Strongly disagree	0

If the company does open a branch office, should it be in Jeddah?

Rating	Number of responses
5 – Strongly agree	6
4 – Agree	4
3 – Neutral	4
2 – Disagree	3
1 – Strongly disagree	3

If the company does open a branch office in Jeddah, should it be on our client's corporate campus?

Rating	Number of responses
5 – Strongly agree	4
4 – Agree	4
3 – Neutral	4
2 – Disagree	5
1 – Strongly disagree	3

If the company does open a branch office, should it be in Khobar?

Rating	Number of responses
5 – Strongly agree	6
4 – Agree	6
3 – Neutral	5
2 – Disagree	3
1 – Strongly disagree	0

2. **Now you try it**

Answer the question of whether the company should open a branch office, and if so, where.

REVIEW QUESTIONS

1. **When you create a numeric representation of the decision, you are creating a(n):**
   - **a.** presentation
   - **b.** model
   - **c.** analytical document
   - **d.** consensus
2. **What should you do before comparing subjective data?**
   - **a.** Plot the data
   - **b.** Find the mean
   - **c.** Create a model
   - **d.** Rate it on a response scale

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Describing Data Objectively

Most people can visualize images, concepts, and trends more easily than large sets of numbers. When presenting data to support a decision, provide your audience with an objective description of that data. You can use statistics to explain and compare the characteristics of data. Table 5-1 lists the do's and don'ts for describing data objectively. case Omar has developed pricing data for the new tours designed for business travelers. He asks you to calculate some basic statistics about the prices.

TABLE 5-1: Modeling decisions do's and don'ts

Guidelines	Do	Don't
Mean	• Add the values and divide the sum by the number of values • Calculate the mean to find the tendency in the data	• **Don't** include extremely high or low values; they are outliers
Median	• Sort values from low to high or high to low, and then find the middle value • Find the median to determine the middle value, which is not affected by extreme values	• **Don't** confuse the median with the mean
Mode	• Sort values and find the ones that occur most frequently • Use to describe data that includes widely varying numbers	• **Don't** look for the mode in all sets of data—some don't have a mode
Standard deviation	• Interpret low standard deviations to mean that the values are very close to the mean so they don't vary much • Interpret high standard deviation to mean that the data are spread over a larger range of values and are farther from the mean	• **Don't** evaluate standard deviations as better or worse—they show which values are more consistent than other values

Essential Elements

QUICK TIP
Technically, you can measure the average in other ways. The mean uses a particular calculation.

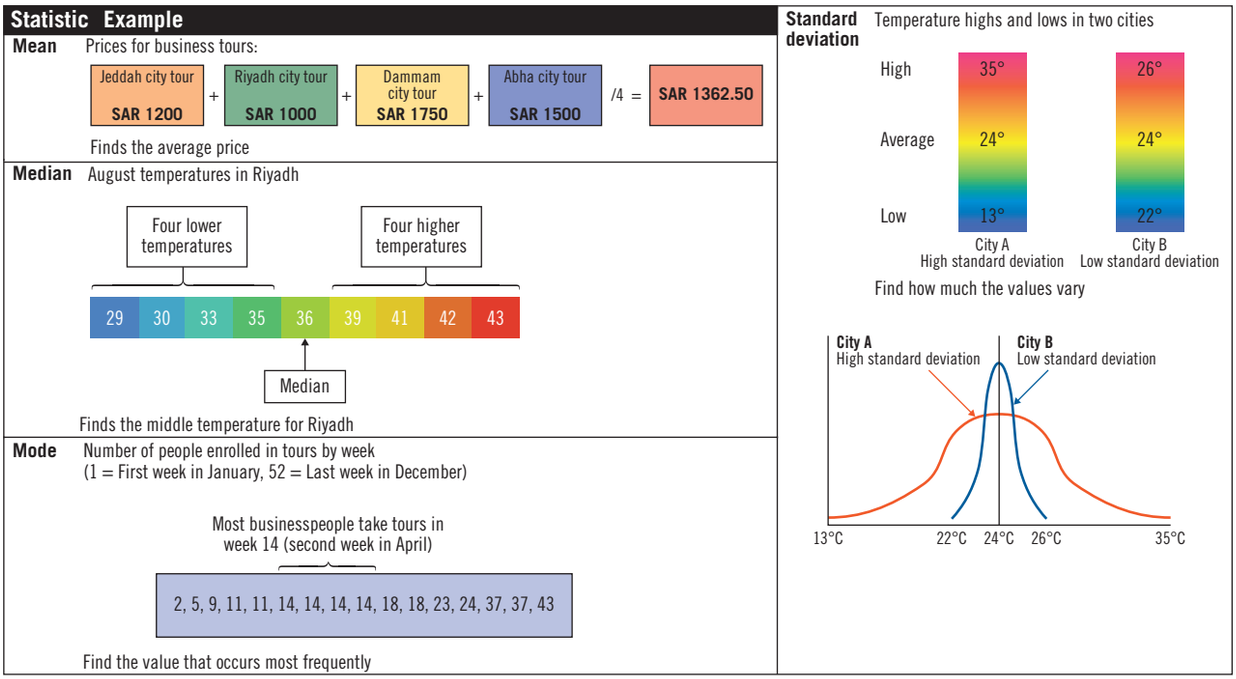
1. Mean

The **arithmetic mean** value of a set of data is usually referred to as the average. The mean is the most common descriptive statistic and is simple to compute. Sum the values in your data and divide by the number of items that you counted. The mean is a single value and describes the data in general by showing its central tendency. See Figure 5-6.

DEFINITION

Arithmetic mean: The value of a set of data that is usually referred to as the average. The mean is a single value and describes the data in general by showing its central tendency.

FIGURE 5-6: Basic statistics



2. Median

The **median** value of a set of data is that point that separates the higher values from the lower values. The median is similar to the mean, but is less susceptible to distortion by extremely large or small values. The median is calculated by ordering all of your data from lowest value to highest value and selecting the middle one. If you have an even number of data points, use the mean of the two middle values.

DEFINITION

Median: The value of a set of data that separates the higher values from the lower values.

3. Mode

The **mode** of a set of data is the value that occurs most frequently. The mode does not have to be a unique number. Some data sets might have more than

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one mode. Although means are affected by extremely large or small values in the data set, modes are not. This makes modes useful for describing data that includes widely varying numbers. The mode itself can also reveal useful patterns. For example, if you are measuring the week of the year (1–52) when people take particular tours, you might find that week 14 is the mode, as in Figure 5-6. This could be useful for planning future marketing campaigns and new tour offerings.

DEFINITION

Mode: The value in a set of data that occurs most frequently. The mode does not have to be a unique number.

QUICK TIP

Data that is normally distributed is sometimes described as having a bell-shaped curve.

4. **Standard deviation**

Standard deviation is a measure of the variability of a set of data. A low standard deviation indicates that the data points tend to be very close to the mean (minimal variability). A higher standard deviation indicates that the data are spread out over a larger range of values and that they are farther from the mean (greater variability). For example, when planning what to wear on a tour, two destination cities might have the same average temperatures (24 degrees). However, the mean alone might not be enough information. One city has daytime highs of 35 degrees and evening lows of 13. The other varies between 26 and 22 degrees. You would need to instruct your clients to pack differently depending on their destination. The standard deviation provides an insight that the mean or median temperatures do not.

DEFINITION

Standard deviation: A measure of the variability of a set of data.

YOU TRY IT

Practice describing data objectively by calculating statistics. Complete the following steps.

1. **Get ready**

   Review the following statistics for business tours:

   1. Jeddah city tour
   2. Riyadh city tour
   3. Dammam city tour
   4. Abha city tour

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Month	Top Tour
January	2
February	4
March	2
April	3
May	2
June	1
July	3
August	1
September	2
October	2
November	4
December	2

2. **Now you try it**

   Decide on the most popular tour for business travelers.

REVIEW QUESTIONS

1. **When you sum the values of items and then divide by the number of items, you are calculating the:**
   a. arithmetic mean
   b. median
   c. mode
   d. arithmetic standard
2. **Which of the following calculations is useful for describing data that includes widely varying numbers?**
   a. Median
   b. Mode
   c. Standard deviation
   d. Norm

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Weighing Factors

Sometimes more than one variable can affect results in a decision model. For these types of decisions, you can assign weights to the variables. For example, deciding which tours to offer to corporate customers involves variables such as amount of travel time, level of activity, meeting facilities, and weather. After surveying potential customers, the travel company you're working at determines that the amount of travel time is worth 50% of the decision and meeting facilities are worth only 10%. Weigh these factors in your decision model to make more accurate decisions. Table 5-2 lists the do's and don'ts for weighing factors.

case Omar wants to return to the decision about which tour to offer first to corporate customers and evaluate it by weighing factors.

TABLE 5-2: Weighing factors do's and don'ts

Guidelines	Do	Don't
Decision variables	• Identify the decision variables that have the most effect on the decision	• **Don't** include minor decision variables
Weights	• Assign a weight to each important decision variable	• **Don't** assign weights to all decision variables
Normalization	• Account for differences in variables by normalizing them	• **Don't** compare values without normalizing them first

Essential Elements

1. **Identify the most important decision variables**

   The most important factors are the decision variables that are most likely to affect the output variables. If the decision includes many independent variables, it should be limited to those that have the most effect on the decision. In Figure 5-7, for a tour of corporate customers, the four variables might be activity level, meeting facilities, travel time, and weather.

FIGURE 5-7: Assigning weights

	A	B	C	D	E	F	G
1	**Tours to Offer Corporate Customers**						
2	**Ratings (1–5)**						
3			Jeddah	Riyadh	Dammam	Abha	
4	Activity level		4	3	2	5	
5	Meeting facilities		1	3	5	4	
6	Travel time		3	5	1	2	
7	Weather		2	5	3	5	
8							
9	**Weighted factors**						
10		Weight	Jeddah	Riyadh	Dammam	Abha	
11	Activity level	20	80				
12	Meeting facilities	10	10				
13	Travel time	50	150				
14	Weather	20	40				
15	**Total**	**100**	**280**				
16							

Four factors are rated for each tour

Each rating is multiplied by the weight

The total weight is always 100

These calculations need to be completed

2. **Determine the appropriate weights**

   Each decision variable is assigned an appropriate weight. This is a number that the variable is multiplied by to reflect the significance in the decision. In Figure 5-7, the most important variable is travel time, which has a weight of 50. Activity level and weather are the next most important, and have a weight of 20 each. The least important variable is meeting facilities, which has a weight of 10. To calculate the weighted ratings, multiply each rating by the weight. Then total the weighted ratings for each alternative to find the best option.

QUICK TIP

When normalizing, you usually multiply or divide the data by a variable so you can compare the variables fairly.

3. **Normalize variables**

   The range of values for one decision variable might vary widely. For example, the travel company you're working at is considering five local tour operators to use in Riyadh. The most expensive tour operator charges SAR 50 per person and the least expensive charges SAR 10. The range of values for the price variable varies widely. Before adding other factors such as transportation and hotel costs to select a tour operator, you can normalize the price variable. **Normalization** makes the values consistent so you can compare them accurately. A simple way to normalize is to divide each variable by the largest instance of that variable. Then you can use the normalized variables as weighted factors. See Figure 5-8.

DEFINITION

Normalization: A way to make all of the data consistent with your decision model.

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FIGURE 5-8: Normalizing variables

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To normalize the other charges, divide each by the value in cell B4

	A	B	C	D	E	F	G	H
1	Riyadh Tour Operators							
2	**Surcharges per person**							
3		1	2	3	4	5		
4	Surcharge	SAR 50.00	SAR 40.00	SAR 25.00	SAR 20.00	SAR 10.00		
5	Normalized	1	0.8	0.5	0.4	0.2		
6	**Transportation per person**							
7		1	2	3	4	5		
8	Charge	SAR 75.00	SAR 100.00	SAR 80.00	SAR 65.00	SAR 50.00		
9	Normalized	0.75	1	0.8	0.65	0.5		
10	**Daily hotel per person**							
11		1	2	3	4	5		
12	Charge	SAR 105.00	SAR 85.00	SAR 90.00	SAR 125.00	SAR 80.00		
13	Normalized	0.84	0.68	0.72	1	0.64		
14								
15	**Charge comparison**							
16		Weight	1	2	3	4	5	
17	Surcharge	50	50	40	25	20	10	
18	Transportation	15	11.25	15	12	9.75	7.5	
19	Hotel	35	29.4	23.8	25.2	35	22.4	
20	**Total**	**100**	**90.65**	**78.8**	**62.2**	**64.75**	**39.9**	
21								

The highest charge is SAR 50 in cell B4

After normalizing, assign weights to compare factors

4. **Consider the runners-up**

   The weights assigned are subjective. When considering the results, the analyst should ask if a small change in the weights would affect the outcome. Look at the runner-up options and see how near they are to the leader. Values close to the top value are often important decision variables.

YOU TRY IT

Practice creating decision trees by completing a diagram. Complete the following steps.

1. **Get ready**

   Consider an important decision that you need to make in your personal life, education, or career development. This could be choosing the right product to buy from a range of options, or which career path to choose as you get older.

2. **Now you try it**

   1. Follow the steps in Lesson 4 in Chapter 5 to help you make the correct decision: identify the most important decision variables and determine the appropriate weights (the normalizing variables step may not be necessary).
   2. Has this process helped you to make a decision? Remember to consider the runners-up. Remember that the weights you assign are subjective. In this case, would a small variation affect the outcome? In your note-

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book, or using a word processor, list the variables and their associated results, then explain how you arrived at your decision

REVIEW QUESTIONS

1. **How can you indicate the significance of each variable in a decision?**
   - **a.** Assign an appropriate weight
   - **b.** Convert the values to the same format
   - **c.** Use one as a constant in the model
   - **d.** Normalize the variables
2. **How can you account for differences in variables?**
   - **a.** Create a decision tree
   - **b.** Normalize them
   - **c.** Find the mean, mode, and median
   - **d.** Find the standard deviation

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Creating Decision Trees

When you want to use a rational approach to select the best option from several alternatives, use a **decision tree**. A decision tree is a support tool that models decisions using a treelike diagram. Each branch of the tree represents an option and its benefits, costs, and likelihood. Organizations use decision trees to identify the strategy or choice that will lead them to a desired goal. Because a decision tree is a graphic, it helps you explore possibilities and track their outcomes. It also creates a simple summary of a complex decision that you can share with other stakeholders. You can create a decision tree by hand or using any basic graphics or drawing package on a computer. case The travel company you're working at finds that culture tours in the Al-Madinah region are becoming more popular among corporate clients, and has identified potential destinations. Omar asks you to create a decision tree to determine the best option.

DEFINITION

Decision tree: A support tool that models decisions using a tree-like diagram. Each branch of the tree represents a different option and its associated benefits, costs, and likelihood.

Essential Elements

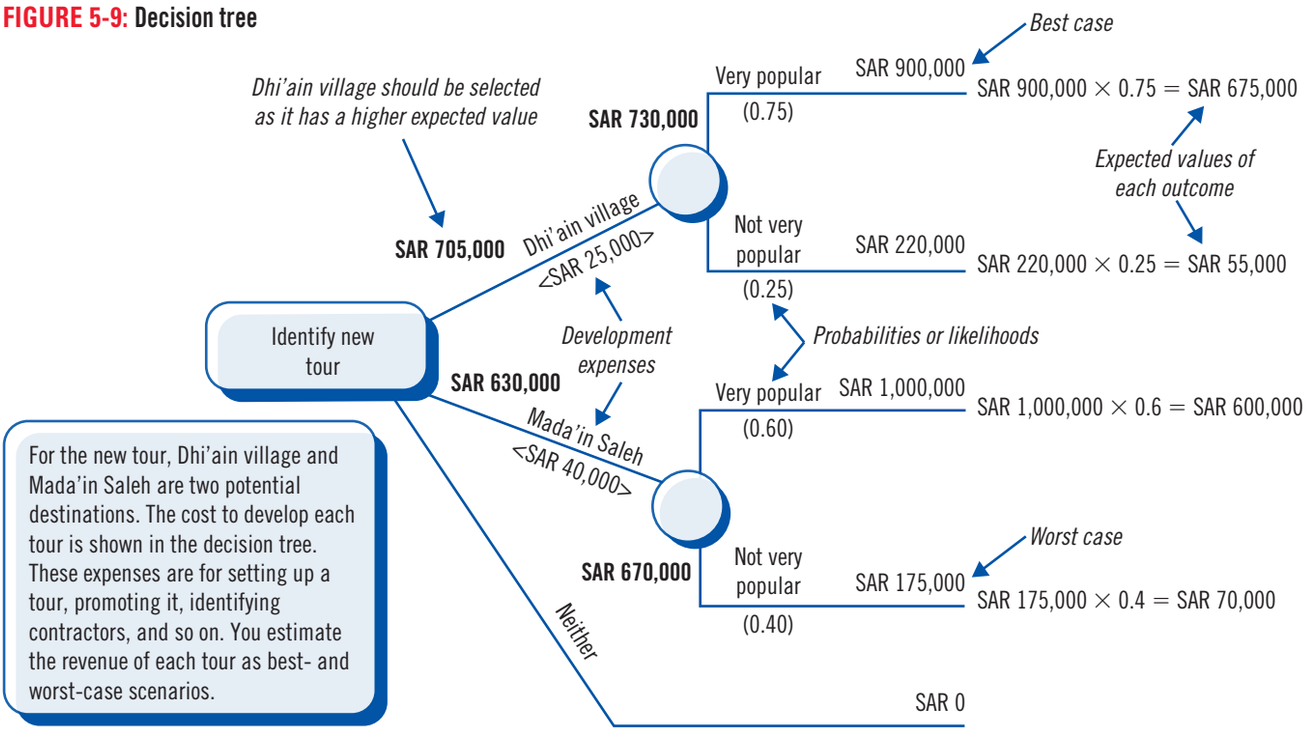
1. **Start with your primary decision**

   Begin by determining the primary decision to make or problem to solve. This becomes your goal, such as to identify the ideal destination in the Al-Madinah region for a culture tour. Draw a small box on the left side of a piece of paper or on your computer screen. Label this objective box with a description of the problem. You can also draw a decision tree on software such as MS Excel or Decision Tree Maker (https://www.smartdraw.com/decision-tree/examples/)

2. **Identify your options**

   Identify the options in the decision or problem. For example, as shown in Figure 5-9, the destinations are Dhi'ain village in Al-Bahah, Mada'in Saleh in Al-'Ula, or neither one. Draw a line for each option from the objective box to the right. Keep the lines far apart to leave yourself room to include labels and add your thoughts. Label each line with a short description of the option.

FIGURE 5-9: Decision tree



QUICK TIP
Squares represent decisions; circles indicate that a choice must be made.

3. **Consider the results**

At the end of each line, insert the result. If the result of choosing that option is uncertain, draw a small circle. If the result requires you to make a decision, draw a small square. Repeat this process from each decision square until you've drawn lines representing all of the possible outcomes that you identified.

QUICK TIP
Use your best judgment about what you think each option is worth and compare each option to the others.

4. **Assign values and probabilities**

Estimate how much each option is worth to you or your organization. This can be a monetary amount or a score, such as one based on a 1–5 rating scale. For example, if the Dhi'ain village tour was very popular it could generate SAR 900,00 in revenue. If it were not very popular it would only generate SAR 220,000. The Mada'in Saleh tour, if very popular, could generate SAR 1,000,000 or only SAR 175,000 if not very popular. Label the outcome with this value. Next, for each circle (called an uncertainty node), estimate the probability or likelihood of each outcome. In this case, using current regional tours as a guide, it has been estimated that the probability of the Dhi'ain village tour being very popular is 0.75, and it being not very popular is 0.25. For Mada'in Saleh, the likelihood of the tour being very popular is 0.60, and it being not very popular is 0.40. The total at each circle must equal 100%. Repeat this for all of your decision nodes.

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5. **Calculate the value for each option**

   Calculate the value associated with each possible outcome. Start at the right side of your decision tree and work back to the left. See Table 5-3.

TABLE 5-3: Calculating the value for each option

Element	Shape	Description
Uncertainties	Circle	• Multiply each outcome by its probability • Insert this value in the decision tree • Repeat this for each uncertainty
Decisions	Square	• Estimate the costs associated with each option • Subtract cost of the outcome value you calculated to find the benefit of that decision • Repeat this for each decision
Results	Line	• When you have calculated all of the decision benefits (value–cost), choose the option that has the largest benefit. This is the optimal decision.

Saudi Vision 2030 and the art of infographics

When presenting information via graphics, the number one rule is to keep it simple: the clearer and more meaningful, the better! Many analysts fall into the trap of creating confusing and cluttered diagrams, charts, and graphics that fail to get their message across. When the Saudi Vision 2030 was announced, it was crucial that the information was presented in a way that was clear, accessible, and easy to understand. In recent years, there has been a steady rise in infographics for delivering information. The official Saudi Vision 2030 website (www.vision2030.gov.sa) put infographics to effective use, combining text with powerful and identifiable visuals to present its message. Goals are specific, quantifiable, simply presented, and supported by visual icons, making the information easy to disseminate at a glance. Never underestimate the power of presentation.

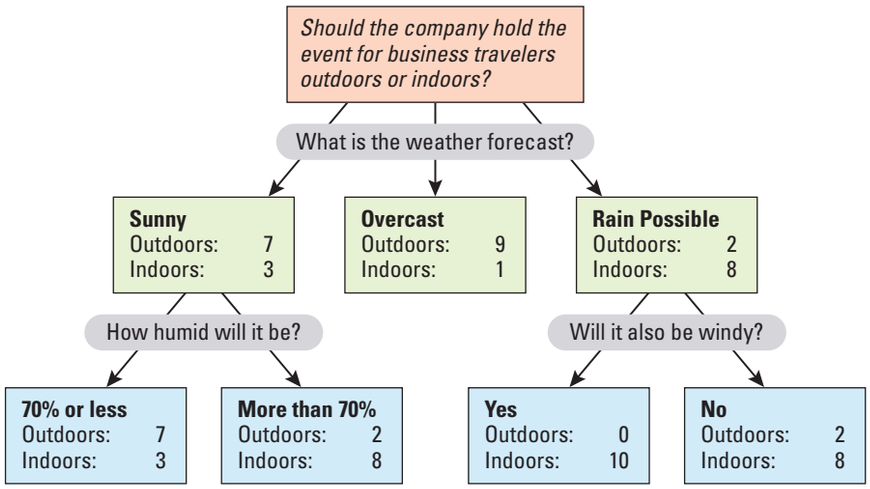
YOU TRY IT

Practice creating decision trees by completing a diagram. Complete the following steps.

1. **Get ready**

   The travel company you're working at is considering whether to organize an event for business travelers to promote the popular Riyadh city tour. The event would take place at King Abdullah Park in Riyadh. The company would serve food from under a large canopy, but otherwise the event would take place out in the open. Depending on the weather forecast, the company could also hold the event in a nearby event hall.

   Below the diagram is a description of the decisions in the decision tree.



According to the diagram:

- If the weather is sunny, 7 people say the event should be outdoors and 3 people say it should be indoors (perhaps because it is too hot).
- If the humidity is over 70%, however, only 2 people say the event should be outdoors and 8 people say it should be indoors.
- If the humidity is 70% or less, 7 people still say the event should be outdoors and 3 people say it should be indoors.

2. Now you try it

Complete the description of the diagram to help the company make its decision.

Considering all of the factors and decisions in the decision tree, should the company hold the event for business travelers indoors or outdoors?

REVIEW QUESTIONS

1. In a decision tree, what does each branch of the tree represent?

a. An assignment to a member of the group

b. An option that is unlikely to work

c. A new idea

d. An option and its benefits, costs, and likelihood

2. What shapes do you use in a decision tree?

a. Circles, squares, and lines

b. Circles and diamonds

c. Rectangles only

d. Tree shapes

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Using Graphics to Display Data

By representing your data, decisions, and solutions graphically you can see trends, relationships, and results that would be hard to detect in a list of numbers. Drawings, charts, and other illustrations also help make your case clearer and easier for others to understand. Software such as spreadsheets and presentation graphics programs provide tools to help you visualize and display data. Table 5-4 lists the do's and don'ts for displaying data graphically. case Before Omar makes a presentation to the other company managers about expanding services to corporate customers, he asks you to create charts to display data graphically.

TABLE 5-4: Using graphics do's and don'ts

Guidelines	Do	Don't
Bar chart	• Use bars to represent data, with the length of the bar corresponding to the size of the data	• **Don't** use long text on the horizontal axis
Line chart	• Plot a series of points and then connect them with a line to show directions or trends in the data over time	• **Don't** plot too many points or you might not be able to see the pattern
Area chart	• Display values for each variable as cumulative totals using numbers or percentages • Use different colors or fill patterns to differentiate each layer • Choose an area chart to represent the volume of data	• **Don't** hide the area you want to emphasize in the middle of the chart—place it along the baseline • **Don't** use if you are making a comparison between multiple series—consider using a bar chart instead • **Don't** use if you are analyzing trends over a period time—consider using a line chart instead
Pie chart	• Compare the percentage of an element with the whole • Use pie charts to compare data at one point in time	• **Don't** use pie charts to show changes over time • **Don't** compare sectors across multiple pie charts • **Don't** create pie charts with many small slices
Scatter plot	• Display two variables for a set of data • Show correlations among variables, especially nonlinear ones	• **Don't** plot more than two variables • **Don't** interpret a scatter plot the same way as a line chart because a scatter plot combines two values in one point

Essential Elements

QUICK TIP
Bar charts with vertical bars are called column charts.

1. **Bar charts**

   A bar chart uses rectangular bars to display data values. The length of each bar represents a value. The longer the bar, the greater the value. Bar charts can be oriented horizontally or vertically. Simple charts use one set of bars to represent a single variables or point in time. Multiple variables or points in time may be represented by several adjacent bars. See Figure 5-10a.

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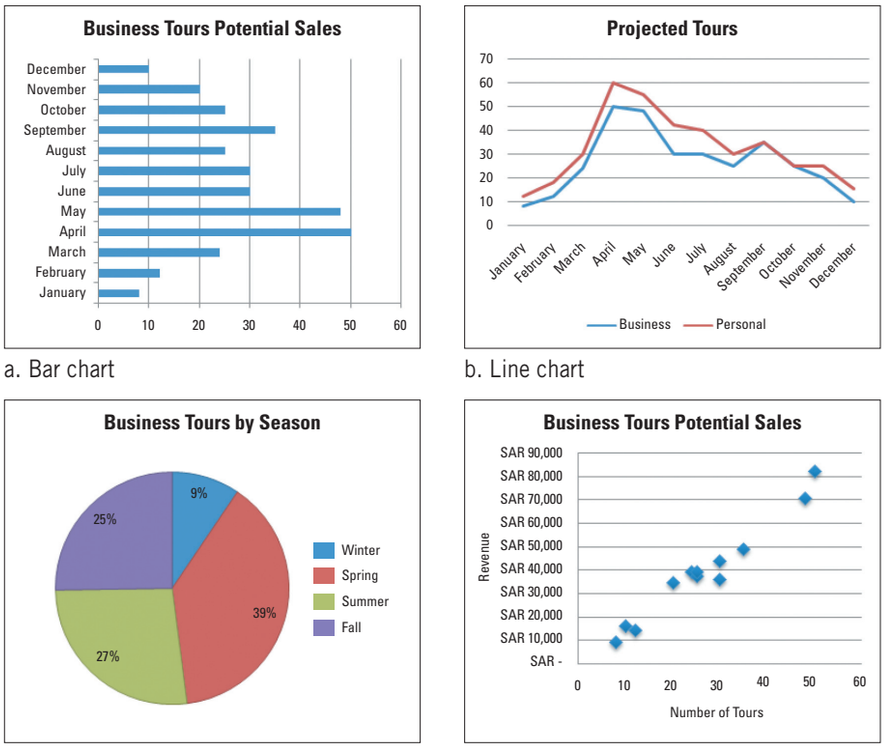
FIGURE 5-10: Types of charts



a. Bar chart

b. Line chart

c. Pie chart

d. Scatter chart

2. **Line charts**

   To create a line chart, you plot a series of points and then connect them with a line. Each point represents a measurement or value. The line shows directions or trends in the data over time. See Figure 5-10b.

3. **Area charts**

   An area chart is similar to a line chart because it compares two or more variables over time. However, it displays the values for each variable as cumulative totals using numbers or percentages. This means that each variable is layered one on top of another. A color or fill pattern highlights each variable.

4. **Pie charts**

   Pie charts are circles divided into sectors, with each sector resembling a slice of a pie. See Figure 5-10c. The size of the slice represents the relative size or frequency of the corresponding variable. Because the entire chart forms a complete circle, it shows the percentage of the whole that each variable represents. Use pie charts to compare data at one point in time, usually to the whole. Pie charts are easiest to interpret when the largest slice represents at least 25–30% of the data. Ideally, a pie chart should emphasize a single variable and compare that slice with the rest of the pie.

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QUICK TIP
Most software tools can display 3D scatter plots with up to four dimensions.

5. **Scatter plots**

   Scatter plots display two variables for a set of data. You plot the data for one variable along the horizontal axis and the other variable on the vertical axis. A scatter plot shows correlations between variables, especially nonlinear ones. If the points appear random and unordered, the two variables do not have a strong relationship. See Figure 5-10d.

YOU TRY IT

Research Web sites that use graphics to display data. Complete the following steps.

1. **Get ready**

   1. Open a Web browser such as Internet Explorer or Firefox, and go to the following site:
      Saudi Vision 2030: www.vision2030.gov.sa
   2. Explore the Web site and find examples of graphics that display data.
   3. Take three screenshots of examples.

2. **Now you try it**

   Using a word processor, paste the screenshots of your results into a new document, describing how the examples succeed in presenting the information. Alternatively, describe your results in your notebook.

REVIEW QUESTIONS

1. **In a line chart, what does the line show?**
   - **a.** The relation of parts to the whole
   - **b.** Directions or trends in the data over time
   - **c.** Accumulated values
   - **d.** Where data is not related
2. **Circular charts divided into sectors are called:**
   - **a.** circle charts
   - **b.** area charts
   - **c.** pie charts
   - **d.** slice charts

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Technology @ Work: Spreadsheet Tools

You use spreadsheet software such as Microsoft Excel, OpenOffice Calc, or Google Spreadsheet to create and format numeric data and calculations, such as for budgets, commission calculators, schedules, and income statements. You use electronic spreadsheets to track numeric information, perform calculations, and create charts, for example. Spreadsheets are especially helpful when recording and analyzing financial information—if you change one cell, the spreadsheet updates all related calculations. case Omar asks you to review five readily available electronic spreadsheets.

1. **Microsoft Excel**
   Part of the Microsoft Office suite of programs, Excel (https://www.microsoft.com/en/microsoft-365/excel) is widely used in business, education, and research. One reason that Excel dominates is that you can use it to create a basic spreadsheet quickly or to develop a sophisticated set of worksheets for making business decisions.

2. **Google Spreadsheet**
   Part of Google Docs, Spreadsheet is a basic tool for creating and editing spreadsheets. Google Spreadsheet (www.google.com/docs) offers basic importing and editing features, and more limited formatting tools than Excel. However, like other Google applications, Spreadsheet is designed for online collaboration and sharing.

3. **OpenOffice Calc**
   A free open source spreadsheet tool, OpenOffice Calc (www.openoffice.org/product/calc.html) is an all-purpose spreadsheet modeled after Microsoft Excel, and is freely available on the OpenOffice Web site. Unlike Excel, Calc can define series for creating charts based on the layout of your data. It can also save spreadsheets as Portable Document Format (PDF) files, making them easy to share with non-Calc users.

4. **Gnumeric**
   Like OpenOffice Calc, Gnumeric (www.gnumeric.org) is a free, open-source spreadsheet program that is part of the GNOME desktop for computers running the Linux operating system. It is designed to be similar to Excel, though it lacks some features. Professionals consider it a reliable spreadsheet tool.

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5. **Apple Numbers**

   If you use a Macintosh computer, you can use Apple Numbers (www.apple.com/iwork/numbers), which is part of the iWork suite of programs. Numbers is designed to be easy to use and can create visually rich charts and tables. It lacks the more sophisticated features of Excel, such as PivotTables, PivotCharts, and a programming language for customizing spreadsheets.

YOU TRY IT

Explore spreadsheet tools. Complete the following steps.

1. **Get ready**
   1. Open a Web browser such as Internet Explorer or Firefox, and go to each of the sites mentioned in this lesson:
      Microsoft Office: https://www.microsoft.com/en/microsoft-365/excel
      Google Docs: www.google.com/docs
      OpenOffice Calc: www.openoffice.org/product/calc.html
      Gnumeric: http://gnumeric.org
      Apple Numbers: www.apple.com/iwork/numbers
   2. Identify the top two or three pros and cons for each program.
2. **Now you try it**

   List the pros and cons of each spreadsheet program.

REVIEW QUESTIONS

1. **Which of the following is not an example of spreadsheet software?**
   a. Microsoft Excel
   b. OpenOffice Calc
   c. Apple Spreadsheets
   d. Google Spreadsheet
2. **Which of the following is an advantage of using Gnumeric?**
   a. It is a free, open-source spreadsheet program
   b. It is designed for online collaboration
   c. It is popular with Macintosh users
   d. It creates elegant PivotTables

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Extra Practice

Critical Thinking Questions

1. How can decision support tools help you in making decisions in your own life?

2. What are the advantages of using mathematical decision tools such as decision trees and weighted factors?

3. Suppose that you are about to make a major decision, such as buying a new computer or taking a particular course in your education. How could you use a tool discussed in this chapter to help you as you make your decision? Recall a big decision you made recently and describe your process for making that decision.

Real Life Independent Challenge

You can apply the problem-solving techniques you learned in this chapter to the decisions you need to make in other parts of your life. Suppose you need to purchase a new computer for your academic or professional work. Complete the following steps to make the purchase decision.

a. In a document or spreadsheet for personal use, list any money you have saved to buy a new computer.

b. List the factors that are important to you, such as computer type (laptop or desktop), monitor type (flat panel, wide screen, or high definition, for example), amount of memory, and so on. These are your decision criteria.

c. Rank how important each factor is in your decision.

d. Assign weights to each factor according to your rankings.

e. Gather information about available computers using online resources or catalogs, for example. List the factors each computer has and compare them to your weighted rankings. In other words, compare each computer against the criteria you selected.

f. The computer with the highest score is the one you should purchase.

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Team Challenge

You are working for Qassim Builders, a company in Buraydah, Al-Qassim Province, specializing in sustainable building. In line with the Saudi Vision 2030, the company is committed to solving environmental problems through green building practices. In its next ad campaign, Qassim wants to promote one example of 'green' technology it uses in sustainable building, such as solar panels, environmentally-friendly insulation, or wind power. You have been asked by your manager to help Qassim Builders decide which technology to promote.

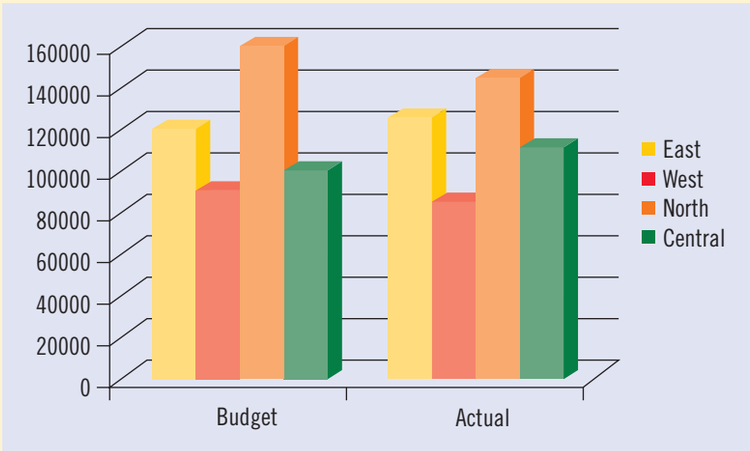
a. Based on the topics discussed in this chapter, consider what types of data you might collect and which tools you might need to analyze the data, to help Qassim Builders in making a decision.

b. Describe how creating a decision tree might help in selecting the right option.

Be the Critic

You are working for Ummah Wheels, a company in Dammam, Eastern Province that provides hybrid and electric vehicles for short-term rental in the Dammam area, in support of Saudi Vision 2030's initiative to promote environmentally conscious energy sources. Ummah Wheels is analyzing its expenses and deciding which ones to reduce. To compare alternatives, the owner has created the chart shown in Figure 5-11. However, there are some flaws in the way the owner has presented the information in his chart.

FIGURE 5-11



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Analyze the chart, using the insights on decision support tools discussed in this chapter. Note any weaknesses, explaining any elements that might be missing, and suggest how it might be improved. If the owner asked you to analyze the company's expenses for him, how would you approach the task?

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Chapter 6

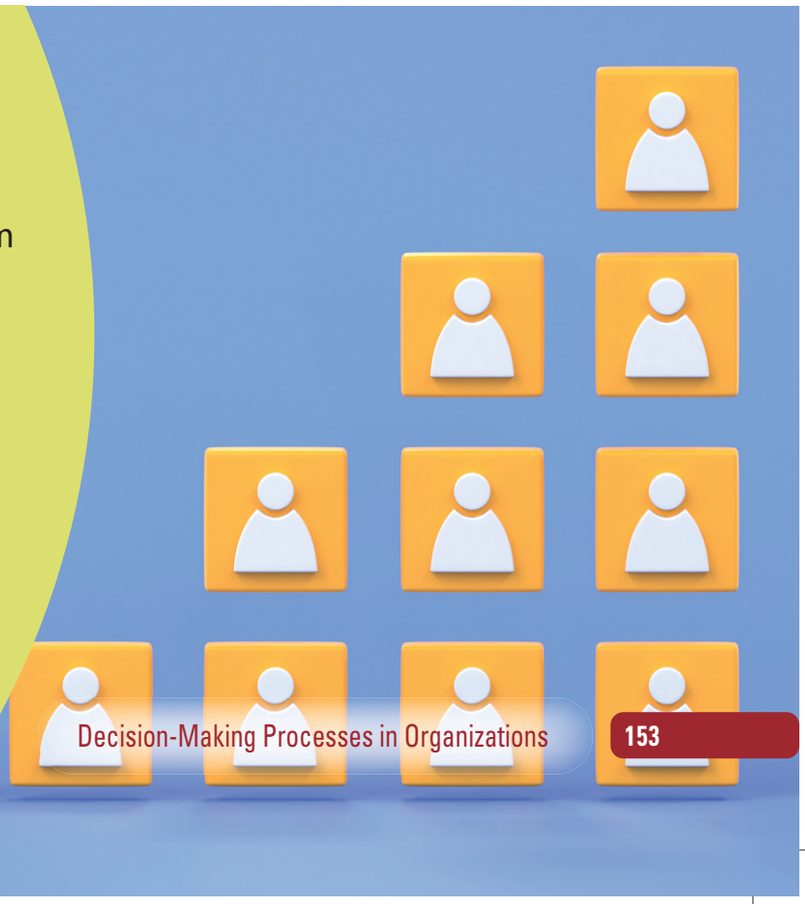
Decision-Making Processes in Organizations

All businesses, government agencies, and organizations have their own unique culture. This typically develops as the business grows over time and is influenced by the organization's leadership and key employees. The organizational system describes the roles different people have within the organization, and how these roles relate to one another. For instance, when working within an organization it will be crucial to understand who you report to, as well as who the problem owners, decision makers, and other stakeholders are. As a member of the organization you must operate within this structure and, if you want to be effective, sell your ideas and solutions to others. To do this you'll need to have a sound understanding of the problem, but also of the causes of the problem. You'll need to understand how best to communicate your ideas and the appropriate chain of command to follow. People who work successfully within the organizational structure earn the respect of others and know how to develop

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Understand the organizational system
2. Learn about working with problem owners and stakeholders
3. Use problem-solving techniques and adapt to new problems
4. Apply root-cause analysis techniques to determine the causes of problems
5. Understand the importance of implementing ethical solutions



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ethical solutions. They also negotiate conflicts and contribute to difficult decisions with tact and ease. Working with the organizational culture will help advance your career and make your day-to-day work life run more smoothly.

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Lesson
1
Chapter 6

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Working within an Organization

1-1 The Organization as a System

Every organization has a system for performing tasks, assigning resources, and rewarding accomplishments. Documents such as company handbooks and employee manuals describe parts of the system, such as how to earn vacation time.

Organizations are also highly structured, so employees and managers know what their responsibilities are, who they work for, and who works for them. There are several different ways that organizations can be structured, depending on the type of work being done and the organization's unique goals.

Usually, an organization will give one or more workers the authority to direct the work of other, more junior employees, or to make important decisions about how the business should be run. These workers are called managers, and they are often organized into a hierarchical structure.

Another common factor in an organization is the importance of measuring performance. This could be how well a product is selling, how many people visit the company's Web site or how efficiently an employee does their job. Employee performance is monitored closely (see Figure 6-1): targets are set and rewards (or sometimes punishments—known as disciplinary action) are issued by managers. An employee will also want to think about their own career and the connection between the goals of their organization and their own personal ambitions.

Another part of the system is rarely defined in writing. This part is called the **tacit culture**—the customs, attitudes, and practices that make a company unique.

DEFINITION

Tacit culture: The customs, beliefs, values, and patterns of behavior of the people of a country or organization.

1-2 Characteristics of Organizations

Organizations have certain characteristics that help explain how they operate. These aspects may be different from one business to another. When you start a

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new job, you will probably notice these differences. It's a good idea to learn how to identify them so you can fit in quickly, be a better employee, and earn rewards that may help to develop your career.

FIGURE 6-1: Managers help workers set goals and monitor performance

A manager appraises the performance of an employee. The employee will try to meet KPIs, to benefit the organization and advance his career.

Some organizational characteristics are:

1. **Organizational structures**

   When you start a new job, particularly early in your career, you may join at the "bottom" of an organization—this is called an entry-level job. As you gain more experience, there may be opportunities to move up through the company's **organizational structure**.

DEFINITION

Organizational structure: The structure of an organization, explaining job classifications, and the reporting relationships among the organization's personnel.

An example of an organizational structure is the hierarchical structure (see Figure 6-2). This is the most common structure found in business organizations, where the chain of command goes from the top—for instance, a CEO or company director—down through various levels of authority. In a hierarchical structure, everyone "above" you is your superior, but only the person directly connected to you is your boss (sometimes called a line manager or supervisor). Being connected to someone "below" you means that you, in turn, are their line manager.

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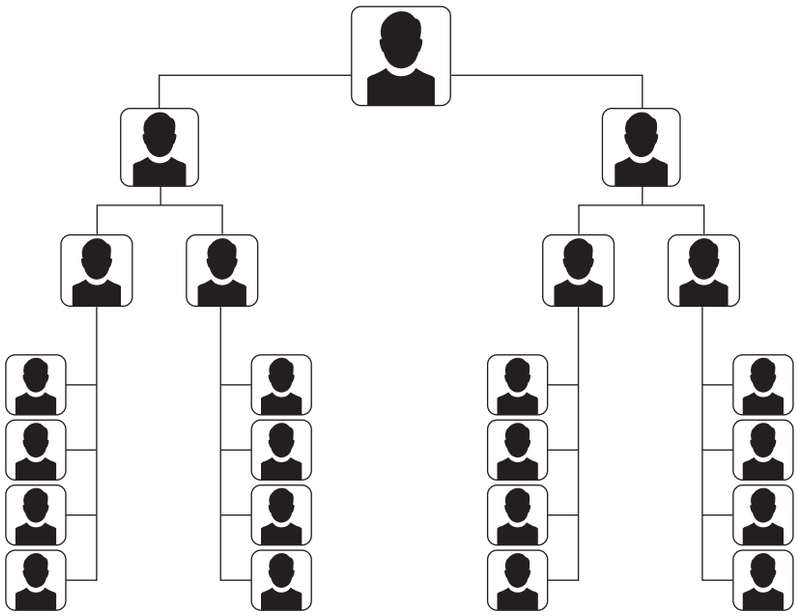
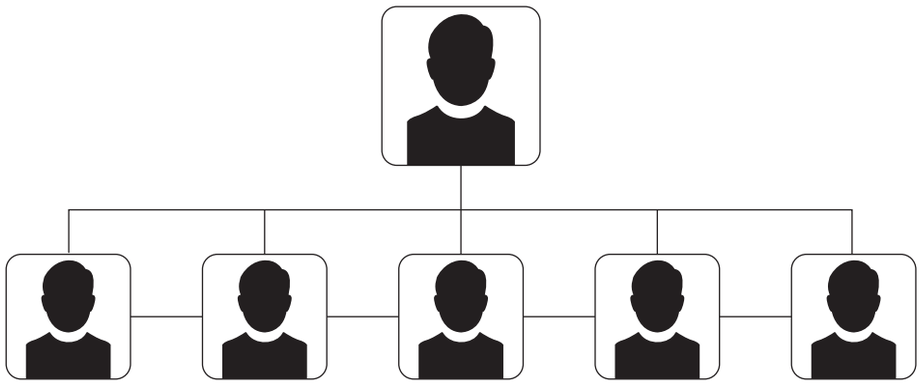
FIGURE 6-2: A hierarchical organizational structure



In a horizontal (sometimes called a "flat") organizational structure (see Figure 6-3), there are fewer "layers" of management—or sometimes none at all. In this structure, sometimes found in smaller organizations, workers may take responsibility for one area of the business, or they may share responsibilities for all areas.

FIGURE 6-3: A horizontal organizational structure works best in smaller businesses



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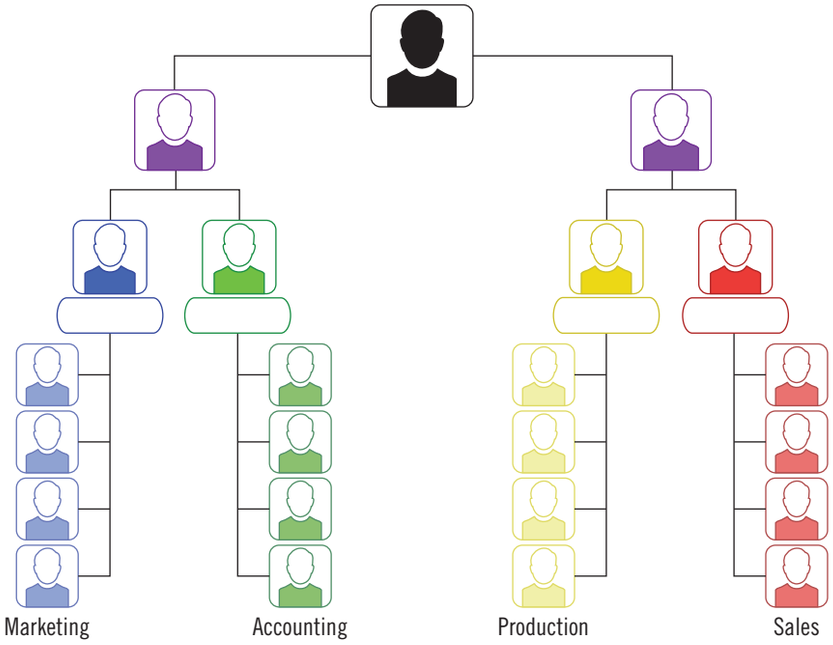
A functional organizational structure (Figure 6-4) is similar to the hierarchical model, but the chart is organized not just by who is "above" or "below", but who is on which team. For example, you may be a member of the organization's marketing team, meaning you and your immediate colleagues are responsible for the promotion of the business, but are not involved with, for example, the organization's accounts (handled by the accounting team).

FIGURE 6-4: A functional structure organizes workers by seniority and the job function



Most companies have more than one level of management. Small companies may have two or three levels. Large companies may have five or six management classifications. The levels of management in an organization can be described as a management pyramid. There are more managers at the lower levels and fewer at higher levels. The chief executive or owner who heads the business is at the top of the pyramid. Figure 6-5 illustrates the management pyramid.

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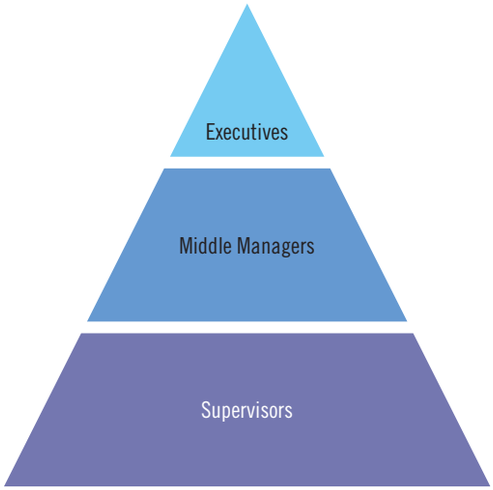
FIGURE 6-5: The management pyramid



2. **Decision making**

   Managers are responsible for making things happen in business. They are **decision makers**: they determine what a company will do and how well it will perform. They choose the people and other resources needed to operate a business. Managers must ensure that ideas are turned into products and services. Managers must show strong **leadership** skills to motivate their workers to achieve a particular goal or objective, which often involves cooperation and collaboration.

DEFINITIONS

Decision maker: A person within a business, often in management, who is responsible for making key decisions or assigning tasks to employees.

Leadership: The ability to influence individuals and groups to cooperatively achieve common goals.

3. **Doing your job**

   When you start a new job, you will be given a job description which explains the different tasks you have to carry out. During your induction—your introduction to the workplace, your colleagues, and the rules you need to follow—the relationship between your job and the wider goals of the organization should be explained.

   Your manager might inform you about your organization's **Key Performance Indicators (KPIs)**. Your manager will also inform you that your performance will be monitored to assess how successful you are at your job—and how

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you are contributing to achieving these KPIs—as part of your performance appraisal. Think about how completing tasks to the best of your ability might relate to your own goals: do you want to move "up" in the organization in the future? How will your actions in your current role help you?

Often, workers are also asked to perform **functions** outside of their regular responsibilities. It is important to remain flexible and **agile**, and you will sometimes be rewarded for your approach.

DEFINITIONS

Key Performance Indicator (KPI): A measure used to evaluate the success of an organization in achieving its planned objectives.

Function: The purpose or objective of a particular job or group of jobs carried out by a team.

Agility: The ability and willingness to adapt to what's happening around you and go "above and beyond" to ensure that tasks are completed on time and to a high standard.

4. **Job performance and rewards**

   If you perform well on the job, employers usually reward you with pay raises. Other rewards include commissions, bonuses, promotions, and benefits such as better office space or travel to popular destinations.

   Ask the human resources department how your company formally evaluates employees—for instance, by setting and monitoring KPIs, conducting periodic appraisals, or analyzing statistics like number of sales. Request a list of the criteria in the evaluation, and then start improving your performance to meet those criteria.

REVIEW QUESTIONS

1. **An organizational structure where every worker is equal is sometimes described as:**

   a. equal
   b. long
   c. flat
   d. a pyramid

2. **Which of the following is *not* a way for a company to measure your performance:**

   a. KPIs
   b. job interview
   c. appraisal
   d. statistical data

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Lesson
2
Chapter 6

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Working with Problem Owners and Stakeholders in an Organization

2-1 Solving Problems in Organizations

Managers, supervisors, colleagues, and clients will ask you to solve problems for them throughout your career. When you solve a problem for someone else, you assume the responsibility for developing a satisfactory solution for them, the **problem owners**. **Stakeholders** are people who are also affected or whose involvement you need to resolve the matter. Involve the problem owners and stakeholders as you begin to work. Table 6-1 lists the do's and don'ts for working with problem owners and stakeholders.

TABLE 6-1: Working with problem owners do's and don'ts

Guidelines	Do	Don't
Initial discussion	• Discuss the problem with the stakeholder • Ask questions to define the problem • Ask for suggested solutions • Make sure you include all the details • See the problem from the stakeholder's perspective • Separate opinions from facts	• **Don't** accept the stakeholder's solution as the only one • **Don't** confuse the stakeholder's opinion with substantiated facts
Progress	• Communicate the progress you make toward solving the problem • Use e-mail and memos to document your progress • Recommend an ideal solution and one or two alternatives • Demonstrate why you suggest one solution over another	• **Don't** overwhelm others with communication • **Don't** surprise the stakeholder by trying a solution without their participation or approval • **Don't** present only one possible solution • **Don't** fail to do your homework
Solution	• Promote effective solutions • Present the solution in a report or presentation	• **Don't** overpromote yourself, but don't let the credit for the solution go to someone else either

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DEFINITIONS

Problem owner: The person who has a problem that needs to be solved.

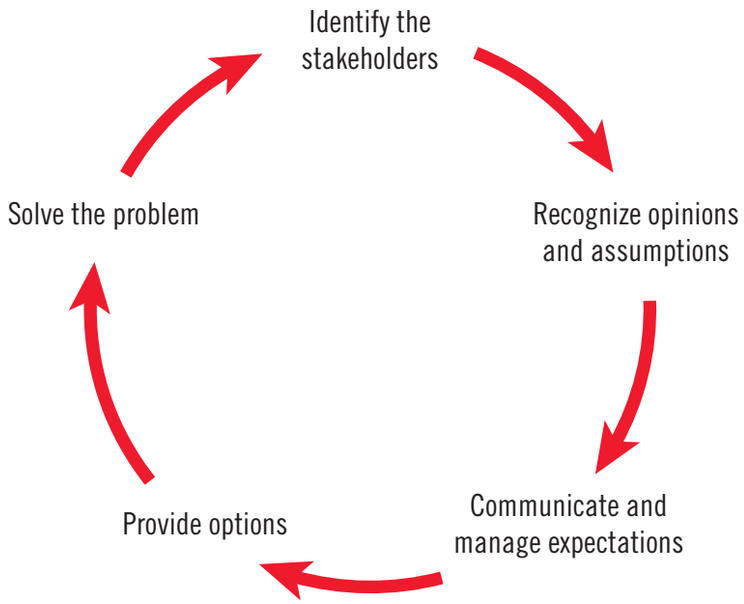
Stakeholder: A person who is affected by a problem or decision or whose involvement you need to resolve the matter.

2-2 Working with Problem Owners and Stakeholders

QUICK TIP
Be sure to ask problem owners to suggest possible solutions.

The process of working with problem owners and stakeholders can be a delicate one, requiring a continuous process of stakeholder management (see Figure 6-6).

FIGURE 6-6: Stakeholder management



1. **Identify the stakeholders**
   Start by finding out exactly what the problem is. It is important to think about the chain of command (see Chapter 6, Lesson 1) to make sure you're communicating with the right person at the right level. For instance, if the problem owner is at the **executive management** level, you may need to communicate with them via your manager. However, treat their explanation and suggestions as possible alternatives because the problem owners do not always see the root cause of the problem.

2. **Recognize opinions and assumptions**
   The opinions and assumptions that your problem owner, stakeholders, and other important people hold are important factors in the success of your solution. Managers establish control over other employees, physical space,

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spending, or a step in the approval process. Consider who you may be able to **cooperate** with, or if solving the problem requires **collaboration**.

DEFINITIONS

Executive management: A top-level manager who spends almost all of his or her time on management functions and making decisions that affect the entire company.

Cooperation: The act of working together to achieve something for the benefit of one or more of the parties involved.

Collaboration: Collaboration is similar to cooperation, but the achievement is shared between all parties.

QUICK TIP

Document conversations with follow-up e-mails to create a record of your communication.

3. Communicate your progress clearly and responsibly

Communicate regularly with problem owners and stakeholders. Use e-mail, memos, and other documents to create a log of your conversations, ideas, alternatives, and solutions. Frequent, though not overwhelming, communication avoids surprising a problem owner or stakeholder. Remember to communicate through agreed upon channels, respecting the chain of command within the organization (see Figure 6-7).

FIGURE 6-7: Sharing information with problem owners

Is this a good way to share information with someone higher up the chain of command? Why, or why not?

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Establish the credibility of your work by pursuing each step systematically. Demonstrate that you have worked through the problem by following the policies and procedures regarding communication inside the organization. Be objective in your communication, both written and oral, and make sure the problem owner is confident about your approach.

4. **Provide choices and promote your solution**
   Selecting one choice from many increases a sense of ownership, so present problem owners with options and ask them to select one or two. Recommend the best solution along with one or two other alternatives. Explain the pros and cons for each and let the problem owner make a final decision.

QUICK TIP
Give the problem owner a final report to create a sense of closure.

After solving a problem effectively, promote your efforts and results to the problem owners and stakeholders with a persuasive report or powerful presentation. The size and format will vary depending on the size and importance of the problem.

YOU TRY IT

Practice working with problem owners and stakeholders by reorganizing a conversation. Complete the following steps.

1. **Read the following conversation that Mariam, assistant in the Finance Department, and Waleed, tour developer for the Wonders of Saudi Arabia tours, are having about what Waleed can do to increase reservations for his tours.**

1	**Mariam:** I looked up the results of recent studies on some travel trade association Web sites. Adventure Travel magazine also had a couple of great articles about tour sales. **Waleed:** Interesting. What did they have to say?
2	**Mariam:** According to one survey I found, right now you could work on building your relationships with existing customers. Current customers are more likely to take another tour with us than new customers, especially if they have a personal connection to the company. **Waleed:** So I should personally contact customers who have already taken one of my tours?
3	**Mariam:** That sounds like it might be helpful in the short term. Anything else? **Waleed:** Oh, I don't know. People just don't want to travel right now. They're nervous about the economy.
4	**Mariam:** Why do you think reservations are declining for your tours? **Waleed:** I'm not really sure. I think I need to expand my mailing list and send out a fresh batch of brochures to new prospects.
5	**Mariam:** Yeah, that's what a lot of people think. I did some research to find out if that's the case throughout the travel industry. **Waleed:** Really? What kind of research did you do?
6	**Mariam:** I'm actually going to write a brief report on what I found, but overall, customers report that they are waiting to see what happens with the economy before spending money on travel. The good news is that they are delaying their plans, not abandoning them. **Waleed:** That's good to know. So people expect to start traveling again in the near future?

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7	**Mariam:** When they have a good sense of their future finances, our typical customers say that they will start traveling again. Also, when they do start traveling again, customers will be looking for high-value experiences like the adventure and cultural tours that you develop. **Waleed:** Really? But what should I do right now?
8	**Mariam:** Exactly. That means a lot of phone calls, but you are likely to get good results. Also, people say they are looking for value—they want extra services and special experiences, not just the usual guided tours. **Waleed:** That means I need to update my tours.
9	**Mariam:** Right. Updating your tours will take some time, but when you do, they'll stand out from the competition. **Waleed:** I guess I need to get busy. Thanks for all the helpful information.

2. **In your notebook, reorganize the conversation according to the information in this lesson.**

REVIEW QUESTIONS

1. **A person who is affected by a problem or needs to be involved to solve it is a:**
   a. stakeholder
   b. crowdsourcer
   c. motivator
   d. risk taker
2. **When solving a problem for someone else, which of the following should you *not* do?**
   a. Let the stakeholders find their own solutions
   b. Communicate your progress
   c. Recommend alternative solutions
   d. Demonstrate the benefits of solutions
3. **Which of the following is *not* an example of a stakeholder?**
   a. The general public
   b. Suppliers
   c. Employees
   d. Friends and family
4. **An example of a professional way to promote the results of your work is:**
   a. An SMS text message
   b. An e-mail sent to the whole company
   c. A report
   d. A phone call to the CEO

Lesson
3
Chapter 6

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Solving Organizational Problems: Adaptive Techniques

3-1 Using Adaptive Techniques

Many groups use **adaptive techniques** to solve problems. Instead of gathering data, analyzing it, and exploring alternatives **systematically**—or trying to **innovate** with an idea nobody has tried before—most adaptive techniques involve a combination of intuition, logic, and common sense. Adaptive techniques are less precise than traditional problem-solving methods but are appropriate in many cases. You should be familiar with these approaches and when they should and should not be used.

DEFINITIONS

Adaptive technique: An alternative method for solving problems. Instead of gathering data, analyzing it, and exploring alternatives systematically, most adaptive techniques involve a combination of intuition, logic, and common sense.

Systematic technique: Systematic techniques rely on existing practices, information, and strategies, using data and rigorous planning to resolve problems.

Innovative technique: A problem-solving approach involving a new idea, or a new implementation of an existing idea.

1. **Consider when to use adaptive techniques**

   You might not want, or be able, to follow a complete problem-solving process for many reasons. In the cases shown in Figure 6-8, it is appropriate to use an adaptive technique.

FIGURE 6-8: Appropriate times to use adaptive techniques

Consider using adaptive techniques when:

- **You have a limited amount of time to work**, for example, a client has brought forward a four-month deadline to two months
- **An exhaustive analysis is not needed**, for example, if the problem is straightforward, and only requires one or two simple actions
- **The risks are minimal and downside costs are low**, for example, a client asks for an in-person meeting rather than a video call

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QUICK TIP
The most obvious problems are not always the most important problems.

2. **Manage by exception**
   When time is limited, managing by exception may be appropriate. Spend your available time concentrating on the most important issues, and address symptoms that are clearly deviating from the expected norm. By focusing your attention on the most significant problems, you are more likely to make a difference than you would if you spread yourself too thin.

3. **Make decisions incrementally**
   When you are faced with an expensive option or an irrevocable decision, consider making incremental choices first. Make partial or intermediate decisions to avoid committing to a major decision.

   Imagine you are working for an adventure tour operator experiencing poor sales. You may decide to launch a new marketing campaign, but you might not know if your strategy is going to work. Instead of spending 100% of your budget on the campaign right away, you might instead decide to run just one or two advertisements, to see if they have an effect, before making more of a commitment.

4. **Spread risk**
   Committing to a single option or alternative is inherently risky. Spread your **risk** by avoiding decisions that lock you into a single choice. Consider a solution that includes multiple options. By using more than one approach, you are more likely to have some success—even if one approach doesn't work.

3-2 Finding Solutions

If you are having trouble finding a good solution that meets your goals, slow down and delay selecting a single course of action. Use the time to develop other options and gather more information. Occasionally, the problem will resolve itself. More often, the symptoms continue to grow, or events change the nature of the problem.

QUICK TIP
Monitor the problem so it doesn't escalate, and set a time limit so you don't delay indefinitely.

For example, the adventure travel company you are working at might be experiencing poor sales performance. There may be many factors that explain this, and a variety of courses of action you could take to improve sales. By addressing problems in marketing, business strategy, and sales—rather than simply reducing prices, for instance—you create more opportunities for the problem to be solved.

DEFINITION

Risk: An exposure to a chance of loss or damage.

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TABLE 6-2: Adaptive techniques do's and don'ts

Guidelines	Do	Don't
Manage by exception	• Spend your available time concentrating on the most important issues • Use your limited time addressing factors deviating from the expected norm	• **Don't** focus on small or insignificant problems, even if they are easier to solve • **Don't** commit to a plan you cannot fulfil
Stagger decisions	• Make incremental changes when faced with expensive or disagreeable alternatives	• **Don't** make a complete commitment to a major decision if you are not prepared to do so
Spread risk	• Look for a solution that includes multiple options	• **Don't** make decisions that lock you into a single choice
Delay decision	• Slow down and delay committing yourself to a course of action • Find time to develop other options and gather more information	• **Don't** ignore the problem while you are deferring the decision

Solving problems in a blink

Many individuals rely on intuition, hunches, and other abilities to make decisions in the blink of an eye. Some commentators contend that these spontaneous decisions—one type of adaptive technique to sense what is important from a very narrow period of experience—can be better than those explored with scientific analysis and precision. This view holds that professionals often collect too much information, and that experts can make better decisions in snap judgments than they do after months of evaluating data. Experienced physicians often use such techniques to diagnose diseases with uncommon symptoms. Effective salespeople use the technique as they meet customers and discuss their needs. However, in both cases, it's important to note that the intuitive decisions might be correct only because years of training, practice, and experience have been condensed to useful information that can be retrieved without conscious effort. A hunch may well prove correct, but it should always be backed up with solid evidence.

YOU TRY IT

Practice using adaptive techniques by finding solutions for common problems. Complete the following steps.

1. **Choose one of the following problem descriptions.**

    1. A company trains and manages all of the customer service representatives at Specialty Travel, which includes up to eight employees working at the same time with customers on the phone or in person. The problem is that sales of extra and supplemental services such as travel insurance are low, though customer service reps have a script to encourage sales of these items.

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2. Leila is the tour developer for Specialty Travel's European tours. She thinks the European Adventure tour should be one of Specialty Travel's most popular tours. Customers report that the price is too high, the 12-day tour is too long, and the size of the tour group is too large. Leila wants to eliminate that tour and design a new one, which would be a major change for Specialty Travel.

3. As marketing director for Specialty Travel, Hashim needs to increase sales overall for the company. He usually encourages tour developers and salespeople to pursue the typical Specialty Travel customer: married, in the 41–60-year-old age group who do not have children living at home, and have household incomes of over 200,000 SAR per year. He wants to open new markets, such as younger travelers, travelers with disabilities, and Specialty group travel, such as for clubs and associations of professionals, students, and retired people. However, salespeople fear that they won't be able to sell as many tours to these new markets and their bonuses will be decreased.

4. Wahid, head of the Human Resources Department at Specialty Travel, has been interviewing potential tour assistants. If Specialty Travel does increase its tour sales by 12% as expected, the company will need more tour assistants. If it doesn't increase sales, the company will need to lay off tour assistants.

2. **In your notebook, choose one of the problems above, then choose which adaptive technique to use when solving this problem. Give an example of a solution to the problem.**

REVIEW QUESTIONS

1. **In which of the following scenarios is an adaptive technique *not* appropriate?**
   a. You have a limited amount of time to work
   b. The solution is easily reversible
   c. The risks are minimal and the costs are low
   d. You need an exhaustive analysis
2. **Negotiating new terms with a tour operator instead of dropping the tour is an example of:**
   a. using your intuition
   b. managing by exception
   c. risk analysis
   d. staggering a decision

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Lesson
4
Chapter 6

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Investigating and Determining Organizational Problems: Root-Cause Analysis

A common tendency is to overlook the root cause of problems and focus on the symptoms. Complex situations usually involve interrelated problems, each with a different cause. To link a problem to its cause, you must perform a **root-cause analysis**, a study that determines the real basis for the problem. Because many problems demand more than a one-time solution, root-cause analysis is often part of a continuous improvement effort. Table 6-3 lists the do's and don'ts for determining causes.

4-1 Peforming a Root-Cause Analysis

In Lesson 3, we dealt with the example of an adventure tour operator that was experiencing poor sales performance. Continuing with this example, we will now explore the ways in which the organization might try to uncover the causes of the problem in order to try and resolve it.

QUICK TIP
Because symptoms are usually easy to identify, it is tempting to pursue them instead of causes.

1. **Differentiate between symptoms and causes**
   A **symptom** is evidence of a change, such as a decrease in revenue. A **cause** is the reason for or the origin (root) of a change, such as customers being unable to afford adventure tour vacations. You can usually determine if something is a symptom by asking whether it is being caused by, or due to, something else. If the answer is "yes", then it is a symptom. A "no" means it is more likely to be a root cause.

2. **Look for more than one cause**
   Organizational problems rarely have a single cause. Many factors typically contribute to complicated issues, and some are easier to identify than others. Find the most significant causes of the problem and work on those first. For example, the most obvious cause of an adventure travel company's problems might be the rising cost of airfares and ground transportation. However, additional research might reveal that people are also concerned about political unrest in some tour locations. Identify the major issues so you can develop appropriate solutions.

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QUICK TIP
Often, the minor factors become less trouble when the major causes are remedied.

3. **Consider the cost**

Although you should identify the basis of a problem before solving it, attacking the root causes is not always the best approach. Sometimes the costs of fixing the problem are higher than treating the symptoms.

DEFINITIONS

Root-cause analysis: A study that determines the real basis for the problems that you solve.

Symptom: Evidence of a change, such as a decrease in revenue.

Cause: The reason for or the origin (root) of a change, such as customers being unable to afford travel vacations.

Organizational problem: A problem within a business or organization which affects many different departments.

For example, the adventure travel company you are working at developed a tour to Asia without local guides to reduce the price of the tour. Customer satisfaction on the tour is very low, and not including guides is the main cause of the problem. However, it is now prohibitively expensive to find, train, and hire local guides in Asia. In such cases, treating the symptom (reducing the tour cost even further to increase customer satisfaction) might be the best solution.

TABLE 6-3: Problem statement do's and don'ts

Guidelines	Do	Don't
Causes and symptoms	• Differentiate between causes and symptoms • Look for more than one cause • Find the most significant causes of the problem and work on those first	• **Don't** mistake evidence of a change (symptom) for the reason for the change (cause) • **Don't** limit yourself to one reason for the problem
Trade-offs	• Consider the pros and cons of addressing the root cause • Choose to treat the symptom if the trade-offs make that the best solution	• **Don't** try to solve every problem by addressing the root cause • **Don't** fix the problem if the costs are much higher than treating the symptoms
Techniques	• Use the "5 Whys" approach to uncover and define problems • Create a cause-and-effect diagram to visualize a complex problem	• **Don't** be afraid to ask the same question more than once • **Don't** hesitate to redefine a problem • **Don't** discard a cause-and-effect diagram if it doesn't reveal the cause of a problem immediately

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4. **Root-cause analysis techniques**

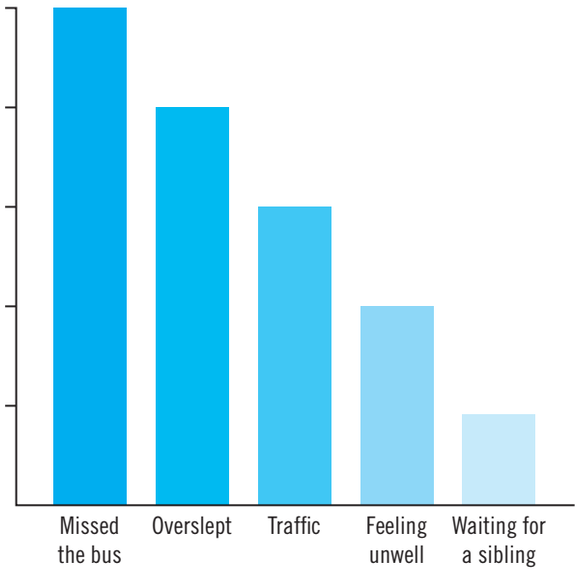
A popular approach used to uncover and define problems is called **5 Whys**. Popularized by Toyota in the 1970s, the 5 Whys involves looking at a problem and asking "why?" or "what was the cause of this situation?" at least five times. Challenge each answer with another "why" until you determine the root cause of the problem. Each answer should help further clarify the cause.

The 5 Whys	
	I was late for class.
Why?	
	I was late for school.
Why?	
	I woke up late.
Why?	
	I slept through my alarm.
Why?	
	I didn't get enough sleep.
Why?	
	I went to bed too late.

4-2 Using a Pareto Chart

A **Pareto** chart (see Figure 6-9) is used to analyze the type/frequency of a problem's causes. It is a type of bar chart and can be a useful visual tool for communicating with others about a problem. The bars represent the cost or frequency of each factor, with the bars organized from left to right—most to least significant.

FIGURE 6-9: A Pareto chart showing the type and frequency of reasons students were late to class



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Complicated problems typically grow out of many related issues. A popular way to visualize a complex problem is by creating a cause-and-effect or **fishbone diagram**. See Figure 6-10. Write the main problem in a box, and then draw a horizontal line from the box across the page like the spine of a fish. Identify related factors that contribute to the problem by drawing lines from the spine and labeling each. Include as many factors as you can. Examine the drawing to determine the main causes of the **problem**.

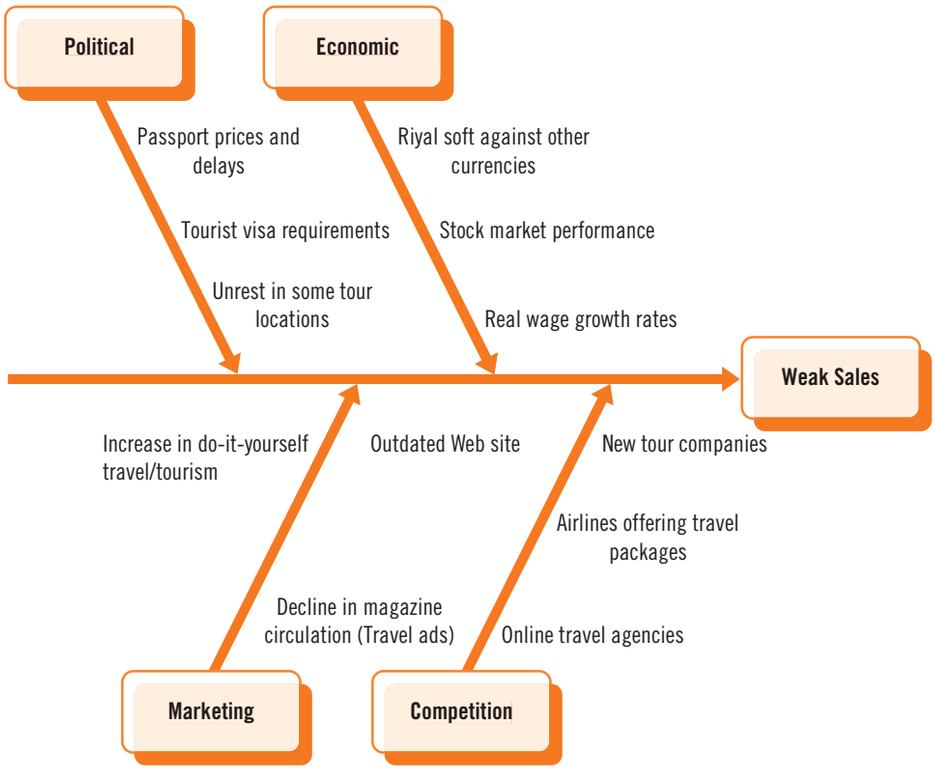
DEFINITIONS

5 Whys: A problem-solving approach that involves looking at a problem and asking "why?" or "what was the cause of this situation?" at least five times.

Pareto principle: Also called the 80/20 law, the Pareto principle states that 80% of outcomes come from 20% of causes.

Fishbone diagram: A diagram, which looks like the skeleton of a fish, showing the causes that contribute to a problem.

FIGURE 6-10: Fishbone diagram of the factors contributing to weak sales in the adventure tour company



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YOU TRY IT

Practice determining causes by creating a list, table, or diagram. Complete the following steps.

1. **Read the following description of a problem.**

   Problem: Typically, the late spring and summer months are the most popular times for personal travel. For the last five years, the top sales months have been April–August. This year, however, sales did not increase during these months. In fact, tours overall have decreased by 8% compared to last year.

   This is true for most travel companies. Only 5% said they sold more tours, 10% said sales were the same, 35% said sales were somewhat lower, and 50% said they were significantly lower.

   Specialty Travel expected adventure travel to increase substantially, but it remained steady compared to last year. Adventure travel includes exploring remote or exotic areas and engaging in activities such as hiking, parasailing, rafting, diving, and sailing.

   Although Specialty Travel promoted popular European tours, sales for those tours are also flat. The most popular European destinations are France and Italy. Another problem is that tour operators in these countries are charging more for their services.

   Specialty Travel also expected tour sales overall to increase by 5% as it has in previous years.

   Specialty Travel surveyed its customers and found that they are delaying travel plans because of concerns about the economy, airline services, and security.

   This means that plans to expand tours, staff, and the Specialty Travel Web site should be put on hold. Other expenses might need to be cut.

2. **In your notebook, use a technique discussed in this lesson, such as the 5 Whys approach or a cause-and-effect analysis, and create a list, table, or diagram to identify the cause of the problem.**

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REVIEW QUESTIONS

1. **What do you do when using the 5 Whys technique?**
   - **a.** Identify You, Yourself, Yours, Youth, and Yield
   - **b.** Draw a cause-and-effect diagram
   - **c.** Ask "why" and challenge the answer with another "why" five times
   - **d.** Limit yourself to five questions
2. **What does a fishbone diagram show?**
   - **a.** Who is causing a problem
   - **b.** Many solutions for a complicated problem
   - **c.** Many causes for a complicated problem
   - **d.** The root cause of a problem
3. **Using Figure 6-10, identify the effect:**
   - **a.** stock market performance
   - **b.** outdated Web site
   - **c.** tourist visa requirements
   - **d.** weak sales
4. **In a small group or on your own, decide which of the causes in Figure 6-10 has the biggest impact on sales. What are your reasons for this choice? Research the subject online to find evidence to support your answer. Ask your teacher for feedback on what you find.**

Lesson
5
Chapter 6

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Developing Ethical Solutions in Organizations

5-1 Developing Ethical Solutions

Ethics are standards of behavior that direct how people should act. **Ethics** involves making moral decisions and choosing between right and wrong. When applied to problem solving, ethical behavior leads to appropriate decisions, not necessarily the optimal ones. As you work to solve problems, consider the situation from an ethical, as well as practical, perspective. One consequence of concentrating tours in a few areas is that adventure travel can create ecological stresses, such as increased demand on water resources, the destruction of animal habitats, and noise and light pollution.

1. **Identify ethical issues**

   Most decisions have an ethical dimension, so you should identify and consider the ethics of each decision you make. Could your decision harm someone else? Should you consider more than simply finding the most efficient solution? What are the long-term implications of your decisions? Consider other people and groups that have a stake in the outcome and keep their perspectives and interests in mind. The Basic Law (in Article One) states that the constitution of Saudi Arabia is "the Holy Qur'an, and the Sunna (Traditions)" of the Islamic prophet Muhammad (Peace be upon him). The country's traditions and customs in government, businesses, and communities as a whole are derived from Islamic guidelines and laws. Following and implementing those laws are very important in establishing a stable and sustainable successful economic system. Organizations and employees in Saudi Arabia strive to operate in accordance with Islamic ethics, for instance, by the Zakat, tax, and customs authority imposing Zakat as one pillar of Islam.

2. **Compare costs and benefits**

   Your solutions can create both **benefits** and **costs** for yourself and others. So-called tough decisions include elements of both. Making decisions involves weighing the pros and cons, and choosing the best trade-offs (see Table 6-4)—in the case of adventure travel, the increase in tours in an area will stimulate the local economy, providing jobs and generating tax

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revenue. Identify the options that produce the most benefit and do the least harm. Many professional organizations develop codes of ethics, which are often available online. For instance, Saudi Basic Industries Corporation (SABIC https://www.sabic.com/en), a chemical manufacturing company, has published its code of ethics (https://www.sabic.com/ar/about/our-compliance-culture/sabic-codeof-ethics) on its Web site.

Imagine you are trying to improve the environment in your local area. You want to encourage residents to make use of the city's recycling services. You also want to add your achievements to your CV. However, you still have to complete your homework and other responsibilities.

There are a number of actions you can take, but each comes with different levels of risk and reward. For instance:

- **Design a leaflet that promotes and explains recycling services to the community.** This could be very effective, but will take quite a lot of time. You will also need to take time to deliver it to people in the community. Therefore, we can say this option has a high payoff but many drawbacks.
- **Make sure you recycle items in your own home.** This is easy to do, but will have a relatively small impact.
- **Research and write a 40-page report about the damaging effects of pollution.** This will take a long time to do, and will have a limited impact on the community.
- **Get involved with projects that are already operating to deal with this issue.** Volunteer an amount of your free time that still allows you to complete your homework and other responsibilities.

You can use a chart to analyze the trade-offs you will need to make, like the one in Table 6-4.

TABLE 6-4: Compare payoffs and drawbacks to your plans in a table, showing all the actions you can take

	High payoff	Low payoff
Few drawbacks	Get involved with projects that are already operating to deal with this issue.	Make sure you recycle items in your own home.
Many drawbacks	Design a leaflet that promotes and explains recycling services to the community.	Research and write a 40-page report about the damaging effects of pollution.

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QUICK TIP
The ideal solution is usually one that benefits everyone involved.

3. Consider other people

Your decisions frequently affect others in an organization. People will remember how you treat them long after the problem that you are working on has been forgotten. Be sensitive to how your actions affect others—both those within and outside of your immediate workgroup. Make decisions that cause the fewest drawbacks for others.

QUICK TIP
Ask whether your solution simply moves the problem to another area.

Look beyond your own objectives and consider the organization as a whole. Consider each alternative and the people who would be affected by it. Solutions that serve the interests of a broader group are preferable to those that only benefit certain individuals.

DEFINITIONS

Business ethics: A collection of principles and rules that define right and wrong conduct for an organization.

Benefits: What an organization, its employees, customers, or stakeholders gain from the production of an item or the provision of a service.

Costs: The value of what an organization spends, in time, money, or both, to produce an item, provide a service, or carry out an item of work.

Why is it important to consider everyone when making big decisions?

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4. **Be true to yourself and your Islamic beliefs**

   When you solve problems, you are contributing to your reputation—either positively or negatively. Not only will you be judged on the success of your solution, but also on the steps you took to accomplish the task. As you make decisions, ask yourself if the option you are considering is consistent with the sort of person you want to be, and your Islamic beliefs. Always assume that other people will be aware of what you are doing. Never compromise your values for some short-term benefit.

TABLE 6-5: Ethical solutions do's and don'ts

Guidelines	Do	Don't
Identify ethical issues	• Consider whether your decision benefits everyone involved • Look for ethical alternatives to the most efficient or practical solution if necessary	• **Don't** make decisions that cause harm to others • **Don't** forget that others have a stake in the outcome of your decision
Consider costs and benefits	• Weigh the pros and cons of each decision, including ethical factors • Determine whether the end result justifies the means according to ethical standards • Find options that produce the most good and do the least harm	• **Don't** select an option that has far more costs than benefits
Consider other people	• Be sensitive to how your actions affect others inside and outside the organization	• **Don't** treat others poorly as you make decisions and solve problems; they are unlikely to forget
Serve broad interests	• Consider the objectives of the organization as well as your own • Look for solutions that serve the interests of a broad group	• **Don't** make a decision solely on how it benefits you
Be true to yourself	• Remember that you are judged on the success of your solution and on the steps you took to accomplish the task	• **Don't** compromise your values for a short-term benefit

YOU TRY IT

Practice developing ethical solutions by making an ethical decision based on a scenario. Complete the following steps.

1. **Read the following description of an ethical dilemma.**

   Ethical dilemma: The Farasan Islands are one of the most popular destinations for Specialty Travel customers. The islands are home to breathtaking marine life, vibrant ecosystems, and tropical beaches. However, the more people take the unique underwater trip and explore the islands' colorful marine life and coral reefs, the more they threaten this natural attraction.

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Tourists introduce pollution and disturb the natural ecosystems. Can Specialty Travel ethically continue to offer tours to the Farasan Islands? If so, how?

2. **In your notebook, describe how you would make a decision in this scenario and why.**

REVIEW QUESTIONS

1. **Ethical problem solving leads to solutions that:**
   - **a.** produce the most good while doing the least harm
   - **b.** serve narrow interests
   - **c.** are perfect
   - **d.** have more costs than benefits
2. **Which of the following is *not* an example of an ethical dilemma?**
   - **a.** Cut expenses, though many employees will lose their jobs
   - **b.** Reduce quality, even if it makes a product less safe
   - **c.** Sell new products abroad, though they are banned in your country
   - **d.** Increase sales of services, though the services are new
3. **Which of the following is an ethical consideration when making a decision:**
   - **a.** how much money will be made
   - **b.** how it will impact my career
   - **c.** how it will affect the environment
   - **d.** what my colleagues will think
4. **In your free time, use the Internet to research a Saudi Arabian company's code of ethics, and answer the following questions:**
   - **a.** What is the name of the company?
   - **b.** What does the company do?
   - **c.** What does it say about environmental issues?
   - **d.** What does it say about Islamic business ethics?

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Technology @ Work: Using Technology in an Organization

Blog

A **blog** (short for *Weblog*) is an interactive online journal. In general, one person writes blog entries on a Web site, and others read and comment on the content. In business, blogs can be internal or external.

Internal blogs are designed for employees and others within an organization, and are often used instead of meetings and e-mail discussions, especially for routine company or project matters, such as policies, procedures, and announcements. External blogs are available to the public and let company employees or spokespersons air their views. Because both types of blogs project an image of an organization and blog posts are usually archived for later searching, they require clear writing more than most forms of corporate communication.

Microblogging uses incredibly short messages, measured in the number of characters (letters, numbers, or symbols) the post uses. A popular platform for microblogging is Twitter, where each post is known as a tweet. Users add **hashtags** to their posts to help connect them with other users who are posting about the same topic, and to enable interested users to find their content. Organizations use microblogging platforms to promote their products and engage with their audiences and consumers.

1. **Determine whether blogs are appropriate for your audience**
   As with any type of writing, start by analyzing the purpose and audience of the blog. Profile your target readers and determine whether a blog is an effective way to reach them. Does your audience spend much time online? Are they comfortable using technology tools to read and respond to information? Be sure to clarify your goals in publishing a blog. The strength of blogs is that they can stimulate discussion if the writing is lively and has personality. If you want to post corporate announcements, newsletters and Web sites are better options.

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2. **Content creation in business using blogs**

Most personal and internal blogs are written to create content that helps the organization promote its objectives. External blogs often have more than one author, especially in companies with many products or services. In that case, the person who knows the product or service well should be the blogger. Each blogger should write in a professional but identifiable style. Personalities and points of view make a blog interesting, though they must always be appropriate for the audience.

DEFINITIONS

Blog: An interactive online journal. Short for *Weblog*.

Microblog: A very short way of conveying information in real time, often used to engage with consumers or provide live updates.

Hashtag: A slogan or phrase—with no spaces between the words—attached to a post so that users can find related information quickly.

QUICK TIP

Experts recommend that you update your blog regularly, at least once a week.

3. **Develop and follow writing guidelines**

Although a blog should have a personal voice, it projects an image of your organization and must be written to meet professional standards. Create a list of best practices and writing tips for the blog in your organization—you may find the information in the "Blogging is writing" box helpful. Decision-makers should review and approve this list, and bloggers should take care to follow it.

QUICK TIP

Respond to all comments—positive and negative—in a professional and business-like way.

4. **Establish a policy for comments**

Remember that blogs are not electronic press releases for your organization—they should allow a two-way conversation between the company and the customer (or between one member of the organization and other members). Encourage readers to participate, but publish and distribute a strict policy about allowable comments. Constructive criticism should be allowed, but rumors and inappropriate language should not.

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Blogging is writing

More than other forms of electronic communication such as e-mail, blogs are crafted pieces of writing that people can access long after they are first published on a Web site. If you are writing a blog, at a minimum, make sure you are using clear sentences and a logical organization for your ideas. Build on these fundamentals with the following techniques to devise an appealing and useful blog:

- *Include descriptive titles and headings*: Your titles and headings tell potential visitors what you are writing about. Make sure these elements use concrete details and active verbs.
- *Get to the point*: People read content on the Web more quickly than they do printed material. Make your point quickly—in the first sentence, if possible. Write economically throughout the post so people keep reading.
- *Stick to one topic*: A blog post can be long or short, but it should cover a single topic. An effective strategy is to present a single problem, discuss a solution, and then describe the results. Support your ideas with facts and references. Come to conclusions based on evidence rather than unsupported opinions.
- *Make it worth your reader's time*: Share knowledge and experiences to teach your readers or stimulate them to think. Write with energy and conviction, and show readers something in a new way to make your post worthwhile.
- *Edit and revise before publishing*: You can write quickly to put your words on the page, but those ideas are likely to remain fuzzy unless you edit them. Professional writers spend more time editing and revising than writing first drafts. Make sure the words you post on a blog today will be valuable and clear in the future.

Professional Networking Sites

A **professional networking** site is a type of **social networking** site a person can use to connect with employers and colleagues via a variety of online methods, such as e-mail and text messages. Some social networking sites such as LinkedIn are designed to communicate and share professional information, including information about jobs and careers. Social networks connect people with minimal expense, which is particularly beneficial to small businesses and job seekers. Similar to a network of colleagues, in a virtual community such as LinkedIn, a person can interact with others who share their career and business interests and employment objectives, learn about suitable positions and employers, and prepare for interviews and other meetings by reading articles, watching slide shows and videos, asking questions, and searching for job information. Figure 6-11 shows responses to a question about travel jobs on LinkedIn.

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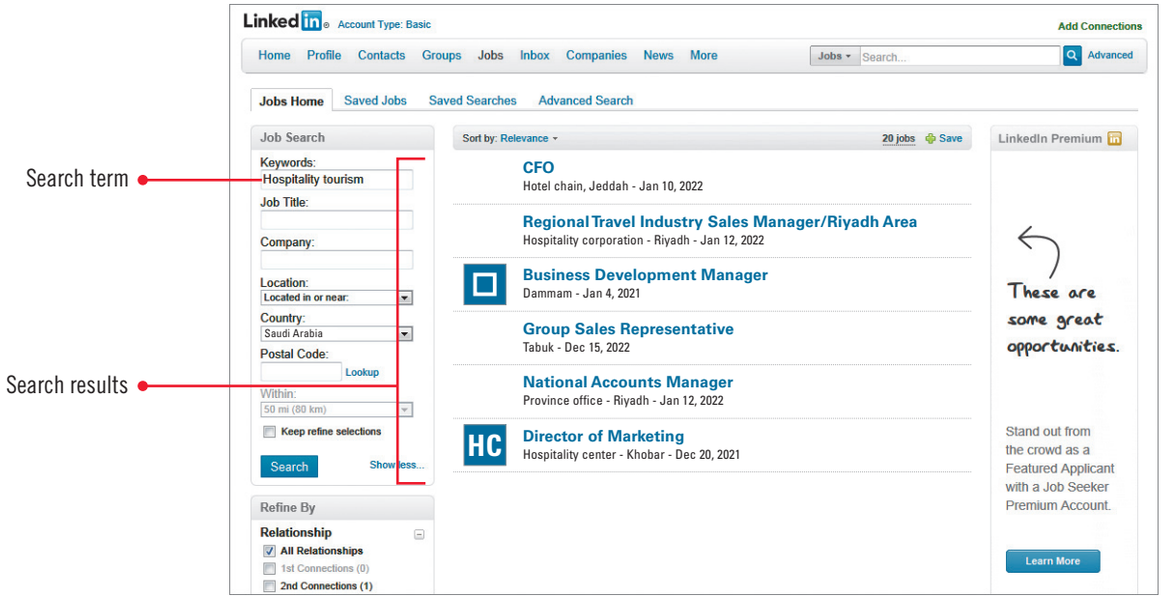
DEFINITIONS

Professional networking: Practices for creating and cultivating business friendships.

Social network: Virtual community that allows users to post information about themselves and share that information with others.

FIGURE 6-11: LinkedIn job search results



1. **Provide two-way communication**

   Professional networking sites allow you to communicate with contacts and allow contacts to communicate with you. Businesses can take advantage of this type of communication by keeping in touch with customers and suppliers and letting customers and suppliers contact them.

2. **Stay in touch while mobile**

   You can use professional networking sites to identify and contact colleagues, employers, and customers even while you are traveling, or moving from one job to another. As the popularity of networking sites continues to grow, you can reconnect with contacts you lost touch with in the past.

3. **Use with in-person networking**

   Setting up contacts with people you meet face to face can be an effective way to prepare for interviews, meetings, and conferences, for example. You can also research companies and job trends. However, professional networking sites don't take the place of in-person meetings.

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4. **Manage your time on networking sites**
   One caution is that building a network takes time, which can detract from other job-seeking or career-building activities. Many employers frown on online conversations that take too much time. They also object to using the computer to deliver messages that are better delivered in person. As with all forms of communication, make sure the audience and purpose of your message are suitable for online networking sites.

Instant Messaging

Instant messaging (IM) is a technology that involves communication between two people who type text messages to one another using a computer, mobile phone, tablet, or other device connected to the Internet. See Figure 6-12. Because they are short, informal, and impermanent, instant messages are the opposite of letters, which are longer, more formal, and more permanent. IM and e-mail are more similar because both technologies send messages across the Internet. IM, however, is like an electronic conversation—you see a message and respond to it immediately. IM software for business use is considered enterprise instant messaging (EIM).

FIGURE 6-12: Instant messaging on mobile devices

1. **Organize contacts into categories**
   Instant messaging software lets you separate contacts into business, friends, and family categories, for example. This means you can easily keep your professional IMs separate from personal IMs. However, to participate in any type of instant messaging, you sign in to the software. Your friends and family can see when you are signed in, even at work. Make sure they know you need to concentrate on professional conversations when you are working.

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So that employees keep personal text messages separate from business messages, some organizations provide EIM software. For example, WhatsApp Business and Telegram are instant messenger services designed for business. They are popular because they run on Windows, iOS, Android, and other operating systems.

2. **Send and reply to messages instantly**
   The instantaneous feature of IM is both an advantage and disadvantage. Instead of waiting for an answer to a letter or e-mail, you can receive a response from a colleague or vendor immediately. However, IM can be a distraction when you need to focus on a project, conversation, or meeting.

3. **Save instant messages for future reference**
   Like e-mail, you can save IMs when you need to reference a conversation with customers or colleagues, for example. You can also send, receive, and save attachments to messages. However, viruses can infect IMs as easily as they do e-mail messages.

4. **Use professional language**
   Personal text messages often use slang, shorthand, "text speak," and emoticons to abbreviate common words or expressions and to reduce the amount of necessary typing. However, these techniques are inappropriate and overly casual in professional settings. Your language can be more informal than in a standard business letter, but it should still be clear, complete, and professional. See Table 6-6 for instant messaging do's and don'ts.

DEFINITION

Instant messaging (IM): A technology that involves communication between two people who type text messages to one another using a computer, mobile phone, or other device connected to the Internet.

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TABLE 6-6: Instant messaging do's and don'ts

IM element	Do	Don't
Etiquette	• Write simple, short, clear messages • Update your status throughout the day • Ask others if they are available to chat • Use IM for brief, informational messages	• **Don't** make statements you wouldn't make in public • **Don't** use a misleading or unprofessional screen name • **Don't** exchange instant messages during meetings or phone calls • **Don't** use jargon, especially when communicating with customers
Security and Privacy	• Keep in mind that instant messages can be saved • Avoid transferring files because they can contain viruses	• **Don't** use IM to share confidential information such as passwords • **Don't** make statements that could damage the reputation of your employer or yourself
Professionalism	• Keep your work contacts separate from your personal contacts • Follow your employer's guidelines about IM at work • Check your spelling and grammar before sending a message	• **Don't** combine a social chat with a professional chat, especially with a customer • **Don't** use IM at work, unless your employer allows it for personal use or as part of your job

YOU TRY IT

Practice working with blogs by reviewing a corporate blog. Complete the following steps.

1. Google has one of the most popular and effective corporate blogs. Create a blog at https://support.google.com/blogger/answer/1623800?hl=ar. Write a post about the importance of using professional language in written communication with colleagues. Give examples of how to communicate professionally, the kind of communication that is considered unprofessional, and summarize the issue for readers who are short of time. Think carefully about the overall message you would like them to remember.
2. In your notebook, write a summary of a post, including the date it was published and the author (if one is given).

Practice using a professional networking site. Complete the following steps.

1. LinkedIn is one of the most popular and effective professional networking sites. Visit the site at www.linkedin.com.
2. In your notebook, write a list of characteristics, including pros and cons, of the professional networking site.

Research enterprise instant messaging (EIM) and consumer instant messaging (CIM). Complete the following steps.

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1. Use your favorite search engine to research enterprise instant messaging and consumer instant messaging. Find at least one example of EIM and one example of CIM software.
2. In your notebook, write a list of the differences between EIM and CIM software.

REVIEW QUESTIONS

1. **A blog is:**
   a. an interactive online journal
   b. a new form of instant messaging
   c. a chart representing inexact data
   d. a type of style checker
2. **Internal blogs are often used to:**
   a. communicate with the public
   b. take the place of company meetings
   c. announce products to customers
   d. conduct research
3. **A professional networking site is:**
   a. a centralized job fair
   b. restricted to company owners
   c. a place to learn about computer networks
   d. a Web site a person can use to connect with employers and colleagues
4. **Which of the following is a disadvantage of using professional networking sites?**
   a. It takes time to develop a network
   b. It provides two-way communication
   c. It lets you stay in touch while mobile
   d. It complements face-to-face networking
5. **How can instant messages be considered the opposite of business letters?**
   a. They are short, informal, and impermanent
   b. Their purpose is to entertain
   c. They have a corporate audience only
   d. They are not intended to establish goodwill
6. **Why should you avoid typical IM techniques such as slang and shorthand?**
   a. No one understands them
   b. They focus on the writer, not the reader
   c. They are inappropriate and overly casual in professional settings
   d. They are entertaining

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Extra Practice

Critical Thinking Questions

1. Ask a family member working for a government or business organization about the organizational structure at their workplace. Can you figure out what kind of structure it is? Try to use the information you get to draw an organizational chart.

2. Suppose that your school has to choose between teaching more science lessons and fewer math lessons; or more math lessons and fewer science lessons. How would you decide? Create a cost-benefit analysis table to show how you reached your decision.

3. Consider a situation where you had a choice to act ethically or unethically. What did you choose?

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4. Why did you make that decision? What was the outcome?

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Real Life Independent Challenge 1

You are a part-time salesperson at a bakery and report directly to the owners, Ibrahim and Naif. In addition to selling bakery products, Ibrahim and Naif ask you to help train new employees. Your goal is to become the sales manager at the bakery.

The amount of business has grown significantly since you were hired, and you spend time each day battling problems with customers, suppliers, and employees. Ibrahim suggests you complete the chart shown below to determine which problems to battle each day.

Assign each of the following problems to a blank area of the chart. Highlight the problem that you should pursue in red font.

	High payoff	Low payoff
Few drawbacks		
Many drawbacks		

Problem #1

You need to schedule part-time employees to work behind the bakery counter at the retail outlet. You get along well with the employees, but don't like scheduling. The owners are not focused on their retail outlet.

Problem #2

Customers are not receiving their orders on time. You have an idea for improving how you deliver bakery products that will cost the bakery a lot of money up front, but could solve this major customer problem.

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Problem #3

Customers are also complaining that the bakery products do not stay fresh for long. You need an easy way to keep the bakery cool and deliver the baked goods faster to improve freshness.

Problem #4

One supplier often delivers the wrong type of flour to the bakery. You need to talk to the supplier about the problem, but know he has a hot temper and is likely to start a conflict with you.

Real Life Independent Challenge 2

Think back to the fishbone diagram in Figure 6-10. Imagine you are an employee of the tour operator, and you need to use adaptive techniques to try to increase sales.

1. Look at the categories of the issues contributing to weak sales. Choose three of the issues that you think would make the biggest contribution to the problem. For each one, research the issue on the Internet and explain your reasons for the choice.

   _____

   _____

   _____

   _____

2. There are likely several ways to tackle the issues you chose in question 1. Adaptive techniques say we should try to make incremental changes—adjusting things in logical stages that are easy to reverse if they don't work out. For each of the issues you chose, write a list of five changes you might make, in the order you would try them.

   _____

   _____

   _____

   _____

3. In pairs, imagine that one student is a manager and the other is an employee who has been called in for a performance review. Conduct the performance review,

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thinking carefully about how the manager would assess the employee's performance. What factors might be used?

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_____

_____

_____

Team Challenge

It's important to consider ethics when making decisions within an organization or workplace. Business ethics are essential, but it's also important to consider Islamic ethics in the decisions we make.

1. As a group, decide what you think are the three most important aspects of business ethics. What were your reasons for choosing them?
2. Do the aspects you chose in question 1 match with Islamic ethics? Why?
3. When doing business internationally, you may work with, sell to, or buy from businesses or individuals with different cultural backgrounds. Discuss how staying true to the three aspects you chose in question 1 will enable you to do business ethically. Will there be a conflict? Why not?

Be the Critic

Imagine a large energy company with over 500 employees. The company has a loose hierarchical organizational structure, but the staff work in open-plan rooms, often next to people who do very different work from them. Job roles are not clearly defined, meaning you might, in a single day, spend time answering phones, attending high-level meetings, opening and sorting through mail, and planning marketing campaigns. Employees are very stressed, but the current structure means that everyone knows something about every aspect of the business.

What are the positive aspects of the way the company is run? What are the negatives?

Recommend a different organizational structure for the company, explaining in detail how you would organize people, what the new organizational chart would look like, and any other changes you would make to working life. What would the advantages be to the changes you would make?

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Chapter 7

Managing Teams to Support Decisions in Organizations

Imagine you have been given an important job to do, such as developing a new sustainable and high-tech community center for your local area. You will need an effective team of people, working together on the project, to achieve the same aim. Organizations are not simply collections of individuals working to their personal preferences. Clearly, teamwork provides benefits over working independently. All organizations are made up of various individuals and groups that must work together and coordinate their activities to accomplish objectives.

Much work in organizations is interdependent, which means that individuals and departments rely on other individuals and departments for information or resources to complete their work.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Understand how to build teams to support an organization
2. Understand how to manage conflicts in organizations
3. Understand negotiation skills

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When tasks are highly interdependent, a team can be the best approach to ensuring the level of coordination, information sharing, and exchange of materials necessary for successful task accomplishment. This chapter addresses the key considerations in building a successful team, and managing teams to support decision making.

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Lesson
1
Chapter 7

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Successful Teams in Organizations

1-1 What are Teams?

A **team** is a unit of two or more people who interact and coordinate their work to accomplish a common goal to which they are committed and hold themselves mutually accountable. The definition of a team has three components. First, two or more people are required. Second, people in a team interact regularly. People who do not interact (e.g., people standing in line at a lunch counter or riding in an elevator) do not compose a team. Third, people in a team share a performance goal, whether it is to design a new smartphone, build an engine, or complete a class project.

QUICK TIP

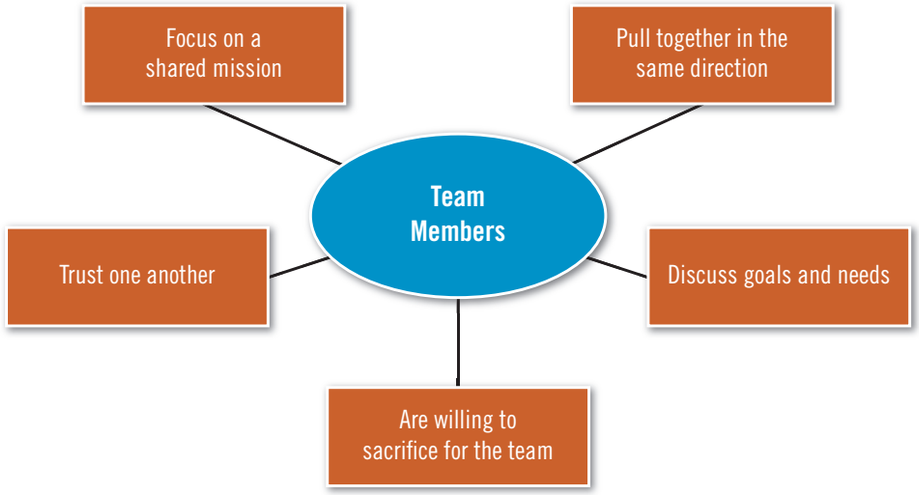
Trust is crucial in teamwork. All members must be willing to collaborate and sacrifice individual objectives for the larger goal, with confidence that others will do the same.

Putting together a *team* and building *teamwork* aren't the same thing. Figure 7-1 shows the elements of effective teamwork. Teamwork requires bringing together the right set of personalities, specialties, and skills; clearly defining roles and responsibilities; focusing everyone on a well-defined mission; establishing clear channels of communication and information sharing so that team members communicate their objectives and needs in all directions; and getting everyone to sublimate their individual egos and pull together in the same direction.

DEFINITION

Team: A unit of two or more people who interact and coordinate their work to accomplish a goal to which they are committed and hold themselves mutually accountable.

FIGURE 7-1: Requirements for effective teamwork



Effective teams in business and other organizations are those in which members trust one another and are willing to forgo their individual objectives if necessary to accomplish a shared goal.

How are these two team members working together effectively?

1-2 Contributions of Teams

Effective teams can provide many advantages, as illustrated in Figure 7-2 and as described in the following list. These contributions of teams lead to stronger competitive advantage and higher overall organizational performance.

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1. **Creativity and innovation**

   Because teams include people with diverse skills, strengths, experiences, and perspectives, they contribute to a higher level of creativity and innovation in the organization.

2. **Improved quality**

   One criterion for organizational effectiveness is whether products and services meet customer requirements for quality. Perhaps nowhere is this more essential than in healthcare. Organizations that provide the highest quality of patient care are those in which teams of closely coordinated professionals provide an integrated system of care.

3. **Speed of response**

   Tightly integrated teams can manoeuvre incredibly fast. A well-known technology company's close-knit team has changed pricing as late as 48 hours before the launch of a new product, which would be inconceivable at most companies. In addition, teams can speed product development, respond more quickly to changing customer needs, and solve cross-departmental problems more quickly.

QUICK TIP

Learn from those who inspire you. Observe other individuals in school teams you are involved with to establish the positive qualities they bring to the team as a whole.

4. **Higher productivity and lower costs**

   Effective teams can unleash enormous energy from employees. **Social facilitation** refers to the tendency for the presence of others to enhance one's performance. Simply being around others has an energizing effect. In addition, the blend of perspectives enables creative ideas to develop.

5. **Enhanced motivation and satisfaction**

   People have needs for belongingness and affiliation. Working in teams can meet these needs and create greater camaraderie across the organization. Teams also reduce boredom, increase people's feelings of dignity and self-worth, and give people a chance to develop new skills. Individuals who work in an effective team cope better with stress, enjoy their jobs more, and have a higher level of motivation and commitment to the organization.

DEFINITION

Social facilitation: The tendency for the presence of other people to influence an individual's motivation and performance.

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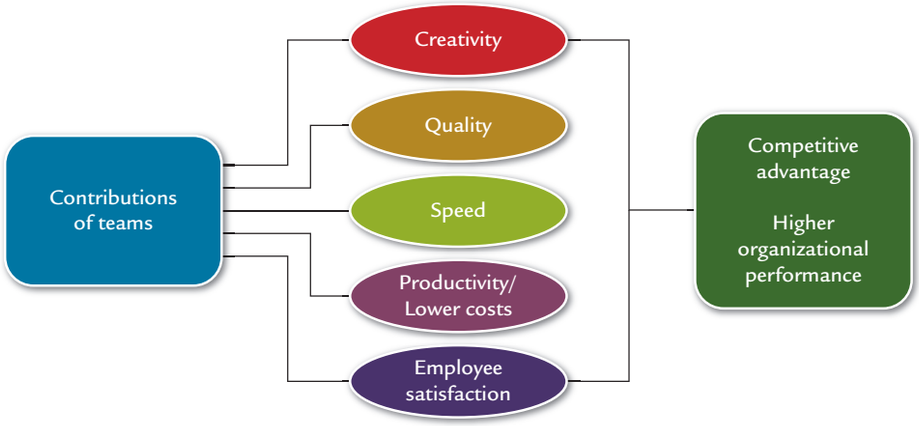
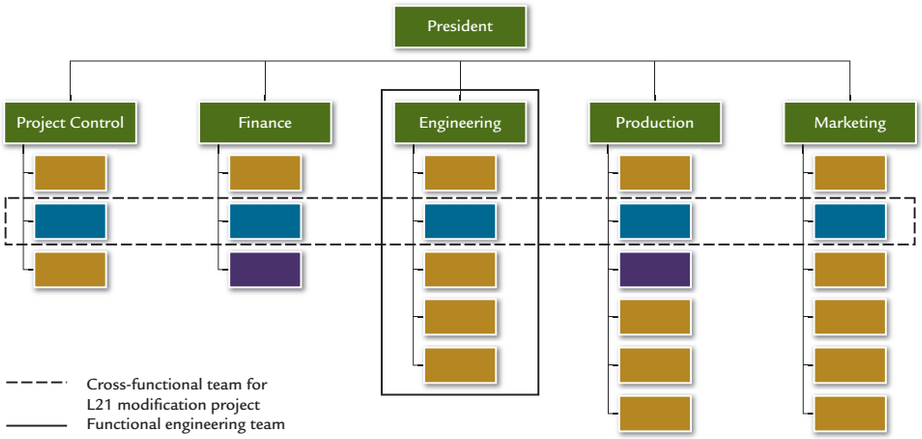
FIGURE 7-2: Five contributions teams make



1-3 Types of Teams and Virtual Teams

Organizations use many types of teams to achieve the advantages discussed in the previous section. Two common types of teams in organizations are functional and cross-functional, as illustrated in Figure 7-3. Organizations also use self-managed teams to increase employee participation.

FIGURE 7-3: Functional and cross-functional teams in an organization



1. **Functional Teams**

   A **functional team** is composed of a manager and their subordinates in the formal chain of command. Sometimes called a *command team*, the functional team in some cases may include three or four levels of hierarchy within a functional department. Typically, the team includes a single department in an organization. A financial analysis department, a quality control department, an engineering department, and a human resources department can all have functional teams. Each is created by the organization to attain specific goals through members' joint activities and interactions.

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2. Cross-Functional Teams

- A **cross-functional team** is composed of employees from about the same hierarchical level but from different areas of expertise. One type of cross-functional team is a *task force*, which is a group of employees from different departments formed to deal with a specific activity and existing only until the task is completed. For example, after one of its suppliers went out of business, an aerospace company created a task force to solve the problem of an unexpected loss of key parts needed to keep the aircraft assembly going.

QUICK TIP

One use of special-purpose teams is for developing new products or services. You might need to assemble such a team if you ever start and grow your own business.

- Another type of cross-functional team, the **special-purpose team**, is created outside the formal organization structure to undertake a project of special importance or creativity. Sometimes called a *project team*, a special-purpose team is still part of the formal organization structure, but members perceive themselves as a separate entity. Companies are increasingly using special-purpose teams, bringing people together for large, complex projects that require many people with complementary skills. Rather than having defined, long-term jobs, employees apply their skills and abilities in short-term, project-based teams.

DEFINITIONS

Functional team: A team composed of a manager and his or her subordinates in the formal chain of command.

Cross-functional team: A team made up of employees from about the same hierarchical level, but from different areas of expertise.

Special-purpose team: A team created outside the formal structure to undertake a project of special importance, such as developing a new product.

QUICK TIP

Self-managed teams typically consist of 5 to 20 multiskilled workers who have the autonomy to perform a range of tasks.

3. Self-Managed Teams

The third common type of team used in organizations is designed to increase the participation of workers in decision making and conducting their jobs, with the goal of improving performance. In **self-managed teams**, multiskilled workers rotate jobs to produce an entire product or service or at least one complete aspect of a product or service (e.g., engine assembly or insurance claim processing).

A self-managed team is a permanent team that typically includes the following elements:

- The team includes employees with several skills and functions, and its combined skills are sufficient to perform a major organizational task. For example, in a manufacturing plant, a team may include members from the foundry, machining, grinding, fabrication, and sales departments with members cross-trained to perform one another's jobs. The team eliminates barriers among departments, enabling excellent coordination to produce a product or service.
- The team is given access to the resources, such as information, equipment, machinery, and supplies needed to perform the complete task.
- The team is empowered with decision-making authority, which means that members have the freedom to select new members, solve problems, spend money, monitor results, and plan for the future. Self-managed teams can enable employees to feel challenged, find their work meaningful, and develop a stronger sense of identity with the organization.

Virtual Teams

An exciting new approach to teamwork has resulted from advances in IT, shifting employee expectations, and the globalization of business. A **virtual team** is a group made up of geographically or organizationally dispersed members who are linked primarily through advanced information and telecommunications technologies. A virtual team can be local, national, or global with members coming from one firm or many.

According to recent surveys, nearly half of all organizations use virtual teams, and about 80% of responding employees say they have worked in a virtual team at some time. Most managers expect that the use of virtual teams will continue to grow. In a virtual team, members use groupware, e-mail, instant messaging, telephone and text messaging, wikis and blogs, videoconferencing, and other technology tools to collaborate and perform their work, although they also might meet face to face at times. Although some virtual teams are made up of only organizational members, virtual teams often include contingent workers, members of partner organizations, customers, suppliers, consultants, or other outsiders. Many virtual teams are also global teams. A **global team** is a cross-border team made up of members of different nationalities whose activities span multiple countries.

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One of the primary advantages of virtual teams is the ability to assemble the most talented group of people to complete a complex project, solve a particular problem, or exploit a specific strategic opportunity. The diverse mix of people can fuel creativity and innovation.

QUICK TIP

On a practical level, organizations can save employees time and cut travel expenses when people meet in a virtual rather than physical space.

DEFINITIONS

Self-managed team: A team consisting of multiskilled employees who rotate jobs to produce an entire product or service, often led by an elected team member.

Virtual team: A team made up of members who are geographically or organizationally dispersed, rarely meet face to face, and interact to accomplish their work primarily using advanced information and telecommunications technologies.

Global team: A group made up of employees who come from, and whose activities span, multiple countries.

What type of team is this employee working in?

1-4 Team Characteristics

Team characteristics of particular concern are size and diversity.

1. **Size**

   One investigation of team size based on data from 58 software development teams found that the best-performing teams ranged in size from three to six members. Teams need to be large enough to incorporate the diverse skills needed to complete a task, enable members to express good and bad feelings, and proactively solve problems. However, they also should be small enough to permit members to feel like an intimate part of the team and to communicate effectively and efficiently.

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2. **Diversity**

Because teams require a variety of skills, knowledge, and experience, it seems likely that **heterogeneous teams** (those that are diverse) would be more effective than **homogeneous teams** (those that are made up of the same types of skills, knowledge, experience, or social backgrounds). In general, research supports this idea, showing that diverse teams produce more innovative solutions to problems. In addition, diversity may contribute to a healthy level of disagreement that leads to better decision making.

QUICK TIP

Diversity, in terms of functional area and skills, thinking styles, and personal characteristics is often a source of creativity.

Research studies have confirmed that both functional diversity and demographic diversity can have a positive impact on work team performance. For example, recent research suggests that gender diversity leads to better performance. Ethnic, national, and racial diversity can sometimes hinder team interaction and performance in the short term, but with effective leadership, these problems fade over time.

DEFINITIONS

Heterogeneous team: A diverse team made up of members with a variety of skills, knowledge, experience, and social backgrounds.

Homogeneous team: A team made up of people with the same types of skills, knowledge, experience, and social backgrounds.

1-5 Team Decision-Making Methods

A range of methods can be utilized to aid decision making in teams.

1. **Brainstorming**

Brainstorming uses a face-to-face interactive group to spontaneously suggest as many ideas as possible for solving a problem. Brainstorming has been found to be highly effective for quickly generating a wide range of alternatives, but it does have some drawbacks. For one thing, people in a group often want to conform to what others are saying. Others may be concerned about pleasing the boss or impressing colleagues. In addition, many creative people simply have social inhibitions that limit their participation or make it difficult to come up with ideas in a group setting. In fact, one study found that when four people are asked to "brainstorm" individually, they typically come up with twice as many ideas as a group of four brainstorming together.

2. **Electronic Brainstorming**

One recent approach, **electronic brainstorming**, takes advantage of the group approach while overcoming some disadvantages. Electronic brain-

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storming brings people together in an interactive group over a computer network. One member writes an idea, another reads it and adds other ideas, and so on. Studies show that electronic brainstorming generates about 40% more ideas than individuals brainstorming alone, and 25 to 200% more ideas than regular brainstorming groups, depending on group size. Because the approach is anonymous, it avoids possible social inhibitions, so more people actively participate. Electronic brainstorming also allows people to write down their ideas immediately, thus avoiding the possibility that a good idea might slip away while the person is waiting for a chance to speak in a face-to-face group. Another advantage is that electronic brainstorming can be done with groups made up of employees from around the world, which further increases the diversity of alternatives.

3. **The Nominal Group Technique (NGT)**

   As noted, brainstorming has its share of critics. Some say it prevents quiet people from participating, and that a group can be too easily influenced by the ideas of some of the dominant players. In response, a number of brainstorming alternatives have been developed. The **nominal group technique (NGT)** is another approach to brainstorming that seeks to address its limitations through a structured process. Group members are asked to write down their ideas independently, rather than airing them in a group discussion. Ideas are then evaluated, prioritized (ranked), and selected through a vote. There is a focus on identifying the problem, generating solutions and then ultimately making the decision. It is regarded as a way of ensuring that everyone participates in generating ideas and quick decisions are made through voting.

QUICK TIP

The Delphi method can be adapted to non-anonymous groups in organizational settings.

4. **The Delphi method**

   Another approach is the **Delphi method**, in which a panel of experts express their views and possible solutions to a problem through a facilitator. The facilitator collates and moderates the contributions which are fed back to the panel for another stage (or round) of evaluation, until a consensus is reached. In some instances, multiple rounds are carried out until the solution is established and refined. Throughout the process, opinions and ideas are expressed anonymously, to prevent bias or a dominant personality or viewpoint from influencing others.

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DEFINITIONS

Brainstorming: A creativity tool for generating ideas and alternatives. A brainstorming session usually starts by defining a problem, and then listing possible solutions as they occur to you, whether they are obvious, impractical, or far-fetched. The goal is quantity, not quality.

Electronic brainstorming: A technique that brings people together in an interactive group over a computer network rather than meeting face to face.

Nominal Group Technique (NGT): A structured approach to brainstorming, in which all participate in generating ideas which are ranked and voted on to reach a quick decision.

Delphi method: A structured technique involving stages of individual input from members of an expert group, followed by evaluation, then more individual input based on this evaluation, until a resolution is reached.

Fun and games get serious

One of Saudi Vision 2030's aims is the development of innovative and state-of-the-art technologies within the Kingdom. This includes 3D virtual worlds that let users interact with one another online. Most of these applications started as games. The gaming industry is one of the fastest growing industries worldwide, attracting many new start-ups as well as established companies. Several technology companies have introduced virtual world applications for business teams. Virtual worlds are especially suited to training for emergencies and immersive team-building exercises. In a virtual world, you can simulate a disaster such as a hurricane or flood, and then record the responses. An entire company can learn from the simulated event and from their mistakes, which don't have real consequences in a virtual world.

YOU TRY IT

In a group of students from your class, try the different approaches to idea generation and decision making through brainstorming, electronic brainstorming, Nominal Group Technique, and the Delphi method. Explain which method you found was the most effective, giving reasons for your answer.

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REVIEW QUESTIONS

1. **Which of the following is a team created outside the formal structure to undertake a project of particular importance, such as developing a new product?**
   a. a self-managed team
   b. a cross-functional team
   c. a global team
   d. a special purpose team
2. **A cross-border team made up of members of different nationalities whose activities span multiple countries is known as a:**
   a. local team
   b. global team
   c. regional team
   d. national team

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Chapter 7

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Managing Team Conflict

The final characteristic of the team process is conflict. It can arise among members within a team or between one team and another. **Conflict** refers to an antagonistic interaction in which one party attempts to block the intentions or goals of another. Whenever people work together in teams, some conflict is inevitable. Bringing conflicts into the open and effectively resolving them is one of the team leader's most challenging yet most important jobs. Effective conflict management has a positive impact on team cohesiveness and performance.

DEFINITION

Conflict: An antagonistic interaction in which one party attempts to block the intentions or goals of another.

2-1 Types of Conflict

Two basic types of conflict that occur in teams are task conflict and relationship conflict.

QUICK TIP

In general, research suggests that task conflict can be beneficial because it leads to better decision making and problem solving.

1. Task Conflict

   Task conflict refers to disagreements among people about the goals to be achieved or the content of the tasks to be performed. Two shop supervisors might disagree over whether to replace a valve or let it run despite the unusual noise that it is making. Alternatively, two members of a top management team might disagree about whether to acquire a company or enter into a joint venture as a way to expand globally.

2. Relationship Conflict

   Relationship conflict refers to interpersonal incompatibility that creates tension and personal animosity among people. For example, in one team at a company that manufactures and sells upscale children's furniture, team members found their differing perspectives and working styles to be a significant source of conflict during crunch times. Relationship conflict is typically associated with negative consequences for team effectiveness.

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DEFINITIONS

Task conflict: Conflict that results from disagreements about the goals to be achieved or the content of the tasks to be performed.

Relationship conflict: Conflict that results from interpersonal incompatibility that creates tension and personal animosity among people.

How can these two employees manage conflict effectively?

2-2 Causes of Conflict

Several factors can lead to conflict. One of the primary causes is competition over resources, such as money, information, or supplies. When individuals or teams must compete for scarce or declining resources, conflict is almost inevitable. In addition, conflict often occurs simply because people are pursuing differing goals. Goal differences are natural in organizations.

Targets of individual salespeople may put them in conflict with one another or with the sales manager. Moreover, the sales department's goals might conflict with those of manufacturing, and so forth.

QUICK TIP

Be aware that the lack of nonverbal cues in virtual interactions can lead to more misunderstandings.

Conflict may also arise from communication breakdowns. Poor communication can occur in any team, but virtual and global teams are particularly prone to communication breakdowns. Trust issues can be a major source of conflict in virtual teams if members feel that they are being left out of important communication interactions.

2-3 Styles of Handling Conflict

Teams, as well as individuals, develop specific styles for dealing with conflict based on the desire to satisfy their own concern versus the other party's concern.

A model that describes five styles of handling conflict is shown in Figure 7-4. The two major dimensions are the extent to which an individual is assertive versus unassertive and cooperative versus uncooperative in their approach to conflict:

1. **Dominating style**
   The *dominating style* (my way) reflects assertiveness to get one's own way and should be used when quick, decisive action is vital on important issues or unpopular actions, such as during emergencies or urgent cost-cutting requirements.
2. **Compromising style**
   The *compromising style* (halfway) reflects a moderate amount of both assertiveness and cooperativeness. It is appropriate when the goals on both sides are equally important, when opponents have equal power and both sides want to split the difference, or when people need to arrive at temporary or expedient solutions under time pressure.
3. **Accommodating style**
   The *accommodating style* (your way) reflects a high degree of cooperativeness, which works best when people realize that they are wrong, when an issue is more important to others than to oneself, when building social credits for use in later discussions, and when maintaining harmony is especially important.
4. **Collaborating style**
   The *collaborating style* (our way) reflects a high degree of both assertiveness and cooperativeness. The collaborating style enables both parties to win, although it may require substantial bargaining and negotiation. The collaborating style is important when both sets of concerns are too important to be compromised, when insights from different people need to be merged into an overall solution, and when the commitment of both sides is needed for a consensus.
5. **Avoiding style**
   The *avoiding style* (no way) reflects neither assertiveness nor cooperativeness. It is appropriate when an issue is trivial, when there is no chance of winning, when a delay to gather more information is needed, or when a disruption would be costly.

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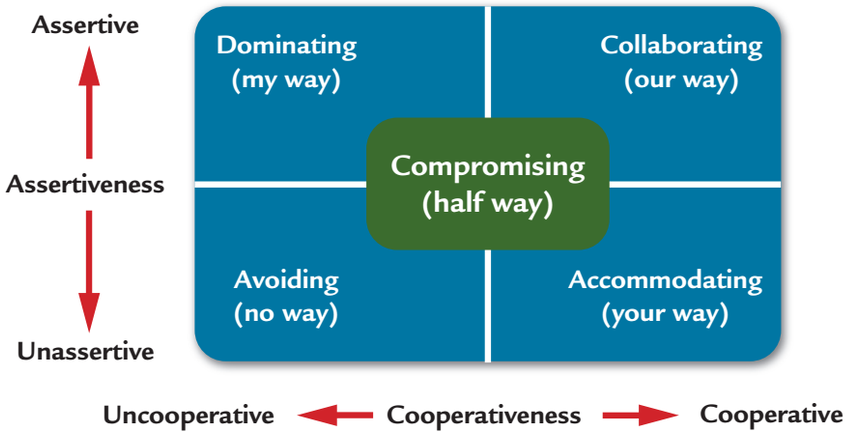
FIGURE 7-4: A model of styles for handling conflict



YOU TRY IT

Imagine a situation in your life when conflict has arisen among your friends. Perhaps you wanted to play a different game or disagreed over how best to solve a particular problem. Consider each of the five styles for handling conflict described in this lesson and see how they could have been applied to solving the problem. Explain which method you think would have been most effective and why.

REVIEW QUESTIONS

1. **Which of the following is *not* one of the key causes of conflict?**
   - **a.** people pursuing different goals
   - **b.** competition over resources
   - **c.** communication breakdowns
   - **d.** team members sharing unified goals
2. **A style for handling conflict that reflects a high degree of cooperativeness is known as:**
   - **a.** avoiding style
   - **b.** compromising style
   - **c.** dominating style
   - **d.** collaborating style

Lesson
3
Chapter 7

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Negotiation

One distinctive type of conflict management is **negotiation**, whereby people engage in give-and-take discussions and consider various alternatives to reach a joint decision that is acceptable to both parties. Negotiation is used when a conflict is formalized, such as between a business and its customers.

DEFINITION

Negotiation: A conflict management strategy whereby people engage in give-and-take discussions and consider various alternatives to reach a joint decision that is acceptable to both parties.

3-1 Types of Negotiation

Conflicting parties may embark on negotiation from different perspectives and with different intentions, reflecting either an integrative approach or a distributive approach.

1. Integrative Negotiation

   Integrative negotiation is based on a win-win assumption in that all parties want to come up with a creative solution that can benefit both sides. Rather than viewing the conflict as a win-lose situation, people look at the issues from multiple angles, consider trade-offs, and try to "expand the pie" rather than divide it. With integrative negotiation, conflicts are managed through cooperation and compromise, which fosters trust and positive long-term relationships.

2. Distributive Negotiation

   Distributive negotiation, on the other hand, assumes that the size of the "pie" is fixed, and each party attempts to get as much of it as possible. One side wants to win, which means the other side must lose. With this win-lose approach, distributive negotiation is competitive and adversarial.

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Which style of negotiation will these employees use?

DEFINITIONS

Integrative negotiation: A collaborative approach, whereby the parties want to come up with a creative solution that benefits both sides of the conflict.

Distributive negotiation: A competitive and adversarial approach in which each party strives to get as much as it can, usually at the expense of the other party.

3-2 Rules for Reaching a Win-Win Solution

Achieving a win-win solution through integrative negotiation is based on four key strategies:

1. **Separate the people from the problem**

   For successful integrative negotiation, people stay focused on the problem and the source of conflict rather than attacking or attempting to discredit each other.

QUICK TIP

Remember that demands create yes-or-no obstacles to effective negotiation, whereas interests present problems that can be solved creatively.

2. **Focus on underlying interests, not current demands**

   Demands are what each person wants from the negotiation whereas underlying interests represent the "why" behind the demands. Consider two sisters arguing over the last orange in the fruit bowl. Each insists that she should get the orange and refuses to give up (demands). If one sister had asked the other why she wanted the orange, the sisters would have discovered that one wanted to eat it, and the other wanted the peel to use for a project (interests). By focusing on interests, the sisters would have been able to arrive at a solution that gave each what she wanted.

QUICK TIP

Rather than taking the attitude of "that's your problem", adopt the opposing party's problem as your own and try to come up with a solution to help get closer to an agreement.

3. **Listen and ask questions**

   A good strategy for most negotiations is to listen and ask questions. You can learn more about your opponent's position, constraints, and needs by being quiet or asking questions. Smart negotiators want to learn the other side's constraints so that they can help overcome them.

4. **Insist that results be based on objective standards**

   Each party in a negotiation has its own interests and naturally would like to maximize its outcomes. Successful negotiation requires focusing on objective criteria and maintaining standards of fairness rather than using subjective judgments about the best solution.

Teamwork and Negotiation to Enact Saudi Vision 2030

Of all the factors that are essential in successfully enacting the objectives of Saudi Vision 2030, perhaps one of the most important is teamwork. Many novel and ambitious initiatives have been founded in response to Saudi Vision 2030, and a wide array of new teams have been created, tasked with meeting this challenge. These teams represent a range of different sizes and incorporate members from diverse groups and backgrounds, including Saudi citizens and consultants from across the globe. Clearly, with so many interested parties involved, each with their unique priorities to consider, strong teamwork and solid negotiating skills will prove critical to ensure the smooth running of operations. As you get older and graduate from school and college, you will become an increasingly important part of the Saudi Vision 2030 plans, too. Throughout your business career, you are likely to encounter the various challenges outlined in this chapter. Learning the four rules for reaching a win-win solution will hold you in good stead for playing an effective role in negotiations, managing conflict, and building successful teams.

YOU TRY IT

Consider the following situation that requires negotiation in order to settle a dispute in the workplace. Due to an impending deadline to launch a new product, your employer wants you to work additional hours without compensation. Your contract renewal is due soon.

What would you do to resolve the conflict? Describe how each of the four strategies to create a win-win solution could be applied to this scenario.

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REVIEW QUESTIONS

1. **In which negotiation strategy does each party strive to get as much as it can, usually at the expense of the other party?**
   a. Integrative negotiation
   b. Combative negotiation
   c. Distributive negotiation
   d. Comparative negotiation
2. **Which of the following is *not* a key strategy for reaching a win-win situation?**
   a. Focusing on underlying interests
   b. Separating people from the problem
   c. Listening and asking questions
   d. Overpowering people you don't agree with

Technology @ Work: Miro: The Visual Collaboration Platform for Teams

Many new online collaborative workspaces are now available worldwide, which allow individuals working remotely in different locations to come together as virtual teams. Among others, these include Miro, Trello, and Slack, which are free to use on a basic plan, with various paid plans available to access the more sophisticated tools.

One of the key benefits of online workspaces is the ability to easily collaborate with anyone, anywhere, regardless of location, from Riyadh to Dammam, to other international locations across the globe. Another benefit is the way in which information can be organized and presented visually in an easily accessible format. Rather than scrolling through endless emails or presentation slides, projects can be grouped, categorized, and illustrated more accessibly.

Relatedly, online workspaces offer greater interactivity and customization, allowing teams to collaborate more fluidly through adding comments, assigning tasks, and allowing multiple users to edit features of the workspace. Online workspaces often integrate with other software applications, such as word processors, spreadsheets, calendars, and cloud storage. Miro, which has 35 million users worldwide, refers to its online workspace as a "whiteboard".

1. **Visit the Miro homepage**
   Open your Web browser and go to www.miro.com and watch the video demo.
2. **Set up an account**
   On the main homepage, click the "Sign up free" button, then follow the instructions to set up a username and password. The basic plan allows three editable whiteboards and unlimited team members.
3. **Create a whiteboard**
   Now you can create your first whiteboard! A range of existing templates can be used to get started, which can be customized.

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4. **Invite other teammates to collaborate**

   While whiteboards can be useful for individuals working independently, to organize their work and help to visualize ideas, they are intended to be most effective for team collaboration. Invite your classmates and practice using the tools.

YOU TRY IT

Practice using Miro. Imagine that your classmates are organizing an event to showcase projects at the end of the semester. Set up an account and a workspace with your classmates to organize the event, using the online whiteboard collaboration tool to capture your ideas.

REVIEW QUESTIONS

1. **Which of the following is *not* a benefit of online workspaces?**
   - **a.** Easy to collaborate with people across the globe
   - **b.** Genuine face-to-face interaction in the real world
   - **c.** Interactivity and customization of workspaces
   - **d.** Highly visual and accessible format
2. **Miro's online workspace is known as a:**
   - **a.** notepad
   - **b.** whiteboard
   - **c.** blank canvas
   - **d.** think hub

Technology @ Work: Internet Monitoring

To learn more about their customers, many companies monitor the Internet for activities and comments related to their products and services. To do so, they use tools such as Google Alerts, as shown in Figures 7-5 and 7-6. Other Internet monitoring tools work in a similar way, such as Mentionmapp, which monitors Twitter comments and trends; Social Mention, which monitors social networking sites; and Brand24, which is designed for businesses. If you work in sales, marketing, or customer service, you can set up keywords or topics you want Google Alerts to track, such as the name of your product or company. Google Alerts then monitors the entire Web and sends the results of what it finds to you by e-mail. The results are links to locations such as Web pages, blogs, online articles, videos, and reviews, that mention your company. If customers comment on your products, you can contact them to show appreciation or offer to solve their problem. This proactive approach is proving popular with consumers, who are often frustrated when trying to contact customer service representatives in large companies.

1. **Visit the Google Alerts homepage**
   Open your Web browser and go to www.google.com/alerts. Enter one or more keywords for the alert you want to set up. For example, to track Web content that mentions your company, enter your company's name.
2. **Select the type of alert you want to receive**
   You can choose one of six types of alerts: Everything, which tracks news articles, Web sites, and blogs; News, which tracks the latest news articles; Blogs, which tracks the latest blog posts; Video, which monitors the latest online videos; Discussion, which tracks discussions in Google Groups; and Books, which tracks content in Google Books.
3. **Select a frequency**
   Choose how often you want to receive the alerts. You can receive them as soon as Google Alerts finds a match to your keyword, once a day, or once a week.
4. **Provide an e-mail address**
   Enter the e-mail address where you would like to receive the Google Alerts.
5. **Finish creating the alert**
   Click the Create Alert button, shown in Figure 7-5. Google Alerts will verify

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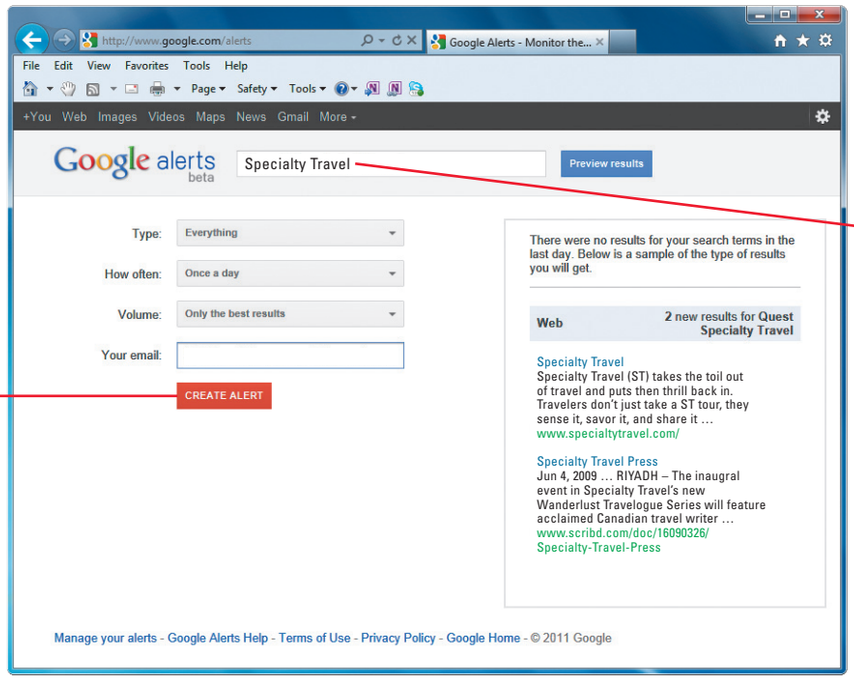
your e-mail address and then send you updated alerts according to the frequency you selected.

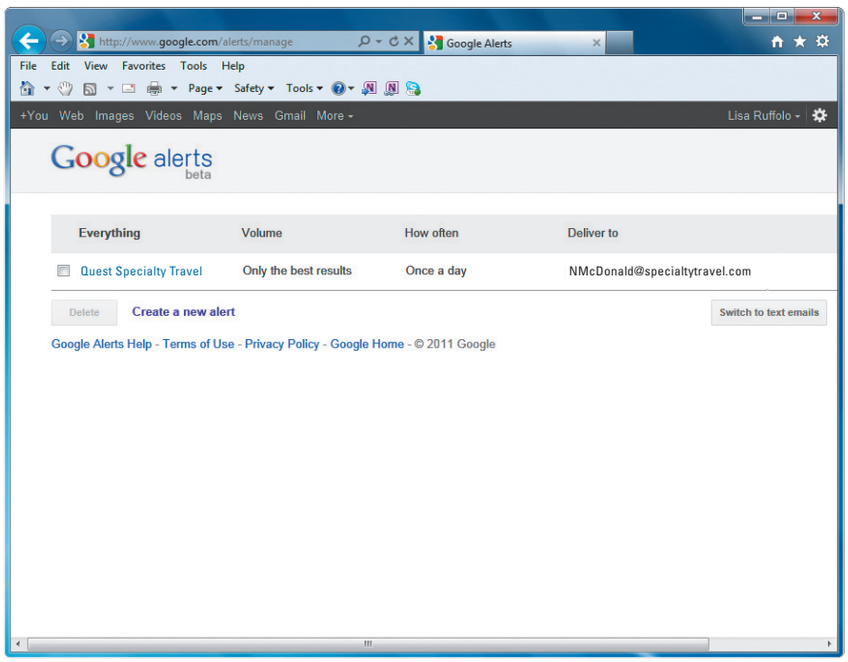
FIGURE 7-5: Setting up Google Alerts



6. **Manage your alerts**

   Revise your alert settings on the Manage Alerts page, shown in Figure 7-6, if you are receiving too much or too little information.

FIGURE 7-6: Managing Google Alerts



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YOU TRY IT

Practice setting up Google Alerts. Open a Web browser and go to https://www.google.com/alerts. Set up a new alert to track Web activity about a company you'd like to work for. In your notebook, write the name of the company you are tracking with a Google alert. Then copy the text of the e-mail you received about your first set of alerts.

REVIEW QUESTIONS

1. **Why do companies use Internet monitoring tools?**
   - **a.** To prevent employees from using the Web.
   - **b.** To learn how to listen actively.
   - **c.** To learn more about their customers.
   - **d.** To learn how to search the Web.
2. **Which of the following alerts does Google Alerts *not* offer?**
   - **a.** blogs
   - **b.** news
   - **c.** weather
   - **d.** video

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Extra Practice

Critical Thinking Questions

1. Imagine yourself as a potential member of a team responsible for designing a new package for a popular brand of Arabian dates. Do you think interpersonal skills would be equally important if the team is organized as a face-to-face versus a virtual team? Why or why not? Might different types of interpersonal skills be required for the two types of teams? Be specific.

2. Not all teams are effective, and many can fail to complete their assigned tasks. List some things you think can make a team ineffective.

3. Think about the most cohesive group or team you have been a part of. How did it feel to be part of that team? How much time did you spend with other members? What was it about that group that made it cohesive?

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Real Life Independent Challenge

To be a more effective team member, analyze the groups you belong to and how you participate in them by answering the following questions:

1. Which groups do you belong to? List as many as possible, including groups such as your family, classes, clubs, sports teams, and social organizations.

_____

_____

_____

_____

2. Which group has changed the most over time? Describe the changes.

_____

_____

_____

_____

3. Have any of these groups evolved into a team? If so, describe this process. If not, explain why it has not developed into a team.

_____

_____

_____

_____

4. Which group has influenced you the most? Describe how the group influences you.

_____

_____

_____

_____

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Team Challenge One

You are working for an interior design company in Dammam. The company specializes in creating contemporary furnishings for business and residential customers. You are the newest employee and are working as an assistant office manager. The owner of the company wants all the employees to work together as a team. During each weekly staff meeting, he wants to spend some time doing team-building exercises. For your first meeting, the owner has planned a warm-up exercise designed to build common bonds.

1. Working with your group, introduce yourself to each person in the group.

_____

_____

_____

_____

2. Mention one place you've visited recently that you enjoyed. This can be a city, area of your town, building, or somewhere that is some distance away. In a sentence or two, explain what you enjoyed about this place.

_____

_____

_____

_____

3. Next, identify a person you admire. This can be someone everyone knows or a personal acquaintance. (For personal acquaintances, use first names only.)

_____

_____

_____

_____

4. After all of the introductions, mention one thing you have in common with each person in the group.

_____

_____

_____

_____

Team Challenge Two

This and That: Best Team/Worst Team

Think of two teams of which you were a member—the best and the worst in terms of personal satisfaction and team performance. These teams could come from any area in your experience—for example, athletic team, student club, class team, work team, or project team. List here the specific behaviors of the teams that made them the best and the worst for you.

Best team behaviors:

_____

_____

Worst team behaviors:

_____

_____

In class:

- Sit in a small group of three to five students. Each student should tell the brief story of his or her best and worst team experiences.
- After all the stories are heard, one team member writes on a flipchart (or blackboard/whiteboard) two headings—"More of This" and "Less of That". Under "More of This", write team member suggestions for positive behaviors that make for effective teamwork. Under "Less of That", write team member suggestions for negative behaviors that prevent effective teamwork.

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- After brainstorming items, each group condenses each list to five key behaviors that the group considers most important.
- After the lists are finalized, students can walk around the classroom and review all lists.
- Discuss answers to the following questions, either in your group or as a class.

1. What are the most important behaviors for "More of This" and for "Less of That"?

_____

_____

2. What factors influence the presence of "More of This" or "Less of That" behaviors on a team?

_____

_____

3. What personal changes would you need to make as a team member to demonstrate "More of This"?

_____

_____

4. What personal changes would you need to make as a team member to demonstrate "Less of That"?

_____

_____

5. How might a team leader be able to attain "More of This" on a team and "Less of That"?

_____

_____

Be the Critic

You have been working for a midsized hotel in Riyadh for a few months. The hotel owner has four other locations in other Saudi Arabian cities: Jeddah, Dammam, Medina and Abha. The manager of your hotel, Waleed, has been trying to create an effective team of 20 employees from the four other hotels. So far, the team has met once in person. Figure 7-7 below lists the activities the team performed at the meeting. Analyze these activities, and then create a list of their strengths and weaknesses.

FIGURE 7-7

Waleed assigned five people from each hotel to be on the team. He chose people all of the same gender and from the same social background, with similar skill sets, as he believes this will create a better team.

↓

Waleed said he would be the team leader. However, he chose all the people on the team from top management positions from the other hotels, to ensure he had the best people on board.

↓

Waleed assigned each person to a particular role on the team:
Scheduler
Assistant to Waleed
Special events coordinator
Secretary
Customer go-between
To appear fair, he selected those roles randomly, by picking names out of a hat. Everyone else would be a support person.

↓

The first task for the team is to address the top 10 complaints from customers.

↓

Waleed said he has an urgent deadline—the task must be complete by next week for a confidential reason that he hasn't shared with the team.

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Chapter 8

Organizational Communication and Decision Making

There are many different ways of communicating information within organizations and businesses. Some communications are written and others are spoken. There are many factors to consider when deciding whether to use written or verbal communication, such as how detailed the information is, what the purpose of the information is and to whom the information is being passed on to. In this chapter, you will be introduced to different methods of communication used in business settings.

Effective communication is a skill that is learned and developed through practice and understanding the effects of different mediums of communication.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Classify organizational communication
2. Explain the channels used in an open communications climate
3. Understand the workplace communication elements
4. Understand the role of effective meetings
5. Develop reports and proposals for business purposes

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Sultan is the manager of a company that creates advertising campaigns. He has had a lot of experience seeing what can happen when problems and issues are not discussed openly. He has a weekly meeting with all of the employees within the business where any issues that have been raised are discussed. Sultan knows that most people are not willing to speak in a large group about problems, therefore he sends a companywide e-mail message with an anonymous question and answer board where employees are encouraged to post anything they think is important to discuss. This means that all employees feel confident about sharing their problems which can be discussed without anyone knowing who raised a particular issue. By using a variety of written and verbal communication tools, Sultan is able to ensure effective organizational communication and decision making throughout the business which benefits the business as a whole.

Communication is not always a one-way process—information can flow from the top to the bottom or from the bottom to the top. Information can also flow sideways, at the same hierarchical level. It is important to choose the most appropriate method of communication to match the needs of the recipient. People often craft communications to managers using different language and styles than when communicating with colleagues.

In this chapter, we will explore different methods of communication and different communication tools to support organizational communication. There will be illustrations integrated into the examples within this chapter to aid understanding of the various methods. Definition boxes will also introduce and explain key terminology, with quick tips to highlight key areas and information.

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Lesson
1
Chapter 8

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Organizational Communication

1-1 Understanding Communication

Many of us think of spoken or written language when we think about communication, but words are only a small part of human **communication**. Managers are observed carefully by employees, so it's important to remember that everything a manager does and says will communicate something. In addition, communication is a two-way street that includes asking questions, seeking feedback, paying attention to nonverbal communication of others, and listening actively.

DEFINITION

Communication: The process by which information is exchanged and understood by two or more people, usually with the intent to influence or motivate behavior.

Organizational communication is broadly defined as all types of communications that enable companies, businesses, government agencies, corporations, or nonprofits to connect and communicate within the organization as well as with external stakeholders. Such communication is a bit different from the informal personal communication we engage in every day with family and friends.

QUICK TIP

If your main idea is especially important, also conclude your message with it.

Keep in mind that communication is successful only when the speaker and listener understand each other. Because the average person is exposed to thousands of **messages** every day, your message must stand out to catch your listener's attention.

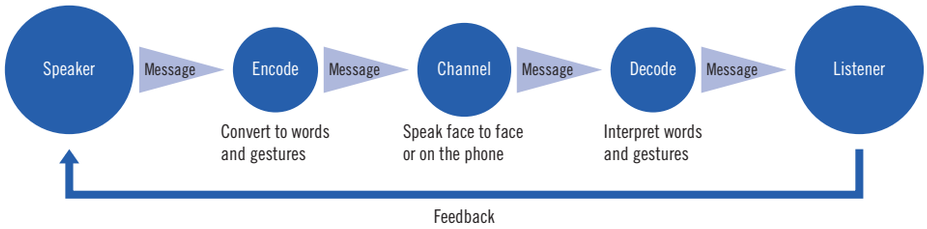
DEFINITION

Message: The information sent from one person to another by the use of speech, writing, actions, or symbols. A message is the content of the communication process.

1-2 The Communication Process

Figure 8-1 outlines the spoken communication process.

FIGURE 8-1: The spoken communication process



There is a sequence of steps that are needed when communicating a message. The spoken communication process shown in Figure 8-1 demonstrates how a message moves from the speaker to the listener.

The process is described below.

1. **The speaker**

   The person sending a message (the speaker) must understand the purpose of the message and predict how it is likely to be received by the listener.

2. **Encoding the message**

   The speaker must choose the most appropriate method of communication when **encoding** the message to ensure it is received in the manner expected. Words or **symbols** can be used.

DEFINITIONS

Encoding: Selecting symbols with which to compose a message and selecting a communication channel.

Symbol: An object, act, or event that conveys meaning to others.

3. **Choosing a channel**

   The message moves from the speaker to the listener by means of the most appropriate **channel**. The choice of channel depends on many factors, such as the message being sent, the relationship between the speaker and the listener, and the level of detail involved in the message. Selecting an appropriate communication channel keeps information flowing effectively.

DEFINITION

Channel: The medium by which a message is sent, such as a phone call, blog, or text message.

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4. **Decoding the message**

   After receiving the message, the listener must be able to interpret, or **decode**, its meaning. Effective communicators organize their messages so they are clear, logical, and easy for the listener to understand.

DEFINITION

Decode: To interpret a message and understand it.

5. **Feedback**

   Once the message has been received by the listener, the listener then has the opportunity to provide **feedback** to the original speaker by reversing the roles and the process. This feedback allows the original sender the opportunity to analyze the effect of the message and evaluate the effectiveness of the message. As shown in Figure 8-1, effective communication is cyclical. The sender and receiver may exchange messages several times to make sure there is a clear understanding of the message.

DEFINITION

Feedback: The response of the reader to the sender's communication with a return message.

1-3 Details to Consider When Planning Messages

It is important to develop communication skills to ensure that you are able to understand:

1. who you are communicating with
2. what information needs to be transferred in the message
3. the most appropriate communication channel.

Effective communicators organize their messages so they are clear, logical, and easy for the listener to understand. Some messages are appropriate for spoken communication, while others are more suited to written communication (see Table 8-1). Mastering communication skills helps when making organizational decisions, as a clear message from a manager can make sure that employees know what is expected and what the employee has to do to reach the organizational objective.

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Keep the following details in mind to help organize your messages and clarify their meaning:

1. **Start with what your listener needs to know**
   Your listener is most likely to remember the first and last parts of your message. Before you speak with someone, identify the purpose of your discussion (e.g., to inform or to persuade)—the purpose becomes your main idea. Start the conversation with what your listener needs to know, then move to the supporting information, such as the instructions or key elements required.

2. **Limit the amount of information**
   People do not always listen to and remember a complete message, especially if they are distracted by noisy surroundings, interruptions, or other communication obstacles. Putting too much information into a conversation can leave your listeners confused or remembering only part of what you said. Limit the amount of information you share in one message. In a one-on-one conversation, for example, express one main idea and up to three supporting ideas. If you need to share more information, have more than one discussion.

3. **Eliminate unnecessary words**
   It can be harder to understand spoken words than written ones. When you use complicated language or unnecessary words, you make it difficult for your listener to interpret what you are saying. Use simple sentences and avoid technical language and **jargon** whenever possible.

   DEFINITION

   Jargon: The special words or expressions used by a profession or group that are difficult for others to understand.

4. **Make your messages relevant to your listener**
   Although it is natural to discuss what you think is important, if your listener does not agree, they might not understand the importance of the message. Structure your messages so they are relevant to your listeners. Understand their point of view, then explain or show how your subject is beneficial to them.

5. **Take a direct approach**
   Your listeners may have to manage several tasks as they listen to you. They must pay attention to what you are saying, interpret your nonverbal signals

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(if face to face), ignore noise and other distractions, and understand incoming information. To help your listeners, take a direct approach by introducing your subject, explaining what you want, and identifying your expectations. Be polite, but don't make your audience guess what you mean.

TABLE 8-1: Appropriate uses for spoken communication

you want to:	use spoken	use written
Receive an immediate answer	✓	
Congratulate a colleague	✓	
Be sure your audience interprets your message correctly	✓	
Negotiate with others to build a consensus	✓	
Minimize misunderstandings when providing information	✓	
Allow your audience to ask questions to clarify information	✓	
Promote a close or friendly working relationship	✓	
Maintain a record of the communication		✓
Save time when providing a response		✓
Avoid interrupting your colleague		✓
Deliver a formal message		✓

Crucial conversations

Conversations such as asking for a raise or promoting a project are crucial conversations, where the stakes and emotions are high. The following 10 recommendations can help to improve the quality of your conversations, especially crucial ones:

1. Be the first to say "hello": Introduce yourself to others, clearly pronouncing your name so everyone catches it.
2. Use names: Listen for the names of your conversation partners and use them when addressing others.
3. Think before you speak: Instead of speaking quickly to fill pauses, take time to think instead of blundering into a mistake.
4. Be receptive to new ideas: If you disagree with an idea, learn more about it. Say, "That's interesting," instead of "I don't agree."
5. Listen: Listen as much as you speak, if not more.
6. Ask questions: Draw others out as necessary by asking thoughtful questions.
7. Make eye contact: Show others that you are engaged and focused on what they are saying.
8. Repeat or paraphrase: In your own words, repeat what others say to make sure you understand.
9. Keep it brief: Instead of monopolizing someone's time, leave them feeling that another conversation with you would be interesting and productive.
10. Be prepared: Before a crucial conversation, anticipate what others might say or ask. Prepare questions and facts ahead of time.

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YOU TRY IT

Practice preparing effective conversations. Complete the following steps.

1. Nawaf is preparing to meet his manager to discuss increasing his salary. Read the following tasks.

Description	Effective way to plan for a conversation?
1. Gather evidence of all of the tasks and activities you complete in the office	
2. Find evidence of other jobs that you can apply for	
3. Set a firm target that you will not go below	
4. Tell everyone before the meeting what you are doing, why, and why you deserve the pay rise	
5. Send an e-mail to your manager asking for a job review meeting	
6. Approach your manager in the canteen while they are eating lunch	
7. Practice your conversation and arguments before the discussion	
8. Think of any objections your manager may have and prepare your potential answers	

2. In your notebook, make a list of tasks 1–8. Decide whether they will or will not contribute to effective communication. Briefly explain your decision.

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REVIEW QUESTIONS

1. **Communication is successful only when:**
   - **a.** you use a sixth-grade vocabulary
   - **b.** you introduce many ideas
   - **c.** you (as the speaker) and the listener understand each other
   - **d.** you identify barriers to understanding
2. **How should you organize a spoken message?**
   - **a.** Begin with supporting information
   - **b.** Start with what your listener needs to know
   - **c.** Plan for frequent pauses
   - **d.** Use a formal outline
3. **Spoken communication is appropriate only when:**
   - **a.** you want to avoid interrupting your colleague
   - **b.** you want to deliver a formal message
   - **c.** there is a specific and long set of instructions to follow
   - **d.** you want to receive an immediate answer
4. **How often should messages be exchanged between the sender and the receiver?**
   - **a.** Until the sender is happy
   - **b.** Until the receiver is happy
   - **c.** Until there is clear understanding between both the sender and receiver
   - **d.** Once only

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Communicating Among People

2-1 The Open Communication Climate

Choosing the most appropriate communication channel reduces the chances of a message being lost, ignored, or misunderstood. To choose the most appropriate communication channel while working on their organization's problems and making decisions about them, an employee must understand the **hierarchy** within their organization. Different organizations and even employees within an organization will interact differently depending on status levels.

QUICK TIP

The hierarchy of an organization can often give a good idea of the communication climate—if there are many levels of management, the climate is likely to be more formal and less open.

DEFINITIONS

Communication climate: The social tone of a relationship. How people interact with each other within their relationships.

Hierarchy: A system of organizing people into different ranks or levels of importance, for example in society or in a company.

Open communication means sharing all types of information throughout the organization, across **functional teams** or departments and hierarchical boundaries. People throughout the organization need to see the big picture, understand the decisions managers make, and know how their work contributes to the success of the company.

DEFINITIONS

Open communication: Sharing all types of information throughout the organization and across functional and hierarchical boundaries.

Functional teams: A team composed of a manager and his or her subordinates in the formal chain of command, such as, but not limited to: sales, marketing, finance, and human resources.

Often, and especially in times of change, if employees don't hear what's happening from managers, they rely on rumors and will often believe the worst possible outcome. In an open communication environment, employees know their position, status, and level of job security and which rules are important to follow.

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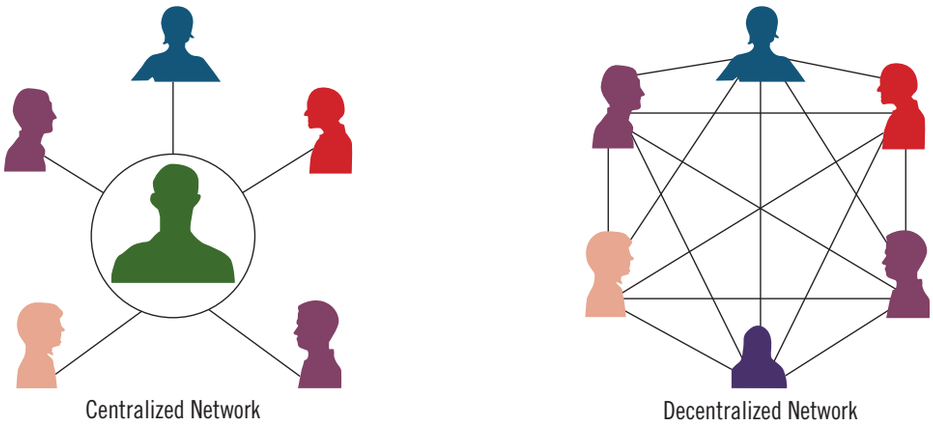
Open communication helps employees accept, understand, and commit to goals. Employees can see how their actions interact with and affect others in the organization. When people have access to complete information, they are more likely to come up with creative solutions to problems and make decisions that are good for the company.

2-2 Communication Networks

Research into employee communication has focused on two characteristics of effective communication: the extent to which team communications are centralized and the nature of the team's task.

The relationship between these characteristics is illustrated in Figure 8-2.

FIGURE 8-2: Communication networks



In a **centralized network**, team members must communicate through one individual to solve problems or make decisions.

Centralized communication can be effective for large teams because:

- it limits the number of people involved in decision making
- it leads to faster decision making that involves fewer people.

DEFINITION

Centralized network: A communication structure in which team members communicate through a single individual to solve problems or make decisions.

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In a **decentralized network**, people can communicate freely with other team members and functional areas. Members process information equally among themselves until all agree on a decision.

Decentralized communication is best for complex, difficult work environments where:

- teams need a free flow of communication in all directions
- complex decisions are made utilizing specific knowledge from many stakeholders.

QUICK TIP

Decentralized networks are more likely to be found in technology-based and fast-paced industries where decisions have to be made quickly and collaboratively.

DEFINITION

Decentralized network: A communication structure in which team members freely communicate with one another and arrive at decisions together.

2-3 Communication Channels

Managers have a choice of many channels through which to communicate. A manager may discuss a problem face to face, make a telephone call, use text messaging, send an e-mail, write a memo or letter, or use social media, depending on the nature of the message. The channels available to managers can be classified into a hierarchy based on **channel richness**, which is illustrated in Figure 8-3 below.

The amount of information each channel can transmit is influenced by three characteristics:

1. The ability by the sender and the listener to handle many pieces of information at the same time.
2. Whether there is a need for very quick, two-way feedback or time is needed to think about, and structure, a response.
3. The ability to create a personal relationship and focus for the communication.

DEFINITION

Channel richness: The amount of information that can be transmitted during a communication episode.

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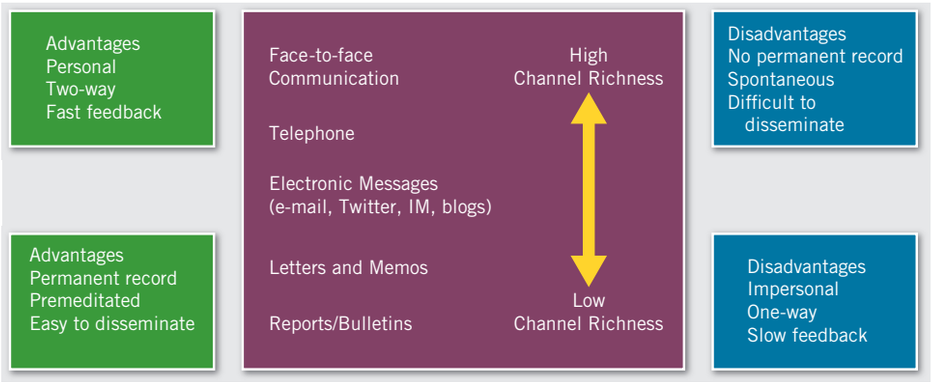
FIGURE 8-3: Channel richness



1. **Face-to-face**

   This discussion is the richest medium because it allows for:

   - direct experience
   - many pieces of information to be transmitted quickly
   - immediate feedback
   - a personal relationship.

   Because of its richness, it is the best channel when communicating with people who are exhibiting strong emotions, such as anxiety, fear, or defensiveness. Face-to-face discussions help understand the meaning and emotion of the situation.

QUICK TIP

Although communication skills have always been important to managers, the ability to persuade and influence others is even more critical today.

2. **Telephone**

   These conversations are next in the richness hierarchy. Although eye contact, posture, and other body language cues are missing, the human voice can still carry a tremendous amount of emotional information.

3. **Electronic communication**

   Communications such as e-mail, instant messaging, and text messaging, are increasingly being used for messages that were once handled face to face or by telephone because:

   - they are a very quick and easy method of sending and storing information
   - the message can be sent and read at different times
   - you can attach documents and evidence to support your argument.

   However, in surveys, most respondents said that they preferred the telephone or face-to-face conversation for communicating difficult news, giving advice, or expressing affection. Because e-mail messages:

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- don't allow for both visual and verbal communication
- limit the chances for interaction and effective feedback
- can easily be misunderstood due to cultural and social reasons
- can lead to interactions and feedback being misunderstood.

Using e-mail to discuss disagreements, for example, can lead to escalation rather than resolution of conflict as messages may be misunderstood when there is little personal relationship and no understanding of the emotional impact of the message.

2-4 Nonverbal Communication

When communicating face to face, managers use **nonverbal** as well as verbal communication. The human body can communicate feelings and emotions very easily to others, using:

- facial expressions
- hand gestures
- use of space.

These can communicate a range of messages, from enthusiasm, warmth, and confidence to arrogance, indifference, displeasure, and condescension.

QUICK TIP
Practicing powerful body poses seems to boost as well as project confidence and assertiveness.

DEFINITION

Nonverbal (communication): Messages sent through human actions and behavior rather than through words.

What does the body language of these two businessmen suggest to you?

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2-5 Asking Questions and Listening

The traditional top-down, **command-and-control** approach to organizational communication is no longer a useful option in today's global, technologically sophisticated workplace. This traditional model is changing to a more open form of communication that includes organizational conversations. This involves managers asking questions, **listening** to feedback, and giving answers to questions in addition to giving orders and instructions. Figure 8-4 highlights the listening skills required for effective communication.

FIGURE 8-4: Ten keys to effective listening

Key	Poor Listener	Good Listener
1. Listen actively	Is minimally involved and unfocused	Shows interest; nods; asks questions; paraphrases what is said
2. Keep an open mind	Pays attention only to ideas that conform to his or her own opinions	Looks for opportunities and new learning
3. Resist distractions	Is easily distracted	Fights distractions; tolerates bad habits; knows how to concentrate
4. Capitalize on the fact that thought is faster than speech	Tends to daydream with slow speakers	Challenges assumptions, anticipates; summarizes; listens between lines to tone of voice
5. Seek understanding	Feigns agreement to bring the conversation to an end	Searches for common ground and new understanding
6. Judge content, not delivery	Tunes out if delivery is poor	Judges content; skips over delivery errors
7. Hold one's fire	Spouts solutions before understanding the problem or question	Does not judge or respond until comprehension is complete
8. Listen for ideas	Listens for facts	Listens to central themes
9. Work at listening	Provides no energy output; is passive and laid back	Works hard; exhibits active body state, eye contact
10. Show respect	Interrupts; talks over the other person when trying to get a point across	Learns to keep quiet and let the other person do most of the talking

DEFINITIONS

Command-and-control: Managers give instructions and employees obey.

Listening: This involves the skill of understanding both facts and feelings to interpret a message's genuine meaning.

There are many reasons why organizations have adopted open communication climates where asking questions is encouraged. Some of the benefits include:

1. **Trust and openness**

   Asking questions builds trust and openness between managers and employees. Managers who ask questions encourage their employees to share ideas and offer feedback.

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2. **Critical thinking skills**
   Asking questions builds critical, independent thinking skills. This encourages people to use their creativity to make better, more informed decisions that are more likely to achieve organizational objectives and lead to deeper, more lasting learning.
3. **Independence**
   Questions stimulate the mind and give people a chance to make a difference. Therefore, asking questions gets people to accept responsibility for solving their own problems.

Asking questions is an important dimension of the organizational conversation. Just as important is listening to the answers.

Listening involves the skill of grasping both facts and feelings to interpret a message's genuine meaning. Only when a manager truly learns to listen can he or she provide the appropriate response. Listening requires attention, energy, and skill as not only must you hear what is being said, but also be able to think of appropriate questions to ask to check your own understanding.

YOU TRY IT

Practice planning effective conversations. Complete the following steps.

1. **Tahani is deciding which would be the best channel of communication for each activity. Read the following tasks.**

Description	Channel of communication
1. Discussing which marketing strategy would be best for a new product launch	
2. Introducing the new human resource plan to the company	
3. Finding out when Fatima last spoke to her client	
4. Building a better working relationship with the sales manager	
5. Contacting a client to discuss a complicated technical issue	
6. Asking a series of questions that need to be answered by Walaa when she returns from her holiday	

2. **In your notebook, make a list of tasks 1–6. Decide which is the most appropriate channel of communication for each example, explaining the benefits of the channel chosen.**

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REVIEW QUESTIONS

1. **An open communication climate is when:**
   - **a.** your manager tells you exactly what to do and when
   - **b.** employee ideas are not listened to by management
   - **c.** managers ask questions and respect the input of their employees
   - **d.** your manager is always annoyed when you ask questions
2. **An advantage of high channel richness is:**
   - **a.** fast feedback
   - **b.** permanent records
   - **c.** impersonal method of communication
   - **d.** difficult to disseminate information
3. **A disadvantage of asking questions is:**
   - **a.** trust and openness is built
   - **b.** critical thinking skills are developed
   - **c.** it leads to an increase in creativity
   - **d.** you might get many conflicting answers
4. **Which of the following describes an effective listener?**
   - **a.** Interrupts and talks over others
   - **b.** Does not judge delivery errors but judges content only
   - **c.** Is easily distracted
   - **d.** Pays attention to ideas that are the same as their own opinions only

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Workplace Communication

Employees need to communicate throughout the organization as a whole. Three elements of modern workplace communication for employees to master are:

1. using social media to improve internal and external communication
2. using informal, personal communication channels
3. establishing formal communication channels.

3-1 Social Media

Social media covers a broad range of applications, including wikis, blogs, microblogs (e.g., Twitter and Instagram), content communities (e.g. YouTube), social networking sites (e.g., Facebook and LinkedIn), and virtual social worlds.

DEFINITION

Social media: A group of Internet based applications that allows the creation and exchange of user generated content.

QUICK TIP

Social media is not just a means of sharing information, but gathering up-to-date information to be used in the decision-making process.

Companies have embraced social media in a big way to communicate with customers and enhance employee collaboration. Social media is mainly used by organizations in the following ways:

1. **Communicating with customers**

   Social media allows for direct communication with others. This allows organizations, from small entrepreneurial firms to huge corporations, to listen to exactly what customers require at that moment. Social media can also be used to communicate corporate news quickly and effectively to customers.

2. **Engaging with employees**

   Using social media can enable people to connect with one another easily across organizational and geographical boundaries based on professional relationships, shared interests, problems, or other criteria. This has the added benefit of enhancing employee collaboration.

   Interacting through public sites and corporate networks gives employees opportunities to participate in an online community—sharing personal and professional information and photos, and producing and sharing all sorts of

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ideas and opinions. Social media has also become an effective employee engagement tool for many companies.

3-2 Personal Communication Channels and Networking

Personal communication channels exist in addition to formal communication channels within an organization but may skip hierarchical levels. These can cut across vertical chains of command to connect virtually anyone in the organization.

DEFINITION

Personal communication channels: Channels that exist outside formally authorized channels and connect people across boundaries for sharing information and accomplishing tasks.

Personal communication channels are often developed by **networking**. Creating and growing personal relationships that cross departmental, hierarchical, and even organizational boundaries allows managers to share information quickly and easily. There are three main types of personal communication channels:

1. **Personal networks**, which often grow from meeting people with similar interests and personalities and gaining both personal and professional contact details.
2. **The grapevine**, which is used to spread unsubstantiated rumors. It is an informal, person-to-person communication network that is not officially sanctioned by the organization.
3. Written communication, which is valued as a more personal method of communicating ideas instead of using oral options.

Some key tips from expert networkers when developing a network include:

1. **Build it before you need it**
   Smart employees don't wait until they need something to start building a network of personal relationships.
2. **Make it win-win**
   Successful networking isn't just about getting what *you* want; it's also about making sure other people in the network get what *they* want.

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3. **Focus on diversity**

   The broader your base of contacts, the broader your range of influence. Build connections with people from as many different areas of interest as possible (both within and outside the organization).

DEFINITIONS

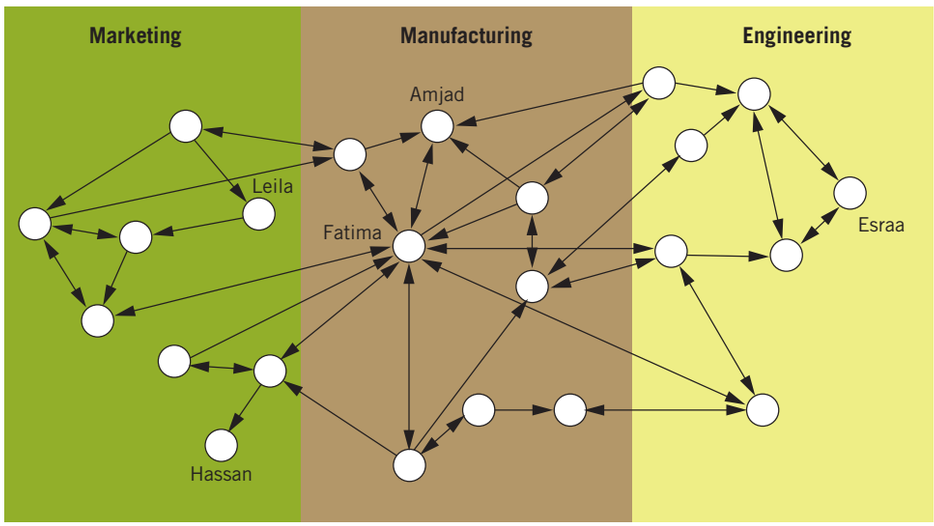
Networking: The process of interacting with others to exchange information and develop professional or social contact.

Personal networks: Acquiring and cultivating personal relationships that cross departmental, hierarchical, and even organizational boundaries.

The grapevine: Carries workplace gossip, a dominant force in workplace communication when official channels are not functioning effectively.

An example of an organizational communication network is shown below in Figure 8-5.

FIGURE 8-5: An organizational communication network



Personal networking enhanced through social and professional networking sites like LinkedIn is an important skill for professionals. People who have more contacts have greater influence in the organization and get more accomplished.

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3-3 Formal Communication Channels

There are three main **formal communication channels** shown in Figure 8-6 and the types of information shared in each channel is illustrated in it. **Downward** and **upward** communications are the primary forms of communication used in most traditional, vertically organized companies. However, many of today's organizations emphasize **horizontal** communication, with people continuously sharing information across departments and levels.

DEFINITIONS

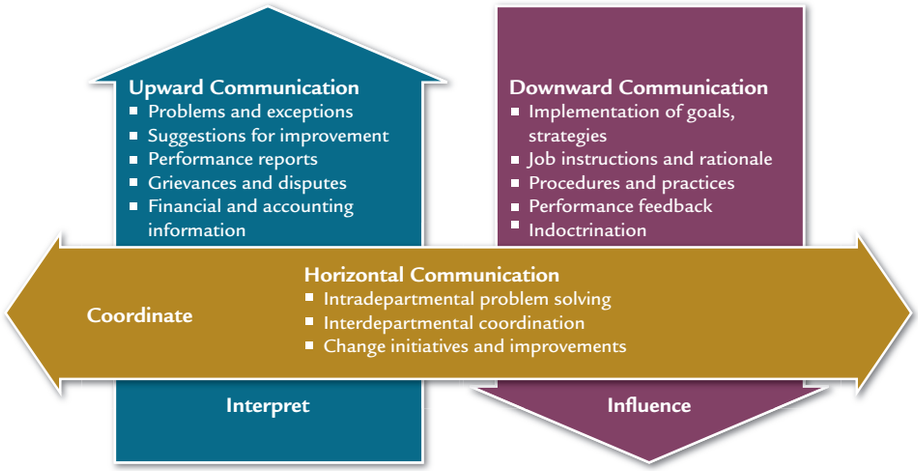
Formal communication channel: A communication channel that flows within the chain of command or task responsibility defined by the organization.

Downward communication channel: Refers to messages sent from top management down to subordinates.

Upward communication channel: includes messages that flow from the lower to the higher levels in the organization's hierarchy.

Horizontal communication channel: The lateral or diagonal exchange of messages among peers or coworkers. Includes team communication within or across departments.

FIGURE 8-6: Downward, upward, and horizontal communication in organizations



Electronic communication methods such as e-mail and social media, as described previously, have made it easier than ever for information to flow in all directions. The most familiar and obvious flow of formal communication, downward communication, consists of the messages and information sent from top management to subordinates in a downward direction.

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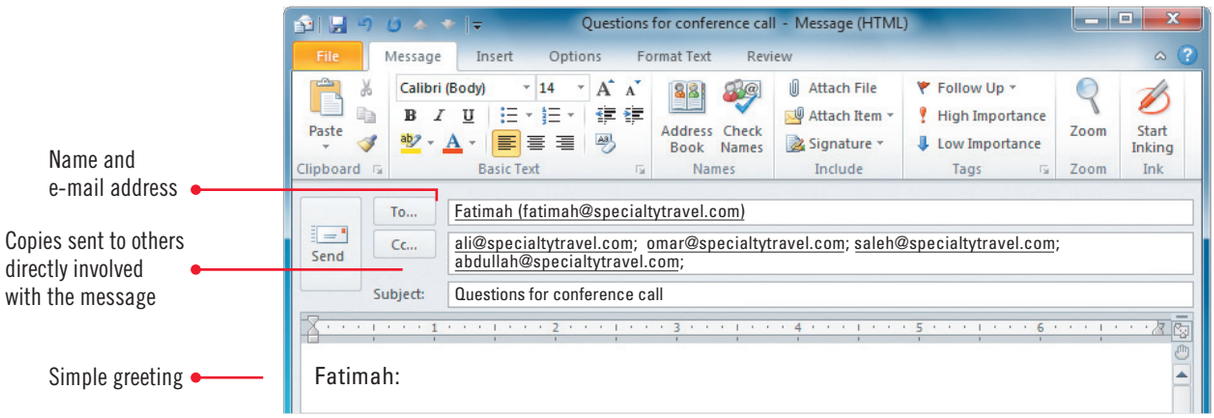
Formal upward communication includes messages that flow from the lower to the higher levels of the organization's hierarchy. Most organizations take pains to build in healthy channels for upward communication.

Horizontal communication may occur within or across departments. The purpose of horizontal communication is not only to inform but also to request support and coordinate activities.

3-4 E-mail Etiquette

E-mail is now the most common written business communication medium and is used daily. As a result, there are agreed-upon conventions and general guidelines for creating professional e-mail messages. Figure 8-7 shows the beginning of an e-mail message that follows these guidelines by including full addresses and a simple salutation.

FIGURE 8-7: Addressing the e-mail message



1. **Full name and address**

   E-mail addresses such as Maj1996@mymail.com don't clearly identify the sender. Instead, include full names and e-mail addresses in the To and From fields of an e-mail message. E-mail programs such as Microsoft Office Outlook let you enter a first and last name followed by the e-mail address (Example: Majed <Maj1996@mymail.com>).

2. **Carbon copy (Cc) and Blind carbon copy (Bcc)**

   In addition to the main recipient, you can send copies of the message to other people by including their e-mail addresses in the Cc field. Be sure the people listed in the Cc field are directly involved with the message and will benefit from its information—most people only want to receive e-mails that they need to read.

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Bcc is a variation on Cc known as "blind carbon copy". Use Bcc to send a copy of a message to a recipient without displaying their name or e-mail address in the e-mail header. This is useful when you need to share the e-mail with someone (like your manager), but don't want to change the dynamics of the communication by making it obvious that you are including them in the message.

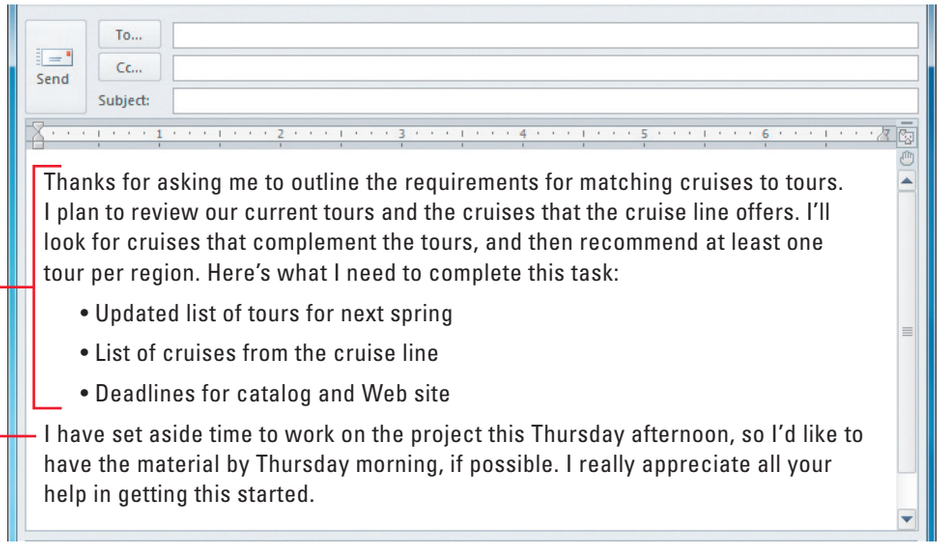
QUICK TIP
A salutation is optional when you are sending an e-mail to a colleague at your organization.

3. **Salutation**

   Start your message with a simple greeting such as "Greetings," "Dear Hassan," "Hi Reem," or "Ali,". The salutation provides a friendly start to your communication and shows where your message begins, which is especially helpful if someone forwards or replies to your e-mail.

   Figure 8-8 shows the body format, content, and closing elements of an e-mail which are explained below.

FIGURE 8-8: Opening and closing the e-mail message



4. **Body format and content**

   Format the opening line and the rest of the message so it is easy to read, as described in Table 8-2. Focus on a single topic and keep the message brief, no more than 25 lines if possible. Ideally, your readers should not have to scroll the message more than once or twice. If you need to discuss more than one topic, send a separate message for each topic. Figure 8-8 shows the opening line and part of the message body for the e-mail message to Fatimah.

5. **Closing**

   End with a signature block that includes your name and contact information,

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such as the name of your organization, address, and your telephone and fax numbers. Most e-mail programs can insert signature blocks for you.

There are some general rules to follow when creating e-mails as described in Table 8-2 below.

TABLE 8-2: Creating e-mail do's and don'ts

message section	do	don't
To and From lines	• Include both a name and e-mail address in each line	• **Don't** rely on your e-mail address as the only way to identify yourself
Cc line	• Send a copy to people directly involved with the message	• **Don't** send blanket copies to people who are not involved with the message
Salutation	• Start with a short greeting	• **Don't** omit the salutation or use one that's too informal unless you are writing to a friend or close colleague
Body format	• Use standard capitalization in English and lowercase characters • Insert blank lines and break up text for readability	• **Don't** use all uppercase or all lowercase text • **Don't** include all of the message content in one long paragraph
Closing	• Include a call to action or deadline, if appropriate • End with a signature block	• **Don't** trail off without a conclusion • **Don't** forget to provide your contact information

YOU TRY IT

Practice creating professional e-mail messages by writing a complete message. Complete the following steps.

1. **Review the following outline of an e-mail message.**

   1. To: Munira
   2. Cc: Zaid
   3. Message body

   Start with a brief statement of the main idea—to outline the requirements for matching new activities to tours. Explain your plan. List what you need to complete the task (list of tours for next spring, list of new activities, and deadlines for catalogue and Web site). Everything received by Thursday afternoon.

   4. Closing

   Signature block with your name

2. **In your notebook, write a subject line and a complete message based on the outline above.**

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REVIEW QUESTIONS

1. **Which of the following is a benefit of creating personal networks?**
   - **a.** You can receive too much information
   - **b.** Allows managers to share information quickly and easily
   - **c.** You can share company secrets with competitors
   - **d.** You have friends to have lunch with
2. **Which of the following is an example of horizontal communication?**
   - **a.** Suggestions for improvement
   - **b.** Intradepartmental problem solving
   - **c.** Financial and accounting information
   - **d.** Job instructions and rationale
3. **Who should you include in the Cc field of an e-mail message?**
   - **a.** Anyone listed in the original message
   - **b.** Only people directly involved with the message
   - **c.** Your manager in all circumstances
   - **d.** No one
4. **Which of the following is an appropriate way to end an e-mail message?**
   - **a.** Summary of the main idea
   - **b.** Short greeting
   - **c.** Call to action or deadline
   - **d.** Bulleted list of questions

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Understand the Role of Effective Meetings

4-1 Understanding the Role of Meetings

Meetings are common in most organizations. Professional staff and managers typically attend a few meetings every week. Senior executives regularly spend over half their working hours in **meetings** and conferences. There are many reasons for holding a meeting as shown in Table 8-3. Many meetings occur in a physical location where participants can talk face to face. Electronic communications also make it possible to have a virtual meeting with people who are in different places. In either case, meetings provide valuable contact with others and let you observe the verbal and nonverbal cues of other participants.

DEFINITION

Meetings: Three or more people get together at a common time to discuss, debate, decide, plan, and solve problems related to a company goal.

TABLE 8-3: Determining whether to hold a meeting

scenario:	hold meeting	send written message
Team members attended a conference on the latest Web technologies and now want to share what they learned	✓	
You reviewed the Web sites of other travel companies and want to report on what you found	✓	
A team member completed a preliminary outline of the new Web site and wants to ask for feedback	✓	
Your manager announced a new Internet usage policy, and you want to discuss how it affects the team	✓	
Some team members have selected two possible designs for the updated Web site and want to seek consensus from the entire team	✓	
The software the team is using to create Web pages is too difficult, which is causing delays	✓	
The team leader wants to invite members to attend a team meeting		✓
You need to tell everyone on your team that a meeting is being postponed		✓
Team members need to review the details of a plan		✓
The team leader wants to remind everyone about due dates they agreed to meet		✓

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Teams hold meetings for the following reasons:

1. **Sharing information**

   Teams hold meetings to exchange information. Informational meetings provide opportunities to ask and answer questions, pool information, and make sure everyone hears and understands the same news. For example, you might hold an informational meeting to introduce a new team member, announce a team success, report on updates to a project, or provide limited training. Informational meetings can be called only when necessary or scheduled on a regular basis.

2. **Solving problems**

   When a team faces a complicated problem, it might hold a meeting to discuss and resolve the problem. Team leaders might call a problem-solving meeting as soon as they learn about a problem. For this reason, they do not provide an agenda in advance or support information during the meeting. In some cases, the meeting is the first time that many participants learn about the problem. Usually, the team assesses the scope and impact of the problem, and then the group works to identify possible solutions.

3. **Planning**

   Teams often use meetings to make plans. They organize and coordinate team activities and tasks. Unlike problem-solving meetings, team leaders should organize planning meetings in advance. They should distribute material to team members before the meeting so everyone is prepared to participate.

QUICK TIP

Update meetings are also called status meetings or department meetings.

4. **Providing updates**

   Teams often use regularly scheduled meetings to keep all members up to date on the team's progress. Typically, a team meets at least once a week. The tone of these meetings is usually informal, to encourage open communication. Some update meetings are **feedback meetings**, where participants have the chance to report their progress on assigned tasks. They can also discuss problems and ask for suggestions to solve the problems. Other update meetings are **feedforward meetings**, where participants look ahead, instead of looking toward the past. In feedforward meetings, teams discuss schedules for the immediate future and coordinate activities.

5. **Making decisions**

   Teams occasionally need to meet so they can work cooperatively on a decision. Examples of these meetings include reviewing applications to hire an

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employee, setting goals for the next stage of a project, or evaluating bids from prospective contractors. In each case, the goal of the meeting is to make a decision.

YOU TRY IT

Check that you understand the role of meetings in organizations. Complete the following steps.

1. **Read the following text.**

   Specialty Travel is updating its policy manual for employees. Jamila formed a team led by Yasser to update the manual. The team meets every week from 9:30 to 10:30 am in the West Conference Room. The next meeting is on October 15, 2024.

   After Jamila makes her opening remarks, Asif wants to report on the current company manual. During the discussion, he wants to identify the strengths of the current manual and sections to change. He estimates 15 minutes for this part of the meeting.

   Next, Hamad will lead a discussion on vacation policies for about 17 minutes, concluding with a vote. The team as a whole will discuss the policy area to study for next week, review deadlines, and assign tasks and responsibilities. This should take about 7 minutes.

   Asif wants to take a few minutes to update the action plan, and then Mariam will open the discussion to the team for the last 10 minutes of the meeting. As always, they will discuss successes and problems during this time.

2. **In your notebook, write down which elements of the meeting described above meet the following purposes for meetings:**

   - sharing information
   - solving a problem
   - planning
   - providing updates
   - making decisions.

4-2 Planning Effective Meetings

Effective meetings are a valuable use of the participants' time. Ineffective meetings are unproductive and frustrating. The difference between the two often comes down to the planning that comes before the meeting. To run an effective meet-

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ing, you need to plan who will attend and what you will discuss. When planning a meeting, consider the following:

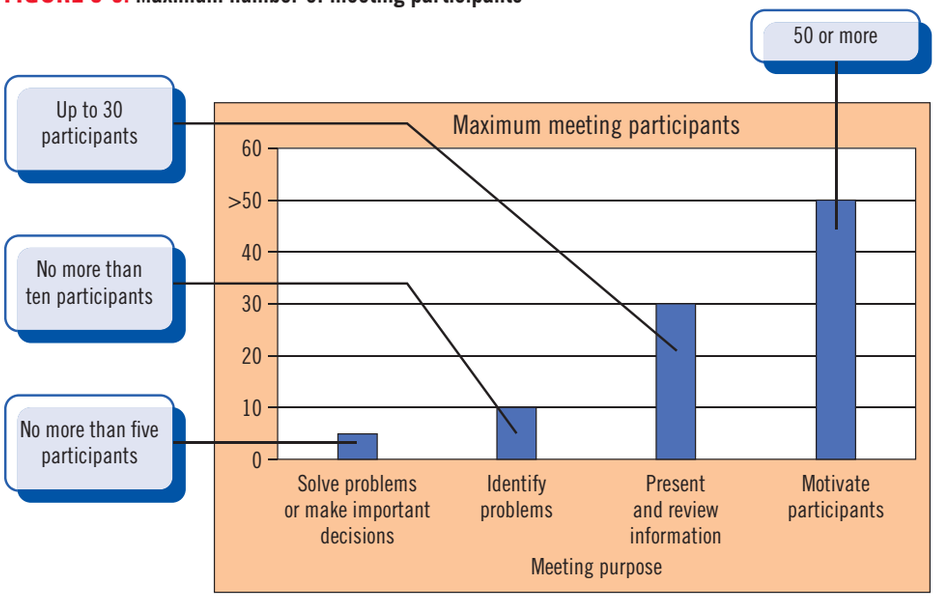
1. **Start with the objective**
   Although you might hold meetings for different reasons, they each have a major objective. Start by defining the purpose of the meeting. You should be able to express the purpose in a few words. Don't start planning the meeting until you have a clear idea of its goal.

2. **Make sure you need a meeting**
   Some organizations prefer meetings to other types of communication and hold them frequently. Keep in mind that a meeting is expensive because it takes the time of all the participants. If someone has to travel to participate in the meeting, it becomes even more costly. Sometimes you can accomplish your objective without having everyone get together. Could an e-mail message, online discussion, or memo meet your goals? If so, try to use them before calling a meeting.

QUICK TIP
Call attendees personally if you want to be sure they will attend.

3. **Identify key participants**
   If you decide that a meeting is the best way to meet your goal, decide who should participate. Ask yourself who needs to attend to make the meeting successful. The purpose of the meeting often determines the number of people to invite. See Figure 8-9. If some participants will present information or play an active role in the meeting, give them time to prepare. If others would directly benefit from attending, add them to your invitation list.

FIGURE 8-9: Maximum number of meeting participants



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QUICK TIP
Add only appropriate items to the agenda.

4. Distribute an agenda and information in advance

At least two days before the meeting, send out an **agenda**. An example is shown in Figure 8-10. Include other information such as reports that participants should read before the meeting. Never start a meeting by passing out materials such as copies of documents or presentation slides. These are distractions and may disrupt your meeting. You want to give people enough time to get prepared and come to the meeting ready to work. You can also ask people what they want to discuss. Add these items to the agenda. Give people something to do so they become interested in the meeting and its outcome.

DEFINITION

Agenda: An outline or a list of topics that will be discussed during the meeting.

FIGURE 8-10: Outline for a meeting agenda

AGENDA

Meeting Title
Annual reports discussion

Date 20-12-2022
Start time: 10:00 a.m.
End time: 12:00 p.m.

Invited to the meeting by Head of Department Mr Nayef:

Reem
Yaser
Nawaf

Please read: Previous reports
Please bring: Completion reports

10:00 a.m.–10:30 a.m.	**Review of first report** Item 1 | Presenter: Reem	**Meetings Office**
10:30a.m.–11:15 a.m.	**Review of second report** Item 2 | Presenter: Yasser	**Meetings Office**
11:15 a.m.–12.00 p.m.	**Third Report Review** Item 3 | Presenter Nawaf	**Meetings Office**

Additional guidelines:
None

QUICK TIP
Try to locate the meeting close to as many people as you can—not somewhere that is only convenient for you.

5. Choose an appropriate setting

Select a time and place that is convenient for most of the attendees. Be sensitive to other obligations and scheduling conflicts as you select a meeting time.

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YOU TRY IT

Practice planning effective meetings. Complete the following steps.

1. Maha is preparing for a meeting of the Specialty Travel Policies team and wants to conduct the meeting effectively.

   Read the following list of meeting activities.

Description	Effective way to manage the meeting?
1. Arrive a few minutes after everyone else so they have a chance to mingle	
2. Start the meeting on time, even if some people have not yet arrived	
3. Hand out an agenda during the meeting, but tell everyone that they can talk about any subject that comes up	
4. So that no one else is burdened with tasks, talk for most of the meeting time yourself	
5. Schedule more than one speaker or presenter	
6. Wait while everyone settles down, and then start the meeting about 10 minutes after the scheduled time	
7. Visit the meeting room ahead of time and adjust the seating, lighting, and temperature so that everyone is comfortable	
8. Distribute an agenda a few days before the meeting and refer to it during the meeting to keep everyone on time	

2. In your notebook, make a list of tasks 1–8 and write Yes or No against each number according to whether each of the above points is an effective way to manage the meeting. Explain your answers.

REVIEW QUESTIONS

1. **In which of the following situations should you not hold a meeting?**
   - **a.** Team members want to report what they learned
   - **b.** Team members need to review the details of a plan
   - **c.** You want to discuss a new policy with the team
   - **d.** Team members want to seek consensus about a decision
2. **Which of the following situations is not the role of a meeting?**
   - **a.** Discuss and solve problems related to a company goal
   - **b.** To meet colleagues face to face
   - **c.** To enable contact and observe the verbal and nonverbal language used
   - **d.** To remind everyone about due dates that have been agreed
3. **At least two days before the meeting, the meeting leader should send out a(n):**
   - **a.** action plan
   - **b.** minutes document
   - **c.** schedule
   - **d.** agenda
4. **How many people can you invite to a motivational meeting?**
   - **a.** Up to five
   - **b.** Up to ten
   - **c.** 30
   - **d.** 50 or more

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Chapter 8

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Writing Professional Reports and Proposals

5-1 Written Communication

Written communication is designed to communicate information about a particular subject, usually in more detail than would be expected in verbal communication. Two types of document that are important for managers are **reports** and **proposals**. Reports are often written objectively, although may include analysis and/or recommendations. A proposal provides information about a product, service, or idea and tries to convince the reader to choose the recommended solution.

DEFINITIONS

Report: A written document designed to communicate information about a particular subject. Reports are written objectively, though some can include analysis and/or recommendations.

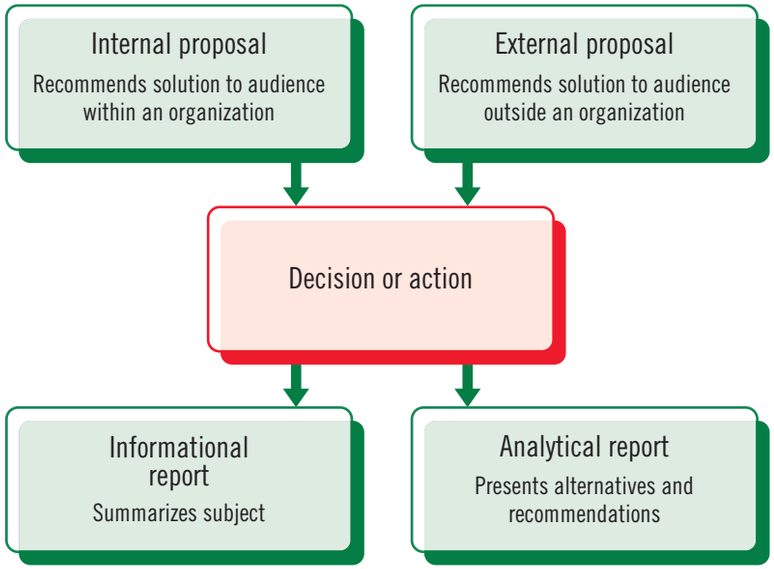
Proposal: A written document designed to persuade and inform. A proposal provides information about a product, service, or idea and tries to convince the reader to adopt the recommended solution.

A key difference between reports and proposals is when they are written. A proposal is normally developed early in the decision-making process when it can influence decisions. A report is usually written after some action has been taken. Some reports document the status of an activity or project as it occurs. Other reports are written at the conclusion of the activity or project.

5-2 Choosing the Form of Communication

Before you decide whether to write a report or a proposal, it is important to understand different types of reports and proposals that can be used, as shown in Figure 8-11. The following questions will help decide which is most appropriate:

FIGURE 8-11: Types of reports and proposals



QUICK TIP
The general goal of reports and proposals is to answer questions and solve problems.

1. **What is your purpose for writing?**
   The first step in writing a report is clearly defining your purpose. Start by analyzing what you want to accomplish. Is your goal to inform, update, analyze, or persuade? Your objective will help you to decide on the format that you should use.

QUICK TIP
The primary audience is often a decision maker.

2. **Who are your readers?**
   As with other types of documents, write a report or proposal with your readers in mind. To best meet your readers' needs, identify how well they understand your subject. What do they want to learn from reading your report or proposal? How are they likely to react? How should you write to make the information clear and understandable to your readers? Be sure to consider your primary (main) audience and the secondary audience, which includes anyone else who might read the document.

3. **Should you write a report or a proposal?**
   You write a report to share information with someone else. You write proposals to persuade your readers to adopt your idea, product, or solution. They are similar to analytical reports except that you are presenting only one recommendation. Table 8-4 lists suggestions for when you should write a report or a proposal.

4. **Will your report present information or analyze a topic?**
   Reports can be one of two types. **Informational reports** present information in a clear, objective format. An informational report is appropriate when you want to provide a written summary of a subject for your reader. Opinions

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and recommendations are not included in an informational report. **Analytical reports** typically present data, analysis, and a conclusion. Analytical reports often provide different options, identify pros and cons for alternatives, and include specific recommendations.

DEFINITIONS

Informational reports: A type of report that presents information in a clear, objective format, and is appropriate when you want to provide a written summary of a subject for your reader.

Analytical reports: A type of report that presents data, analysis, and a conclusion by providing different options, identifying pros and cons for alternatives, and including specific recommendations.

5. **Is your proposal for an internal or external audience?**
   Proposals are also one of two types. **Internal proposals** recommend how to solve problems within an organization, such as by changing a procedure or using different products or services from vendors. **External proposals** are designed to sell products or services to customers and are usually written in response to a request.

   The answers to these questions help you decide how long your report or proposal should be, what information to include, and the degree of formality that is appropriate.

DEFINITIONS

Internal proposals: A type of proposal that recommends how to solve problems within an organization.

External proposals: A proposal written for an audience that is outside of your organization.

Table 8-4 shows the different scenarios in which a report, a proposal, or a different channel is most suitable.

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TABLE 8-4: When to write a report or a proposal

scenario	report	proposal	other
You attended a trade show and want to inform others about your competitors' products	✓		
You need to document company procedures	✓		
You are analyzing whether to purchase new computer equipment or upgrade the current equipment	✓		
You are proposing to purchase new computer equipment		✓	
You are recommending a new way to schedule staff resources		✓	
You are offering your company's services to a person or organization		✓	
You are summarizing notes you took at a conference for your own future reference			Informal notes or outline
You are promoting your company's services for a general audience			Advertisement
You are describing your company's products and providing examples to potential customers			Presentation

5-3 Developing Effective Reports and Proposals

It takes a lot of practice to write effective reports and proposals. It is possible to develop and improve writing skills by following these guidelines:

1. **Respect the reader**

   The reader's time is valuable; don't waste it with a rambling, confusing memo or e-mail that must be read several times to make sense of it. Pay attention to your grammar and spelling. Poor writing indicates that you think your time is more important than that of your readers. You'll lose their interest—and their respect.

2. **Know your point and get to it**

   What is the key piece of information that you want the reader to remember? Many people just sit and write, without clarifying in their own mind what it is they're trying to say. To write effectively, know what your central point is and write to support it.

3. **Write clearly**

   Write clearly rather than impressively. Don't use complicated language and avoid jargon. The goal of good writing for business is to be understood the first time through. State your message as simply and as clearly as possible.

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4. **Peer review the message**

   Get a second opinion. When the communication is very important, such as a formal memo to the department or organization, ask someone you consider to be a good writer to read it before you send it.

There are readymade online templates for reports and proposals in Microsoft Word. Open Word, click on **File**, then **New**. You can then search for online templates in the search bar, e.g., by using the search word "report" or "proposal".

YOU TRY IT

Practice writing effective reports. Complete the following steps.

Part 1: Practice writing beginnings by revising a report introduction

1. **Review the following report introduction.**

   Introduction

   This report describes opportunities for Specialty Travel to expand its tour destinations and activity offerings. This report compares the following information about the tour destinations and activities provided by Specialty Travel's competitors. This report shows that TJ Travel offers five more tours to destinations in America than Specialty Travel and three more tours to destinations in Asia. This company also offers two types of on-site activities not provided by Specialty Travel. This report also shows that Global Tours offers seven more tours to destinations in Europe, six more tours to destinations in the Caribbean, and four more tours to destinations in America. This company also offers five types of on-site activities not provided by Specialty Travel.

2. **In your notebook, revise the above material so it's clear, appealing, and appropriate for a report introduction.**

Part 2: Practice writing the body of a document

1. **Review the following report text and then brainstorm four or five recommendations to include in the report.**

   Competitive Advantages

   Specialty Travel distinguishes itself from other tour organizers because Specialty Travel tours emphasize adventure, culture, and education (ACE). Specialty Travel travelers enjoy activities ranging from hiking to hang-gliding while learning about the culture of the region—the food, the people, and the history. Recent customer surveys show that Specialty Travel's target audi-

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ence prefers cultural tourism. This means tours that take travelers into the heart of the region they are visiting and include a broad range of physical and cultural activities. People don't want to sit on a tour bus and feel like tourists. They want eco-friendly travel that makes them feel like participants in the world rather than spectators.

2. **Write your list of recommendations in your notebook, starting your notes with:**

   To meet this need, Specialty Travel can do the following:

REVIEW QUESTIONS

1. **A meeting where participants have the chance to report their progress on assigned tasks is called a:**
   a. report meeting
   b. full participation meeting
   c. feedback meeting
   d. feedforward meeting
2. **What kind of long document presents information in a clear, objective format?**
   a. Electronic notes
   b. Analytical report
   c. Informational report
   d. Interview
3. **What type of long document often provides different options, identifies pros and cons for alternatives, and includes specific recommendations?**
   a. Analytical report
   b. Informational report
   c. Informational proposal
   d. Citation
4. **What can you do to develop effective reports?**
   a. Ask somebody else to write them
   b. Copy an existing document
   c. Ask someone to check the report
   d. Ask the receiver for improvements

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Technology @ Work: Online Collaboration Tools

Online collaboration tools such as Google Docs and Office Web Apps are forms of software designed to help teams achieve their goals and are used to streamline and speed up communications. These communications tools have allowed networks to expand internationally, creating connections between people who would never normally meet. Online collaboration tools are often organized into three categories: communication tools, conferencing tools, and coordination tools. All of these tools are especially helpful for virtual teams and are explained below.

1. **Communication tools**

   You use electronic communication tools to exchange messages, as in e-mail, or keep in touch with a team and its project. **Wikis** allow team members to share documents and information. For example, Wikipedia (https://en.wikipedia.org/), an online encyclopedia, is a well-known wiki. The same applies to Microsoft 365 (outlook.live.com) works in a similar way.

DEFINITION

Wiki: A Web site that many users can contribute to by creating and editing the content.

2. **Conferencing and collaboration tools**

   You use online conferencing and collaboration tools to quickly share information. For example, instant messaging is a form of basic online conferencing. Web conferencing tools like Microsoft Teams, Zoom, and Google Meet may be used to conduct online meetings, especially when you want to share one user's desktop with another.

   More recent conferencing tools include those that let you and at least one other team member access a shared application or document from your computers at the same time. For example, Microsoft Office 365, available with Microsoft Office, provide online versions of some Office software and let you store, edit, and share documents with other Office users. See Figure 8-12.

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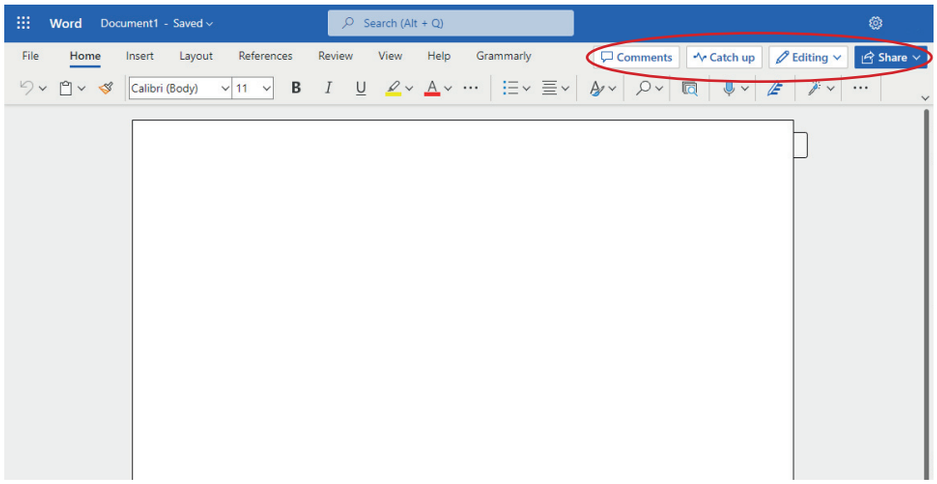
FIGURE 8-12: Office 365 with collaboration tools for workgroups



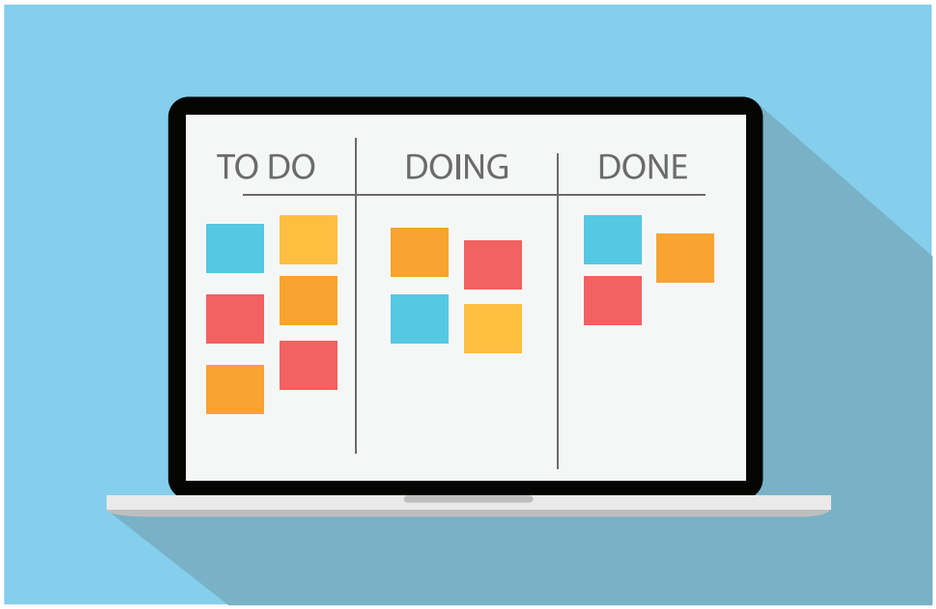
QUICK TIP

You can also use online event tools such as Meetup (www.meetup.com) to organize physical meetings.

3. **Coordination tools**

   This category of online collaboration tools includes online calendars, such as Google Calendar (www.google.com/calendar), which lets you or your team schedule events and notify team members. Kanban board systems (see Figure 8-13) help you schedule, track, and chart the steps in a project as it is being completed.

FIGURE 8-13: Kanban board system



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REVIEW QUESTIONS

1. **Which of the following is not a category of online collaboration tools?**
   - **a.** Communication tools
   - **b.** Conferencing tools
   - **c.** Conforming tools
   - **d.** Coordination tools
2. **An example of an online communication tool where team members can share documents and information is:**
   - **a.** Microsoft Teams
   - **b.** Zoho Projects
   - **c.** LinkedIn
   - **d.** Meetup

Technology @ Work: Online Meetings

If you need to meet with larger groups of people who are not in the same physical location, you can use online meeting tools such as Zoom, or Teams. Each of these tools is available for a monthly subscription fee for the complete package or a free option for meetings of shorter duration.

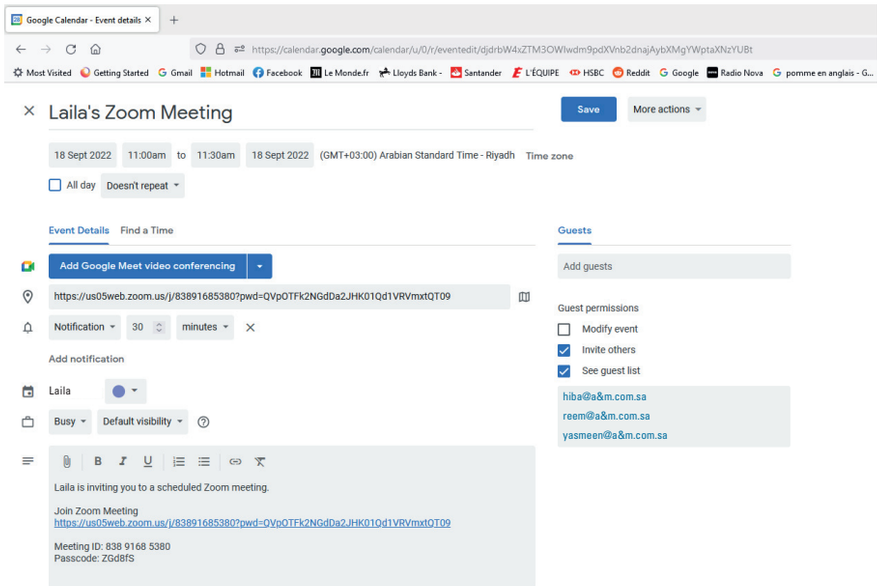
Teams (https://www.microsoft.com/en/microsoft-teams/) is part of Microsoft's Office suite and integrates well with other Office applications. These meeting tools let you display presentations, your desktop, and your applications to other meeting participants. The meeting software lets you chat through text, voice, or video. To encourage participation, these tools run in Web browsers, on mobile devices, and can support telephone call-in.

This charts the process of creating, sharing, and accessing an online meeting.

1. **Create a meeting in Zoom**

   Go to Zoom (https://zoom.us/) and sign in. You can create an account and then sign in with your Zoom ID. After logging in, click the Host tab and choose if you want the meeting to include video or just screen sharing. A Web page opens where you can enter meeting information. See Figure 8-14. Follow the steps to create a meeting and receive a meeting ID. The process on Teams is similar.

FIGURE 8-14: Creating a Zoom meeting



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2. **Invite participants**

   You must invite the other participants to the meeting through Zoom or Teams. You can invite many other people by sending them an e-mail message that includes the meeting date, time, and a link they can follow to join. Both Zoom and Teams can also send a link in the e-mail message that participants can click to go directly to the meeting page, or they can run the Zoom client and enter the meeting ID manually.

QUICK TIP

Web conferencing software includes chatting or instant messaging features so meeting participants can ask questions without interrupting a speaker.

3. **Start the meeting**

   When you set up the meeting, Zoom and Teams will send you an e-mail invitation along with your participants. To start the meeting, open the e-mail message, and click Join Meeting. Zoom and Teams may install some software for you, or update your application if you haven't used it in a while. Before joining the meeting, each user will be shown a screen where they can adjust their audio and video settings.

   When you conduct an online meeting, everything you display on your desktop may also be displayed to your participants. Meeting participants can communicate with each other by typing chat messages within the meeting software. When you're finished, close the Web browser to end the meeting.

4. **Plan the visuals**

   Gather material for the meeting, including software, documents, and electronic presentations such as Google Slides. Take advantage of the technology to enrich the discussion with video, images, slides, and shared applications. Create a welcome slide to display when participants first arrive so they know they are in the right place.

5. **Record the conference**

   Online meetings let you record the conference for people who can't attend. You can send them a digital copy of the meeting to watch at their convenience.

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YOU TRY IT

Practice creating an online meeting and invitation. Complete the following steps.

1. Open a Web browser such as Microsoft Edge, Google Chrome, or Mozilla Firefox, and go to https://zoom.us/.
2. Log on or create a free account at the site, if necessary.
3. Press the Print Screen key to take a screen shot of the following pages. Open a word processing program such as Microsoft Office Word, open a new document, and press Ctrl+V to paste each screen shot with a short description.
4. Click the Create Meeting button, enter information about a meeting to discuss a memorable trip with one of your classmates, and then click the Create button.
5. Use e-mail to invite your classmate to join the meeting.
6. When you receive an e-mail message about the meeting, click Create Meeting.
7. Tell your classmate to join the meeting.
8. Save the document and then send the document to your teacher.

REVIEW QUESTIONS

1. **When evaluating online meeting tools, what features should you look for?**
   a. Ability to display your desktop to others
   b. Ability to create small groups
   c. Ability to chat with participants
   d. All of the above
2. **In Zoom, how can you invite people to an online meeting?**
   a. Send an e-mail message
   b. Post an invitation on their calendars
   c. Start the meeting, and then call participants
   d. All of the above

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Technology @ Work: Presentation Software

Presentation software is used to create and deliver electronic slide shows. Microsoft PowerPoint in particular, has become the standard way to make and give business presentations. PowerPoint is easily the most well-established of the presentation software tools. In fact, Microsoft estimates that more than 30 million PowerPoint presentations are given each day.

You can also use other presentation software, some of which is designed for special circumstances and is shown below.

QUICK TIP
Use very few words on a slide so people have to listen to your words instead.

1. **Microsoft PowerPoint**
   Part of the Microsoft suite of programs, PowerPoint (https://www.microsoft.com/en-gb/microsoft-365/powerpoint) is widely used in business and education. Some of the main criticisms are:

   - It dictates the way you communicate by reducing ideas to short bullet points.
   - Slides are often very text heavy. This means viewers often read the words and do not listen to the explanation or the speaker.

2. **Prezi**
   If you want to use sophisticated animation effects in your presentation, Prezi is an excellent choice (www.prezi.com). However, Prezi requires some practice to produce the sophisticated effects that you want. One advantage of using Prezi is that you can easily publish a presentation online.

3. **Google Slides**
   One of the applications available from Google is called Slides (https://www.google.co.uk/slides/about/), a tool for creating slide shows. The strength of Slides is not its features, which are more limited than PowerPoint's , but the fact that you are able to work directly in your Web browser and you don't need any special software. Everyone can work on the same set of slides at the same time and all changes are automatically saved. Like other Google applications, Slides is designed for online **collaboration** and sharing.

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DEFINITION

Collaboration: A joint effort between people from two or more departments to produce outcomes that meet a common goal or shared purpose.

4. **Apple Keynote**

   If you use an Apple device, the presentation program is Apple Keynote (https://www.apple.com/keynote/). One key feature is called Keynote Remote, which you connect to an iPhone, or iPad so you can use it as a wireless controller. You can then move around the room in which you are presenting, using your iPhone or iPad to control slides and read your slide notes. Figure 8-15 shows Apple Keynote for iOS, which runs on mobile devices.

FIGURE 8-15: Apple Keynote for mobile devices

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YOU TRY IT

Practice working with presentation software. Complete the following steps.

1. Open a Web browser such as Microsoft Edge, Google Chrome, or Mozilla Firefox, and go to each of the Web sites mentioned in this chapter:

   a. https://www.microsoft.com/en-us/microsoft-365/powerpoint
   b. https://prezi.com/
   c. https://www.google.co.uk/slides/about/
   d. https://www.apple.com/keynote/

2. Identify the top two or three pros and cons for each program and write them in your notebook.

REVIEW QUESTIONS

1. **Which of the following is not an example of presentation software?**
   a. Microsoft PowerPoint
   b. Adobe Flash
   c. Apple Keynote
   d. Google Slides
2. **Which of the following is an advantage of using Apple Keynote?**
   a. It is free to use
   b. It is designed for online presentations
   c. It is designed to be used with mobile devices
   d. All of the above

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Technology @ Work: Social Networking Groups

The purpose of an online social network is to build social relationships among its members. These people usually share interests, activities, or professions. When you join a social network, you create a profile that describes yourself and your interests. You add links to other people you know on the network, and interact with others by exchanging messages, photos, videos, and other files. Most social networks allow you to form a group so you can easily connect to other people you know. Groups also enhance a feeling of community among its members.

The process to join a social networking group is shown below.

1. **Choose the most appropriate group**

   On a social networking site such as Facebook (www.facebook.com), X (formerly Twitter) (https://x.com/), or LinkedIn (www.linkedin.com), look for groups that share your interests. Determine whether and how you can join the group. Often, you have to ask and be approved to join a group.

2. **Create a group**

   If you want to meet online with people from work, create a group. When you do, you become the owner or manager of the group, which means you can determine who can join. You can also create a group logo and select a group name.

   You can also select a group type. For example, on LinkedIn, you can create an alumni group, corporate group, networking group, or professional group, among others. Next, set the access policies to determine who can join the group. For example, you can allow any LinkedIn member to join, or you can approve the people who want to join the group.

QUICK TIP

Be careful not to disclose any private or confidential information while online.

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3. **Start or follow discussions**

   Most social networks let you start a discussion about a topic. You can post a question or discussion topic, and then read the responses by following the discussion. You can also elect to follow discussions that involve only members of your group. As the group manager, you can stop a discussion by deleting the topic or question that you posted.

YOU TRY IT

Practice creating a group on a social networking site. Complete the following steps.

1. Open a Web browser such as Microsoft Edge, Google Chrome, or Mozilla Firefox and go to a social networking site mentioned in this lesson.
2. Log on or create a free account at the site if necessary, and then look for a directory of groups.
3. Look for a link to create a group, and then click the link to open a page requesting information about the group.
4. Press the Print Screen key to take a screen shot of the group directory and the group creation page, open a word-processing program such as Microsoft Word, press Ctrl+V to paste each screen shot in a new document, then send the document to your instructor.

REVIEW QUESTIONS

1. **Most social networks allow you to form a group so you can:**
   - **a.** connect to other people you know
   - **b.** complete the performing stage of group development
   - **c.** avoid team conflicts
   - **d.** avoid team-building exercises
2. **When you create a group at a social networking site, you become the:**
   - **a.** team leader
   - **b.** discussion leader
   - **c.** manager of the group
   - **d.** profile of the group

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Extra Practice

Critical Thinking Questions

1. "When you click the send button in your e-mail program, assume that your e-mail message has been published."

   What implications does this statement have when you compose an e-mail message?

   _____

   _____

   _____

   _____

2. Suppose you are writing an e-mail message to a classmate asking them to meet you after school to study for an exam. What kind of language and tone do you use? Does the language and tone change if you are writing to your teacher? To someone you are applying for a job with? To someone in another country? If so, explain how your message changes in each case.

   _____

   _____

   _____

   _____

3. What are the characteristics of an open communication climate? Describe the organizational benefits of managers cultivating an open communication climate.

   _____

   _____

   _____

   _____

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4. Proposals are different from reports because they persuade readers to take a particular action. Do you think that makes proposals basically unethical?

_____

_____

_____

_____

5. You are part of a group brainstorming to solve a problem for your school. During the brain storming sessions, the group leader who has the most experience takes control and only lists their ideas on the whiteboard for discussion. The group leader then tells everyone what their roles are and sets tasks and deadlines for everybody.

How might this affect the trust, openness, and willingness of the group members?

_____

_____

_____

_____

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Real Life Independent Challenge 1

After graduating from school, you start working in the marketing department of a small Web-design company. This morning, the director of marketing hands you a letter from a customer who is requesting information about the company's services. The customer's letter is shown below. The director asks you to write a letter in response.

FIGURE 8-16: Customer letter

910 2nd Street
Dammam

January 12, 2022

Director of Marketing
Overland Designs
38 5th Street
Riyadh

Dear Director of Marketing,

I am the owner of a sports equipment manufacturing company, and I would like to set up a Web site to attract and service customers. Please let me know the answers to the following questions:

- What types of Web site design services do you offer?
- Can you provide graphic design services?
- What types of clients do you have?
- How can we start to work together?

Please also send me any examples of your work or other promotional materials.

Sincerely,

Sufyan

Sufyan
President

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The response should contain the following elements:

- letterhead, address, and current date
- opening sentence that directly responds to the customer's request
- letter body that provides the details of the response, which should be positive
- lists and graphics highlighting techniques that make the letter body easy to read
- appropriate closing statement, complimentary close, and signature block.

The company offers:

- Web design services (page design, programming, and maintenance)
- Graphic design services (drawings, page layouts, photos)
- Working with clients that include small start-ups to large corporations
- Initial consultations where we review and discuss the client's needs. These meetings are complimentary.

Real Life Independent Challenge 2

You are preparing to apply for a job after finishing school. Before you apply for a job with a company, learn as much as you can about that firm, including its products or services, competition, corporate philosophy, and background. Create an informal report to your instructor with your findings, and explain why you want to pursue employment with this company or research other employment possibilities.

1. Using your favorite search engine, search for articles in business publications about the best companies to work for in Saudi Arabia. You can also narrow your search to a particular city.

2. Select a company and then research company information on the Web. Be sure to review the following information about the company:

   - company Web site
   - basic facts about the company, such as location, number of employees, and products or services provided
   - articles about the company
   - type of employment opportunities
   - type of career paths.

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3. Write an informal informational report with the following sections:
   - introduction
   - body section presenting your findings
   - conclusion explaining whether you want to pursue employment with this company.
4. Proofread the report carefully to fix any grammar or formatting errors.

Team Challenge

After completing school, you started work with a company specializing in information services. Recently, you have been promoted and you now travel around the country with a small group and help your clients install computers and software. You and your team have just returned from Riyadh, where you attended a conference on high technology. You and your team need to prepare a conference report, describing your experience and what you learned at the conference.

1. Using your favorite search engine, search for information about a conference in Riyadh that covered a topic in high technology such as wireless communications, networks, or future technology. Note the addresses of the Web sites that provide the most useful information.
2. Meet as a team to discuss your findings.
3. As a team, outline a five-paragraph conference report describing a conference.
4. Individually, write one paragraph of the report. Then assemble the paragraphs into a cohesive report as a group.
5. Submit the report to your instructor as requested.

Be the Critic

Review the poorly written report excerpt shown below. Create a list of the weaknesses of the report and make specific suggestions for improvement.

FIGURE 8-17: Report excerpt

Date: March 12, 2022
To: Zainab
From: Laila
Subject: Current State of Work from Home Program

Introduction
At your request, I prepared the following report on telecommuting.

Recommendations
- Allow employees who have worked for the company at least two years to work from home.
- Restrict telecommuting to two days per week.

Justifications
Telecommuting matches the company goal of flexible work options, such as flexible scheduling. Telecommuting seems to make employees more productive and efficient. This is especially true for salespeople. It also makes managing employees easier.

The purpose of this report is to evaluate the Work from Home program. By any criteria, it is quite successful.

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Part 2

Chapter 9: Using Data to Support the Decision Making Process

Key Skills

Chapter 10: Decision Support System Fundamentals

Chapter 11: Using Microsoft Excel Solver

Projects

Chapter 12: The Car Production Project

Chapter 13: The Ski Resort Project

Chapter 14: The Electric Car Project

Chapter 15: The Airline Project

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Chapter 9

Using Data to Support the Decision Making Process

There are many different ways to make a decision or approach a problem. Some decisions are made randomly, such as by flipping a coin in the air. Other decisions are made on the basis of instinct and "gut feeling". Important decisions should be made objectively and, ideally, supported with measurable data. In this chapter, you will be introduced to data-driven decision making and problem solving.

After finishing school, Ahmed begins working for a company that produces a variety of temperature gauges and sensors. These precision instruments are used in a variety of industrial, manufacturing, and medical applications. Each quarter, the accounting department produces financial statements and production reports for the company.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Understand Data and Information
2. Follow the Data Analysis Process
3. Collect Data to Support Decision Making
4. Describe Data with Statistics
5. Describe a Dataset's Variability
6. Work with Spreadsheets
7. Create an Excel Spreadsheet

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During the past three months, the number of sensors that failed quality-control testing has increased significantly. This, in turn, has had an adverse effect on the company's profits. Ahmed's manager asks him to determine what the problem is and recommend solutions to fix the situation.

During his lunch break, Ahmed mentions this project to several coworkers. "Oh, that's an obvious problem," remarks a colleague, Ali. "The company has steadily increased its production quota for those sensors, but they haven't hired any additional assembly workers. No wonder there is a quality problem. Everyone on that assembly line is scrambling to keep up with orders."

Is this really the underlying cause of the company's quality-control issues? Based on this anecdotal feedback, should Ahmed feel comfortable presenting this to his manager? Might there be other issues to consider? If so, how could he determine what they are?

In most businesses and organizations, problems routinely arise and call for informed decisions to be made. The way that people examine, evaluate, and address these matters impacts the quality of the solutions. Learning how to objectively and quantitatively assess and evaluate available data will help you to become a more effective problem solver.

In this chapter, we will explore the fundamentals of data and data analysis to support the decision making process. As a result of this transition into "hard skills", the figures and illustrations are integrated into the examples throughout the chapter to aid understanding of the processes. Definition boxes are also introduced to explain key terminology, while Q&A boxes provide additional step-by-step hints in the final lesson.

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Understanding Data and Information

1-1 Why Data?

There is an old saying that "without data, you are just another person with an opinion." While anecdotes and coincidences may make for interesting stories, you wouldn't want to make important decisions on the basis of anecdotes alone. For example, just because a friend of a friend ate 16 apricots and then experienced relief from joint pain doesn't mean that this is all you need to know to help one of your parents choose a treatment for arthritis!

Before recommending that they start eating apricots, you would definitely want to consider relevant **data**—that is, data that would allow you to investigate the effectiveness of apricots as a treatment for arthritis. It is challenging to function in today's world without a basic understanding of **data analysis** and **statistics**. Studying statistics will also enable you to collect data in a sensible way and then use the data to answer questions of interest. In addition, studying data analysis will allow you to critically evaluate the work of others by providing you with the tools you need to make informed judgments. Let's start by developing an understanding of data collection, data, different types of data, and information.

DEFINITIONS

Data: Known facts used as a basis for analysis.

Data analysis: The different methods used to interpret data.

Statistics: The collection and analysis of numerical data.

1-2 Collecting Data

Before you can analyze your data, you first need to collect it.

There are many methods of data collection. They include:

- **Surveys**: Researchers and businesses all use surveys to gather data. This method of data collection is typically used to generate responses about individuals' preferences, opinions, and habits. Respondents will usually be asked "closed" questions, designed to provide simple answers such as "yes" or "no", or multiple-choice questions, so answers can be grouped together for analysis and comparison.

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- **Interviews**: When an organization wants to collect more detailed information, they may use interviews to gather data. An interview often uses a more "open" form of question, allowing the respondent to answer more fully and even, in some cases, to direct the flow of the conversation. Interviews can be structured, semi-structured, or unstructured, depending on the objectives of the interviewer. The data this method produces requires more detailed analysis as it is usually less statistical.

- **Focus groups**: Like an interview, the questions in a focus group can be more open, but in this case multiple respondents are asked the questions at the same time, and are invited to share their responses with each other, and even to discuss their ideas between themselves. Many businesses use focus groups to "test" a new product or idea and use the data they collect to influence its ongoing development.

- **Tracking**: Tracking is an increasingly common method in the modern world, although it has been in use for a long time. Tracking involves collecting data about a customer's behavior, habits, and purchases in "real time". For instance, supermarkets record information about customer purchases to inform all sorts of choices: if a product is selling well, they may increase their order; if the store is busier at certain times of the day, they may increase the number of staff working at that time; if a particular product is popular with a specific group of people, they may use that information to change their marketing. Tracking is also used online: Web sites record how many visitors they have, who is clicking on their advertisements, and even what device they are using.

1-3 Data Sets

The individuals or objects in any particular **population** might possess many characteristics that could be studied.

DEFINITION

Population: Any finite or infinite collection of items under discussion.

Consider a group of students currently enrolled in a math class:

- One characteristic of the students in the population is the brand of calculator they use. Another characteristic is the number of textbooks used that semester, and yet another is the distance from the school to each student's home. A **variable** is any characteristic whose value may change from one individual or object to another. For example, calculator brand is a variable, and so are number of textbooks used and distance to the school. Data results from making observations either on a single (univariate) variable or on two or more (multivariate) variables at the same time.

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DEFINITION

Variable: Any characteristic (of a population) whose value may change from one individual object to another.

QUICK TIP

It's important to remember that you can easily perform mathematical calculations on numerical data. Categorical data can only be sorted and counted.

- There are two types of univariate data sets: categorical (sometimes also called qualitative or nominal) and numerical (sometimes also called quantitative). In the previous example, calculator brand is a categorical variable, because each student's response to the query, "What brand of calculator do you use?" is a category. The collection of responses from all these students forms a categorical data set. The other two variables, number of textbooks purchased and distance to the school, are both numerical in nature. Determining the values of a numerical variable (by counting or measuring) results in a numerical data set.

- There are two different types of numerical data: **discrete** and **continuous**. Consider a number line for locating values of a numerical variable. Each possible number (2, 3.125, 8.12976, etc.) corresponds to exactly one point on the number line. Suppose that the variable of interest is the number of courses in which a student is enrolled.

FIGURE 9-1: A number line representing the number of courses in which a student is enrolled

If no student is enrolled in more than eight courses, the possible values are 1, 2, 3, 4, 5, 6, 7, and 8. These values are identified in Figure 9-1 by the dots at the points marked 1, 2, 3, 4, 5, 6, 7, and 8. Because students either take a class, or they don't, the values for this variable are **discrete**. A student cannot take 4.32167 classes.

QUICK TIP

In general, data are continuous when observations involve making measurements, as opposed to counting.

On the other hand, the line segment in Figure 9-2 identifies a plausible set of possible values for the time (in seconds) it takes for the first kernel in a bag of microwave popcorn to pop when heated. Here the possible values can be any point on the number line. These time values are said to be **continuous**. This is because each kernel of popcorn will pop when its internal temperature reaches a critical point. This doesn't necessarily happen at discrete times (in seconds).

FIGURE 9-2: A number line representing the times taken for the first kernel in a bag of popcorn to pop when heated

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DEFINITIONS

Discrete data: Where values are whole; or yes/no.

Continuous data: Data that can take any value, such as height, weight, temperature.

- Some numerical data is logically organized in a particular order or sequence. This data is said to use an **ordinal scale**. For example: you might construct a customer-satisfaction survey to measure your clients' opinions on their shopping experience. The questionnaire would ask, "On a scale of 1–5, how would you rate your shopping experience?" (1 – Unsatisfactory, 3 – Neutral, 5 – Very Satisfactory). Because there is a rank ordering associated with the responses, they fall on an ordinal scale.

DEFINITION

Ordinal scale: Where data is organized in a particular order or sequence.

- **Information** is broadly defined as data that has been organized, analyzed, or visualized in a way that makes it more valuable. By themselves, individual elements of a data set are of limited value. However, when a statistical analysis is performed on the data, the results are more useful. As a general rule, raw data by itself is seldom informative enough to be actionable. We wouldn't make decisions or solve problems based on the data alone. When the data is transformed into information, it is more likely to be actionable.

DEFINITION

Information: Data that has been organized, analyzed, or visualized in a way that makes it more valuable.

Let's look at another example. The number of text messages sent on a particular day is recorded for each of 12 students. The resulting data set is:

23	0	14	13	15	0
60	82	0	40	41	22

Possible values for the variable number of text messages sent are 0, 1, 2, 3, … . These are isolated points on the number line, so this data set consists of discrete numerical data.

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Suppose that instead of the number of text messages sent, the time spent texting had been recorded. Even though time spent may have been reported rounded to the nearest minute, the actual time spent could have been 6 minutes, 6.2 minutes, 6.28 minutes, or any other value in an entire interval. So, recording values of time spent texting would result in continuous data.

1-4 Representing Data Sets

How to Construct a Dot Plot

1. Draw a horizontal line and mark it with an appropriate measurement scale.
2. Locate each value in the data set along the measurement scale, and represent it by a dot. If there are two or more observations with the same value, stack the dots vertically.

Dot plots convey information about:

- A representative or typical value in the data set.
- The extent to which the data values vary.
- The shape of the distribution of values along the number line.
- The presence of unusual values in the data set.

How to Construct a Bar Chart

1. Draw a horizontal axis, and write the category names or labels below the line at equally spaced intervals.
2. Draw a vertical axis, and label the scale using either frequency or relative frequency.
3. Place a rectangular bar above each category label. The height is determined by the category's frequency or relative frequency, and all bars should have the same width. With the same width, both the height and the area of the bar are proportional to frequency and relative frequency.

YOU TRY IT

Carry out online research to find an example of categorial data and an example of numerical data. With each example, explain the characteristics that have helped you to classify which type of data it is. For the numerical data example, explain whether the data is discrete or continuous, giving reasons for your answer.

REVIEW QUESTIONS

1. **If an organization wants to collect a large amount of data from multiple customers at the same time, they should use:**
   a. interviews
   b. focus groups
   c. surveys
   d. tracking
2. **Classify each of the following variables as either categorical or numerical.**
   a. number of students in a class of 35 who submit an assignment before the due date
   b. gender of the next baby born at a particular hospital
   c. amount of fluid (in milliliters) dispensed by a machine used to fill bottles with soda pop
   d. thickness of the gelatin coating of a vitamin E capsule
3. **For the following numerical variables, state whether each is discrete or continuous.**
   a. the length of a one-year-old snake
   b. the latitude of a location in Saudi Arabia selected by pointing a finger on a map of the Kingdom while blindfolded
   c. the distance from the left edge at which a 30cm plastic ruler snaps when bent sufficiently to break
   d. the price per liter paid by the next customer to buy gas at a particular station
4. **In a survey of 100 people who had recently purchased motorcycles, data on the following variables were recorded:**
   - age of the purchaser (in years)
   - brand of motorcycle purchased
   - number of previous motorcycles owned by purchaser
   - telephone area code of purchaser
   - weight of motorcycle as equipped at purchase.

   a. Which of these variables are categorical?
   b. Which of these variables are discrete?
   c. Which graphical display would be an appropriate choice for summarizing the age data: a bar chart or a dot plot?
   d. Which graphical display would be an appropriate choice for summarizing the weight data: a bar chart or a dot plot?

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Following the Data Analysis Process

Statistical studies are undertaken to answer questions about our world. For example, is a new flu vaccine effective in preventing illness? Are consumers buying more luxury items? Data collection and analysis allow researchers to answer questions like these.

2-1 The Data Analysis Process

The data analysis process can be viewed as a sequence of steps that lead from planning, to data collection, to making informed conclusions based on the resulting data. The process can be organized into the six steps described below.

The Data Analysis Process

1. **Understanding the nature of the problem**
   Effective data analysis requires an understanding of the research problem. We must know the goal of the study and what questions we hope to answer. It is important to have a clear direction before gathering data to ensure that we will be able to answer the questions of interest using the data collected.

QUICK TIP
When you are deciding what you want to measure, start with the results you want to find. Make sure that you are collecting the right data to answer the question.

2. **Deciding what to measure and how to measure it**
   The next step in the process is deciding what information is needed to answer the questions of interest. In some cases, the choice is obvious. For example, in a study of the relationship between the height of a basketball player and position played, we would need to collect data on player height and position. In other cases, the choice of information is not as straightforward. For example, in a study of the relationship between preferred learning style and intelligence, how should we define learning style and measure it? What measure of intelligence should we use? It is important to carefully define the variables to be studied and to develop appropriate methods for determining their values.

3. **Data collection**
   The data collection step is very important. You must first decide whether an existing data source is adequate or whether new data must be collected. If a decision is made to use existing data, it is important to understand how the data were collected and for what purpose, so that any resulting limitations —for instance, if it is incomplete—are also fully understood. If new data are

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to be collected, a careful plan must be developed, because the type of analysis that is appropriate and the conclusions that can be drawn depend on how the data are collected. Think about the different methods of data collection discussed in Lesson 1.

QUICK TIP

Summarizing your data is an important step. It will often tell you what the next step in analysis is, whether additional data needs to be collected, or whether you need to start over with a different design.

4. **Data summarization and preliminary analysis**

   After the data are collected, the next step is usually a preliminary analysis that includes summarizing the data graphically and numerically. This initial analysis provides insight into important characteristics of the data and provides guidance in selecting appropriate methods for further analysis.

5. **Formal data analysis**

   The data analysis step requires you to select appropriate statistical methods. Much of this chapter is devoted to methods that can be used to carry out this step.

6. **Interpretation of results**

   Several questions should be addressed in this final step. Some examples include: What can we learn from the data? What conclusions can be drawn from the analysis? How can our results guide decisions that we need to make? The interpretation step often leads to the formulation of new questions to explore. These new questions lead back to the first step. In this way, good data analysis is often an iterative process. In other words, it is a process that is often repeated and refined in order to improve the quality of information.

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YOU TRY IT

Suppose that book sales (in millions of Riyals) for each of the top 20 bestselling new books in Saudi Arabia in 2020 and 2021 are shown in the table below.

2020		2021	
Bestselling Book (chart position)	2020 Sales (millions of Riyals)	Bestselling Book (chart position)	2021 Sales (millions of Riyals)
1	350.1	1	936.7
2	337.1	2	652.3
3	333.1	3	459.0
4	259.8	4	356.5
5	257.8	5	353.0
6	255.1	6	336.0
7	245.4	7	281.7
8	241.4	8	228.4
9	233.9	9	201.2
10	222.5	10	200.1
11	208.5	11	195.0
12	202.9	12	184.3
13	200.7	13	183.6
14	191.7	14	180.2
15	191.2	15	177.4
16	188.0	16	169.7
17	177.0	17	166.2
18	167.8	18	163.0
19	150.9	19	161.2
20	150.2	20	155.2

1. Construct a dot plot of the 2020 book sales data. Comment on any interesting features of the dot plot.
2. Construct a dot plot of the 2021 book sales data. Comment on any interesting features of the dot plot.
3. In what ways are the distributions of the 2020 and 2021 book sales observations similar? In what ways are they different?

REVIEW QUESTIONS

1. **Which of the following is not a stage in the data analysis process?**
   a. understanding the nature of the problem
   b. deciding what to measure and how to measure it
   c. interpretation of results
   d. deleting results you don't agree with
2. **The next step following data collection is usually:**
   a. preliminary analysis
   b. final analysis
   c. the iterative process
   d. qualitative research

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Chapter 9

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Collecting Data to Support Decision Making

3-1 The Importance of Data Collection

Data collection is a particularly important step in the data analysis process. When we set out to collect information, it is important to keep in mind the questions we hope to answer on the basis of the resulting data. Sometimes we are interested in answering questions about the characteristics of a single population or in comparing two or more populations. To accomplish this, we select a sample from each population under consideration and use the sample information to gain insight into characteristics of those populations.

- For example, an ecologist might be interested in estimating the average shell thickness of eagle eggs. A social scientist studying a rural community may want to determine whether age and attitude toward educational attainment are related. These are examples of studies that are observational in nature. In these studies, we want to observe characteristics of members of an existing population or of several populations, and then use the resulting information to draw conclusions. In **observational studies**, it is important to obtain samples that are representative of the corresponding populations. Consider data that tells you about the population you are sampling, for instance, by looking at census data for a country or, for a smaller organization, information from a human resources department.

QUICK TIP

Experiments allow you to test "*what if?*" questions. Experiments are usually harder to conduct than observational studies, but when done properly can also yield more valuable results.

- Sometimes the questions we are trying to answer deal with the effect of certain variables on some response and cannot be answered using data from an observational study. These questions are often of the form, "What happens when...?" or, "What is the effect of...?". For example, an educator may wonder what would happen to test scores if the required lab time for a chemistry course was increased from three hours to six hours per week. To answer such questions, an **experiment** is carried out to collect relevant data.

DEFINITION

Observational study: A study in which characteristics of a sample selected from one or more existing populations are observed. The goal of an observational study is usually to draw conclusions about the corresponding population or about differences between two or more populations. In a well-designed observational study, the sample is representative of the population.

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DEFINITION

Experiment: A study that investigates how a response variable behaves when one or more explanatory variables, also called factors, are manipulated. The usual goal of an experiment is to determine the effect of the explanatory variables (factors) on the response variable. In a well-designed experiment, the composition of the groups that will be exposed to different experimental conditions is determined by random assignment.

3-2 Variables

The value of a response variable (test score in the chemistry example) is recorded under different experimental conditions (three-hour lab and six-hour lab). In an experiment, one or more explanatory variables, also sometimes called factors, define the experimental conditions.

- A well-designed experiment can result in data that provide evidence for a cause-and-effect relationship. This is an important difference between an observational study and an experiment. In an observational study, it is not possible to draw clear cause-and-effect conclusions because we cannot rule out the possibility that the observed effect is due to some variable other than the explanatory variable being studied. Such variables are called **confounding variables**.

DEFINITION

Confounding variable: A variable that is related to both how the experimental groups were formed and the response variable of interest.

Consider the role of confounding variables in the following study. Studies have shown that people over the age of 65 who get a flu shot are less likely to die from a flu-related illness during the following year than those who do not get a flu shot. However, research has shown that people over the age of 65 who get flu shots are also less likely to die from any cause during the following year than those who don't get flu shots. This has led to the speculation that those over the age of 65 who make the effort to get flu shots are generally healthier as a group than those who do not get flu shots. If this is the case, observational studies that compare two groups—those who get flu shots and those who do not—may overestimate the effectiveness of the flu vaccine because general health differs in the two groups. General health is a possible confounding variable in such studies.

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3-3 Sampling

QUICK TIP

This idea is the most important part of your data collection: When choosing a sample of data to measure, be very careful to ensure that everything has an equal chance of being the one selected. If you do this, your sample will be very representative of the population as a whole.

- Many methods introduced in this chapter are based on random selection. The most straightforward sampling method is called **simple random sampling**. A simple random sample is a sample chosen using a method that ensures that each different possible sample of the desired size has an equal chance of being the one chosen.

DEFINITION

Simple random sample: A sample chosen using a method that ensures that each different possible sample of the desired size has an equal chance of being chosen.

For example, suppose that Nora wants a simple random sample of 10 employees chosen from everyone at a large design firm where she works. For the sample to be a simple random sample, the method used by Nora to select the sample must ensure that each of the many different subsets of 10 employees are equally likely to be selected. A sample taken from only full-time employees would not be a simple random sample of all employees, because someone who works part-time has no chance of being selected. Although a simple random sample may, by chance, include only full-time employees, it must be selected in such a way that each possible sample, and therefore every employee, has the same chance of being selected.

A number of different methods can be used to select a simple random sample. One way is to put the name or number of each member of the population on different but identical slips of paper. The process of thoroughly mixing the slips and then selecting n slips yields a random sample of size n. This method is easy to understand, but it has obvious drawbacks. The mixing must be adequate, and producing the necessary slips of paper can be extremely tedious, even for relatively small populations.

A commonly used method for selecting a random sample is to first create a list, called a sampling frame, of the objects or individuals in the population. Each item on the list is identified by a number. A table of random digits or a random number generator can then be used to select the sample. A random number generator is an algorithm that produces a sequence of numbers that satisfies properties associated with the notion of randomness. Most statistics software packages and many calculators include a random number generator.

Simple random sampling provides researchers with a sampling method that

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is objective and free of selection bias. In some settings, however, alternative sampling methods may be less costly, easier to implement, and sometimes even more accurate.

QUICK TIP

Cluster sampling can greatly simplify your data collection. When choosing your clusters, be sure that the cluster mirrors what the overall population looks like. Avoid clusters with different population characteristics.

- Sometimes it is easier to select groups of individuals from a population than it is to select individuals themselves. **Cluster sampling** involves dividing the population of interest into non-overlapping subgroups, called clusters. Clusters are then selected at random, and then all individuals in the selected clusters are included in the sample.

DEFINITION

Cluster sampling: Involves dividing the population of interest into non-overlapping subgroups, or clusters, and clusters are then selected at random.

For example, suppose that a large school in Dammam has 600 senior students, all of whom are enrolled in a first period registration class. There are 24 senior classes, each with approximately 25 students. If school administrators wanted to select a sample of about 75 seniors to participate in an evaluation of the school and career advising available to students, they might find it much easier to select three of the senior classes at random and then include all the students in the selected classes in the sample. Then, a survey could be administered to all students in the selected classes at the same time—certainly easier to implement than randomly selecting 75 individual seniors and then administering the survey to these students. Because whole clusters are selected, the ideal situation for cluster sampling is when each cluster mirrors the characteristics of the population. When this is the case, a small number of clusters results in a sample that is representative of the population.

- **Systematic sampling** is a method that can be used when it is possible to view the population of interest as consisting of a list or some other sequential arrangement. A value k is specified (for example, $k = 50$ or $k = 200$). Then, one of the first k individuals is selected at random, after which every kth individual in the sequence is included in the sample. A sample selected in this way is called a 1 in k systematic sample.

DEFINITION

Systematic sampling: A way to randomly select a sample from a population to avoid sampling error.

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For example, a sample of Safiya's customers might be selected from her client database. One of the first $k = 20$ customers listed could be selected at random, and then every 20th customer after that on the list would also be included in the sample. This would result in a 1 in 20 systematic sample. The value of k for a 1 in k systematic sample is generally chosen to achieve a desired sample size. For example, in Safiya's customer database scenario just described, if there were 900 customers, the 1 in 20 systematic sample described would result in a sample size of 45. If a sample size of 100 was desired, a 1 in 9 systematic sample could be used (because 900/100 = 9). As long as there are no repeating patterns in the population sequence, systematic sampling works reasonably well.

QUICK TIP

In spite of being a very poor way to form a sample, convenience sampling is commonly used in business. Sometimes, this is due to restrictions or constraints. If you have to use a convenience sample, give careful thought to how you can randomize elements of it.

- It is often tempting to resort to **convenience sampling**—that is, using an easily available or convenient group to form a sample. This is a recipe for disaster! Results from such samples are rarely informative, and it is a mistake to try to generalize from a convenience sample to any larger population.

DEFINITION

Convenience sampling: Using an easily available or convenient group to form a sample.

One common form of convenience sampling is sometimes called **voluntary response sampling**. Such samples rely entirely on individuals who volunteer to be a part of the sample, often by responding to an advertisement, calling a publicized telephone number to register an opinion, or completing a pop-up online survey. It is extremely unlikely that individuals participating in such voluntary response surveys are representative of any larger population of interest.

DEFINITION

Voluntary response sampling: A form of convenience sampling. Relies on individuals who volunteer to be part of the sample, e.g., by completing an online survey.

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YOU TRY IT

Research examples of sampling methods online. Using either real examples or hypothetical situations to illustrate your answer, describe an example of each of the following:

- simple random sampling
- systematic sampling
- cluster sampling
- convenience sampling
- voluntary response sampling.

For each example, explain the benefits and drawbacks of using that particular sampling method. Explain whether every sampling method is appropriate for every situation.

REVIEW QUESTIONS

1. **A research study was conducted to identify relationships between physical activity during the teenage years, middle age, and potential cognitive impairment later in life. 9,000 women who were being seen at a large mental-health clinic were asked about their levels of physical activity as teenagers and at ages 30 and 50. Data about the subjects' mental health were also collected as part of the process. A press release about this study generalized the results of this study to all women. In the press release, the researcher who conducted the study is quoted as saying, "Our study shows that women who are regularly physically active at any age have lower risk of cognitive impairment than those who are inactive, but that being physically active as a teenager is most important in preventing cognitive impairment."**
   Answer the following three questions for this observational study.
   a. What is the population of interest?
   b. Was the sample selected in a reasonable way?
   c. Is the sample likely to be representative of the population of interest?
2. **For each of the situations described, state whether the sampling procedure is simple random sampling, cluster sampling, systematic sampling, or convenience sampling.**
   a. All first-year students at a university are enrolled in one of 30 sections of a seminar course. To select a sample of first-years at this university, a researcher selects four sections of the seminar course at random from the 30 sections and all students in the four selected sections are included in the sample.
   b. To obtain a sample of the seniors at a particular high school, a researcher writes the name of each senior on a slip of paper, places the slips in a box and mixes them, and then selects 10 slips. The students whose names are on the selected slips of paper are included in the sample.
   c. To obtain a sample of those attending a football game, a researcher selects the 24th person through the door. Then, every 50th person after that is also included in the sample.

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Chapter 9

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Describing Data with Statistics (Part One)

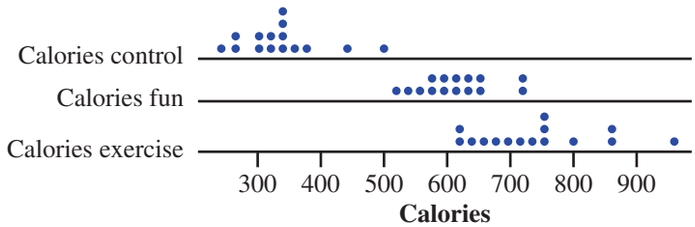
4-1 The Importance of Statistics

Humans can sometimes be irrational when making decisions. This isn't meant as a criticism, but rather an observation about the way our minds tend to process incoming data and information. For example, studies have shown that in some cases people overestimate the extent to which physical exercise can compensate for food consumption. When this happens, people increase food intake more than is justified based on the exercise performed. A group of researchers began to wonder whether even thinking about exercise would lead to increased food consumption, "Just Thinking About Exercise Makes Me Serve More Food: Physical Activity and Calorie Compensation".

They carried out an experiment in which people were offered snacks as a reward for participating in the experiment. People read a short essay and then answered a few questions. In Figure 9-3, some participants read an essay that was unrelated to exercise labeled "Calories control", some read an essay that described listening to music while taking a casual 30-minute walk labeled "Calories fun", and some read an essay that described strenuous exercise labeled "Calories exercise".

Participants were then given two plastic bags and invited to help themselves to two types of sweet and savory snacks. After the participants served themselves, the bags were weighed so that the researchers could determine the number of calories in the snacks that were consumed. The number of calories consumed by each group were used to construct the comparative dot plots shown in the figure below. From the dot plots, it is clear that the number of calories consumed differs from person to person and also tends to be quite a bit higher for those who read about exercise than for those in the control group. To further compare the three distributions, it is helpful to summarize them numerically.

FIGURE 9-3: Dot plot of calories



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4-2 Numerical Summary Measures

Next, we will look at how to calculate numerical summary measures that describe both the center and the extent of variability in a data set.

QUICK TIP

Measures of center are useful because in most things we measure, the data tend to group around this center point. This central measure tells us a lot about the data with a simple figure.

- When describing numerical data, it is common to report a value that is representative of the observations in the data set. Such a number describes roughly where the data are located or "centered" along the number line, and is called a **measure of center**. The two most widely used measures of center are the mean and the median.

DEFINITION

Measure of center: A summary measure that attempts to describe a whole set of data with a single value that represents the middle or center of its distribution.

- The **mean** of a numerical data set is just the familiar arithmetic average: the sum of the observations divided by the number of observations. At this point, it is helpful to introduce notation for the variable on which observations are made, for the number of observations in the data set, and for the individual observations:

x = the variable observed
n = the number of observations in the data set (the sample size)
$x1$ = the first observation in the data set
$x2$ = the second observation in the data set
…
xn = the nth (last) observation in the data set

For example, we might have a sample consisting of $n = 4$ observations on x = time it takes to complete an online hotel reservation (in minutes):

$x1 = 5.9$ $\quad$ $x2 = 7.3$ $\quad$ $x3 = 6.6$ $\quad$ $x4 = 5.7$

Notice that the value of the subscript on x has no relationship to the magnitude of the observation. In this example, $x1$ is just the first observation in the data set and not necessarily the smallest observation, and xn is the last observation but not necessarily the largest.

The sum of $x1, x2, \ldots, xn$ can be denoted by $x1 + x2 + \ldots + xn$, but this can also be written using summation notation. The Greek letter $\sum$ denotes summation. In particular, $\sum x$ denotes the sum of all the x values in the data set under consideration.

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DEFINITION

Sample mean: The sample mean of a sample consisting of numerical observations $x_1, x_2, \ldots, x_n$ is denoted by $\bar{x}$, and its formula is given by

$$\bar{x} = \frac{\text{sum of all observations in the sample}}{\text{number of observations in the sample}} = \frac{x_1 + x_2 + \ldots + x_n}{n} = \frac{\sum x}{n}$$

- The median strip of a highway divides the highway in half, and the median of a numerical data set does the same thing for a data set. Once the data values have been listed in order from smallest to largest, the **median** is the middle value in the list, and it divides the list into two equal parts.

  Depending on whether the sample size n is even or odd, the process for determining the median is slightly different. When n is an odd number (say, 5), the sample median is the single middle value. But when n is even (say, 6), there are two middle values in the ordered list, and we average these two middle values to obtain the sample median.

DEFINITION

Sample median: The sample median is obtained by first ordering the n observations from smallest to largest (with any repeated values included, so that every sample observation appears in the ordered list). Then sample median = the single middle value if n is odd, the average of the middle two values if n is even

- When would you use the median versus the mean to describe a set of data? Consider the following example: A company hosts product information on its Web site for its customers to access. A report showing the number of times that each product information page was accessed during the past week is shown below. The sample size for the Web site access data was $n = 40$, an even number.

  Arranging the data in order from smallest to largest produces the following ordered list (with the two middle values highlighted):

0	0	0	0	0	0	3	4	4	4
5	5	7	7	8	8	8	12	12	**13**
13	13	14	14	16	18	19	19	20	20
21	22	23	26	36	36	37	42	84	331

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QUICK TIP

Because outliers can affect your results, you should treat them thoughtfully. Sometimes you can eliminate the outliers from the data set before you work with it. In other cases, it makes sense to use the median rather than the mean.

The mean of this data set = (sum of the values) / 40 = **23.10**.

Which of these results appears to be a more typical value for the data set? In this example, the median is a better description of the data than the mean. This is due to an "**outlier**", a piece of data that is much larger or smaller than the other values in the data set. The sample mean can be sensitive to even a single value that lies far above or below the rest of the data. The value of the mean is pulled toward such outlying values.

DEFINITION

Outlier: A piece of data in a data set that is much larger or smaller than the other values in the data set, or an experience that is extremely good or bad.

- The **mode** of a data set is the value that appears most often. It is another measure of central tendency, but is less descriptive of the data than either mean or median. In some analyses, it is useful to identify whether a particular value appears more frequently than others.

DEFINITION

Mode: The value in a set of data that occurs most frequently. The mode does not have to be a unique number.

TABLE 9-1: Mean, median, and mode

Mean	Median	Mode
Mean is the average value that is equal to the ratio of sum of values in a data set and total number of values. Mean = Sum of observations / Number of observations.	**Median** is the central value of a given set of values when arranged in an order.	**Mode** is the most repetitive value of a given set of values.
For example, if we have a set of values = 2, 2, 3, 4, 5, then:		
Mean = (2+2+3+4+5)/5 = 3.2	Median = 3	Mode = 2

Example: Number of Visits to a Class Web site

40 students were enrolled in science classes at a local school in Jeddah. The instructor made course materials, grades, and class notes available to students on a class Web site, and the Web server kept track of how often each student accessed any of the Web pages. One month after the course began, the instructor produced a report that indicated how many times each student had accessed

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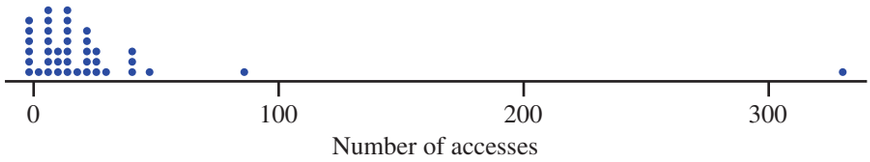
a Web page on the class site. The 40 observations were:

20	37	4	20	0	84	14	36	5	331	19	0
0	22	3	13	14	36	4	0	18	8	0	26
4	0	5	23	19	7	12	8	13	16	21	7
13	12	8	42								

The sample mean for this data set is $x = 23.10$. A dot plot of the data is shown in the figure below. Many would argue that 23.10 is not a very representative value for this sample, because 23.10 is larger than most of the observations in the data set. Notice that only 7 of 40 observations, or 17.5%, are larger than 23.10. The two outlying values of 84 and 331 (no, that was not a typo!) have a substantial impact on the value of x.

FIGURE 9-4: A dot plot of the data in the example



YOU TRY IT

With a friend or family member, count how many times you can throw a ball to each other in one minute. If you don't have a ball, choose another suitable household item. Repeat this exercise a total of ten times, recording your results in the table below. Use the data you have collected to work out the mean, median, and mode (where applicable), showing how you have worked these out.

Go	Number of catches in one minute
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Mean	
Median	
Mode	

REVIEW QUESTIONS

1. **The following are the prices (in Riyals) of the six truck tires rated most highly by a consumer review in 2018:**

   159.00 199.00 157.00 127.65 123.99 126.00

   a. Calculate the values of the mean and median.

   b. Why are these values so different?

   c. Which of the two—mean or median—appears to be better as a description of a typical value for this data set?

2. **A recent medical study reported the sodium content (mg) per serving for each of 11 different brands of peanut butter:**

   120 50 140 120 150 150 150 65 170 250 110

   a. Display these data using a dot plot. Comment on any unusual features of the plot.

   b. Calculate the mean and median sodium content for the peanut butters in this sample.

   c. The values of the mean and the median for this data set are similar. What aspect of the distribution of sodium content—as pictured in the dot plot from Part (a)—provides an explanation for why the values of the mean and median are similar?

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Chapter 9

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Describing Data with Statistics (Part Two)

5-1 Variability

In the previous lesson, we learned how we can simplify our understanding of a large set of data by calculating what the center value of the dataset is. Although this description of the data is very useful, reporting a measure of center gives only partial information about a dataset. It is also important to describe how much the observations differ from one another. When individual data elements are different from each other we say that there is **variability** in the data set. The three different samples displayed in the figure below all have **mean** = **median** = **45**. There is a lot of variability in the first sample compared with the third sample. The second sample shows less variability than the first and more variability than the third. Most of the variability in the second sample is due to the two extreme values being so far from the center.

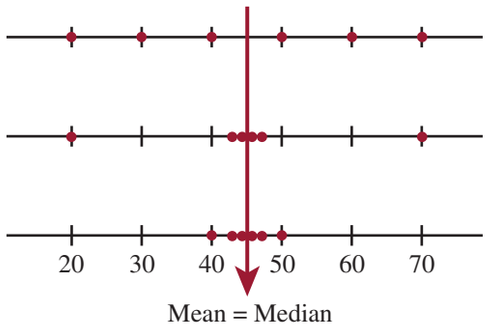
DEFINITION

Variability: The extent to which individual data elements in the data set are different from one another.

FIGURE 9-5: Three samples with the same center and different amounts of variability

Sample

1. 20, 40, 50, 30, 60, 70
2. 47, 43, 44, 46, 20, 70
3. 44, 43, 40, 50, 47, 46



In this example, we can see that the mean and median alone don't fully describe the data. In fact, they are the same for all three samples (= 45), yet we can visually see that the data sets are different. It would be useful to also have a measure that describes how much the data set varies from its central point.

QUICK TIP

If the range of a data set is relatively small, then using the range to describe data can be useful. When the range is large, other techniques are preferred.

- The simplest numerical measure of variability is the **range**. In general, more variability will result in a larger range. However, variability is a characteristic of the entire data set, and each observation contributes to variability. The first two samples plotted above both have a range of 70 – 20 = 50, but there is less variability in the second sample. Because it is calculated using only the largest and smallest values in the data set, the range is not usually the best measure of variability.

DEFINITION

Range: The range of a data set is defined as Range = Largest Value – Smallest Value

- The most widely used measures of variability describe the extent to which the sample observations deviate from the sample mean x. Subtracting x from each observation gives a set of **deviations from the mean**.

DEFINITION

Deviations from the mean: The n deviations from the sample mean are the differences

$(x_1 - \bar{x}), (x_2 - \bar{x}), \ldots , (x_n - \bar{x})$

Notice that a deviation will be positive if the corresponding x value is greater than x and negative if the x value is less than x. To prevent negative and positive deviations from cancelling each other out, we can square them before adding them together into a combined score. Then deviations with opposite signs but with the same magnitude, such as +2 and –2, make identical contributions to a measure of variability.

The squared deviations are $(x_1 - \bar{x})^2, (x_2 - \bar{x})^2, \ldots , (xn - \bar{x})^2$

and the sum is $(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \ldots + (xn - \bar{x})^2 = \sum(x - \bar{x})^2$

Dividing this sum by the sample size n gives the average squared deviation. Although this seems to be a reasonable measure of variability, we use a divisor slightly smaller than n $(n - 1)$.

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QUICK TIP

Variance values tend to be very large with some data sets. Standard deviation is more commonly used as it shows the "typical" deviation from the mean (rather than the larger measure of overall variance).

The calculation of s^2 can be a bit tedious, especially if the sample size is large. Fortunately, many calculators and computer software packages can compute the **variance** and **standard deviation**. The standard deviation can be informally interpreted as the size of a "typical" or "representative" deviation from the mean (see Figure 9-6).

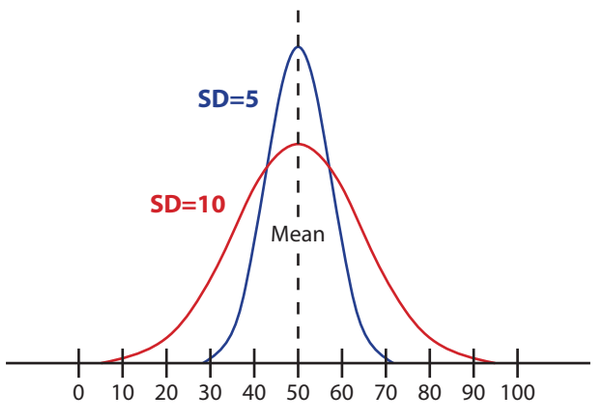
DEFINITIONS

Sample variance: The sample variance, denoted by s^2, is the sum of squared deviations from the mean divided by $n - 1$. That is:

$$s^2 = \frac{\sum(x - \bar{x})^2}{n - 1}$$

Sample standard deviation: The sample standard deviation is the positive square root of the sample variance and is denoted by s.

FIGURE 9-6: Standard deviation from the mean



- As with x, the value of s can be greatly affected by the presence of even a single unusually small or large observation. The **interquartile range** is a measure of variability that is resistant to the effects of outliers. It is based on quantities called quartiles. The **lower quartile** separates the smallest 25% of the data set from the greatest 75%, and the **upper quartile** separates the greatest 25% from the smallest 75%. The middle quartile is the median, and it separates the lower 50% from the upper 50%. Figure 9-7 illustrates the locations of these quartiles for a smoothed histogram.

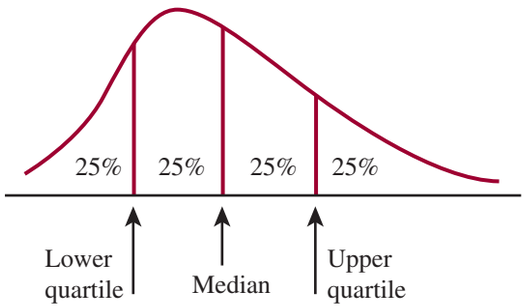
DEFINITIONS

Interquartile range (IQR): A measure of variability that is not as sensitive to the presence of outliers as the standard deviation. The IQR is calculated as:
IQR = upper quartile – lower quartile

Lower quartile: Median of the lower half of the sample.

Upper quartile: Median of the upper half of the sample (if *n* is odd, the median of the entire sample is excluded from both halves when calculating quartiles).

FIGURE 9-7: The quartiles for a smoothed histogram



5-2 Correlation

The relationship between two or more variables is called **correlation**. Correlation can be **positive**, where points in the data set move in the same direction, or it can be **negative**, where the relationship between data points is inverse—they move in the opposite direction.

Table 9-2 shows the attendance rates and test scores of a group of students. Note that, in general, the more days a student attends school, the greater their success.

TABLE 9-2: A group of students' attendance rates and test scores

Student	Attendance (%)	Test scores (%)
Abdullah	95	85
Maryam	74	67
Muhammad	83	81
Ali	87	65
Saad	98	91
Layla	91	94

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DEFINITIONS

Positive correlation: A relationship between two variables that move in the same direction, like a person's height and weight.

Negative correlation: Also called an "inverse relationship"; two related variables move in opposite directions. For example, a higher number of school absences will likely result in lower grades.

YOU TRY IT

Understanding Variability: Head Sizes

Materials needed: Each team will need a measuring tape. For this activity, you will work in teams of 6 to 10 people.

1. Designate a team leader for your team.
2. The team leader should measure and record the head size (measured as the circumference at the widest part of the forehead) of each of the other members of his or her team.
3. Record the head sizes for the individuals on your team as measured by the team leader.
4. Next, each individual on the team should measure the head size of the team leader. Do not share your measurement with the other team members until all team members have measured the team leader's head size.
5. After all team members have measured the team leader's head size, record the different team leader head size measurements obtained by the individuals on your team.
6. Using the data from Step 3, construct a dot plot of the team leader's measurements of team head sizes. Then, using the same scale, construct a separate dot plot of the different measurements of the team leader's head size (from Step 5).

Now use the available information to answer the following questions:

7. Do you think the team leader's head size changed in between measurements? Ask the other members of the team to share the measurements they took. Are they all the same? If not, can you explain why they might be different?
8. Which data set was more variable—head size measurements of the different individuals on your team or the different measurements of the team leader's head size? Explain the basis for your choice.

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9. Consider the following scheme (you don't actually have to carry this out): Suppose that a group of 10 people measured head sizes by first assigning each person in the group a number between 1 and 10. Then person 1 measured person 2's head size, person 2 measured person 3's head size, and so on, with person 10 finally measuring person 1's head size. Do you think that the resulting head size measurements would be more variable, less variable, or show about the same amount of variability as a set of 10 measurements resulting from a single individual measuring the head size of all 10 people in the group? Explain.

REVIEW QUESTIONS

1. The following data are costs (in SAR) per kilogram for nine different brands of dates:

12.90 16.20 13.70 14.10 17.00 18.20 14.70 15.20 14.90

a. Calculate the variance and standard deviation for this data set. (Hint: Use a spreadsheet.)

b. If a very expensive brand of luxury dates with a cost per kilogram of SAR 35.0 was added to the data set, how would the values of the mean and standard deviation change?

2. The price (in SAR) of the eight smartphones that were rated highest in 2022 were:

1,730 2,150 2,130 2,100 1,480 2,300 2,250 3,520

a. Calculate the values of the variance and the standard deviation.

b. The standard deviation is quite large. What does that tell you about the prices of these highly rated smart phones?

3. Look closely at Table 4-2. The data shows a positive correlation between the two variables, but which student's data doesn't fit with the correlation?

a. Muhammad

b. Layla

c. Ali

d. Saad

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Lesson
6
Chapter 9

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Working with Spreadsheets

6-1 The Evolution of Spreadsheets

We live in an era where data are abundant and available. We are constantly connected to the Internet at home, school, and work. Never in human history have so many people had so much access to so much information. Imagine at this very moment if you wanted to know:

- the score from a recent sporting event
- what programs will be on TV this evening
- the price of an item that you would like to buy from a local store.

In a matter of moments, you could use a computer, tablet, or cellphone to find the information you need. Because of rapid advances in computer, Internet, and wireless technology we are accustomed to accessing data on demand—something that was unthinkable a generation ago.

Businesses rely heavily on this abundance of data to guide their decisions and help them shape their strategy. The expression "data-driven decision making" describes how managers and other professionals take actions that are guided by carefully analyzing relevant information. It is no longer acceptable to make important business decisions based on one's own assumptions. As you prepare to start your career and begin to take on professional responsibilities, learning how to use decision-support technology will become very important.

How do professionals manage the large amounts of data they have to work with? How can managers process information quickly enough that they can use it to respond to new challenges and opportunities? A couple of decades ago these were the most significant obstacles to making data-driven decisions. There was simply more data than a human could reasonably be expected to manage and work with. Today there are many different types of decision-support systems available, and one of the most popular is the computer **spreadsheet**.

DEFINITION

Spreadsheet: An electronic file used to arrange data in a grid, which can then be used in calculations.

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SPREADSHEET APPLICATIONS

The first commercial spreadsheet was called VisiCalc ("Visible Calculator"). It was released in 1979 on the Apple computer. It became an instant success with accountants, financial managers, and other people who worked with numeric data. Today, Microsoft's Excel spreadsheet is the market leader. It is available for PCs, Macs, and online in a Web-based format. However, there are other spreadsheet applications including Apple Numbers, Google Sheets, and OpenOffice Calc.

A modern personal computer has the power to work with extremely large sets of data. If the computer is connected to the Internet, it may also be used to access publicly available information from businesses, government, and educational sites. The computer can quickly perform complex calculations and produce detailed solutions and graphic representations of the information. All of the computations are done by the computer itself, which allows the user to focus on how to model the data, what tests to run, and how to analyze and interpret the results.

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If your experience with computer spreadsheets is limited, you can access a tutorial that reviews the basics of this important software tool. Click on the QR code on this page to access this guide.

If you have prior experience with spreadsheets, this lesson will present the basic functions needed to begin using the application as a decision-support system. In this lesson, you will work through a simple example that demonstrates how a spreadsheet may be used to create a model of a real business situation. Then, you will use the model to make important business decisions for the firm. These decisions are more complex than most people could manage if working without a computer. However, you will see in this example how the computer can simplify this process and give you valuable insights and recommendations based on the data you've provided.

When learning something new, one of the best ways to understand it is to actually work with it. In this lesson, you will learn about spreadsheet concepts by actually creating a workbook, populating it with data, performing some basic analyses, and generating a chart. To complete this exercise, you will need to use

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a computer (PC, Mac, Chromebook) and a spreadsheet application. There are several popular options for spreadsheets including Microsoft Excel, Apple Numbers, Google Sheets, and OpenOffice Calc. Each of these spreadsheet applications are similar to each other with only minor differences in the way they look and feel. For the example in this lesson, we will use the popular Excel spreadsheet in Windows.

6-2 Spreadsheet Basics

The intersection of each column and row is a **cell**. A cell is the box, formed by the intersection of a column and a row, where you enter data.

A cell is referred to by its unique address, or **cell reference**, which is the column letter and row number location that identifies a cell within a **worksheet**, such as A1. To identify a cell, specify the column letter first, followed by the row number.

DEFINITIONS

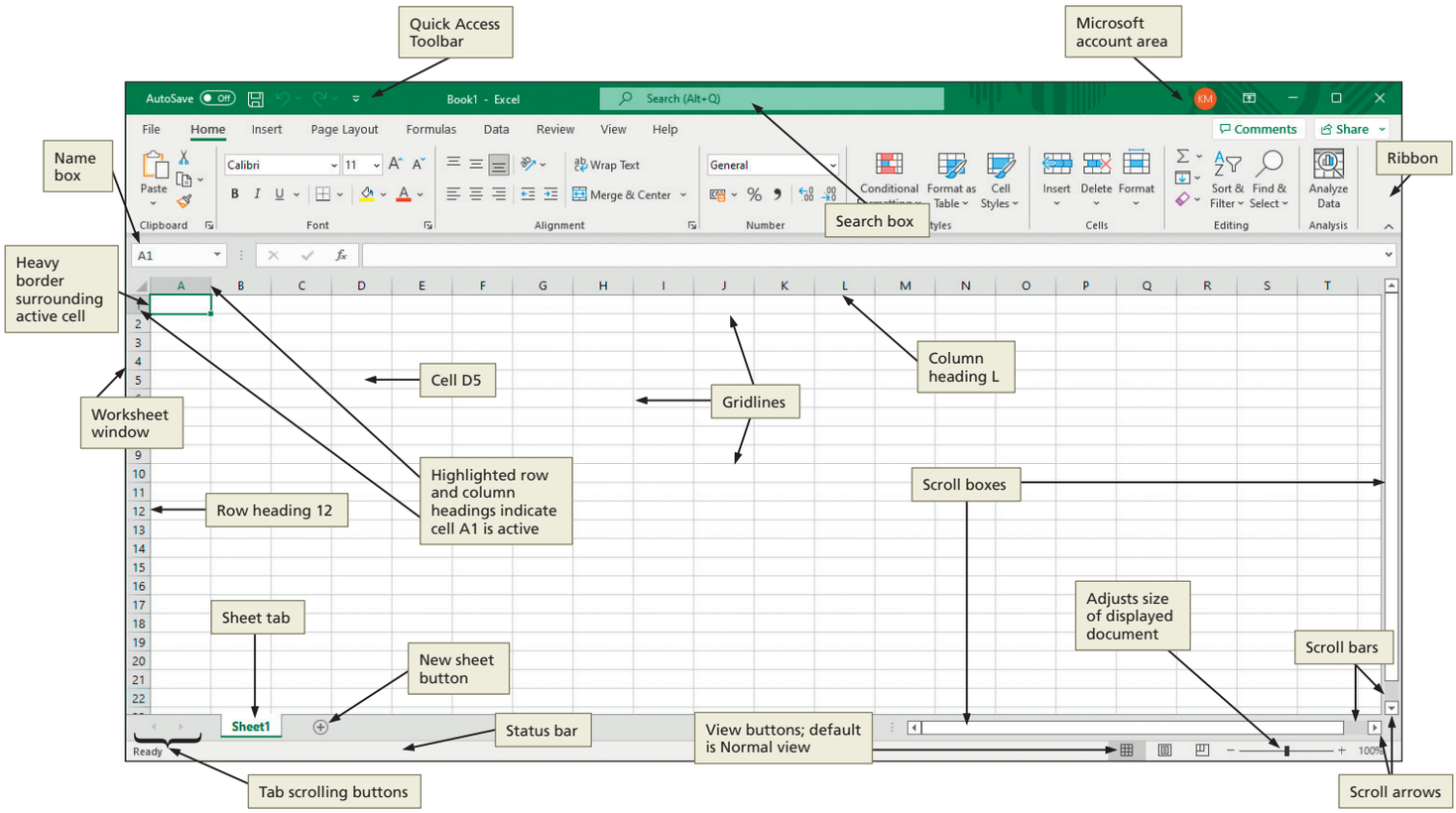
Cell: The intersection of a row and a column in a spreadsheet.

Cell reference: The combination of column letter and row number that identifies a cell on a worksheet.

Worksheet: The basic element of a spreadsheet, made up of rows and columns.

6-3 Worked Example

FIGURE 9-8: A workbook—even a blank one—contains many elements



1. **Enter Text**

   Let's begin this exercise by creating a worksheet for a real estate agency. To do this, follow along with the steps shown below. Common questions are answered at each step.

- Type **Real Estate Company Budget** in cell A1 (Figure 9-9).

Q&A **Why did the appearance of the formula bar change?**
Excel displays the title in the formula bar and in cell A1. When you begin typing a cell entry, Excel enables two additional buttons in the formula bar: the Cancel button and the Enter button. Clicking the Enter button completes an entry. Clicking the Cancel button cancels an entry.

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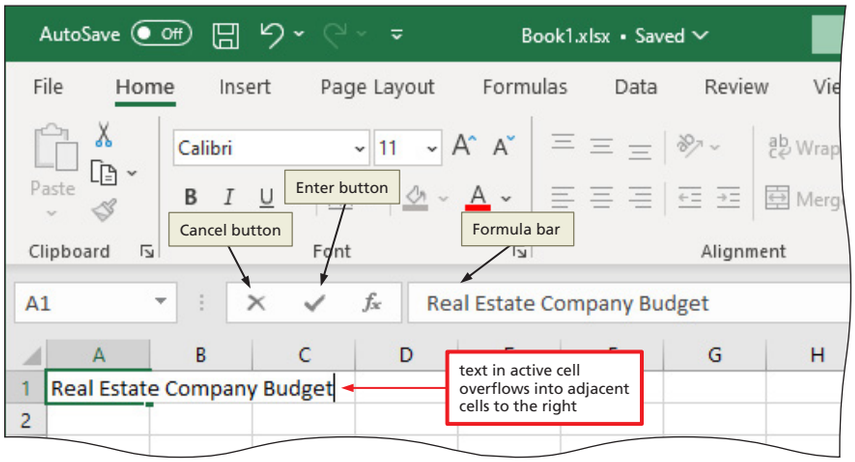
FIGURE 9-9: Making a start by typing into cell A1



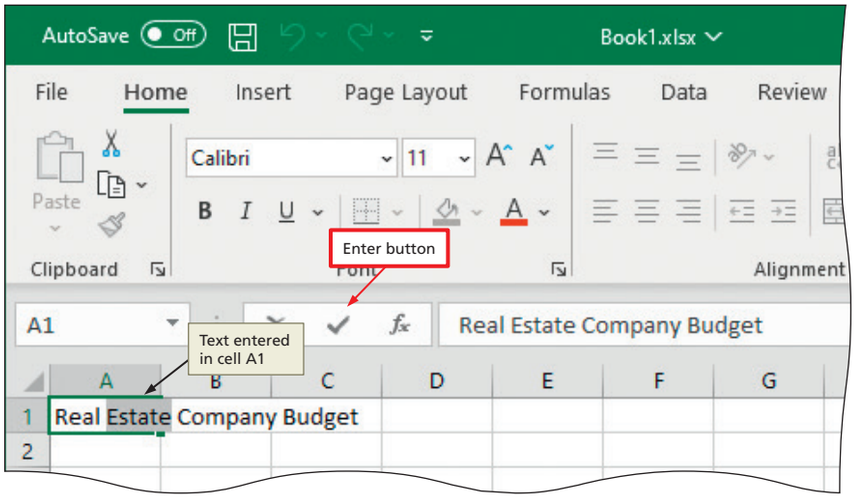
- Click the Enter button in the formula bar to complete the entry and enter the worksheet title (Figure 9-10).

Q&A

Why does the entered text appear in three cells?

When the typed text is longer than the width of a cell, Excel displays the overflow characters in adjacent cells to the right as long as those adjacent cells contain no data. If the adjacent cells contain data, Excel hides the overflow characters. The overflow characters are visible in the formula bar whenever that cell is active.

FIGURE 9-10: Use the Enter button when you've finished typing, or press Enter on the keyboard



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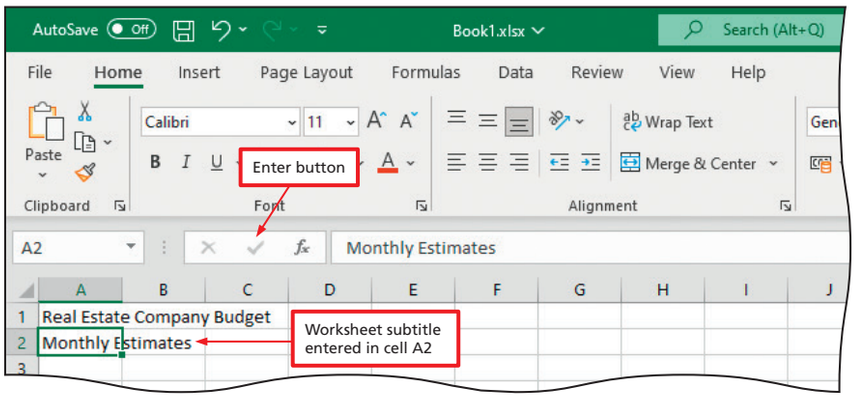
- Click cell A2 to select it.
- Type **Monthly Estimates** as the cell entry.
- Click the Enter button to complete the entry and enter the worksheet subtitle (Figure 9-11).

Q&A **What happens when I click the Enter button?**
When you complete an entry by clicking the Enter button, the cell below the newly filled data cell becomes the active cell.

FIGURE 9-11: Moving from cell A1 to A2 by pressing the Enter button



2. Enter Column Titles

The worksheet is divided into two parts, income and expense, as shown in Figure 4-14. Grouping income and expense data by month is a common method for organizing budget data. The column titles shown in row 3 identify the income section of the worksheet and indicate that the income values will be grouped by month.

Likewise, row 8 is clearly identified as the expense section and similarly indicates that the expense values will be estimated on a per-month basis. The following steps enter the column titles in row 3. Why? Data entered in columns should be identified using column titles to identify what the column contains.

STEP 1

- Click cell A3.
- Type **Income** to begin entry of a column title in the cell (Figure 9-12).

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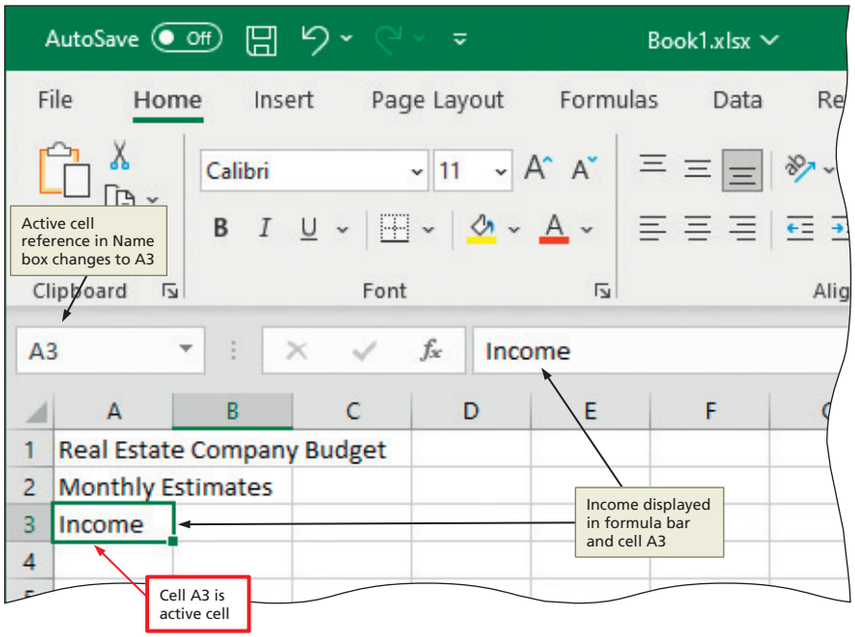
FIGURE 9-12: Entering the first column title in cell A3



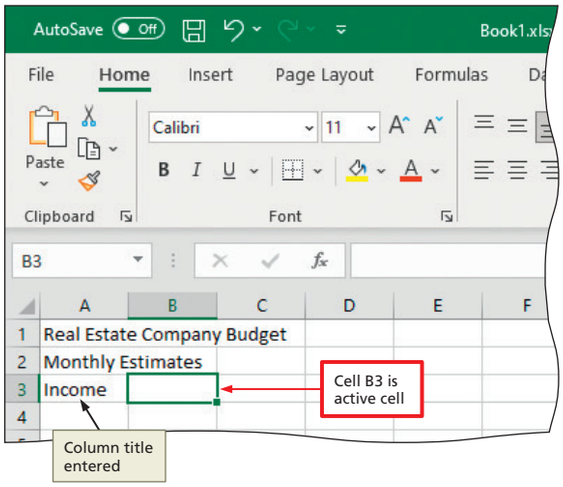
STEP 2

- Press the RIGHT ARROW key to enter the column title and make the cell to the right the active cell (Figure 9-13).

Q&A

Why is the RIGHT ARROW key used to complete the entry in the cell?
Pressing an arrow key to complete an entry makes the adjacent cell in the direction of the arrow (up, down, left, or right) the next active cell. However, if your next entry is in a non-adjacent cell, you can complete your current entry by clicking the next cell in which you plan to enter data. You also can press ENTER and then click the appropriate cell for the next entry.

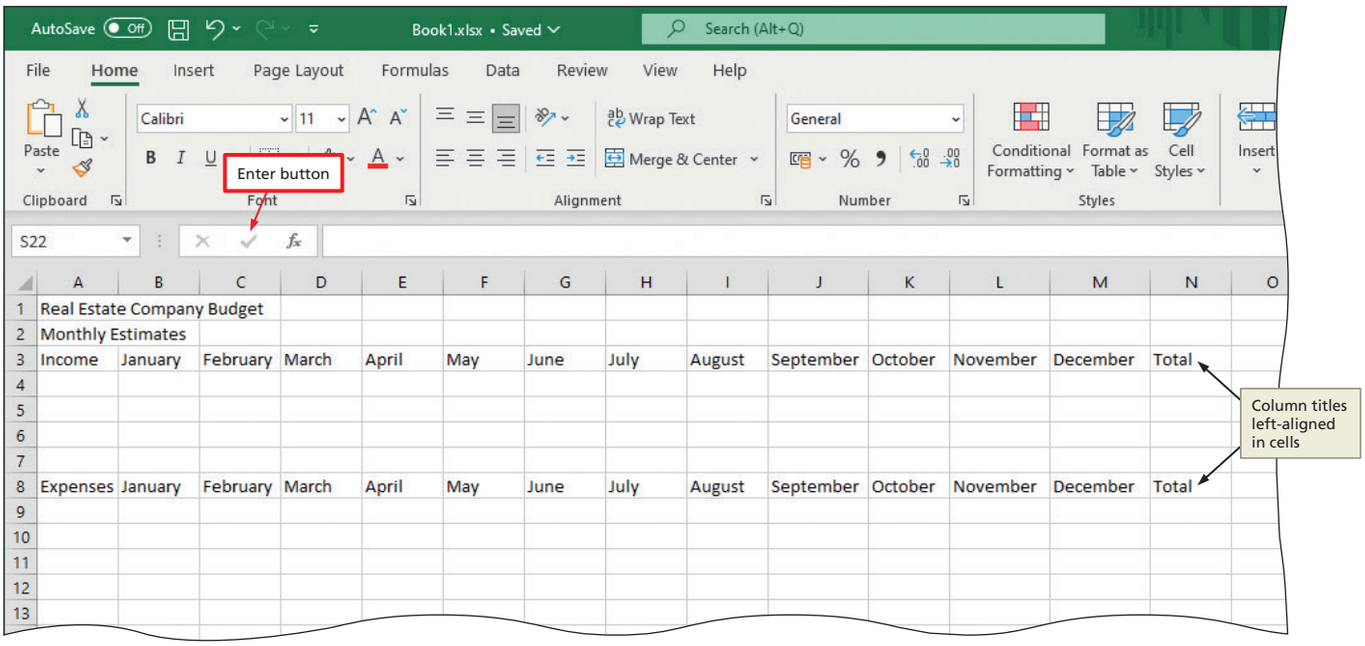
FIGURE 9-13: Moving between cells by using the arrow keys



STEP 3

- Repeat Steps 1 and 2 to enter the remaining column titles; that is, enter **January** in cell B3, **February** in cell C3, **March** in cell D3, **April** in cell E3, **May** in cell F3, **June** in cell G3, **July** in cell H3, **August** in cell I3, **September** in cell J3, **October** in cell K3, **November** in cell L3, **December** in cell M3, and **Total** in cell N3 (complete the last entry in cell N3 by clicking the Enter button in the formula bar).
- Click cell A8 to select it.
- Repeat Steps 1 and 2 to enter the remaining column titles: **Expenses** in cell A8, **January** in cell B8, **February** in cell C8, **March** in cell D8, **April** in cell E8, **May** in cell F8, **June** in cell G8, **July** in cell H8, **August** in cell I8, **September** in cell J8, **October** in cell K8, **November** in cell L8, **December** in cell M8, and **Total** in cell N8 (complete the last entry in cell N8 by clicking the Enter button in the formula bar) (Figure 9-14).

FIGURE 9-14: Completing the list of column titles



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3. **Enter Row Titles**

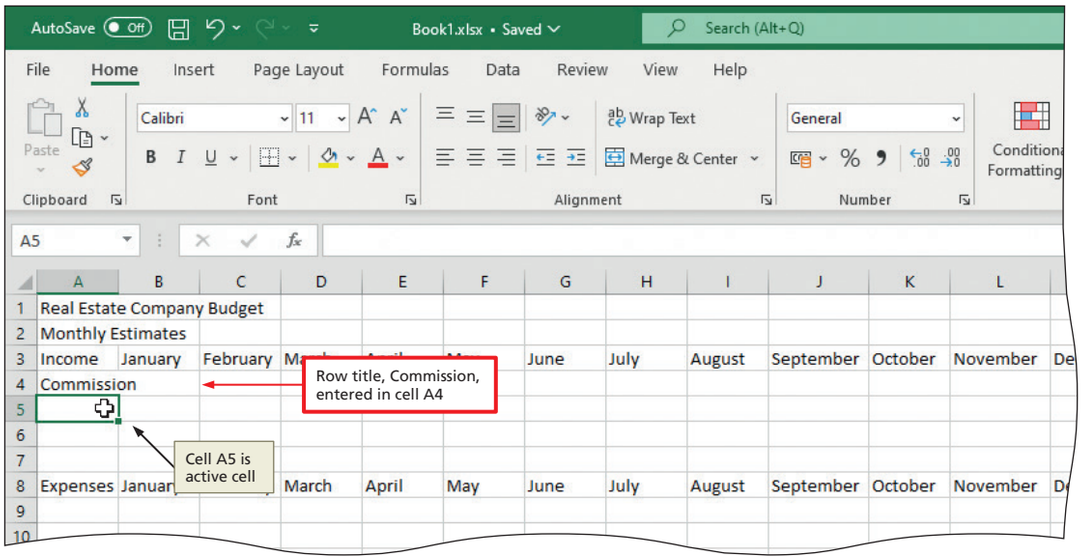
The next step in developing the worksheet for this project is to enter the row titles in column A. For the real estate budget worksheet data, the row titles contain a list of income types and expense types.

Each income or expense item should be placed in its own row. Why? Entering one item per row allows for maximum flexibility, in case more income or expense items are added in the future. The following steps enter the row titles in the worksheet.

STEP 1

- Click cell A4 to select it.
- Type **Commission** and then click cell A5 or press the DOWN ARROW key to enter a row title (Figure 9-15).

FIGURE 9-15: Navigate from cell A4 to cell A5 by clicking on A5 or pressing the DOWN ARROW key



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STEP 2

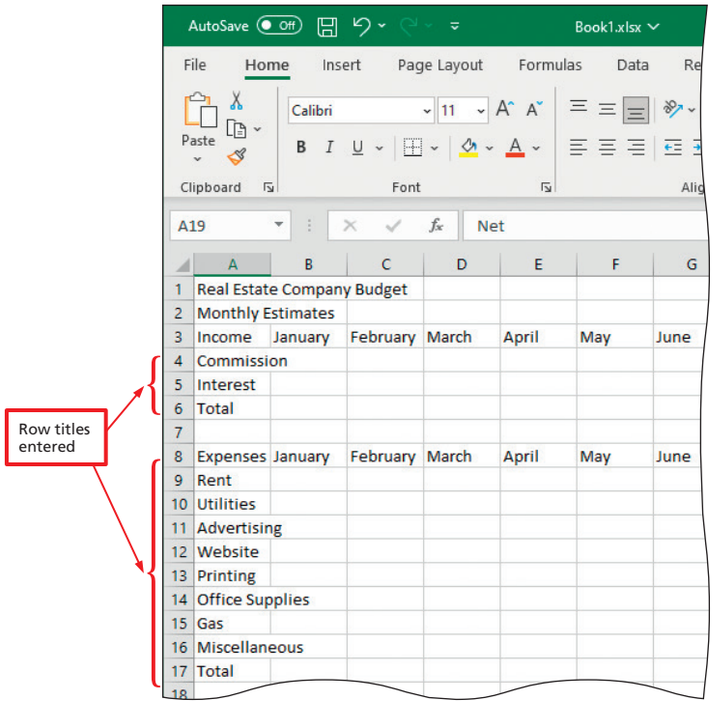
- Repeat Step 1 to enter the remaining row titles in column A; that is, enter **Interest** in cell A5, **Total** in cell A6, **Rent** in cell A9, **Utilities** in cell A10, **Advertising** in cell A11, **Web site** in cell A12, **Printing** in cell A13, **Office Supplies** in cell A14, **Gas** in cell A15, **Miscellaneous** in cell A16, and **Total** in cell A17.

Q&A

Why is the text left-aligned in the cells?

Excel automatically left-aligns the text in the cell. Excel treats any combination of numbers, spaces, and non-numeric characters as text. For example, Excel would recognize the following entries as text: 401AX21, 921–231, 619 321, 883XTY. See Figure 9-16.

FIGURE 9-16: Completing the spreadsheet's row titles



	A	B	C	D	E	F	G
1	Real Estate Company Budget						
2	Monthly Estimates						
3	Income	January	February	March	April	May	June
4	Commission						
5	Interest						
6	Total						
7							
8	Expenses	January	February	March	April	May	June
9	Rent						
10	Utilities						
11	Advertising						
12	Website						
13	Printing						
14	Office Supplies						
15	Gas						
16	Miscellaneous						
17	Total						
18							

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4. **Using Numbers**

   In Excel, you enter a number into a cell to represent an amount or value. A number is an amount or value using any of the following characters: 0 1 2 3 4 5 6 7 8 9 + – ( ) , / . $ E e.

   The use of special characters is explained when they are used in this book. If you are entering numbers that will not be used in a calculation, you should format those numbers as text. You can format numeric data as text by typing an apostrophe before the number(s).

5. **Enter the Numbers**

   The real estate budget worksheet numbers are summarized in Table 9-3. These numbers, which represent yearly income and expense amounts, are entered in rows 4–5 and 9–16. Why? One of the most powerful features of Excel is the ability to perform calculations on numeric data. Before you can perform calculations, you must first enter the data. The following steps enter the numbers in Table 9-3 one row at a time.

TABLE 9-3 Real Estate Company Budget Worksheet

Income	January	February	March	April	May	June	July	August	September	October	November	December
Commission	12000	12000	14000	14000	16000	18500	20000	18500	18500	14000	14000	16500
Interest	100	100	100	100	100	100	100	100	100	100	100	100

Expenses	January	February	March	April	May	June	July	August	September	October	November	December
Rent	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
Utilities	325	325	325	325	325	325	325	325	325	325	325	325
Advertising	400	400	400	400	400	400	400	400	400	400	400	400
Web site	0	0	0	0	0	0	500	0	0	0	0	0
Printing	200	200	200	200	200	200	200	200	200	200	200	200
Office Supplies	200	0	0	200	0	0	200	0	0	200	0	0
Gas	100	100	100	100	100	100	100	100	100	100	100	100
Miscellaneous	250	250	250	250	250	250	250	250	250	250	250	250

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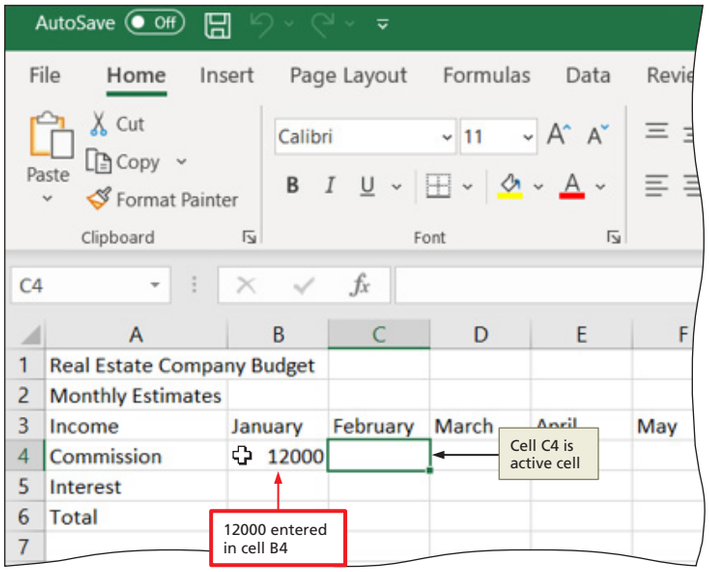
STEP 1

- Click cell B4 to select it.
- Type **12000** and then press the RIGHT ARROW key to enter the data in the selected cell and make the cell to the right (cell C4) the active cell (Figure 9-17).

FIGURE 9-17: Begin to enter data in the corresponding cells



STEP 2

- Refer to Table 9-3 and enter the appropriate values in cells C4, D4, E4, F4, G4, H4, I4, J4, K4, L4, and M4 to complete the first row of numbers in the worksheet (Figure 9-18).

Q&A

Why are the numbers right-aligned?

When you enter numeric data in a cell, Excel recognizes the values as numbers and automatically right-aligns the values in order to vertically align decimal and integer values.

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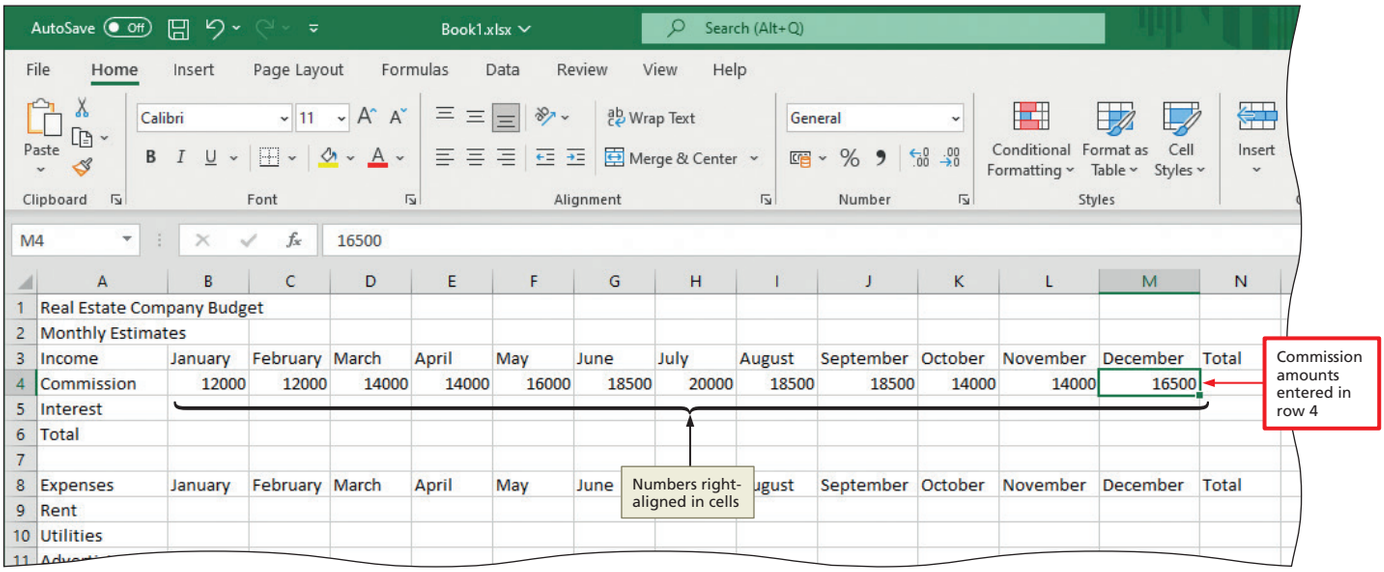
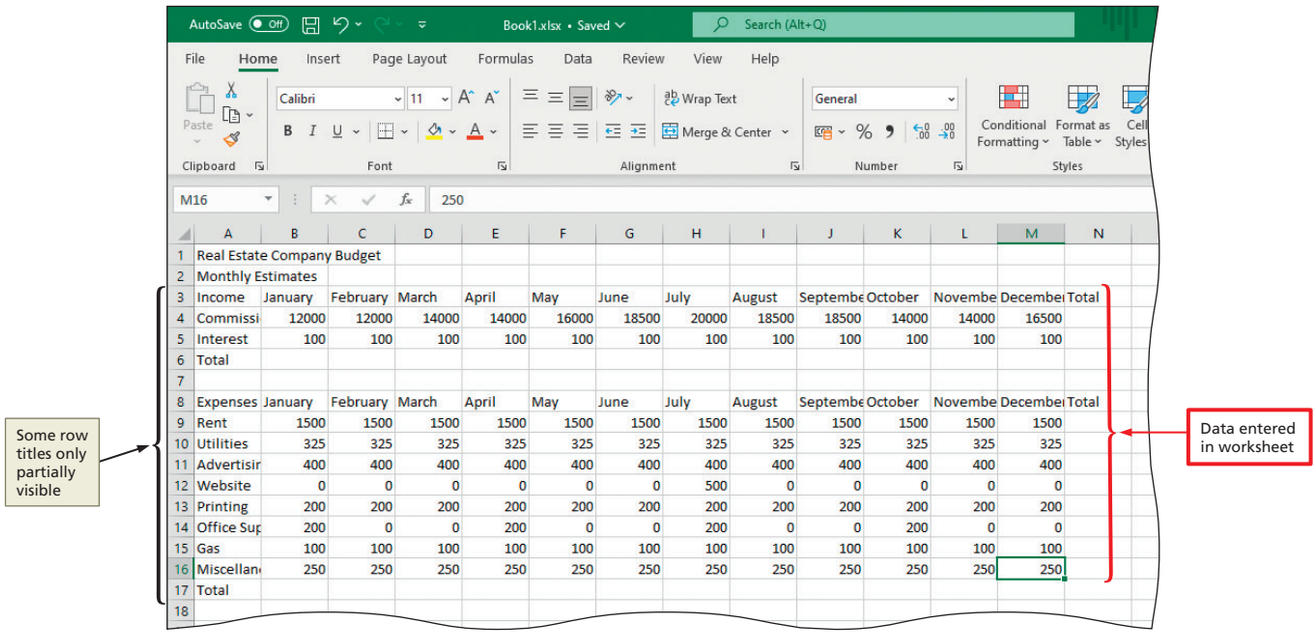
FIGURE 9-18: Note that Excel right-aligns numeric data automatically, making it easier to view and compare



STEP 3

- Click cell B5 to select it and complete the entries below.
- Enter the remaining numbers provided in Table 4-3 for each of the nine remaining budget items in row 5 and rows 9–16 (Figure 9-19).

FIGURE 9-19: Text in cells where text had overflowed across adjacent cells is partially obscured



6. **Calculating Sums and Using Formulas**

The next step in creating the worksheet is to perform any necessary calculations, such as calculating the column and row totals. In Excel, you can easily perform calculations using a **function**. A function is a special, predefined formula that provides a shortcut for a commonly used calculation, for example, SUM or COUNT. When you use functions, Excel performs the calculations for you, which helps to prevent errors and allows you to work more efficiently.

DEFINITION

Function: A pre-defined set of formulas that work together to calculate a commonly-used operation.

7. **Sum a Column of Numbers**

In this workbook, totals are required for each month and each budget item. The first calculation is to determine the total of Commission and Interest income in the month of January (column B).

To calculate this value in cell B6, Excel must add, or sum, the numbers in cells B4 and B5. The SUM function adds all the numbers in a range of cells. Why? The Excel SUM function is an efficient means to accomplish this task.

Many Excel operations are performed on a **range** of cells. A range is a series of two or more adjacent cells in a column, row, or rectangular group of cells, notated using the cell address of its upper-left and lower-right corners, such as B5:C10. For example, the group of adjacent cells B4 and B5 is a range.

DEFINITION

Range: The range of a data set is defined as Range = Largest Value – Smallest Value.

After calculating the total income for January, you will use the fill handle to calculate the monthly totals for income and expenses and the yearly total for each budget item.

A fill handle is a feature in Excel used to extend (or fill) several numbers, dates, or text to other adjacent cells.

The following steps sum the numbers in column B.

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Use the fill handle:

- Move the block arrow to the small square at the bottom right-hand corner of cell B6.
- Click and hold down the mouse and drag across to the right all the way to cell M6. This copies the SUM formula across all the cells selected.

STEP 1

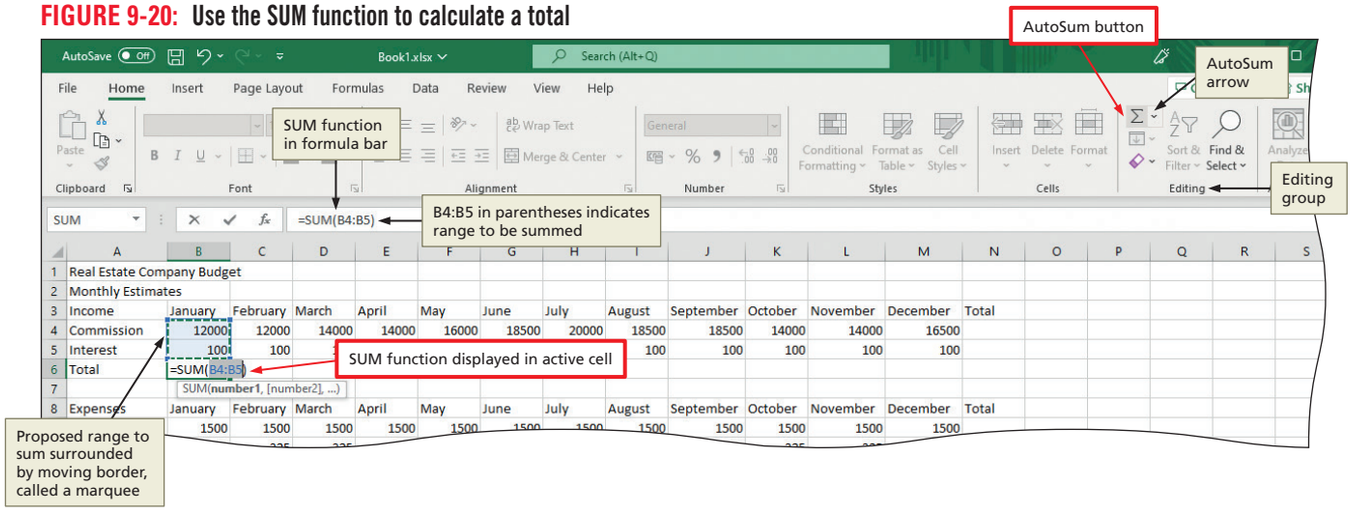
- Click cell B6 to make it the active cell.
- Click the AutoSum button (Home tab | Editing group) to enter a formula in the formula bar and in the active cell (Figure 9-20).

Q&A

What if my screen displays the Sum menu?
If you are using a touch screen, you may not have a separate AutoSum button and AutoSum arrow. In this case, select the desired option (Sum) on the AutoSum menu.

How does Excel know which cells to sum?
Excel automatically selects what it considers to be your choice of the range to sum. When proposing the range, Excel first looks for a range of cells with numbers above the active cell and then to the left. If Excel proposes the wrong range, you can correct it by dragging through the correct range before pressing ENTER. You can also enter the correct range by typing the beginning cell reference, a colon (:), and the ending cell reference.

FIGURE 9-20: Use the SUM function to calculate a total



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STEP 2

- Click the Enter button in the formula bar to enter the sum in the active cell.

Q&A

What is the purpose of the arrow next to the AutoSum button on the ribbon?

The AutoSum arrow (shown in Figure 9-20) displays a list of functions that allow you to easily determine the average of a range of numbers, the number of items in a selected range, or the maximum or minimum value of a range.

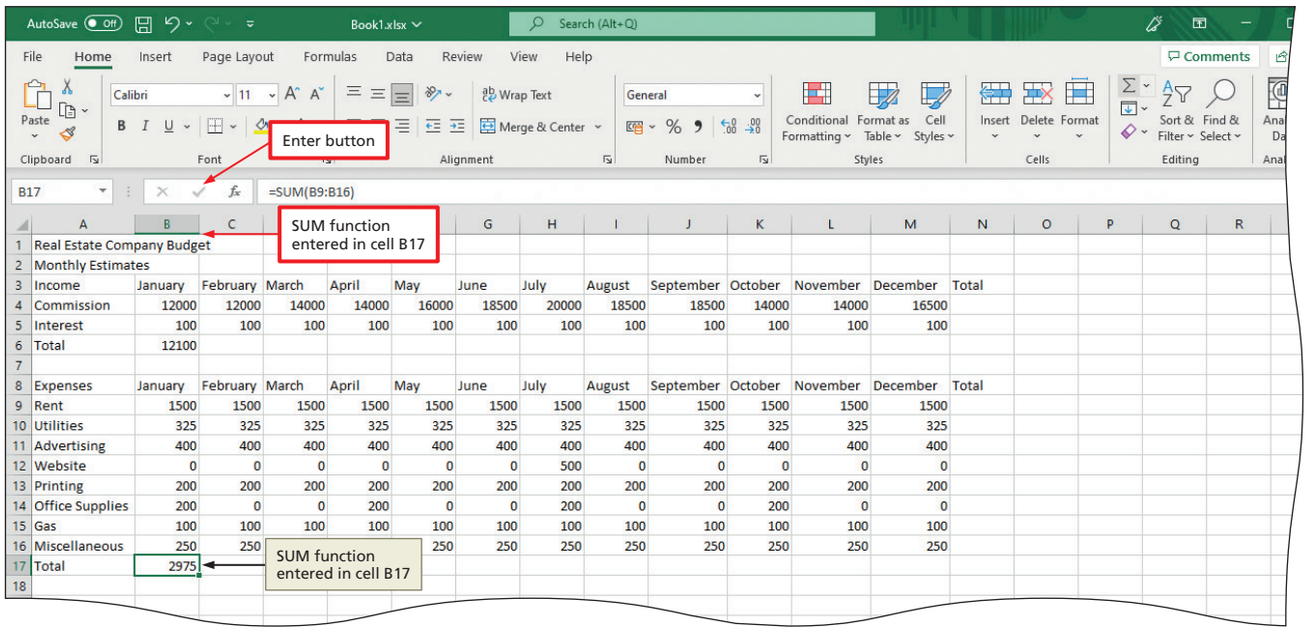
STEP 3

- Use the fill handle to complete the row B6 to M6.

STEP 4

- Repeat Steps 1 and 2 to enter the SUM function in cell B17 (Figure 9-21).

FIGURE 9-21: The SUM function can be used to cover cell ranges of any size



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Real Estate Company Budget													
2	Monthly Estimates													
3	Income	January	February	March	April	May	June	July	August	September	October	November	December	Total
4	Commission	12000	12000	14000	14000	16000	18500	20000	18500	18500	14000	14000	16500	
5	Interest	100	100	100	100	100	100	100	100	100	100	100	100	
6	Total	12100												
7														
8	Expenses	January	February	March	April	May	June	July	August	September	October	November	December	Total
9	Rent	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	
10	Utilities	325	325	325	325	325	325	325	325	325	325	325	325	
11	Advertising	400	400	400	400	400	400	400	400	400	400	400	400	
12	Website	0	0	0	0	0	0	500	0	0	0	0	0	
13	Printing	200	200	200	200	200	200	200	200	200	200	200	200	
14	Office Supplies	200	0	0	200	0	0	200	0	0	200	0	0	
15	Gas	100	100	100	100	100	100	100	100	100	100	100	100	
16	Miscellaneous	250	250			250	250	250	250	250	250	250	250	
17	Total	2975												
18														

STEP 5

- Use the fill handle to complete the row B17 to M17.

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8. **Calculate Multiple Totals at the Same Time**

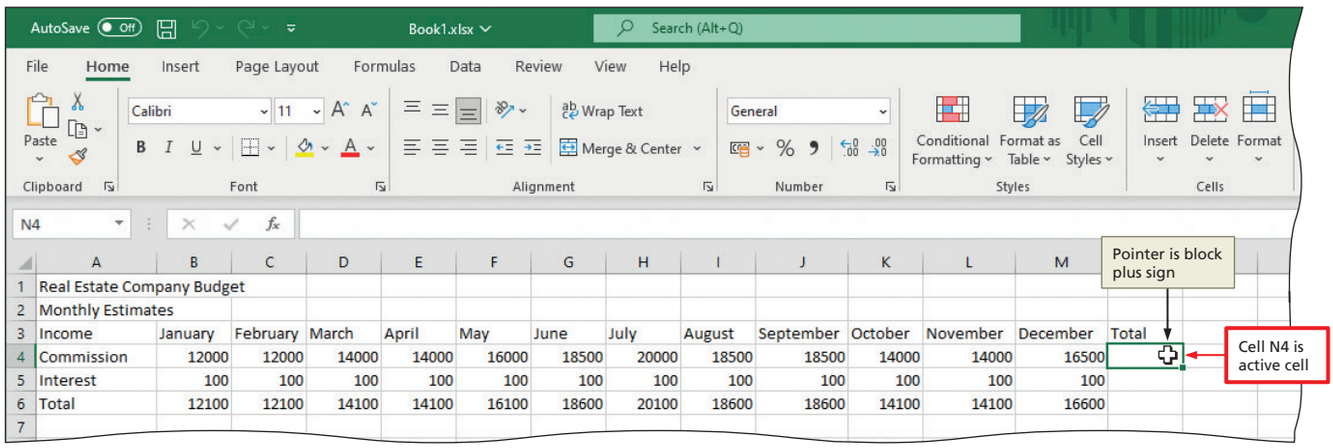
The next step in building the worksheet is to determine the total income, total expenses, and total for each budget item in column N. To calculate these totals you use the SUM function, similarly to how you used it to total the income and expenses for each month in rows 6 and 17.

In this case, however, Excel will determine totals for all of the rows at the same time. Why? By determining multiple totals at the same time, the number of steps to add totals is reduced. The following steps sum multiple totals at once.

STEP 1

- Click cell N4 to make it the active cell (Figure 9-22).

FIGURE 9-22: Using the SUM function across multiple cells

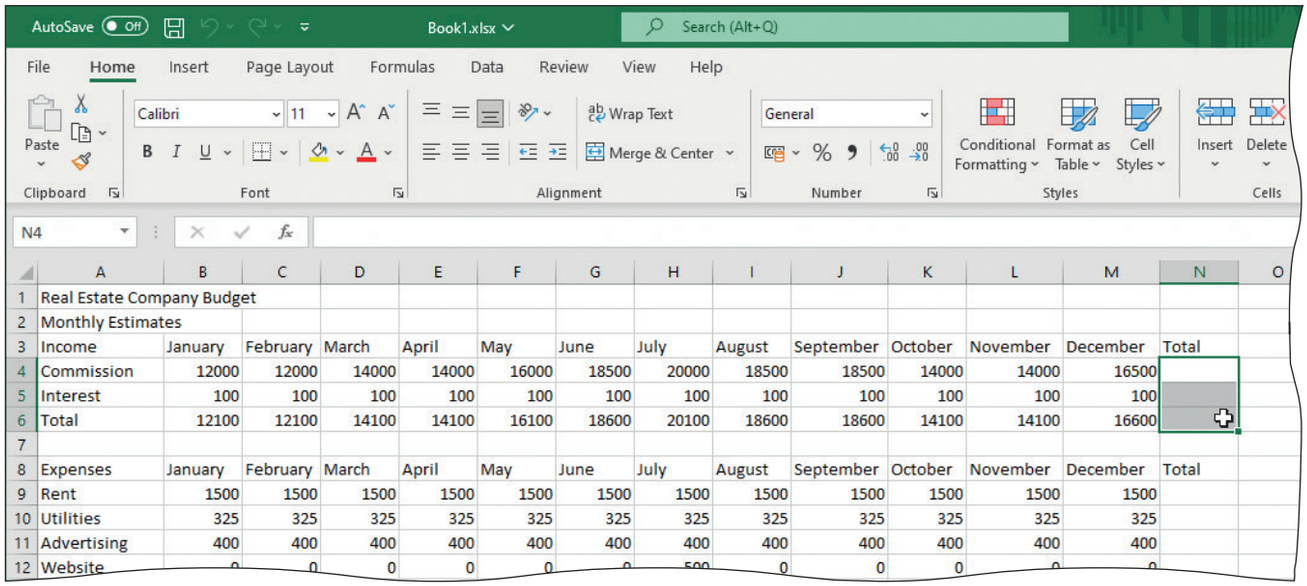


	A	B	C	D	E	F	G	H	I	J	K	L	M	
1	Real Estate Company Budget													
2	Monthly Estimates													
3	Income	January	February	March	April	May	June	July	August	September	October	November	December	Total
4	Commission	12000	12000	14000	14000	16000	18500	20000	18500	18500	14000	14000	16500	
5	Interest	100	100	100	100	100	100	100	100	100	100	100	100	
6	Total	12100	12100	14100	14100	16100	18600	20100	18600	18600	14100	14100	16600	
7														

STEP 2

- With the pointer in cell N4 and in the shape of a block plus sign, drag the pointer down to cell N6 to select the range (Figure 9-23).

FIGURE 9-23: Use the block plus sign pointer to select the cell range



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Real Estate Company Budget													
2	Monthly Estimates													
3	Income	January	February	March	April	May	June	July	August	September	October	November	December	Total
4	Commission	12000	12000	14000	14000	16000	18500	20000	18500	18500	14000	14000	16500	
5	Interest	100	100	100	100	100	100	100	100	100	100	100	100	
6	Total	12100	12100	14100	14100	16100	18600	20100	18600	18600	14100	14100	16600	
7														
8	Expenses	January	February	March	April	May	June	July	August	September	October	November	December	Total
9	Rent	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	
10	Utilities	325	325	325	325	325	325	325	325	325	325	325	325	
11	Advertising	400	400	400	400	400	400	400	400	400	400	400	400	
12	Website	0	0	0	0	0	0	500	0	0	0	0	0	

STEP 3

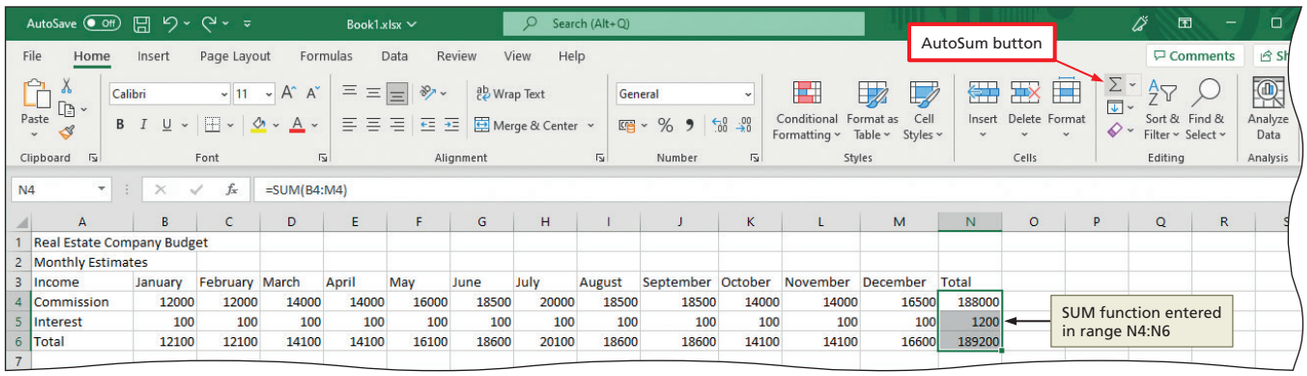
- Click the AutoSum button (Home tab | Editing group) to calculate the sums of all three rows (Figure 9-24).

Q&A

How does Excel create unique totals for each row?

If each cell in a selected range is adjacent to a row of numbers, Excel assigns the SUM function to each cell when you click the Sum button.

FIGURE 9-24: The AutoSum button makes it possible to add a variety of functions to your spreadsheet using fewer clicks



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Real Estate Company Budget													
2	Monthly Estimates													
3	Income	January	February	March	April	May	June	July	August	September	October	November	December	Total
4	Commission	12000	12000	14000	14000	16000	18500	20000	18500	18500	14000	14000	16500	188000
5	Interest	100	100	100	100	100	100	100	100	100	100	100	100	1200
6	Total	12100	12100	14100	14100	16100	18600	20100	18600	18600	14100	14100	16600	189200
7														

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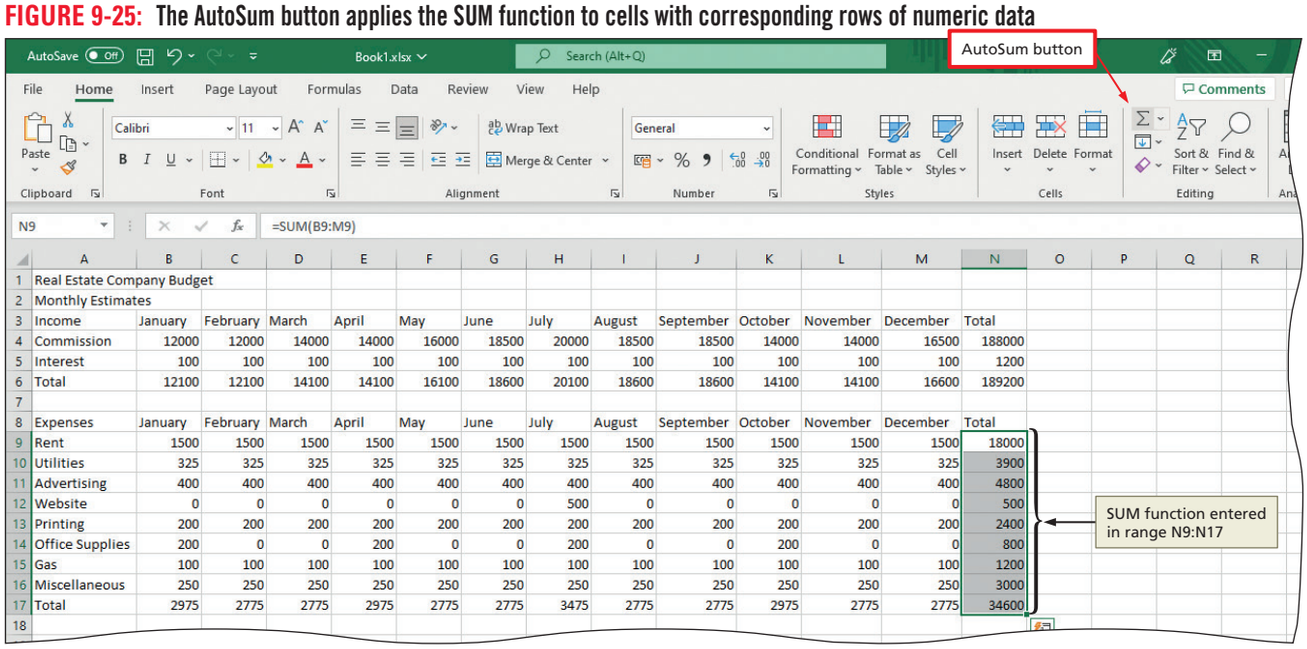
STEP 4

- Repeat Steps 1–3 to select cells N9 to N17 and calculate the sums of the corresponding rows (Figure 9-25).

FIGURE 9-25: The AutoSum button applies the SUM function to cells with corresponding rows of numeric data



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Real Estate Company Budget													
2	Monthly Estimates													
3	Income	January	February	March	April	May	June	July	August	September	October	November	December	Total
4	Commission	12000	12000	14000	14000	16000	18500	20000	18500	18500	14000	14000	16500	188000
5	Interest	100	100	100	100	100	100	100	100	100	100	100	100	1200
6	Total	12100	12100	14100	14100	16100	18600	20100	18600	18600	14100	14100	16600	189200
7														
8	Expenses	January	February	March	April	May	June	July	August	September	October	November	December	Total
9	Rent	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	18000
10	Utilities	325	325	325	325	325	325	325	325	325	325	325	325	3900
11	Advertising	400	400	400	400	400	400	400	400	400	400	400	400	4800
12	Website	0	0	0	0	0	0	500	0	0	0	0	0	500
13	Printing	200	200	200	200	200	200	200	200	200	200	200	200	2400
14	Office Supplies	200	0	0	200	0	0	200	0	0	200	0	0	800
15	Gas	100	100	100	100	100	100	100	100	100	100	100	100	1200
16	Miscellaneous	250	250	250	250	250	250	250	250	250	250	250	250	3000
17	Total	2975	2775	2775	2975	2775	2775	3475	2775	2775	2975	2775	2775	34600
18														

9. Saving the Project

While you are building a worksheet in a workbook, it is important to save the workbook frequently, for the following reasons:

- The worksheet will be lost if the computer is turned off or you lose electrical power while Excel is open.
- If you run out of time before completing your workbook, you can finish your worksheet at a future time without starting over.

Where should you save the workbook? When saving a workbook, you must decide which storage medium to use:

- If you always work on the same computer and have no need to transport your projects to a different location, then your computer's hard drive will suffice as a storage location. It is a good idea, however, to save a backup copy of your projects on a separate medium, such as an external drive, in case the file becomes corrupted or the computer's hard drive fails. The workbooks used in this book are saved to the computer's hard drive.

- If you plan to work on your workbooks in various locations or on multiple computers or mobile devices, then you should save your workbooks on a portable medium, such as a USB flash drive. Alternatively, you can save your workbooks to an online cloud storage service such as OneDrive.

  Save a Workbook. The following steps save a workbook in the Documents library on the hard drive using the file name, Real Estate Budget. Why? You have performed many tasks while creating this project and do not want to risk losing the work completed thus far.

- Click on "File" on the ribbon
- Click on "Save As"
- Click on "Browse'"
- Click on "Documents"
- Click on the "File Name" field and type in "Real Estate Budget"
- Click "Save"

10. Adding a Chart to the Worksheet

Excel includes 17 **chart** types from which you can choose: column, line, pie, bar, area, X Y (scatter), map, stock, surface, radar, tree map, sunburst, histogram, box & whisker, waterfall, funnel, and combo. The type of chart you choose depends on the type and quantity of data you have and the message or analysis you want to convey.

DEFINITION

Chart: Information in the form of a table, graph, or diagram.

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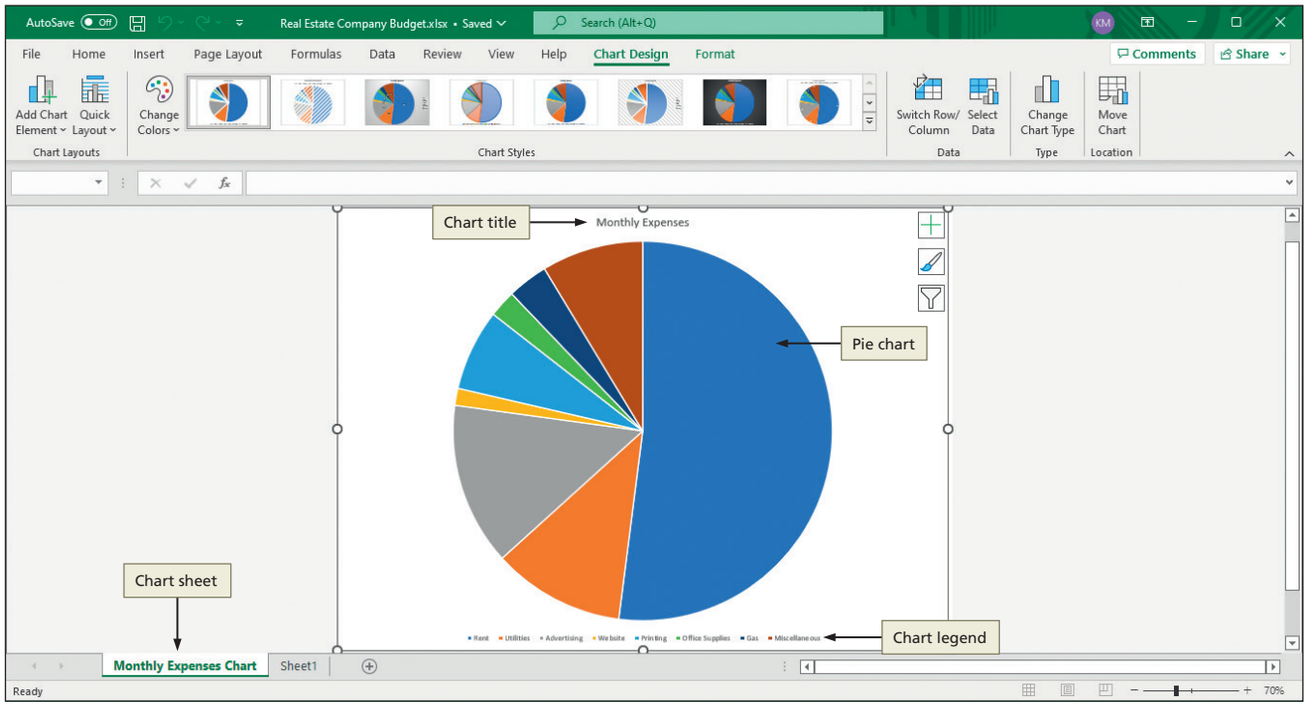
Pie charts show the contribution of each piece of data to the whole, or total, of the data. A pie chart can go even further in comparing values across categories by showing each pie piece in comparison with the others. Your budget worksheet should include a pie chart to graphically represent the yearly expense totals for each item in the Real Estate Company's budget. The pie chart shown in Figure 9-26 is on its own sheet in the workbook. The pie chart resides on a separate sheet, called a chart sheet. A chart sheet is a separate sheet in a workbook that contains only a chart, which is linked to the workbook data.

DEFINITION

Pie chart: A graph of a frequency distribution for a categorical data set. Each category is represented by a slice of the pie, and the area of the slice is proportional to the corresponding frequency or relative frequency.

FIGURE 9-26: Data in a spreadsheet can be converted into visual tools like charts



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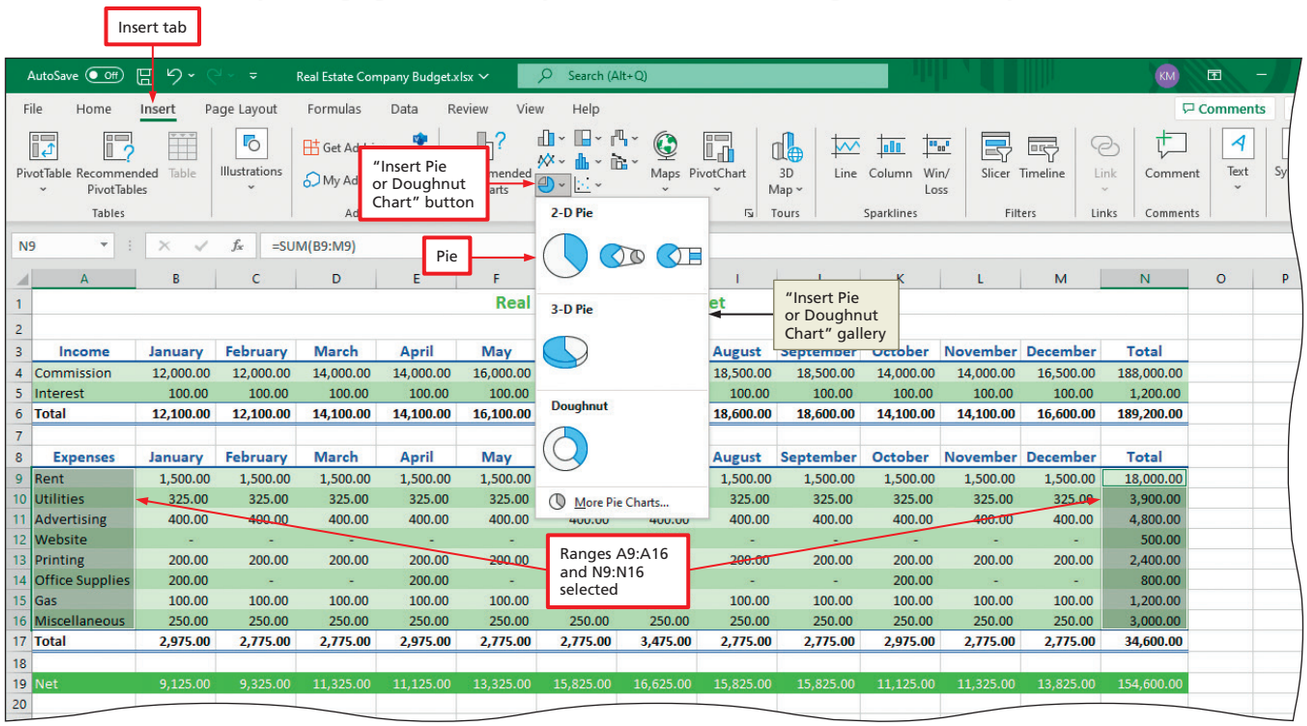
11. Add a Pie Chart

When you want to see how each part relates to the whole, you use a pie chart. Use the following steps to draw the pie chart for your data.

STEP 1

- Select the range A9:A16 to identify the range of the category names for the pie chart.
- While holding down ctrl, select the non-adjacent range N9:N16.
- Click Insert on the ribbon to display the Insert tab.
- Click the "Insert Pie or Doughnut Chart" button (Insert tab | Charts group) to display the Insert Pie or Doughnut Chart gallery (Figure 9-27).

FIGURE 9-27: Make sure you've highlighted all the data you want to use before inserting the kind of chart you want to use



STEP 2

- Click Pie in the 2-D Pie category of the Insert Pie or Doughnut Chart gallery to insert the chart in the worksheet (Figure 9-28).

Q&A **Why have new tabs appeared on the ribbon?**
The new tabs provide additional options and functionality when you are working with certain objects, such as charts, and only display when you are working with those objects.

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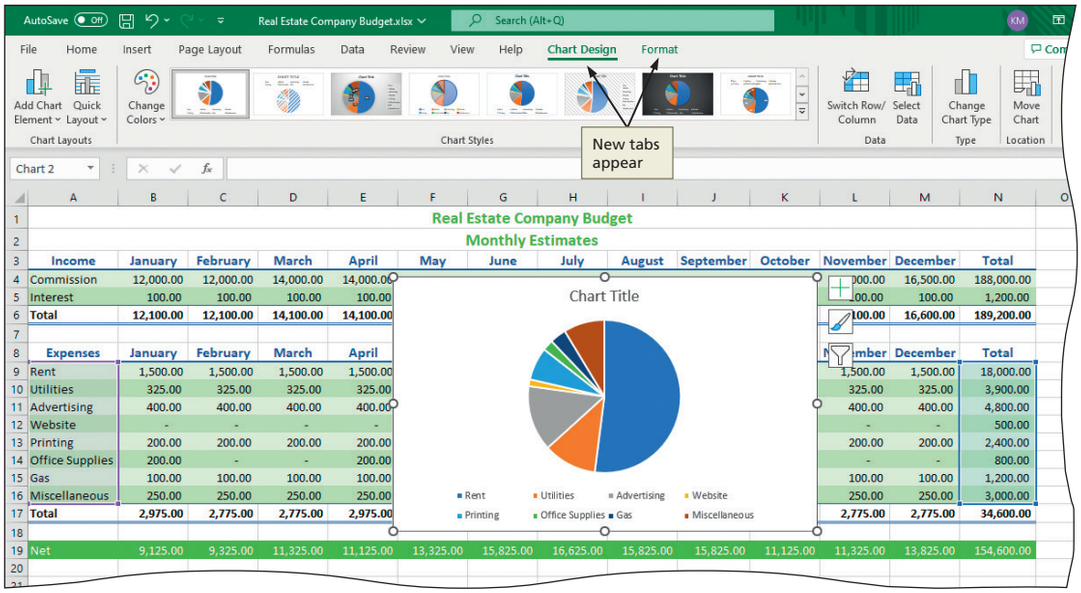
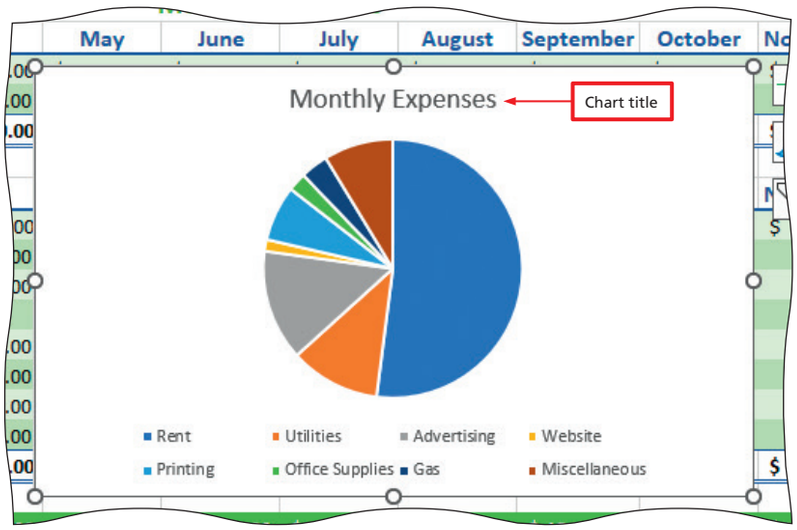
FIGURE 9-28: **You can modify the appearance of the chart using the Chart Design or Format tabs on the ribbon**



STEP 3

- Click the chart title to select it.
- Click and drag to select all the text in the chart title.
- Type **Monthly Expenses** to specify the title.
- Click a blank area of the chart to deselect the chart title (Figure 9-29).

FIGURE 9-29: **Click on the chart title to make any changes**



To create the Chart sheet:

- Click anywhere in the chart box.
- Click on “Chart Design” on the ribbon.
- Click on “Move Chart” (top right).
- Select “New Sheet”; click OK.

To rename your newly created Chart 1 sheet:

- Right click on the tab containing the word Chart 1.
- Scroll to “rename”.
- Over type with: Monthly Expenses Chart.

12. Add a Column or Bar Chart

When you want to compare the total expenses from each month, use a column or bar chart. Use the following steps to draw a column or bar chart for your data.

STEP 1

- Select the range B8:M8 to identify the range of the category names for the column or bar chart.
- While holding down ctrl, select the non-adjacent range B17:M17.
- Click Insert on the ribbon to display the Insert tab.
- Click the “Insert Column or Bar Chart” button (Insert tab | Charts group) to display the Insert Column or Bar Chart gallery (Figure 9-30).

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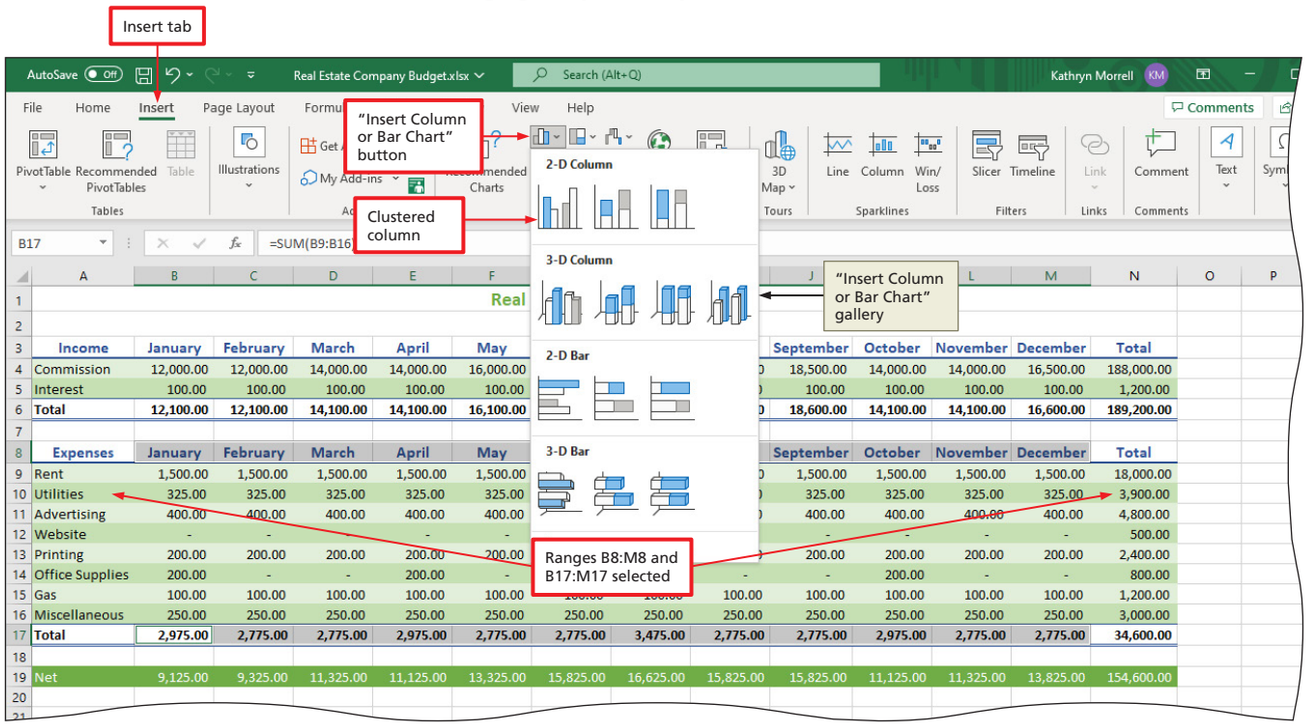
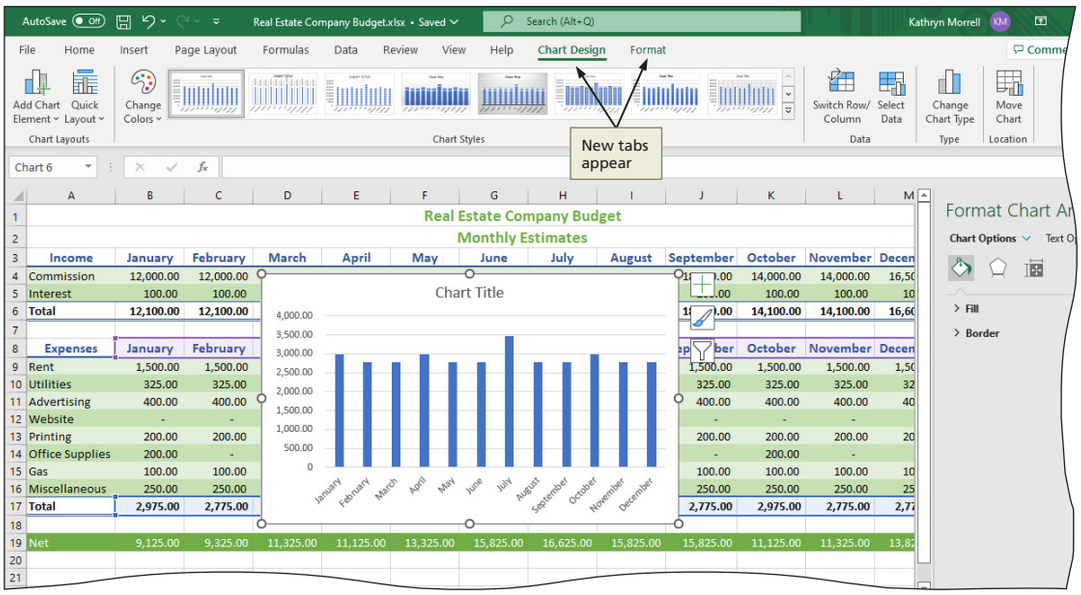
FIGURE 9-30: Highlight only the data you want to use for a bar chart



STEP 1

- Click Clustered column in the 2-D Column category of the Insert Bar or Column Chart gallery to insert the chart in the worksheet (Figure 9-31).

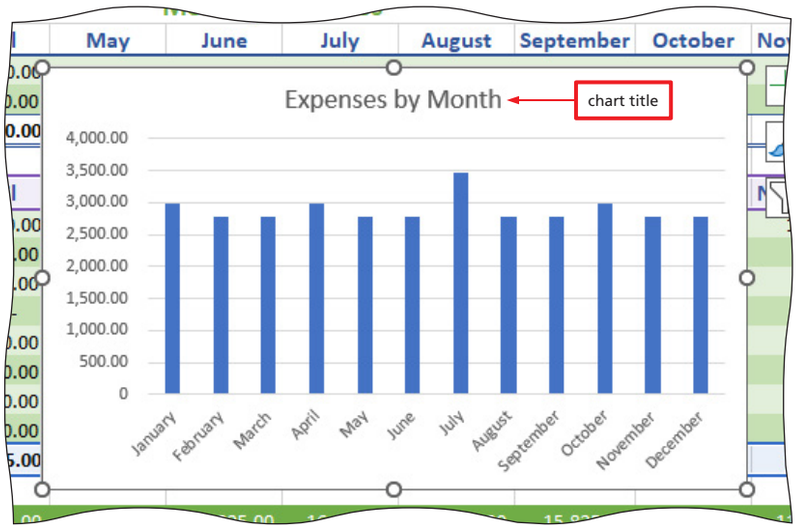
FIGURE 9-31: The bar chart allows the user to easily compare expenses figures each month



STEP 3

- Click the chart title to select it.
- Click and drag to select all the text in the chart title.
- Type Expenses by Month to specify the title.
- Click a blank area of the chart to deselect the chart title (Figure 9-32).

FIGURE 9-32: Changing the chart title



To create the Chart sheet:

- Click anywhere in the chart box.
- Click on “Chart Design” on the ribbon.
- Click on “Move Chart” (top right).
- Select “New Sheet”; click OK.

To rename your newly created Chart 1 sheet:

- Right click on the tab containing the word “Chart 1”.
- Scroll to “rename”.
- Over type with: Expenses by Month Chart.

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13. Calculating Average, Maximum, and Minimum Values

As you learned earlier in this lesson, the **AutoSum** list lets you calculate not only sums but also the average, the number of items, or the maximum or minimum value of a range. You can calculate these using three additional functions: AVERAGE, MAX, and MIN. The **AVERAGE** function calculates the average value in a range of cells, the **MAX** function calculates the maximum value in a range of cells, and the **MIN** function calculates the minimum value in a range of cells. Table 4-4 shows examples of each of these functions.

DEFINITION

AutoSum: Function in a spreadsheet that lets you calculate sums, the average, the number of items, or the maximum or minimum value of a range.

TABLE 9-4 AVERAGE, MAX, and MIN functions

Function	Result
=AVERAGE(H1:H5)	Determines the average of the values in cells H1, H2, H3, H4, and H5
=MAX(H1:H5)	Determines the maximum value entered in cells H1, H2, H3, H4, and H5
=MIN(H1:H5)	Determines the minimum value entered in cells H1, H2, H3, H4, and H5

YOU TRY IT

Use the functions (shown previously) to calculate the Average, Minimum, and Maximum values for each of the Income and Expense categories. To do this, create three new columns (in O, P, and Q). Add column titles (e.g., "Average", "Min", "Max") in cells O3, P3, Q3 and O8, P8, Q8. Remember to adjust the range of data in the functions to match your worksheet values (B:M). Your new columns should show the Average, Min, and Max values for the year.

REVIEW QUESTIONS

1. **The first spreadsheet developed for the personal computer was called:**
   a. Excel
   b. WordStar
   c. dBase
   d. Visicalc
2. **A special, predefined formula that provides a shortcut for a commonly used calculation is a:**
   a. table
   b. function
   c. range
   d. cell
3. **When you want to see how each part relates to the whole, you use a:**
   a. map
   b. scatter diagram
   c. pie chart
   d. bar chart

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Technology @ Work: Online Survey Tools

When you want to survey members of your team, you can use online survey tools to take care of the mechanics of creating and administering online surveys. Survey tools such as Google Survey (https://surveys.google.com/) let you use your Web browser to create surveys. Using online survey tools, you can select the types of questions you want to ask, customize the survey form, collect responses, and then analyze the results. Team members can then use their Web browsers to complete the surveys (Figure 9-33).

1. **Design the survey**

   Using an online survey tool, you can start by naming the survey and then selecting a theme. Next, you enter each survey question. Select the type of question you want to ask, such as multiple choice with one correct answer, a rating scale, or a short answer question, and then enter the question text. Google Survey provides templates to help you create typical types of surveys.

2. **Select how to collect responses**

   After you create a survey, you need to let team members know it's available. Using Google Survey or similar tools, you can generate a link that you paste into an e-mail message or Web page. Team members can open the e-mail message or Web page, and then click the link to display the survey in their Web browser. To manage the questionnaire on Survey Monkey, you can choose whether to allow multiple responses, and set a cut-off date for responses.

3. **Analyze results**

   Online survey tools also collect the responses to your survey, and then analyze the results. For example, online survey tools typically record how many people selected each option for each question on your survey. They also record how many people in total answered the question and how many skipped the question. You can also view the responses in different ways, including as a summary or as a detailed list.

FIGURE 9-33: Creating a survey

YOU TRY IT

Practice using online survey tools. Go to one of the survey Web sites mentioned in this lesson. Create a free account and follow the instructions to create a new survey that asks questions about favorite vacation spots. Send a link to the survey to at least three classmates. After your classmates have completed the survey, analyze the results.

REVIEW QUESTIONS

1. **Which of the following is a task you can perform with an online survey tool?**
   a. create a survey
   b. collect responses
   c. analyze results
   d. all of the above
2. **After you create an online survey, how do team members complete it?**
   a. by using their Web browsers
   b. by printing the survey
   c. by using their e-mail software
   d. by meeting to complete the survey together

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Extra Practice

1. Suppose that the student council at a Saudi university with 15,000 students is interested in the proportion of students who favor a change in the grading system to allow for plus and minus grades (for example, B+, B, B-, rather than just B). 200 students are interviewed to determine their attitude about this proposed change.

a. What is the population of interest?

_____

_____

b. What group of students constitutes the sample in this problem?

_____

_____

_____

_____

2. Classify each of the following variables as either categorical or numerical. For those that are numerical, determine whether they are discrete or continuous.

a. birth order classification (only child, firstborn, middle child, lastborn) of a student

_____

_____

_____

_____

b. brand of computer purchased by a customer

_____

_____

_____

_____

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c. the number of kernels in a bag of microwave popcorn that have not popped after three minutes of cooking

_____

_____

_____

_____

3. A university research team published a report titled "Technical Review of Plagiarism Detection Software". The authors of this report asked faculty at academic institutions about the extent to which they agreed with the statement "Plagiarism is a significant problem in academic institutions." The responses are summarized in the accompanying table. Construct a bar chart for these data.

Response	Frequency
Strongly disagree	5
Disagree	48
Not sure	0
Agree	140
Strongly agree	39

4. Many adolescent boys aspire to be professional athletes. The paper "Why Adolescent Boys Dream of Becoming Professional Athletes" (*Psychological Reports* [1999]:1075–1085) examined some of the reasons. Each boy in a sample of teenage boys was asked the following question: "Previous studies have shown that more teenage boys say that they are considering becoming professional athletes than any other occupation. In your opinion, why do these boys want to become professional athletes?" The resulting data are shown in the following table:

Response	Frequency
Fame and recognition	94
Money	56
Competitiveness	29
Like sports	27
Easy life	24
Don't need education	19
Other	19

Construct a bar chart to display these data.

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5. A psychologist recommends that if you feel the need to check your e-mail in the middle of a movie or if you sleep with your cell phone next to your bed, it might be time to "power off" (*AARP Bulletin*, September 2010).

   Suppose that you want to learn about the proportion of students at your school who would feel the need to check e-mail during the middle of a movie and that you have access to a list of all students enrolled at your school. Describe how you would use this list to select a simple random sample of 100 students.

   _____

   _____

   _____

   _____

6. For each of the situations described below, state whether the sampling procedure is simple random sampling, stratified random sampling, cluster sampling, systematic sampling, or convenience sampling:

   a. To obtain a sample of students, faculty, and staff at a university, a researcher randomly selects 50 faculty members from a list of faculty members, 100 students from a list of students, and 30 staff members from a list of staff.

   _____

   _____

   _____

   _____

   b. A university researcher obtains a sample of students at his university by using the 85 students enrolled in his Accounting class.

   _____

   _____

   _____

   _____

7. A report published the circulation numbers for 15 major international news magazines as follows:

3,284,012	1,469,223	1,214,590	1,046,977	993,04
931,228	905,755	843,914	783,353	574,370
483,360	412,062	147,808	119,297	41,518

Explain why the average may not be the best measure of a typical value for this data set.

_____

_____

_____

_____

_____

_____

_____

Quick Challenge

1. Descriptive statistics is the study of a sample that enables us to make projections or estimates about the population from which the sample is drawn (T or F)?

2. A population is typically a very large collection of individuals or objects about which we desire information (T or F)?

3. A representative sample is a sample obtained in such a way that all individuals had an equal chance of being selected (T or F)?

4. A statistic is the calculated measure of some characteristic of a population (T or F)?

5. The "number of rotten apples per shipping crate" is an example of a categorical variable (T or F)?

6. Classify each of the following variables as nominal, ordinal, discrete, or continuous:

   a. method of payment for purchases (cash, credit card, check)

   _____

   _____

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b. customer satisfaction (very satisfied, satisfied, not satisfied)

_____

_____

c. amount of a purchase

_____

_____

d. number of items purchased

_____

_____

e. student's identification number

_____

_____

7. The mean checkout time for all customers at a local grocery store in Riyadh is to be estimated by using the mean checkout time for 75 randomly selected customers. Match the items with the statistical terms in the columns below:

Data value	the 75 customers
Data	the mean time for all customers
Experiment	two minutes, one customer's checkout time
Parameter	the mean time for the 75 customers
Population	all customers at Corner Convenience Store
Sample	the checkout time for each customer
Statistic	the 75 checkout times
Variable	the process used to select 75 customers and measure their times

Critical Thinking

A "meaningful paragraph" is a coherent piece of writing in an appropriate context that uses all of the listed words. The paragraph should show that you understand the meanings of the terms and their relationships to one another. A sequence of sentences that just defines the terms is not a meaningful paragraph. When choosing a context, think carefully about the terms you need to use. Choosing a good context will make writing a meaningful paragraph easier.

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Write a meaningful paragraph that includes the following six terms: sample, population, descriptive statistics, bar chart, numerical variable, and dot plot.

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Key Skills

The Key Skills section is designed to introduce you to several key concepts and skills that will underpin the rest of your learning this semester. You will also learn some techniques needed to work with complex financial data in a decision-making context, using spreadsheet software.

Key Skills is an opportunity for you to refresh your memory about some of the skills you've learned already in Business Decision Making, as well as to see how these skills support and complement other work you've done with finance. The section provides helpful reminders about the most important concepts that you've seen before, with easy-to-follow, step-by-step instructions to guide you.

You'll learn how to work with:

- key performance indicators (KPIs)
- spreadsheets
- simple and complex formulas
- Scenario Manager
- Solver.

To prepare you for the rest of the semester, you'll be taking a practical, hands-on approach to learning, working through realistic business examples to bring your learning to life. You'll then need to review your learning, demonstrating your critical thinking, independent, and group work skills before moving on to Section 2.

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Chapter 10

Decision Support System Fundamentals

When running a business, a lot of information is generated about budgets, suppliers, cost of production, customers, sales, and much more.

Before this data is processed, the business needs to decide on its objectives: what does it hope to achieve, what information does it need to guide its decisions, and how will it measure success? Businesses use key performance indicators (KPIs) to set goals and track progress. This is when data can be processed so that the business owners can make informed decisions.

A decision support system (DSS) is a computer-based application that assists business decision-makers who deal with unstructured problems. A DSS can represent or "model" the outcomes of different decisions, so that decision makers can test different scenarios before deciding on the best solution to a problem. Some DSS programs even make recommendations on the best solution to a problem.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Explain why business decision makers need to model decisions
2. Apply the principles of modeling to follow a decision-making process
3. Explain the decision-making process using relevant computer programs
4. Test what you've learned by using Scenario Manager

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Lesson
1
Chapter 10

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Spreadsheet-Based Decision Support Systems

Businesses use **decision support systems (DSS)** to help them understand how different decisions will impact the future of the business. DSS are designed to **model** different scenarios so that decision makers can understand and better anticipate what may or may not happen. There are three types of models:

- **Descriptive models** describe a system or a process, providing a simple overview of how something is currently working.
- **Predictive models** use mathematics to examine and estimate how future events or outcomes might be affected by certain conditions and decisions.
- **Prescriptive models** are designed to recommend a course of action for a business by examining detailed data and identifying the options that best support the desired outcome.

In this book we will look at predictive data models.

DSS can be built using computing languages like C++, or spreadsheet software like Excel, Google Sheets, or Power BI. Once a DSS has been developed, the information contained within it can be used to generate reports, scorecards, and interactive **dashboards**, like the example in Figure 10-1.

Spreadsheets offer built-in arithmetic, statistical, and financial functions to support the **data** analysis. Because spreadsheets provide a convenient, flexible, and easily accessible platform for most businesspeople, this book will focus on using Microsoft Excel. As you will see, many kinds of problems, such as those in accounting, operations, and finance, can be modeled using spreadsheets.

DEFINITIONS

Dashboard: A window that graphically summarizes information about how a business is operating.

Data: A collection of uninterpreted information.

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DEFINITIONS

Decision support system (DSS): Interactive software designed to help you compile useful information from raw data, documents, and business knowledge.

Model: *(n.)* A collection of information that shows how an organization is working, or could be working in the future; *(v.)* to produce such a collection of information.

QUICK TIP

Companies will often use a timeframe in which certain goals should be reached, sometimes over several years. Each year is then referred to as Year 1, Year 2, etc.

Business decision makers and managers use **key performance indicators (KPIs)** to track their progress against predetermined objectives.

Imagine it is Year 1 of a three-year period, and you are trying to build a model of a company's net income (the amount of money a business has left over after it has paid its expenses) and cash flow (the total amount of money coming into or going out of the business) for Years 2 and 3 successively.

DEFINITION

Key performance indicator (KPI): A measure used to evaluate the success of an organization in achieving its planned objectives.

FIGURE 10-1: Dashboards are a great way to compile visual representations of the data you have modeled and created

1-1 Forecasting

You need to **forecast** net income and cash flow in those years. This is because decision makers in the business need to know how much money they might make and whether they will meet their KPIs.

DEFINITION

Forecast: A way to predict a future outcome, using relevant data to inform your prediction.

The business is likely to use your forecast to make decisions, so the estimates need to be as accurate as possible. Of course, no one can fully predict the future, so you need to base your estimates on the best and most relevant information available. You decide that the estimates should be based on three factors:

- **Year 1 results:** You choose these because they accurately show how the business has performed so far and are a good indication of how Years 2 and 3 will perform.
- **Estimates of the underlying economic variables:** We can estimate how an economy might behave based on relevant economic indicators.
- **The cost of the products the company sells:** Knowing how much a product costs to make, relative to its selling price, is crucial to understanding how much profit can be made.

Your model will use an income statement and cash flow framework—business indicators in this case. The user can enter values for two possible states of the economy in Years 2 and 3: an "O" for an **optimistic** outlook or a "P" for a **pessimistic** outlook. In this example, we will assume that the economic outlook for both years is optimistic.

DEFINITIONS

Optimism: The belief or hope that things that happen in the future will be good, positive, and useful.

Pessimism: The opposite of optimism; the belief that events in the future will be bad, unhelpful, and negative.

The state of the economy is expected to affect the number of units the company can sell, as well as each unit's selling price. In an optimistic economy, more units can be sold at a higher price. Your model needs to take account of the way

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things like economic conditions will affect demand for your products and what you will be able to sell them for.

The decision maker should be able to enter values into your model to see two possible trends in the cost of goods sold, entering "U" for up or "D" for down. A "U" means that the cost of an item sold will be higher than it was in Year 1; a "D" means it will cost less.

QUICK TIP

"What-if Analysis" is a popular application for spreadsheet models. The decision maker can change the different inputs of the model and see how these changes affect the outcomes. They can try out different options before committing to a particular course of action.

The decision maker can then use the DSS to play *"what if?"* with the **input variables**, changing them to model different scenarios so they can see the effect this will have on net income and cash flow. These variables will be used in equations with the **constants**.

DEFINITIONS

Input variable: A data point that the decision maker can change or influence. For example, the quantity of raw materials purchased, etc.

Constant: A data point in a DSS that is known in advance and will not change, or that the decision maker has no influence over. For example, Lease Payments—these are already established and so are a constant for the purposes of the decision.

The user of the forecast can ask these questions:

- What if the economy is good and costs go up? What will net income and cash flow be in that case?
- What will happen if the economy is bad and costs go down? What will be the company's net income and cash flow in that case?

With a properly designed spreadsheet software model, the answers to such questions can quickly be found.

Scan the QR code to access the workbook (**Chapter 10 data file 1.xlsx**). This workbook will be used in this lesson and Lesson 2.

Before starting the work in this chapter, or if you have forgotten how to work with Microsoft Excel, you can use the second QR code to access a lesson designed to refresh your basic spreadsheet skills.

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DEFINITIONS

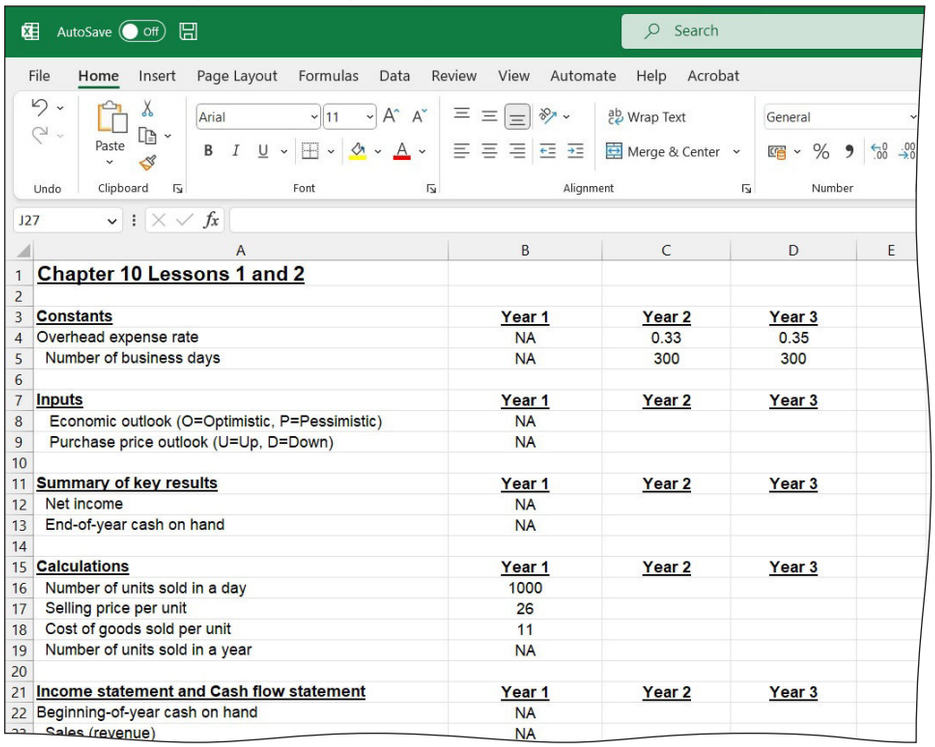
Formula: A mathematical expression of a calculation that your spreadsheet software will complete for you.

Function: A pre-defined set of formulas that work together to calculate a commonly-used operation. For example, =Average(), to calculate the mean of a set of values. The function is much simpler than using all of the individual formulas that would be required to find the average.

QUICK TIP

In the spreadsheet, "NA" means that a cell will not be used in any **formula**. The Year 1 values are only needed for certain calculations, so most of Year 1's cells show NA—which stands for "not applicable."

FIGURE 10-2: The spreadsheet being used by the DSS



	A	B	C	D
1	**Chapter 10 Lessons 1 and 2**			
2				
3	**Constants**	**Year 1**	**Year 2**	**Year 3**
4	Overhead expense rate	NA	0.33	0.35
5	Number of business days	NA	300	300
6				
7	**Inputs**	**Year 1**	**Year 2**	**Year 3**
8	Economic outlook (O=Optimistic, P=Pessimistic)	NA		
9	Purchase price outlook (U=Up, D=Down)	NA		
10				
11	**Summary of key results**	**Year 1**	**Year 2**	**Year 3**
12	Net income	NA		
13	End-of-year cash on hand	NA		
14				
15	**Calculations**	**Year 1**	**Year 2**	**Year 3**
16	Number of units sold in a day	1000		
17	Selling price per unit	26		
18	Cost of goods sold per unit	11		
19	Number of units sold in a year	NA		
20				
21	**Income statement and Cash flow statement**	**Year 1**	**Year 2**	**Year 3**
22	Beginning-of-year cash on hand	NA		
23	Sales (revenue)	NA		

QUICK TIP

When using a Constant or Input value in a calculation you should ALWAYS use a cell reference to point to these values (e.g., =C4). NEVER retype the hard value of constants or inputs in other cells in your spreadsheet. These values should only appear ONCE!

The spreadsheet (Figure 10-2) contains the data we will use for the DSS in this chapter. It contains the following sections:

1. **Constants**

   This section of Figure 10-2 records values that are used in spreadsheet calculations. The constants are the input values used by the model, and they do not change. The constants for this business are Overhead expense rate and Number of business days.

   Overhead expenses are ongoing costs that a business incurs that aren't direct costs or the cost of goods sold. Expenses like rent, insurance, employees' salaries, etc. are all necessary for the business to function. Many companies forecast overhead by expressing it as a percentage of revenue.

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2. **Inputs**

   The inputs shown in Figure 10-2 are for the economic outlook and purchase price outlook (the outlook for input costs). Inputs can be entered for each year. The model covered here is for Years 2 and 3. It will let you enter an "O" (for optimistic) for Year 2's economy in one cell and a "P" (for pessimistic) for Year 3's economy in another cell. Alternatively, one input (of "O" or "P") for the two-year period can be entered in one cell, if the decision maker wants to model a scenario with an optimistic or pessimistic outlook for both years.

3. **Summary of business indicators**

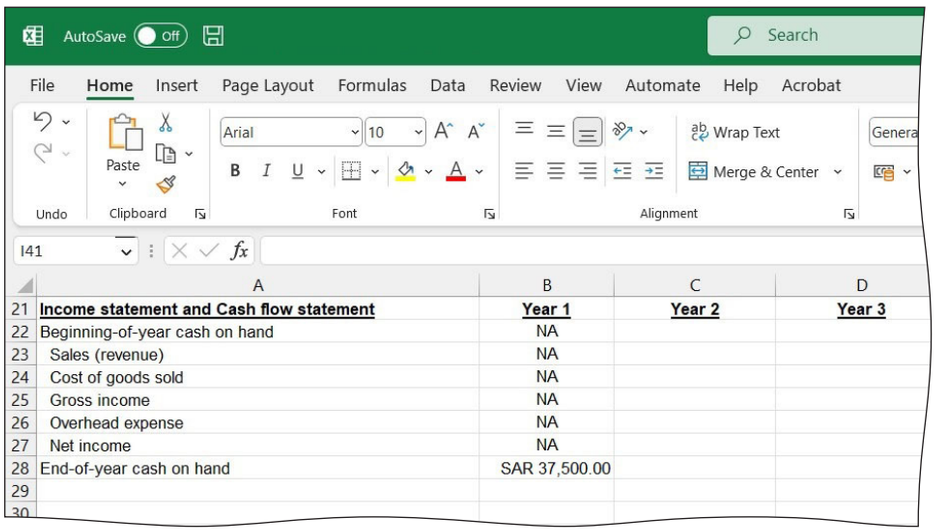
   This section of the spreadsheet captures Years 2 and 3 Net income and End-of-year cash on hand, which are the two outputs in this model. The summary repeats the results in one easy-to-see location. Collecting business indicators in one place also makes for easier charting, which can be done using the Charts menu, under the Insert menu.

4. **Calculations**

   This area is used to compute the following data:

   - the number of units sold in a day
   - the selling price per unit
   - the cost of goods sold per unit
   - the number of units sold in a year.

FIGURE 10-3: The Income statement and Cash flow statement in this lesson's spreadsheet



	A	B	C	D
21	**Income statement and Cash flow statement**	**Year 1**	**Year 2**	**Year 3**
22	Beginning-of-year cash on hand	NA		
23	Sales (revenue)	NA		
24	Cost of goods sold	NA		
25	Gross income	NA		
26	Overhead expense	NA		
27	Net income	NA		
28	End-of-year cash on hand	SAR 37,500.00		
29				
30				

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5. **Business Indicators**

This section (shown in Figure 10-3) is the "body" of the spreadsheet. It shows:

- the beginning-of-year cash on hand
- sales (revenue)
- the cost of goods sold, which is the units sold during the year multiplied by the price paid to acquire or make the unit sold
- gross income before expenses
- overhead expenses, which is the income before overhead
- net income after expenses
- end-of-year cash on hand.

1-2 Constructing the Spreadsheet Model

You already have the spreadsheet (see the QR code on page 355), so you can use this to get started with the formulas. You can enter formulas in any order you choose, but because it is best to enter the simple formulas before moving on to more complex ones, we will start with these.

1. **Entering the "Simple" Formulas**

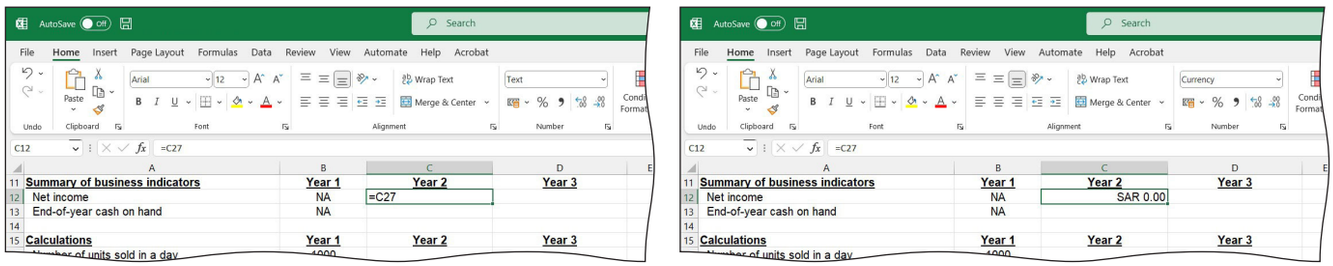
QUICK TIP

With the insertion point in C12, the cell's contents—in this case, the formula **=C27**—appears in the editing window above the lettered column indicators, as shown in Figure 10-4.

STEP 1

- The Summary of business indicators section (see Figure 10-4) echoes results shown in the Cash flow statement. Consider Figures 10-2 and 10-3, and notice that cell C27 in Figure 10-3 contains the Year 2 Net income. You need to echo that amount to cell C12, so the formula in C12 is **=C27** (as shown in Figure 10-4).

FIGURE 10-4: Echoing Year 2 Net income to Summary of business indicators section



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Cell C27 has a zero value, but you can still copy the formula in the cell. Copy cell C12's formula to cell D12. Copying puts **=D27** into D12. Year 3's Net income is in D27, as shown in step 2.

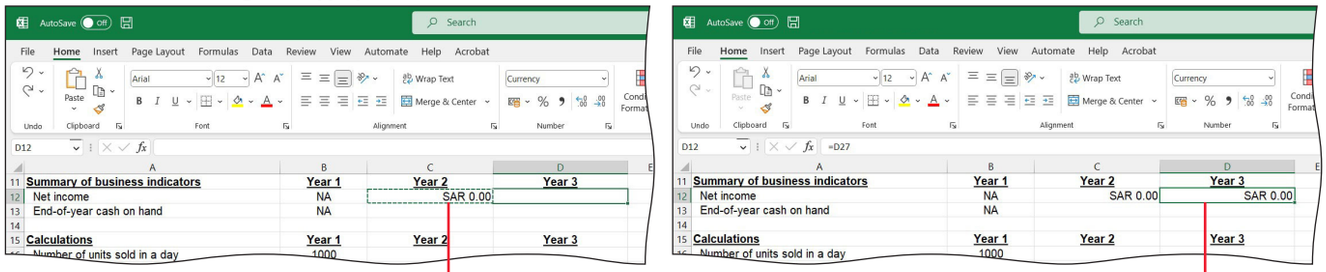
STEP 2

To perform the copy operation (as shown in Figure 10-5), use the following steps:

- Click in the cell or range of cells that you want to copy.
- Press Ctrl+C.
- Select the destination cell.
- Press Ctrl+V.
- Press the Escape key to deactivate the copied cell or range.

QUICK TIP
If the destination for your copy is a range of contiguous cells, select the upper-left cell of the destination range and paste (Ctrl+V).

FIGURE 10-5: Performing the copy operation

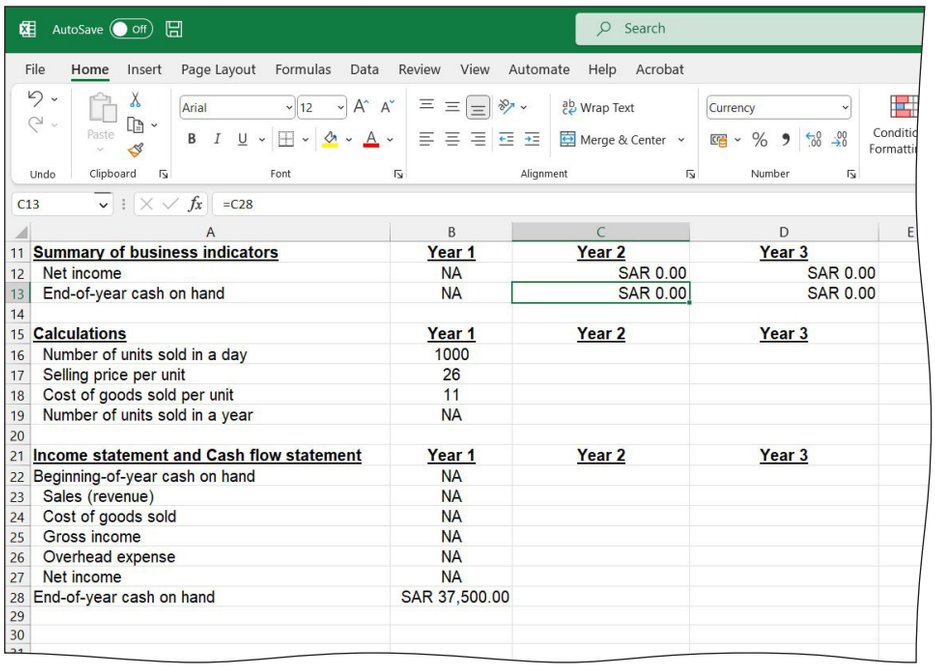


Select the cell(s) you want to copy and press Ctrl+C.

Press Ctrl+V to paste the data into the destination cell(s).

As you can see in Figure 10-6, End-of-year cash on hand for Year 2 is echoed to cell C13. Echo the cash results in cell C28 to cell C13. (Enter the formula **=C28** in cell C13, as shown in Figure 10-6.) Copy the formula from C13 to D13.

FIGURE 10-6: Echoing Year 2 End-of-year cash on hand to Summary of business indicators section



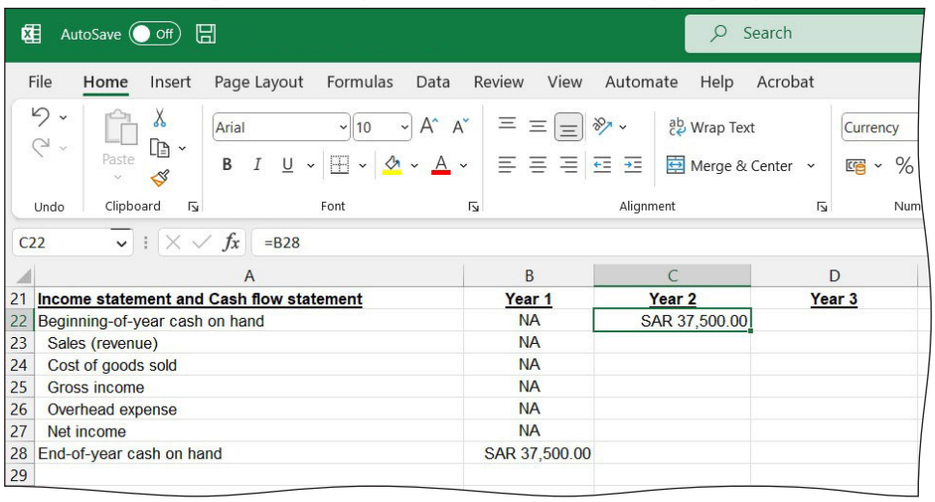
C13 =C28

	A	B	C	D
11	**Summary of business indicators**	**Year 1**	**Year 2**	**Year 3**
12	Net income	NA	SAR 0.00	SAR 0.00
13	End-of-year cash on hand	NA	SAR 0.00	SAR 0.00
14				
15	**Calculations**	**Year 1**	**Year 2**	**Year 3**
16	Number of units sold in a day	1000		
17	Selling price per unit	26		
18	Cost of goods sold per unit	11		
19	Number of units sold in a year	NA		
20				
21	**Income statement and Cash flow statement**	**Year 1**	**Year 2**	**Year 3**
22	Beginning-of-year cash on hand	NA		
23	Sales (revenue)	NA		
24	Cost of goods sold	NA		
25	Gross income	NA		
26	Overhead expense	NA		
27	Net income	NA		
28	End-of-year cash on hand	SAR 37,500.00		
29				
30				

As you can see in Figure 10-7, Beginning-of-year cash on hand is the cash on hand at the end of the prior year. Cell B28 has the End-of-year cash on hand for Year 1. This is because businesses always start the new year with the cash on hand from the previous year.

- In cell C22 for Year 2, type **=B28**, as shown in Figure 10-7.

FIGURE 10-7: Echoing Year 1 End-of-year cash on hand to Year 2 Beginning-of-year cash on hand



C22 =B28

	A	B	C	D
21	**Income statement and Cash flow statement**	**Year 1**	**Year 2**	**Year 3**
22	Beginning-of-year cash on hand	NA	SAR 37,500.00	
23	Sales (revenue)	NA		
24	Cost of goods sold	NA		
25	Gross income	NA		
26	Overhead expense	NA		
27	Net income	NA		
28	End-of-year cash on hand	SAR 37,500.00		
29				

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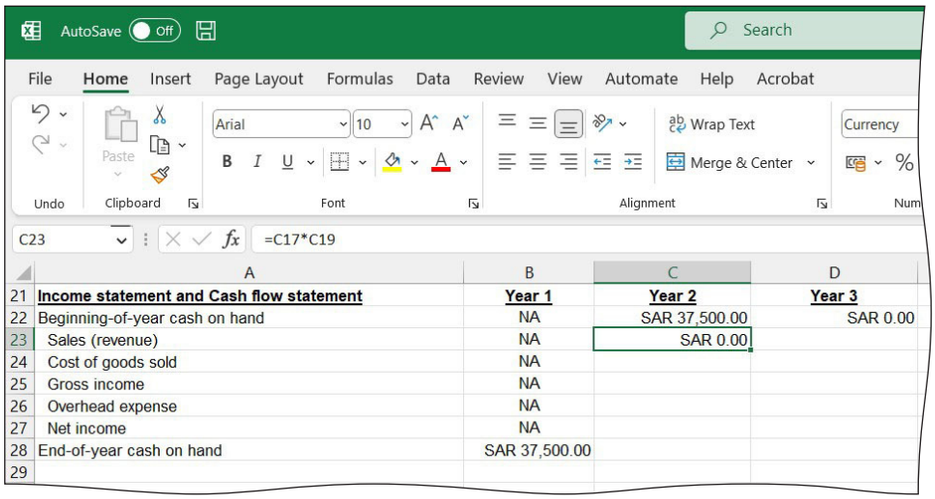
QUICK TIP

A fill handle is a small, square marker in the bottom corner of an active spreadsheet cell or cells, which allows you to copy the cell(s) formula to other adjacent cells.

- Copy the formula in cell C22 to cell D22. Click on the fill handle in the lower right corner of cell C22 and drag it to cell D22.
- In cell C23, enter **=C17*C19**, as shown in Figure 10-8.

  The formula **=C17*C19** multiplies Selling price per unit by the Number of units sold in a year. (Cells C17 and C19 are empty now, which is why Sales shows a zero after the formula is entered.)
- Copy the formula from C23 to cell D23.

FIGURE 10-8: Entering the formula to compute Year 2 sales

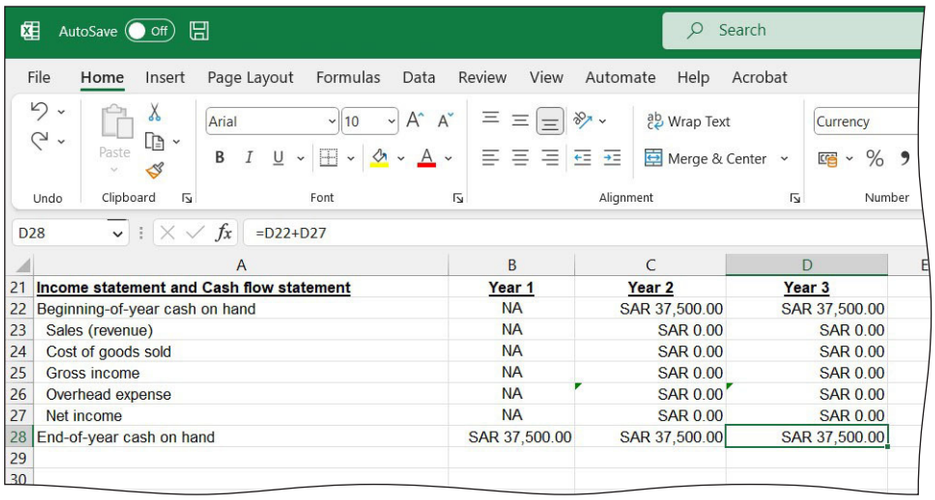


	A	B	C	D
21	**Income statement and Cash flow statement**	**Year 1**	**Year 2**	**Year 3**
22	Beginning-of-year cash on hand	NA	SAR 37,500.00	SAR 0.00
23	Sales (revenue)	NA	SAR 0.00	
24	Cost of goods sold	NA		
25	Gross income	NA		
26	Overhead expense	NA		
27	Net income	NA		
28	End-of-year cash on hand	SAR 37,500.00		
29				

- In C24, enter **=C18*C19**, which equals Cost of goods sold per unit multiplied by Number of units sold in a year. Copy the formula to D24.
- In cell C25, the formula for Gross income (Sales or revenue minus the cost of goods sold) is **=C23–C24**. Enter the formula and copy it to D25.

  In this example, the accountants want to use an estimated amount for overhead expenses in these forecasts. They suggest that overhead will be approximately 33% of gross income in Year 2 and 35% in Year 3. Overhead expense (C26) is calculated as the product of Gross income and the Overhead expense rate (**=C25*C4**).
- In cell C27, Net income (Gross overhead minus overhead expense) **=C25–C26**. Enter the formula and then copy it to cell D27.
- The End-of-year cash on hand is the Beginning-of-year cash on hand plus Net income. In cell C28, enter **=C22+C27**. Copy the formula to cell D28. The Income statement and Cash flow statement section at this point is shown in Figure 10-9.

FIGURE 10-9: Status of Income statement and Cash flow statement



D28 =D22+D27

	A	B	C	D
21	**Income statement and Cash flow statement**	**Year 1**	**Year 2**	**Year 3**
22	Beginning-of-year cash on hand	NA	SAR 37,500.00	SAR 37,500.00
23	Sales (revenue)	NA	SAR 0.00	SAR 0.00
24	Cost of goods sold	NA	SAR 0.00	SAR 0.00
25	Gross income	NA	SAR 0.00	SAR 0.00
26	Overhead expense	NA	SAR 0.00	SAR 0.00
27	Net income	NA	SAR 0.00	SAR 0.00
28	End-of-year cash on hand	SAR 37,500.00	SAR 37,500.00	SAR 37,500.00

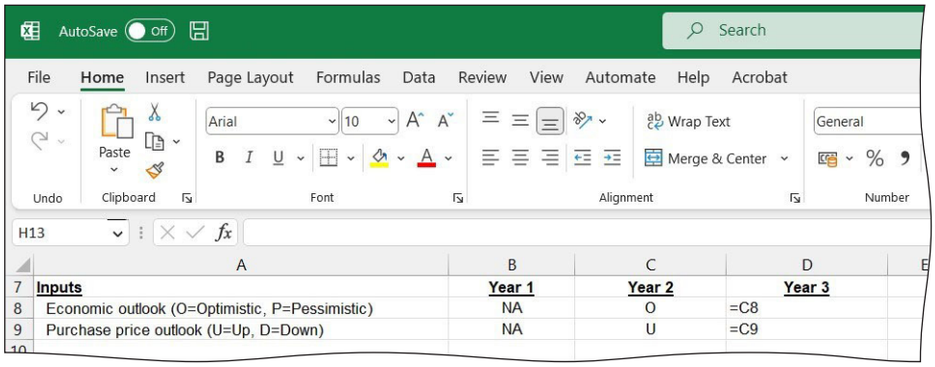
2. Entering the "Complex" Formulas

The next step is to finish the spreadsheet by filling in the "complex" formulas.

STEP 1

- In cell C8, enter an "O" for Optimistic economy, and in C9, enter a "U" for Up meaning, for example, that purchase prices will be high. There is nothing special about these values—they just give the worksheet formulas input values to process. In this example, the inputs will cover both Years 2 and 3. Enter **=C8** in cell D8 and Enter **=C9** in cell D9. This automatically copies the value of Year 2 to Year 3, as shown in Figure 10-10.

FIGURE 10-10: Copying data from the previous year



H13

	A	B	C	D
7	**Inputs**	**Year 1**	**Year 2**	**Year 3**
8	Economic outlook (O=Optimistic, P=Pessimistic)	NA	O	=C8
9	Purchase price outlook (U=Up, D=Down)	NA	U	=C9

Remember that cell addresses in the Calculations section are already being referred to in formulas in the Income statement and Cash flow statement section.

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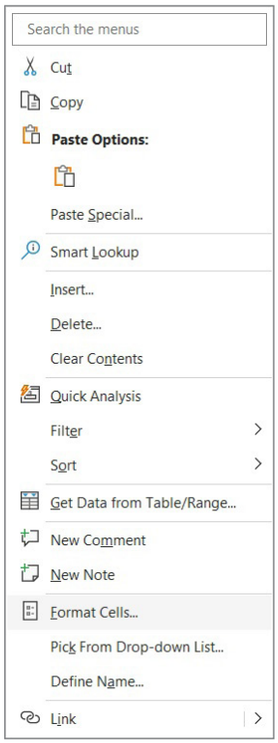
For Years 2 and 3, you need to change the format of the Number of units sold in a day and the Number of units sold in a year cells.

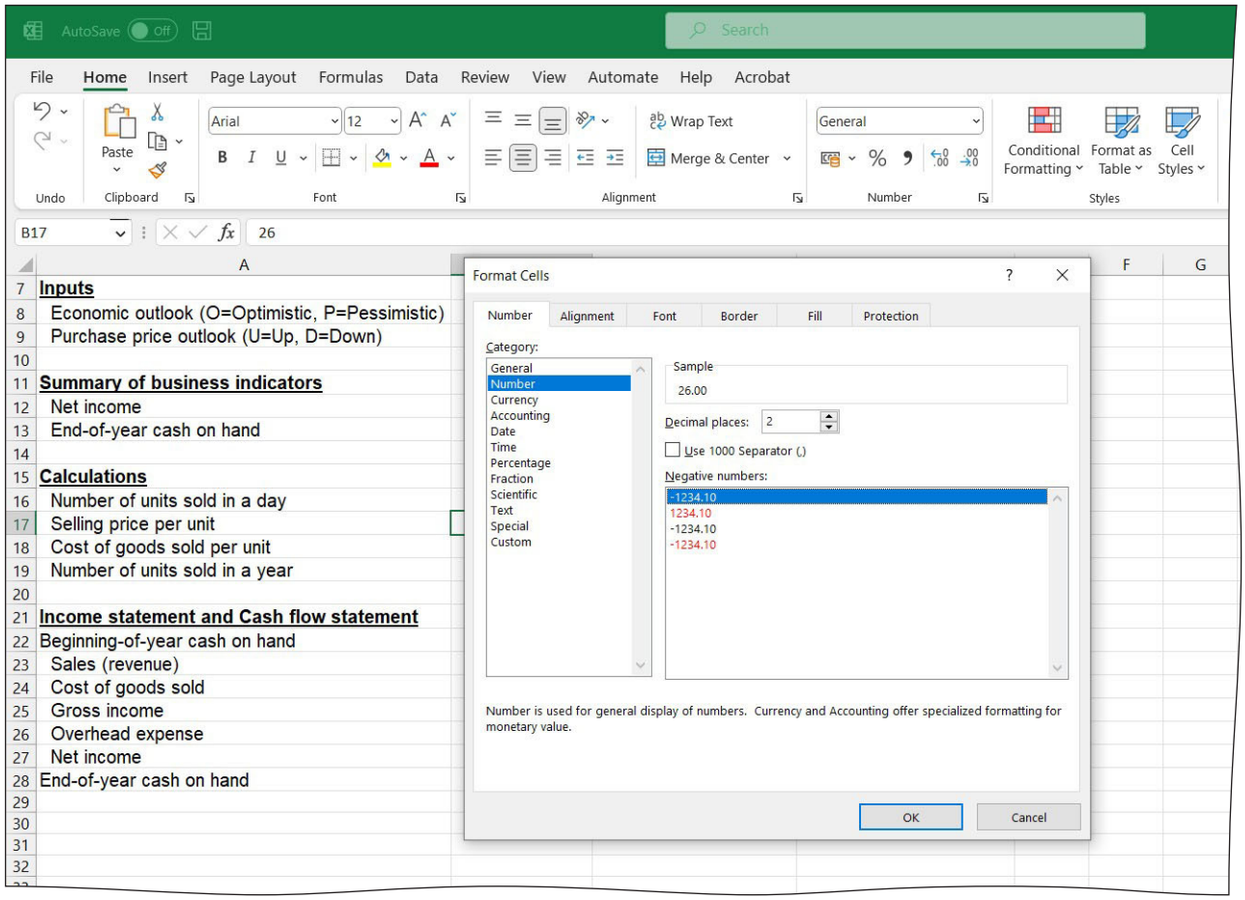
- With the Number of units sold in a day and the Number of units sold in a year cells selected, open the Format Cells dialogue box by right-clicking with your mouse (see Figure 10-11).

FIGURE 10-11: The right-click menu contains the Format Cells dialogue box



- Under the Number tab, make sure the number of decimal places is set to 0. This is because you cannot sell a part or fraction of a unit. Click OK.

FIGURE 10-12: Setting the number of decimal places to 0



Next, you need to make sure that the Selling price per unit and Cost of goods sold per unit use decimal places for Years 2 and 3. This is because these figures are in the format of a currency.

- With the Selling price per unit and Cost of goods sold per unit cells selected, open the Format Cells dialog box by right-clicking with your mouse which (will result in the window shown in Figure 10-12).
- This time, make sure that the number of decimal places is set to 2. Click OK.

STEP 2

- Enter formulas for the calculations.
- Next we will work on the formula for the Number of units sold in a year, which is the Number of business days (shown in C5) multiplied by the Number of units sold in a day (shown in C16). In C19, enter **=C5*C16**, as shown in Figure 10-13.

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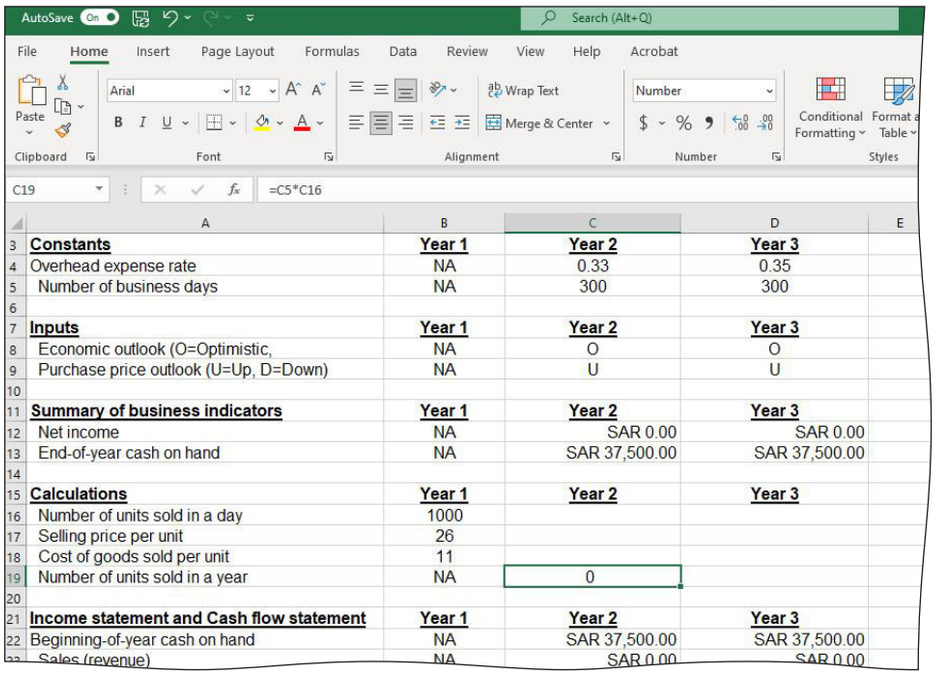
FIGURE 10-13: Entering the formula to compute Year 2 Number of units sold in a year



C19 =C5*C16

	A	B	C	D	E
3	**Constants**	**Year 1**	**Year 2**	**Year 3**	
4	Overhead expense rate	NA	0.33	0.35	
5	Number of business days	NA	300	300	
6					
7	**Inputs**	**Year 1**	**Year 2**	**Year 3**	
8	Economic outlook (O=Optimistic,	NA	O	O	
9	Purchase price outlook (U=Up, D=Down)	NA	U	U	
10					
11	**Summary of business indicators**	**Year 1**	**Year 2**	**Year 3**	
12	Net income	NA	SAR 0.00	SAR 0.00	
13	End-of-year cash on hand	NA	SAR 37,500.00	SAR 37,500.00	
14					
15	**Calculations**	**Year 1**	**Year 2**	**Year 3**	
16	Number of units sold in a day	1000			
17	Selling price per unit	26			
18	Cost of goods sold per unit	11			
19	Number of units sold in a year	NA	0		
20					
21	**Income statement and Cash flow statement**	**Year 1**	**Year 2**	**Year 3**	
22	Beginning-of-year cash on hand	NA	SAR 37,500.00	SAR 37,500.00	
23	Sales (revenue)	NA	SAR 0.00	SAR 0.00	

- Copy the formula to cell D19 for Year 3.

Assume that if the Economic outlook is Optimistic, the Year 2 Number of units sold in a day will be 6% more than in Year 1; in Year 3, they will be 6% more than in Year 2. Also assume that if the Economic outlook is Pessimistic, the Number of units sold in a day in Year 2 will be 1% less than those sold in Year 1; in Year 3, they will be 1% less than those sold in Year 2. An IF statement is needed in cell C16 to express this logic. An **IF statement** uses the following **syntax**:

=IF(test condition, result if test is True, result if test is False)

DEFINITION

IF statement: An IF statement is a programming conditional statement that, if proved true, performs a function or displays information.

Syntax: In Excel, syntax is the layout of a function. Functions need to be presented precisely or they will not work.

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Therefore, in this example, our calculation would be as follows:

```
=IF(economy variable = Optimistic,
      Then Number of units sold in a day will go UP 6%, Else Number of
      units sold in a day will go DOWN 1%)
```

To turn this logic into a formula your spreadsheet can use, make substitutions in the above formula so it looks like this:

```
=IF($C$8="O",B16*1.06,B16*0.99)
```

QUICK TIP

In Excel, quotation marks denote text. The input is one letter of text, so quotation marks are needed around the "O". Also note that multiplying by 1.06 results in a 6% increase whereas multiplying by 0.99 results in a 1% decrease, because, in a spreadsheet, the value "1" represents 100%.

Enter the entire IF formula into cell C16, as shown in Figure 10-14. The "$" symbol on both the row and columns show that this cell uses an Absolute Address. **Absolute addressing** is needed when referring to the input value ($C$8), because you always want your formulas to refer to this specific cell and not change when you copy the formula to another location. Absolute addressing maintains the $C$8 reference when the formula is copied and does not change.

QUICK TIP

To easily make a cell value absolute, press F4 after typing in the values. In this example, absolute addressing is done for you.

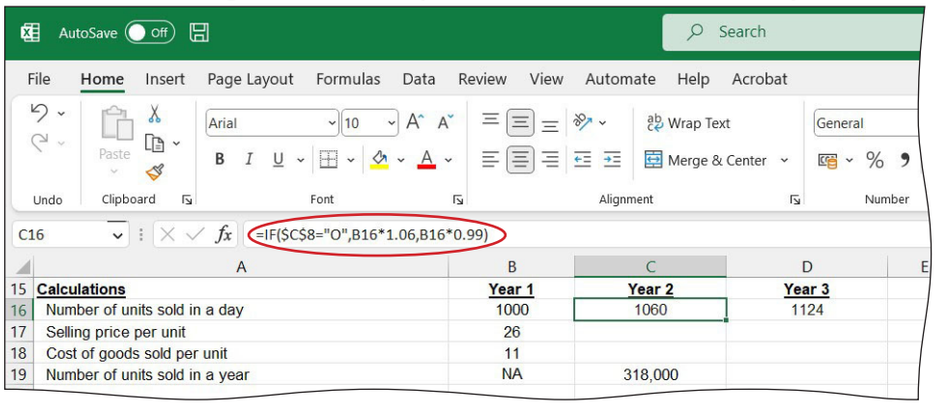
DEFINITION

Absolute addressing: A cell reference that maintains the cell address no matter where they are copied to. A "$" on the letter of the address maintains the column, and a "$" on the number maintains the row.

- Copy the formula in C16 to D16 for Year 3.

STEP 3

FIGURE 10-14: Entering the formula to compute Year 2 Number of units sold in a day



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The Selling price per unit is also a function of the Economic outlook. Assume that the two-part rule is as follows:

- If the Economic outlook is Optimistic, the Selling price per unit in Year 2 will be 7% more than that of Year 1; in Year 3, it will be 7% more than that of Year 2. This is calculated as Selling price per unit × 1.07.
- If the Economic outlook is Pessimistic, the Selling price per unit in Year 2 and Year 3 will equal the per-unit price in Year 1; that is, the price will not change.

Testing the formulas

Test your understanding of the selling price calculation by figuring out the formula for cell C17. Enter the formula and copy it to cell D18. You will need to use absolute addressing.

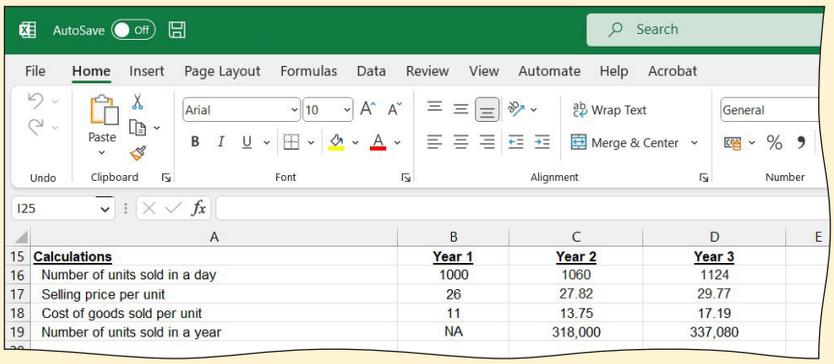
The Cost of goods sold per unit is a function of the Purchase price outlook:

- If the Purchase price outlook is Up (U), Cost of goods sold per unit in Year 2 will be 1.25 times that of Year 1; in Year 3, it will be 1.25 times that of Year 2.
- If the Purchase price outlook is Down (D), the multiplier in Years 2 and 3 will be 1.01.

To test your understanding of the process so far, figure out the formula for cell C18. Enter and copy the formula to cell D18. Again, you will need to use absolute addressing.

Your formulas for selling price and cost of goods sold, given Opt-Up input values, should yield the calculated values shown in Figure 10-15.

FIGURE 10-15: Calculated values given Opt-Up input values



	A	B	C	D
15	Calculations	Year 1	Year 2	Year 3
16	Number of units sold in a day	1000	1060	1124
17	Selling price per unit	26	27.82	29.77
18	Cost of goods sold per unit	11	13.75	17.19
19	Number of units sold in a year	NA	318,000	337,080

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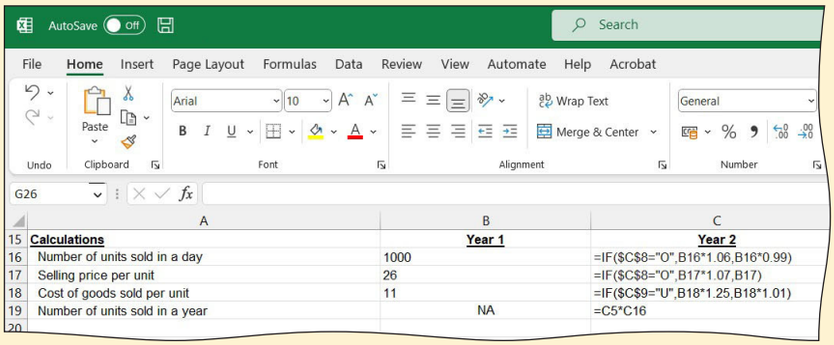
QUICK TIP

Use CTRL+`. The ` symbol, called a backtick, is located on a button on the top-left of your keyboard.

Assume that you change the input values to Pess-Down. You can check your formula is correct by toggling the spreadsheet between displaying values and formulas. To do this, press CTRL+` to switch between them.

Figure 10-16 shows the correct formula.

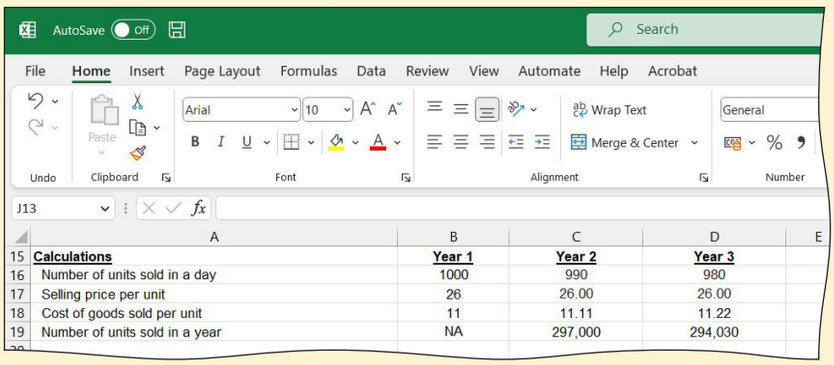
FIGURE 10-16: Toggling between values and formulas allows you to check the formula



	A	B	C
15	Calculations	Year 1	Year 2
16	Number of units sold in a day	1000	=IF($C$8="O",B16*1.06,B16*0.99)
17	Selling price per unit	26	=IF($C$8="O",B17*1.07,B17)
18	Cost of goods sold per unit	11	=IF($C$9="U",B18*1.25,B18*1.01)
19	Number of units sold in a year	NA	=C5*C16

Your formulas should yield the calculated values shown in Figure 10-17.

FIGURE 10-17: Calculated values given Pess-Down input values



	A	B	C	D	E
15	Calculations	Year 1	Year 2	Year 3	
16	Number of units sold in a day	1000	990	980	
17	Selling price per unit	26	26.00	26.00	
18	Cost of goods sold per unit	11	11.11	11.22	
19	Number of units sold in a year	NA	297,000	294,030	

That completes the body of your spreadsheet. The values in the Calculations section ripple through the Income statement and Cash flow statement section because the income statement formulas reference the calculations. Assuming Opt-Up, the income and cash flow numbers should look like those in Figure 10-18. In the next lesson we will learn how to use Scenario Manager with this workbook.

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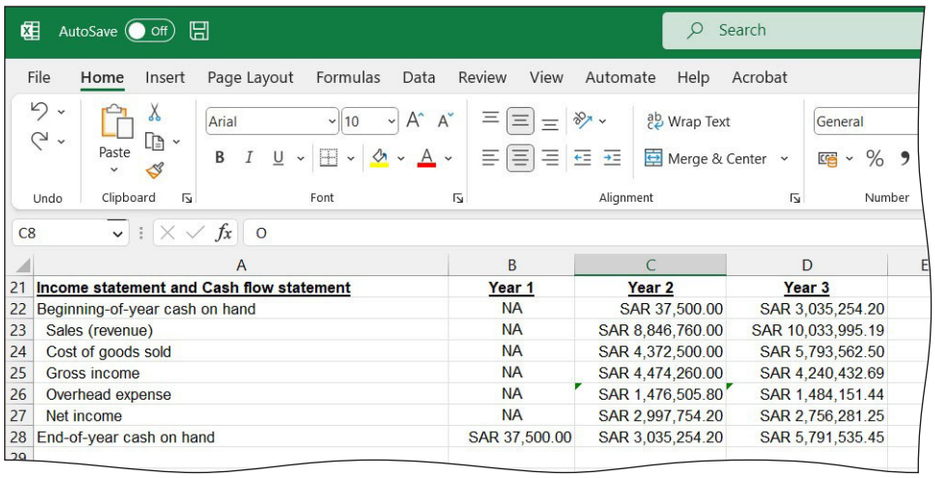
FIGURE 10-18: Completed Income statement and Cash flow statement section



	A	B	C	D
21	**Income statement and Cash flow statement**	**Year 1**	**Year 2**	**Year 3**
22	Beginning-of-year cash on hand	NA	SAR 37,500.00	SAR 3,035,254.20
23	Sales (revenue)	NA	SAR 8,846,760.00	SAR 10,033,995.19
24	Cost of goods sold	NA	SAR 4,372,500.00	SAR 5,793,562.50
25	Gross income	NA	SAR 4,474,260.00	SAR 4,240,432.69
26	Overhead expense	NA	SAR 1,476,505.80	SAR 1,484,151.44
27	Net income	NA	SAR 2,997,754.20	SAR 2,756,281.25
28	End-of-year cash on hand	SAR 37,500.00	SAR 3,035,254.20	SAR 5,791,535.45

REVIEW QUESTIONS

1. **Which forecast will most businesses be more successful in?**
   - **a.** Good economy with low costs
   - **b.** Bad economy with high costs
   - **c.** Good economy with high costs
   - **d.** Bad economy with low costs
2. **What is absolute addressing?**
   - **a.** A way to undo an error made in a spreadsheet
   - **b.** Using decimal places for figures
   - **c.** A way to ensure cell references remain constant wherever they are copied
   - **d.** The method for creating a chart based on your data
3. **What is an input variable?**
   - **a.** A data point in a DSS that is known in advance and will not change
   - **b.** A data point that the decision maker can change or influence
   - **c.** A measure of quantifiable indicators of performance against a strategic goal or objective
   - **d.** A way to predict a future outcome using relevant data to inform your prediction

Lesson
2
Chapter 10

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Using Scenario Manager

Excel's Scenario Manager is a tool that allows a decision maker to create, analyze, and compare results in different situations. In this lesson you will learn to use Excel's Scenario Manager to capture different combinations of inputs and results as you play *"what if?"* with the spreadsheet you were working on in Lesson 1.

There are four possible combinations of input values: Opt-Up (Optimistic-Up), Opt-Down (Optimistic-Down), Pess-Up (Pessimistic-Up), and Pess-Down (Pessimistic-Down). Financial results for each combination will be different. Each combination of input values can be referred to as a **scenario**. Scenario Manager records the results of each combination of input values as a separate scenario and then shows a summary of all scenarios in a separate worksheet. The summary worksheet values can be used as a raw table of numbers and then printed or copied into a document or report. The table of data can then be used to create an Excel chart, which can also be printed or inserted into a document.

DEFINITION

Scenario: A set of values that collectively represent a particular situation in a spreadsheet that can be saved and then used for modeling the outcomes of business decisions. (For example: higher or lower profits).

The four sets of input values produce different financial results. When you use Scenario Manager, you will define the four scenarios, run the input values, and put the results for each input scenario in a summary sheet.

2-1 Defining a Scenario

When you define a scenario in Scenario Manager, you give it a name and identify the input cells and input values. Then you identify the output cells so Excel can capture the output values in a summary sheet.

STEP 1

- Select the Data tab. In the Forecast group, click the drop-down arrow on the What-If Analysis icon, and then click the Scenario Manager option. Initially, no scenarios are defined, as you can see in Figure 10-19.

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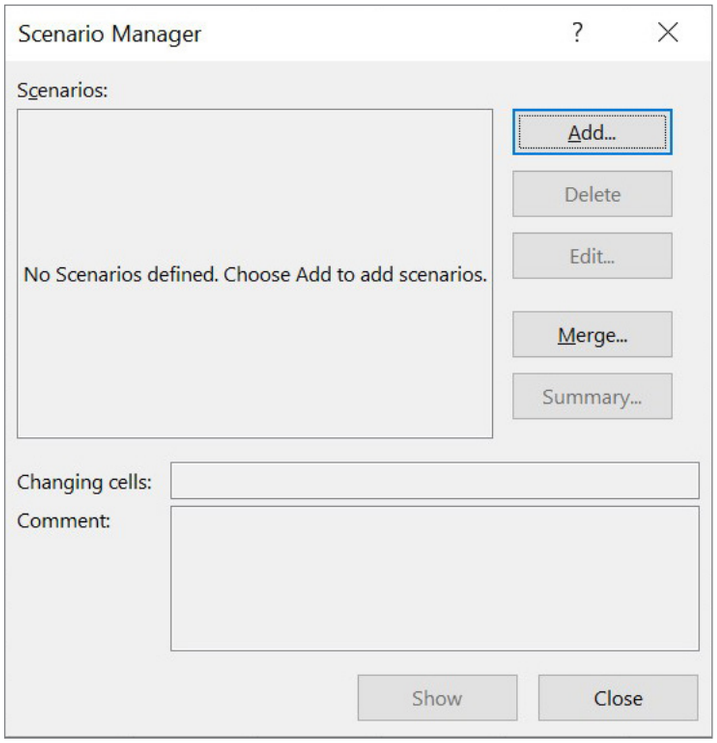
FIGURE 10-19: Initial Scenario Manager window



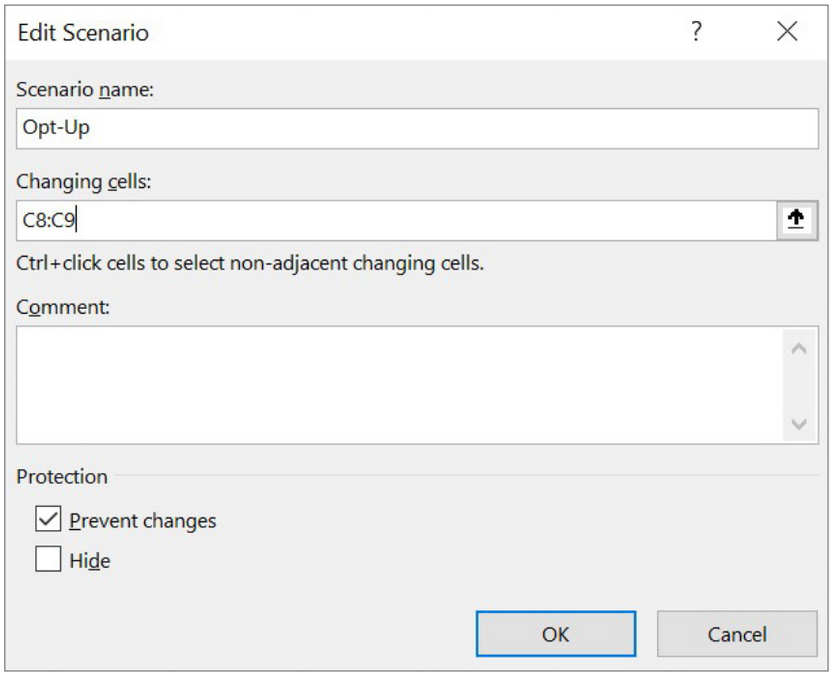
QUICK TIP
When working with this window, and the ones that come after it, do not press the Enter key to navigate. Use mouse clicks to move from one step to the next.

QUICK TIP
Contiguous cells are cells that are next to each other, and can be represented as a cell range (e.g., C8:C15). Non-contiguous cells are separated by other cells (that aren't part of the set), and so need to be grouped (e.g., C8, C10, C14). C8 and C9 are contiguous input cells and shown with a colon symbol. Noncontiguous input cells are grouped using commas.

You can use this window to add, delete, or edit scenarios. Toward the end of the process, you create the summary sheet.

- Click the Add button.
- In the Add Scenario window, name the first scenario "Opt-Up". Then type the input cells in the Changing cells field—here, they are C8:C9. Excel may add dollar signs to the cell address, but do not be concerned about that. The window should look like the one shown in Figure 10-20.

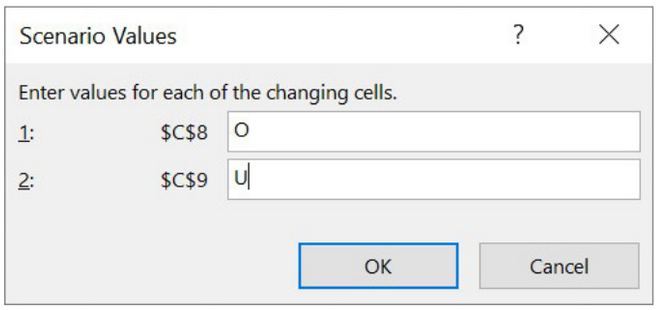
FIGURE 10-20: Entering Opt-Up as a scenario



STEP 2

- Click OK, which moves you to the Scenario Values window. Here you indicate what the input values will be for the scenario. Values in the current spreadsheet cells will be displayed. They may or may not be the correct ones for your scenario. For the Opt-Up scenario, you need to enter an "O" and a "U" if they are not the displayed values. Enter those values if needed, as shown in Figure 10-21.

FIGURE 10-21: Entering Opt-Up scenario input values



- Click OK, which takes you back to the Scenario Manager window. Enter the other three Opt-Down, Pess-Up, and Pess-Down scenarios, including the related input values. When you finish, you should see that the names and changing cells for the four scenarios have been entered, as in Figure 10-22.

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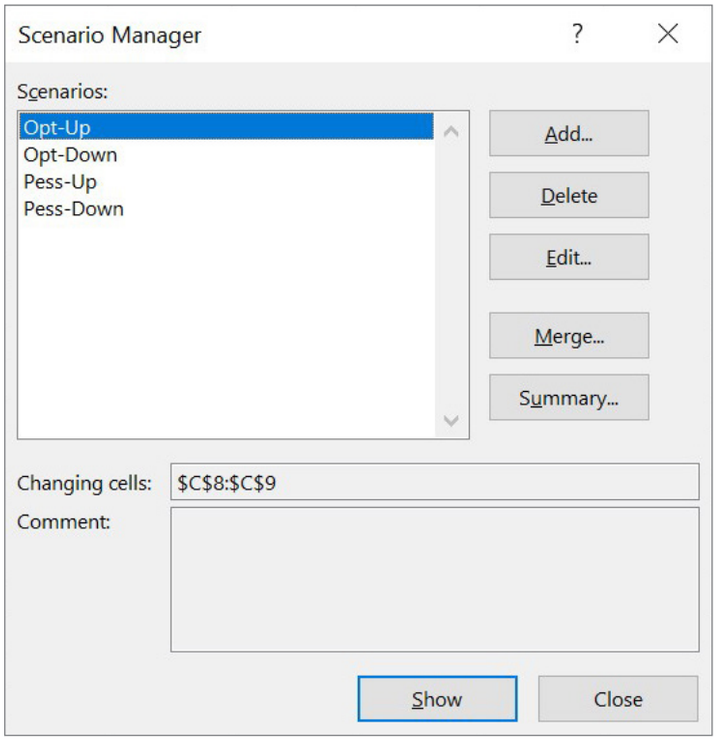
FIGURE 10-22: Scenario Manager window with all scenarios entered



QUICK TIP

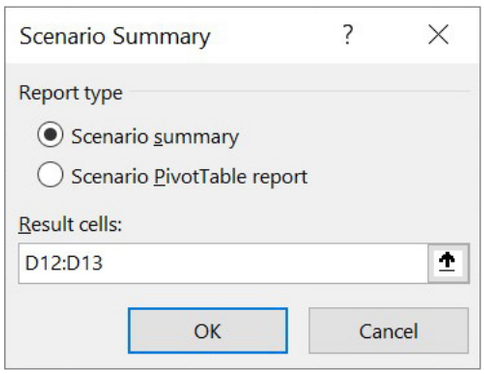
When input values change, the output values in output cells are updated but the addresses of the output cells do not change.

STEP 3

You can now create a summary sheet that shows the results of the four scenarios. Click the Summary button to open the Scenario Summary window. You must provide Excel with the output cell addresses—they will be the same for all four scenarios.

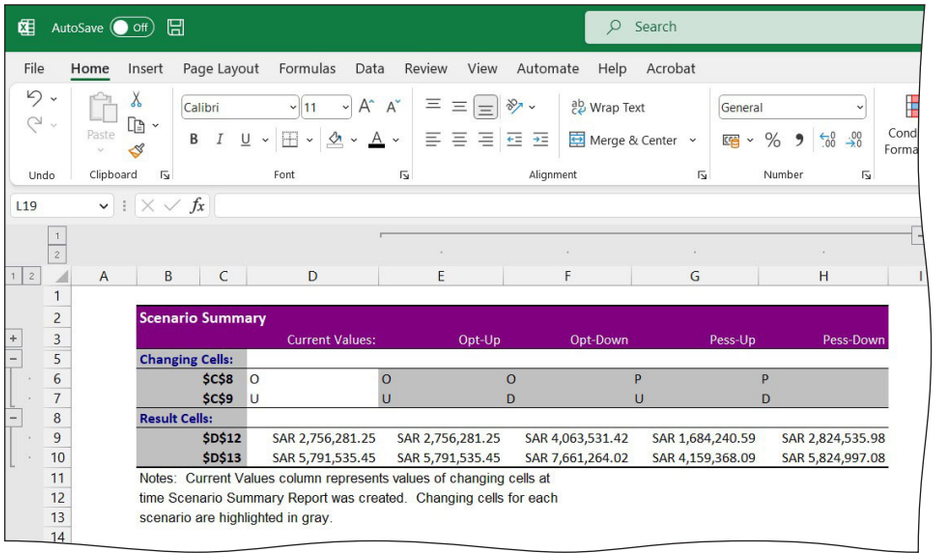
- Assume that you are interested in the results that have accrued at the end of the two-year period. These results are your two Year 3 Summary of business indicators section cells for Net income and End-of-year cash on hand (D12 and D13). Type those addresses in the window's input area, as shown in Figure 10-23.

FIGURE 10-23: Entering Result cells addresses in the Scenario Summary window



- Click OK. Excel calculates the results for each set of inputs and lists each of the outputs in tabular format. When it finishes this task, Excel creates a new sheet called the Scenario Summary and displays the results, as shown in Figure 10-24.

FIGURE 10-24: Scenario Summary sheet created by Scenario Manager



Scenario Summary	Current Values:	Opt-Up	Opt-Down	Pess-Up	Pess-Down
Changing Cells:					
$C$8	O	O	O	P	P
$C$9	U	U	D	U	D
Result Cells:					
$D$12	SAR 2,756,281.25	SAR 2,756,281.25	SAR 4,063,531.42	SAR 1,684,240.59	SAR 2,824,535.98
$D$13	SAR 5,791,535.45	SAR 5,791,535.45	SAR 7,661,264.02	SAR 4,159,368.09	SAR 5,824,997.08

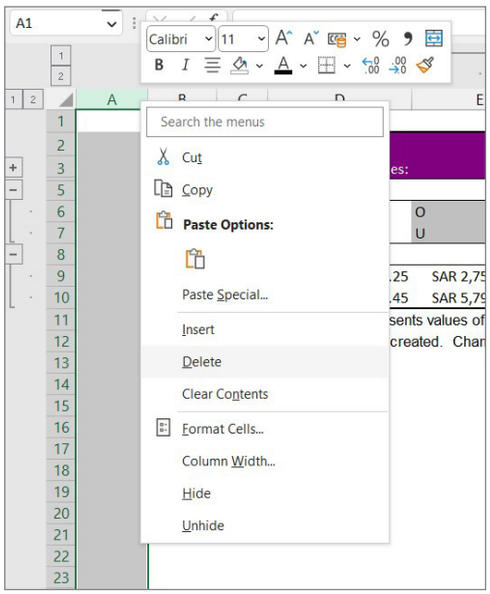
Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

QUICK TIP

The Current Values in the spreadsheet are given an output column, which duplicates one of the four defined scenarios. Because we don't need it, you can delete it by selecting it, selecting the Home tab, locating the Delete icon's drop-down arrow within the Cells group, and selecting Delete Sheet Columns. To delete a sheet's row, follow these steps but select Delete Sheet Rows instead of Delete Sheet Columns.

- Column A is unused. You can click on the A tab and right-click your mouse. Choose the Delete option to delete it and to move everything to the left (see Figure 10-25). Columns of data should be easier to see on the screen without scrolling.

FIGURE 10-25: Deleting column A and moving the rest of the spreadsheet to the left



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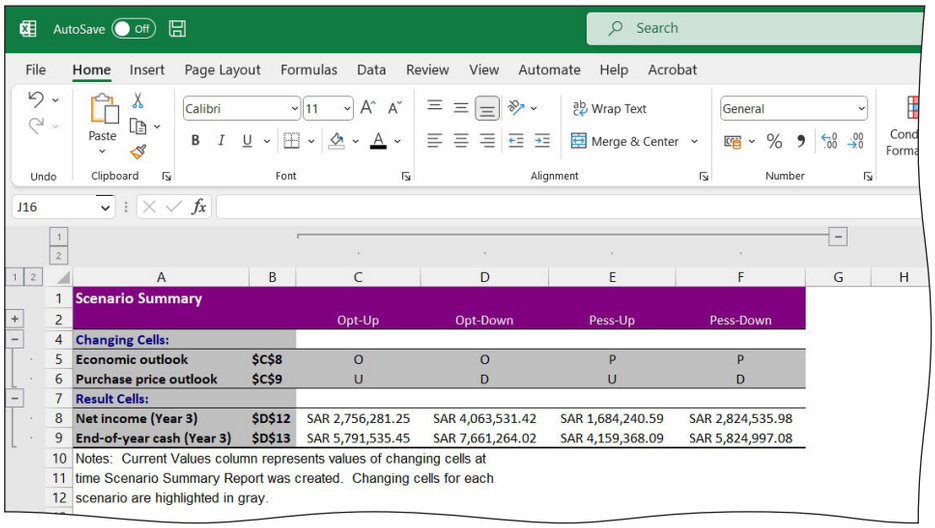
Other ways to make the worksheet easier to read include:

- entering text in column A to describe the input and output cells
- centering cell values by using the Center icon in the Home tab's Alignment group
- showing data in Currency format by using the Number Format drop-down menu within the Home tab's Number group.

When finished, your summary sheet could resemble the one shown in Figure 10-26.

FIGURE 10-26: Scenario Summary sheet after formatting



	A	B	C	D	E	F
1	Scenario Summary					
2			Opt-Up	Opt-Down	Pess-Up	Pess-Down
4	Changing Cells:					
5	Economic outlook	$C$8	O	O	P	P
6	Purchase price outlook	$C$9	U	D	U	D
7	Result Cells:					
8	Net income (Year 3)	$D$12	SAR 2,756,281.25	SAR 4,063,531.42	SAR 1,684,240.59	SAR 2,824,535.98
9	End-of-year cash (Year 3)	$D$13	SAR 5,791,535.45	SAR 7,661,264.02	SAR 4,159,368.09	SAR 5,824,997.08
10	Notes: Current Values column represents values of changing cells at					
11	time Scenario Summary Report was created. Changing cells for each					
12	scenario are highlighted in gray.					

Note that column C shows the Opt-Up case. The Net income in that scenario is SAR 2,756,281.25, and End-of-year cash is SAR 5,791,535.45.

- What combination of Year 3 Net income and End-of-year cash would be best? Opt-Down (O-D) is the best result because it yields the highest income and highest cash.
- What is the worst combination? Pess-Up (P-U) yields the lowest income and lowest cash.

2-2 Using Summary Sheets

When you complete Scenario Manager case studies, you'll need to use summary sheets and their data. Next, you will look at some of those operations.

1. **Rerunning Scenario Manager**

   The Scenario Summary sheet does not update itself when the spreadsheet formulas or inputs change. To see an updated Scenario Summary sheet after making a change to the data, you must rerun Scenario Manager by clicking the Summary button in the Scenario Manager dialog box and then click OK. Another summary sheet is created.

2. **Deleting Unwanted Scenario Manager Summary Sheets**

   Suppose you want to delete a summary sheet. With the summary sheet on the screen, follow this procedure:

   - Select the Home tab.
   - Within the Cells group, select the Delete icon's drop-down arrow.
   - Select Delete Sheet. When asked if you really want to delete the sheet, click Delete.

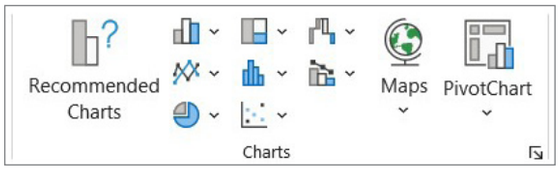
QUICK TIP

You can also delete a sheet by right-clicking its tab at the bottom of the screen. In the resulting menu, select Delete. Click Delete again when asked if you really want to delete the sheet.

3. **Charting Summary Sheet Data**

   The summary sheet results can be conveniently charted using Excel's charting tools (see Figure 10-27).

FIGURE 10-27: The Charts menu in Excel



4. **Copying Summary Sheet Data to the Clipboard**

   If you want to copy the summary sheet data into the Clipboard to use in a word processing document, follow these steps:

   - Select the data range.
   - Copy the data range into the Clipboard (Ctrl+C).
   - Open your word processor document.
   - Click the cursor where you want the upper-left part of the data to be positioned.
   - Paste the data into the document (Ctrl+V).

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REVIEW QUESTIONS

1. **What is the next step in Scenario Manager after you have added a scenario in the Initial Scenario Manager window?**
   - **a.** Indicate what the input values will be for the scenario in the Scenario Values window
   - **b.** Format the summary sheet to make it easier to read
   - **c.** Create a summary sheet in the Scenario Summary window
   - **d.** Copy the summary sheet data to the clipboard to use elsewhere
2. **How can you use summary sheets once they are completed?**
   - **a.** Rerun Scenario Manager to create an updated summary sheet
   - **b.** Chart summary sheet data using Excel
   - **c.** Copy summary sheet data to use in a word processing document
   - **d.** All of the above

Lesson
3
Chapter 10

Practicing with Scenario Manager

Imagine you have an uncle who works for a large company. He has a good job and makes SAR 300,000 a year. At age 60, which he will be in three years, he must retire from his company and start drawing his **pension**.

DEFINITION

Pension: A regular payment received by retired people to support living costs.

However, the company has an early-out plan in which employees are paid to retire early. The company pays all employees in the plan a bonus in the year they retire and each year thereafter, until their official retirement date. If your uncle left the company early, he could find a part-time job to make ends meet in the years before taking his normal pension.

The opportunity to leave early is open for three years after the end of the current year, which is now ending. That means your uncle could leave the company any time in the next three years, and receive the early-out bonuses in the years he has retired early. If he works another year, he would lose the bonus for that year. If he works two more years, he would lose two years of early-out bonuses, and so on until he must retire.

Your uncle is also deciding whether to continue his gym membership. He likes the gym's amenities, but it is expensive. The retirement decision can be revisited each year, but the decision about the gym membership must be made now. If your uncle does not withdraw now, he will remain a member (and be charged) indefinitely.

Your uncle asks you to make a spreadsheet model of his situation in Scenario Manager. Your spreadsheet would let him play *"what if?"* with the possibilities and see his various projected personal finances for each of the next three years. With each scenario, your uncle wants to know what cash on hand will be available for each year in the period.

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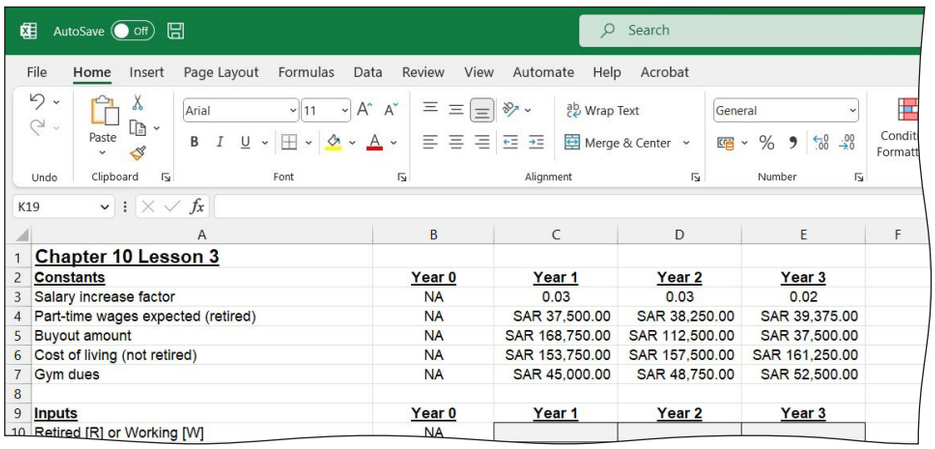
Complete the spreadsheet for your uncle. Remember that your Summary of business indicators, Calculations, and Income statement and Cash flow statement section cells must show values by using cell formulas, so do not type amounts in those sections. Also, do not use the address of a cell if its contents are "NA" in any of your formulas. Use the spreadsheet (**Chapter 10 data file 2.xlsx**), you can find it by scanning the QR code.

3-1 Constants Section

This section explains the contents of the spreadsheet's Constants section (see Figure 10-28).

FIGURE 10-28: Constants section values



	A	B	C	D	E
1	**Chapter 10 Lesson 3**				
2	**Constants**	**Year 0**	**Year 1**	**Year 2**	**Year 3**
3	Salary increase factor	NA	0.03	0.03	0.02
4	Part-time wages expected (retired)	NA	SAR 37,500.00	SAR 38,250.00	SAR 39,375.00
5	Buyout amount	NA	SAR 168,750.00	SAR 112,500.00	SAR 37,500.00
6	Cost of living (not retired)	NA	SAR 153,750.00	SAR 157,500.00	SAR 161,250.00
7	Gym dues	NA	SAR 45,000.00	SAR 48,750.00	SAR 52,500.00
8					
9	**Inputs**	**Year 0**	**Year 1**	**Year 2**	**Year 3**
10	Retired [R] or Working [W]	NA			

1. **Salary Increase Factor**

   Your uncle's salary, as of the current working year (Year 0), is SAR 300,000 and raises are expected each subsequent year; for example, a 3% raise is expected in the upcoming year (Year 1). If your uncle does not retire in a year, he will get his salary (including a raise) for the next year.

2. **Part-time Wages Expected (Retired)**

   For the next three years, your uncle has estimated what his part-time wages would be when he is retired from the company and working part-time (Years 1–3). For example, he thinks he could earn SAR 37,500 in part-time wages in Year 1 if he retired.

3. **Buyout Amount**

   The amounts for the company's preretirement plan are shown. For example, if your uncle retires now (and does not work for the company in Years 1–3), he gets SAR 168,750, SAR 112,500, and SAR 37,500 in those years. If he works another year and leaves before Year 2 starts, he will give up the SAR 168,750 payment for Year 1 but will get SAR 112,500 and SAR 37,500 in Years 2 and 3.

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4. **Cost of Living (Not Retired)**

   Your uncle has estimated how much cash he needs to meet his living expenses, assuming he continues to work for the company. His cost of living would be SAR 41,000 in Year 1, increasing each year thereafter.

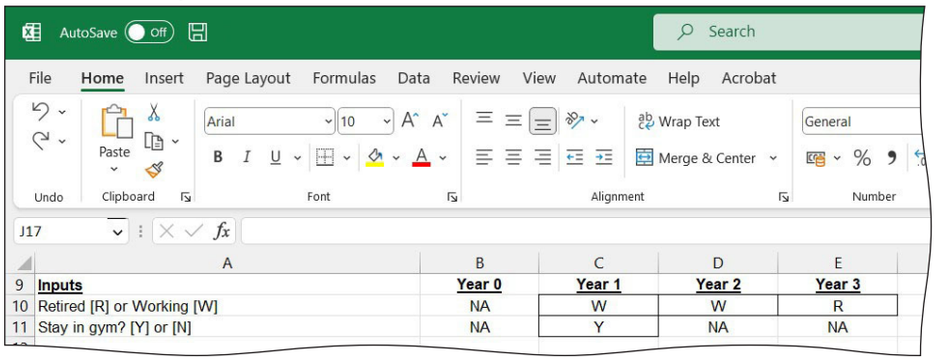
5. **Gym Dues**

   Gym dues will be SAR 45,000 for Year 1. Dues increase each year thereafter, as shown.

3-2 Inputs Section

This section explains the contents of the spreadsheet's Inputs section (see Figure 10-29).

FIGURE 10-29: Inputs section



	A	B	C	D	E
9	Inputs	Year 0	Year 1	Year 2	Year 3
10	Retired [R] or Working [W]	NA	W	W	R
11	Stay in gym? [Y] or [N]	NA	Y	NA	NA

1. **Retired or Working**

   Enter an "R" if your uncle would be retired in the year or a "W" if he would still be working. If he is working the next three years, you should enter the pattern "W W W" in cells C10:E10. If he plans to retire now you would enter the pattern "R R R". If he works for one year and then retires, you should enter the pattern "W R R".

2. **Stay in Gym?**

   If your uncle remains a member of the gym, you should enter a "Y" in cell C11. If your uncle leaves the gym now, you should enter an "N". The decision applies to Years 1–3.

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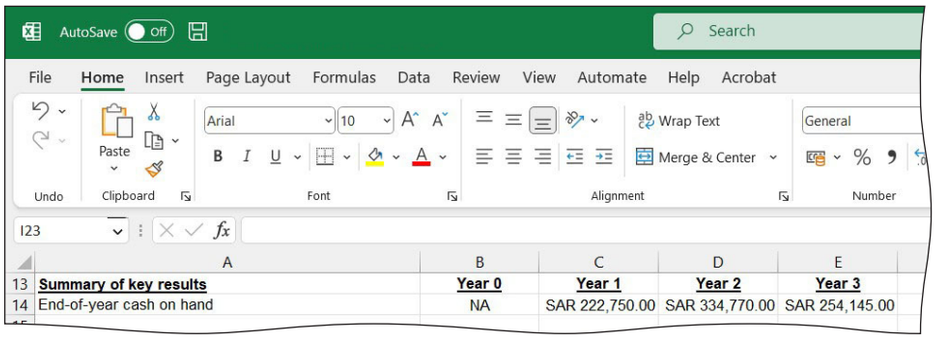
3-3 Summary of Business Indicators Section

Your spreadsheet should show the results in Figure 10-30.

FIGURE 10-30: Summary of business indicators section



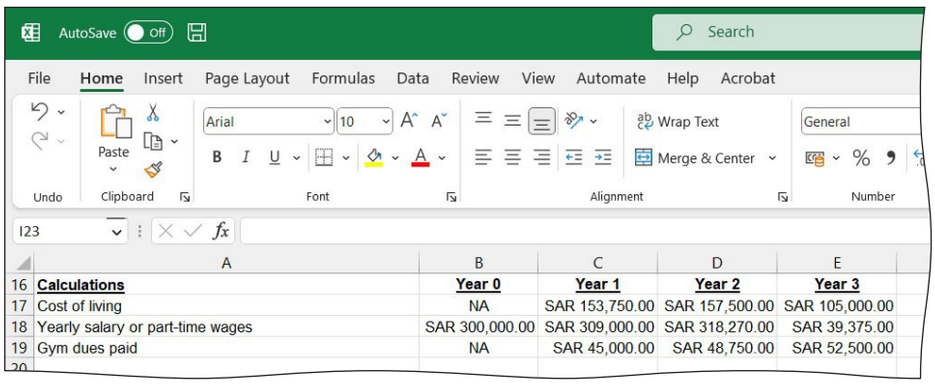
	A	B	C	D	E
13	Summary of key results	Year 0	Year 1	Year 2	Year 3
14	End-of-year cash on hand	NA	SAR 222,750.00	SAR 334,770.00	SAR 254,145.00

Each year's End-of-year cash on hand value is echoed from cells in the spreadsheet body.

3-4 Calculations Section

Your spreadsheet should calculate, by formula, the values shown in Figure 10-31. Calculated amounts are used later in the spreadsheet.

FIGURE 10-31: Calculations section



	A	B	C	D	E
16	Calculations	Year 0	Year 1	Year 2	Year 3
17	Cost of living	NA	SAR 153,750.00	SAR 157,500.00	SAR 105,000.00
18	Yearly salary or part-time wages	SAR 300,000.00	SAR 309,000.00	SAR 318,270.00	SAR 39,375.00
19	Gym dues paid	NA	SAR 45,000.00	SAR 48,750.00	SAR 52,500.00

1. **Cost of Living**

   In any year that your uncle continues to work for the company, his cost of living is the amount shown in the Cost of living (not retired) field of the Constants section (C6:E6). But, if he chooses to retire, his cost of living will be SAR 56,250 less than the amount shown in C6:E6.

2. **Yearly Salary or Part-time Wages**

   If your uncle keeps working, his salary will increase each year (due to expected pay rises). The yearly percentage increases are shown in the Constants section. Assume that the salary earned in Year 1 would be 3%

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more than that earned in Year 0, salary earned in Year 2 would be 3% more than that earned in Year 1, and salary earned in Year 3 would be 2% more than that earned in Year 2. If your uncle retires, he will make the part-time wages shown in the Constants section.

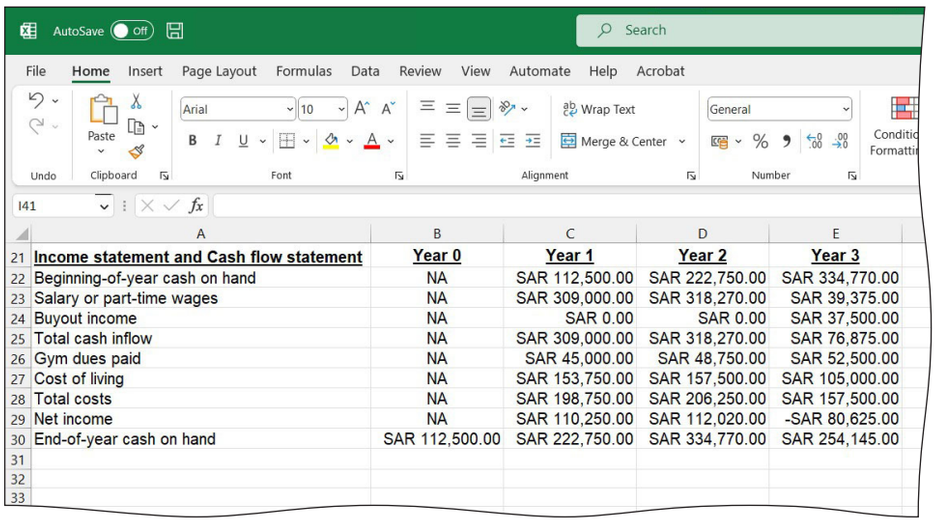
3. **Gym Dues Paid**

   If your uncle leaves the gym, the dues are zero each year; otherwise, the dues are as shown in the Constants section.

3-5 Income Statement and Cash Flow Statement Section

As in the previous example, this section begins with the cash on hand at the beginning of the year, followed by the income statement, and concluding with the calculation of cash on hand at the end of the year. The format is shown in Figure 10-32.

FIGURE 10-32: Income statement and Cash flow statement section



	A	B	C	D	E
21	**Income statement and Cash flow statement**	**Year 0**	**Year 1**	**Year 2**	**Year 3**
22	Beginning-of-year cash on hand	NA	SAR 112,500.00	SAR 222,750.00	SAR 334,770.00
23	Salary or part-time wages	NA	SAR 309,000.00	SAR 318,270.00	SAR 39,375.00
24	Buyout income	NA	SAR 0.00	SAR 0.00	SAR 37,500.00
25	Total cash inflow	NA	SAR 309,000.00	SAR 318,270.00	SAR 76,875.00
26	Gym dues paid	NA	SAR 45,000.00	SAR 48,750.00	SAR 52,500.00
27	Cost of living	NA	SAR 153,750.00	SAR 157,500.00	SAR 105,000.00
28	Total costs	NA	SAR 198,750.00	SAR 206,250.00	SAR 157,500.00
29	Net income	NA	SAR 110,250.00	SAR 112,020.00	-SAR 80,625.00
30	End-of-year cash on hand	SAR 112,500.00	SAR 222,750.00	SAR 334,770.00	SAR 254,145.00
31					
32					
33					

- **Beginning-of-year cash on hand:** This amount is the cash on hand at the end of the prior year. Note that cash on hand at the end of the current year is SAR 112,500.
- **Salary or part-time wages:** This amount is a yearly calculation, which can be echoed here.
- **Buyout income:** This amount is the year's buyout amount if your uncle is retired that year. Buyout amounts are shown in the Constants section.
- **Total cash inflow:** This amount is the sum of salary or part-time wages and the buyout amount (if retired).

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- **Gym dues paid:** This amount is a calculation, which can be echoed here.
- **Cost of living:** This amount is a calculation, which can be echoed here.
- **Total costs:** This amount is the sum of the Cost of living and Gym dues paid (if a member).
- **Net income:** This amount is the income after costs and dues are paid.
- **End-of-year cash on hand:** This amount is the Beginning-of-year cash on hand plus the year's Net income.

3-6 Scenario Manager Analysis

Set up Scenario Manager and create a Scenario Summary sheet. Your uncle wants to look at the following four possibilities:

- retire now, stay in the gym ("Retire-In").
- retire now, leave the gym ("Retire-Out").
- work three more years (that is, do not take any buyout bonuses), staying in the gym ("Delay-In")
- work three more years, leave the gym ("Delay-Out").

You should enter the non-contiguous input cell ranges as follows: **C10:E10,C11**. The only output cell should be the Year 3 End-of-year cash on hand cell in the Summary of business indicators section.

Your uncle knows that the highest Year 3 End-of-year cash on hand would be realized if he continues to work and cancels his gym membership. However, he wants to see what the End-of-year cash would be in the other scenarios. These will help him decide if he can retire, and when.

The Scenario Summary (Figure 10-33), presents the four different options that your uncle is considering. The four scenarios are shown in columns C–F. Row 10 shows the amount of cash your uncle would expect to have at the end of Year 3 for each of these options. For many decisions, the choice isn't as simple as picking the scenario with the highest (or lowest) value.

Your uncle would like to retire early, and he would like to maintain his gym membership. Your decision model gives your uncle a projection for each of these scenarios. It will be up to him to decide how much cash on hand he is willing to sacrifice for the enjoyment of an early retirement. He will need to determine if he can afford to maintain the gym membership and take the early buyout.

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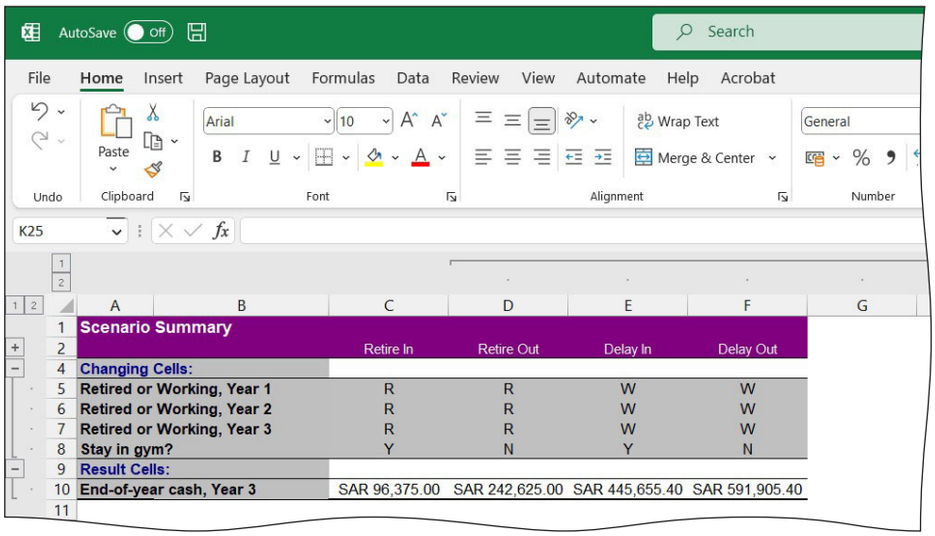
FIGURE 10-33: Scenario Summary



	Scenario Summary	Retire In	Retire Out	Delay In	Delay Out
4	Changing Cells:				
5	Retired or Working, Year 1	R	R	W	W
6	Retired or Working, Year 2	R	R	W	W
7	Retired or Working, Year 3	R	R	W	W
8	Stay in gym?	Y	N	Y	N
9	Result Cells:				
10	End-of-year cash, Year 3	SAR 96,375.00	SAR 242,625.00	SAR 445,655.40	SAR 591,905.40

REVIEW QUESTIONS

1. **You can calculate End-of-year cash on hand by adding the Beginning-of-year cash on hand to what?**
   - **a.** Total costs
   - **b.** Cost of living
   - **c.** Gym dues
   - **d.** Net income
2. **What does NA stand for?**
   - **a.** No accounting
   - **b.** Not applicable
   - **c.** Net amount
   - **d.** Number above

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Extra Practice

Critical Thinking Questions

1. The examples in this lesson have encouraged you to think about optimistic and pessimistic outlooks because it is important for businesses to think about the best- and worst-case scenarios. Are there any disadvantages to this? Are there other possibilities that businesses need to plan for? Explain your answer.

2. There are many different ways you can format your spreadsheet; you can use options like fonts, font sizes, colors, alignment, and backgrounds to present your data in very different ways. In your opinion, what is the purpose of formatting? Is there such a thing as good or bad formatting? Explain your answers with examples.

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3. In Lesson 3, we explored how Excel can be used to plan and make decisions about your uncle's retirement. Can you think of any examples of similar planning you could do, using Excel Scenario Manager, to plan for something in your own life?

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Chapter 11

Using Microsoft Excel Solver

Decision support systems (DSS) help people make decisions, as you learned in Chapter 10. Chapter 11 teaches you how to use Solver, one of Excel's built-in decision support tools.

For some business problems, decision makers want to know the best solution. Usually that means maximizing a variable or minimizing another variable. For example, you might want to maximize net income or minimize total costs. This optimization is subject to constraints, which are rules that must be observed when solving a problem. Solver computes answers to such problems.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Demonstrate how to build a Solver spreadsheet
2. Apply your knowledge of Solver to manage constraints, objectives, and variables in real-world examples
3. Interpret output in Solver where multiple variables and shared resources are a factor
4. Identify common issues users experience when working with Solver

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Lesson
1
Chapter 11

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Using Solver

Imagine a company must set a production schedule for its products, each of which has a different profit margin (the selling price minus the costs of labor and materials). At first, you might assume that the company will maximize production of all products to optimize net income. However, a company typically cannot make and sell an unlimited number of its products.

One constraint that affects production is the shared resource problem. For example, several products in a manufacturer's line might require the same raw materials, which are in limited supply. Similarly, the manufacturer might require the same machines to make several of its products. In addition, a limited pool of skilled workers might be available to make the products.

Management policies sometimes impose constraints. For example, management might decide that the company must have a broader product line. As a consequence, a certain production quota (a goal set by a business or organization for the quantity of a given product it needs to produce) must be met for several products, regardless of profit margins.

Thus, management must find a production schedule that will optimize profit given the constraints.

Optimization programs like Solver look at each combination of products, one after the other, ranking each combination by profitability (the amount of money that can be made). Then the program reports the most profitable combination.

DEFINITION

Optimization: A continuous process of identifying the best possible outcomes given a particular set of inputs and constraints.

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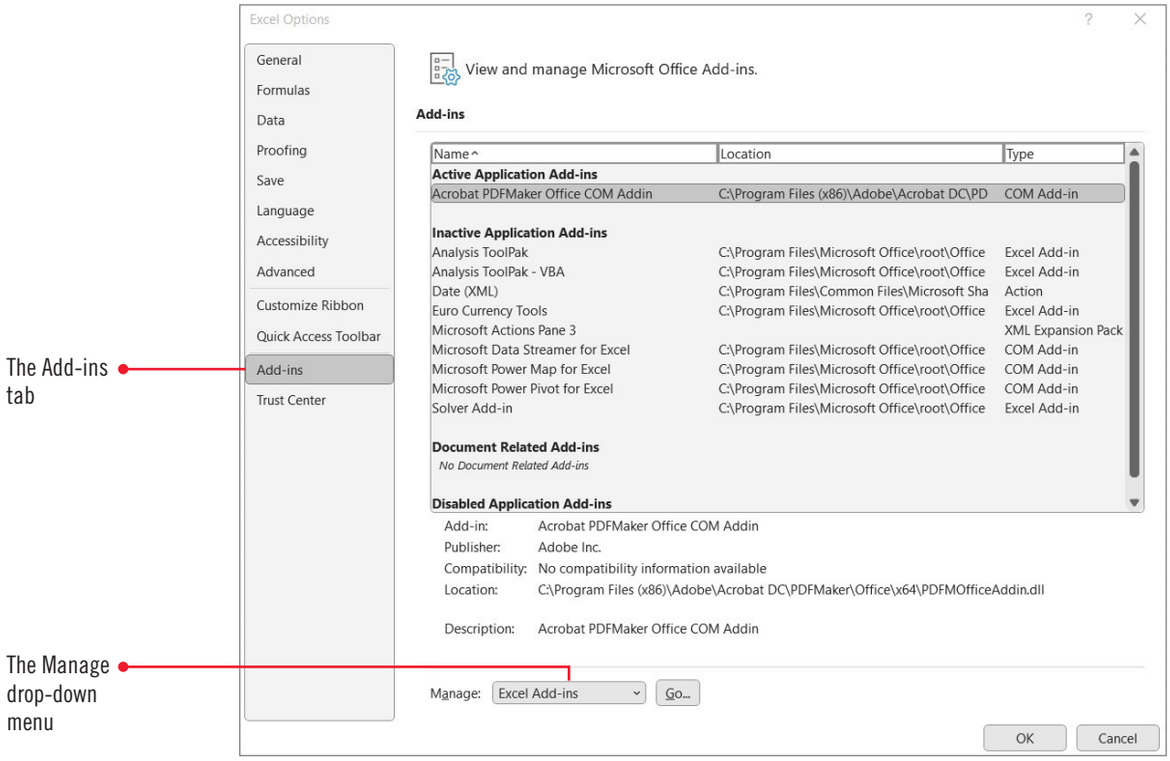
1-1 Adding Solver to the Excel Ribbon

Before you can use Solver, it must be installed in Excel. To see if it is, start Excel. Click the Data tab in the Ribbon. If you see a group on the right side of the menu named Analysis that contains Solver, Solver has been installed. If Solver is not visible, do the following:

- Click the File tab.
- Click Options. The Excel Options window should appear.
- In the menu on the left, click Add-Ins to display utilities you can add to Excel.

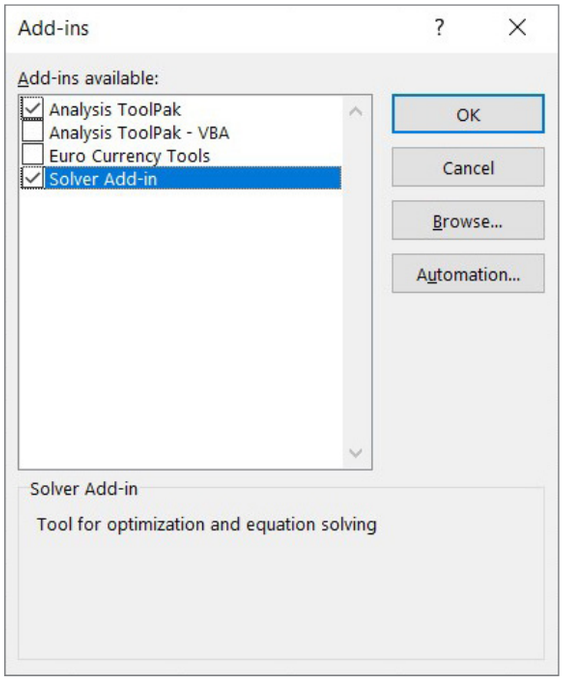
FIGURE 11-1: The Add-ins menu



- At the bottom of the screen, set the Manage drop-down box to Excel Add-ins and click the Go button.

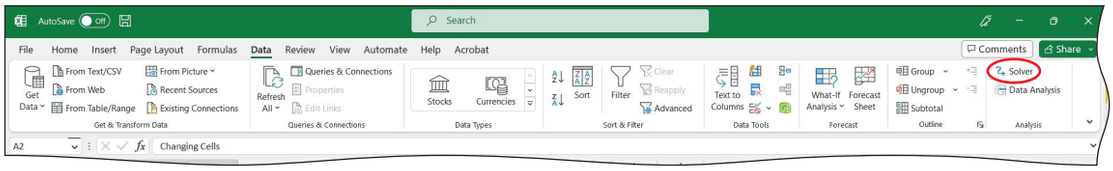
- The Add-ins window appears (Figure 11-2). Click the box for Solver Add-in. Then click the OK button to close the window and return to the Ribbon.

FIGURE 11-2: The Add-ins window



- If you click the Data tab again, you should see that the Analysis group contains Solver (Figure 11-3).

FIGURE 11-3: Solver is now available to use in your Data tab



To use Solver, set up a model of the problem. Include the factors that can vary, the constraints on how much they can vary, and the goal—that is, the value you are trying to optimize. Usually, you want to maximize net income or minimize total costs. Solver then computes the best solution.

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1-2 Setting Up a Spreadsheet Skeleton

Suppose your company makes two products—basketballs and footballs. Assume that you will sell all the balls you produce. To maximize net income, you want to know how many of each kind of ball to make in the coming year.

Making each kind of ball requires a certain number of working hours, and each ball has a different cost of raw materials. Because you have only a limited number of workers and machines, you can devote a maximum of 40,000 hours of time to production, which is a **shared resource**. You do not want the machines to be idle, however. You should not have more than 1,000 hours of downtime in a year, so machines should be used for at least 39,000 hours.

DEFINITION

Shared resource: A component part of a product, or something needed to make a product, that is also a part or is used in the production of another product.

Marketing executives say that you should not make more than 60,000 basketballs or fewer than 30,000. They say that you should make at least 20,000 footballs but not more than 40,000. The marketing team also says you should produce at least as many basketballs as footballs.

What would be the best production plan? You can set up this problem in Solver. The spreadsheet sections are discussed in the pages that follow.

Scan the QR code to access the workbook (**Chapter 11 data file 1.xlsx**) you'll be using for the rest of this lesson.

1. **Changing Cells Section**

   The Changing cells section contains the variables Solver is allowed to change while it looks for the solution to the problem. Figure 11-4 shows the skeleton of this spreadsheet section and the values you should enter.

   The changing cells are for the number of basketballs and footballs to be made and sold. The changing cells are like input cells, except that Solver plays *"what if?"* with the values, trying to maximize or minimize. In this case, you want Solver to maximize net income.

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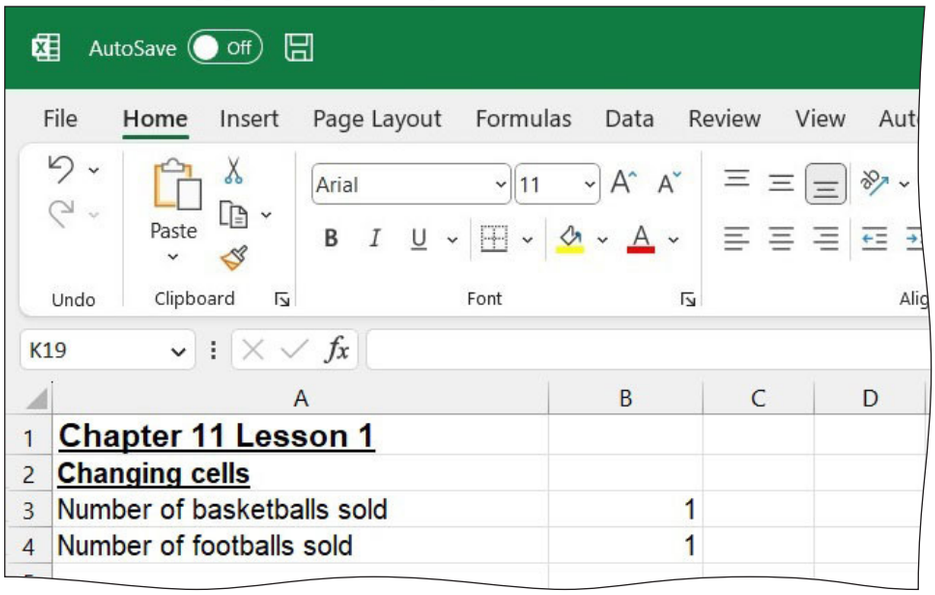
FIGURE 11-4: Changing cells section showing the number of basketballs and footballs sold



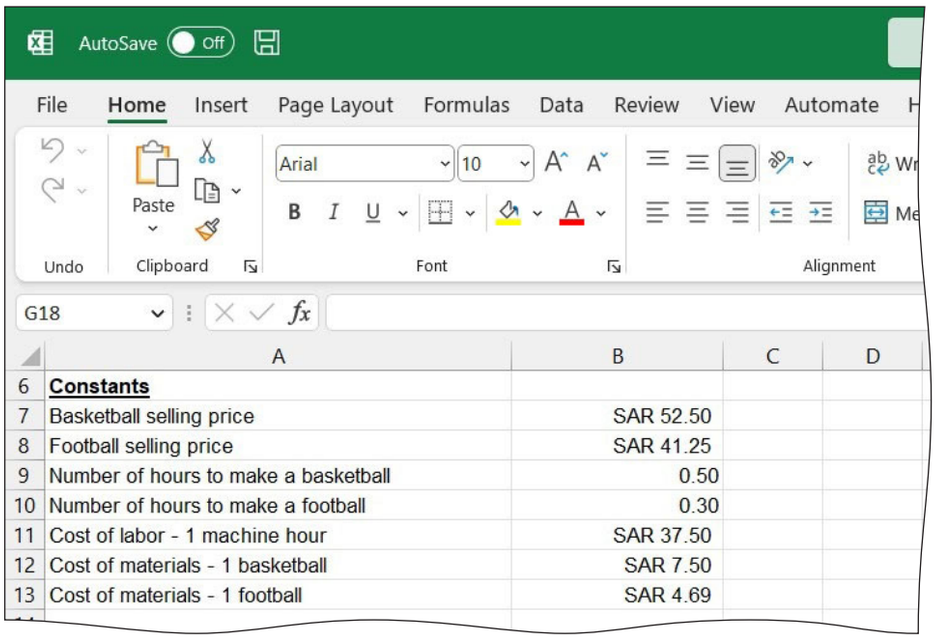
You should enter a number in the changing cells each time you set up a problem, before running Solver. It is customary to enter 1s in the changing cells, as shown in Figure 11-4. Solver will change these values when the program is run.

QUICK TIP
You should format cells in the Constants section for currency or for two decimal place numbers.

2. **Constants Section**

Your spreadsheet should also have a section for values that will not change. Figure 11-5 shows the Constants section values that you should enter.

FIGURE 11-5: Constants section



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- **Selling price:** The selling price for a single basketball and a single football.
- **Number of hours:** The time needed to make a basketball and a football. Note, for example, that a ball-making machine can produce two basketballs in an hour.
- **Cost of labor:** A worker makes a ball using a ball-making machine. A worker is paid SAR 37.50 for each hour of work at the machine.
- **Cost of materials:** The costs of raw materials for a basketball and a football.

Notice that the profit margins for the two products are not the same. They have different selling prices and different inputs (raw materials and hours to make), and the inputs have different costs per unit. Also note that you cannot tell from the data how many machine hours of the shared resource will be devoted to basketballs and how many will be devoted to footballs. This is because you don't know in advance how many basketballs and footballs will be made.

3. **Calculations Section**

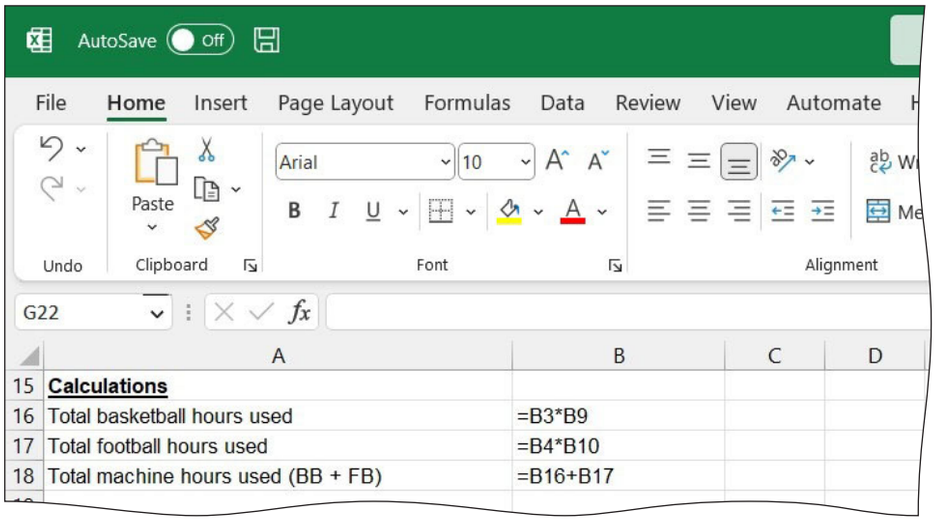
In the Calculations section, you will calculate intermediate results that will be used in the spreadsheet body and as constraints. Before entering formulas, format the cells in the Calculations section for two decimal places.

Figure 11-6 shows the skeleton and formulas you should enter.

QUICK TIP

Constants in the Excel cell formulas in Figure 11-6 are referred to by their cell addresses. Use the cell address of a constant rather than hard-coding a number in the Excel expression. If the number must be changed later, you will have to change it only in the Constants section cell, not in every cell formula in which you used the value.

FIGURE 11-6: Cell formulas in the Calculations section



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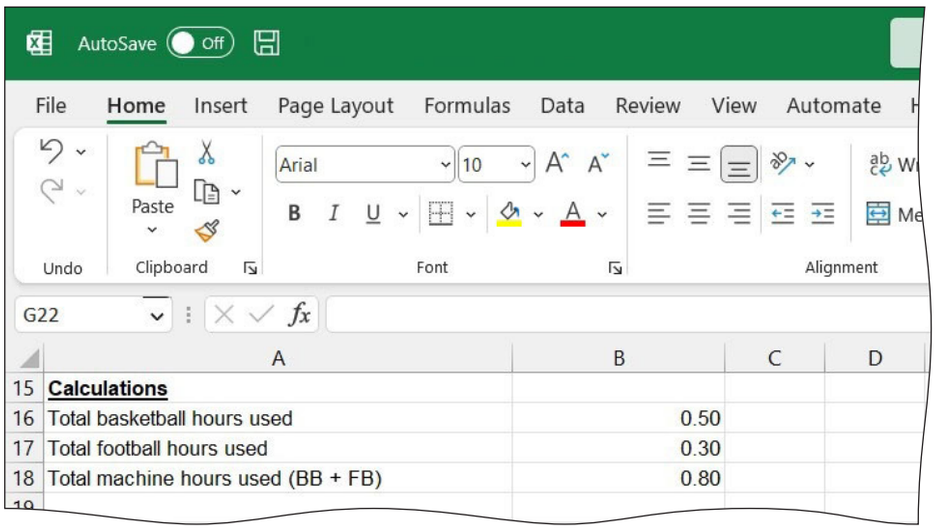
QUICK TIP
Do not calculate the amounts shown in the changing cells—Solver will compute those numbers. Also, notice that you can use the changing cell addresses in your formulas. When you do, you assume Solver has inserted the optimal values in each changing cell; your expression makes use of those numbers.

- **Total basketball hours used:** The number of machine hours needed to make all basketballs. This is calculated as Total = Number of basketballs × Hours needed for manufacture (**B3*B9**) and is computed in cell B16. Cell B9 contains the constant for the hours needed to make one basketball. Cell B3, a changing cell, contains the number of basketballs made. Currently, this cell shows one ball, but that number will change when Solver works on the problem.
- **Total football hours used:** The number of machine hours needed to make all footballs is calculated the same way.
- **Total machine hours used (basketballs, BB, and footballs, FB):** The number of hours needed to make both kinds of balls (cell B18) will be used in the constraints. This value is the sum of the hours calculated for making footballs and basketballs.

Figure 11-7 shows the calculated values after Excel evaluates the cell formulas (with 1s in the changing cells).

FIGURE 11-7: Cell values in the Calculations section



QUICK TIP
Income statement cells should be formatted as currency and two decimal places.

4. Income Statement Section

The target value is calculated in the Income statement section of the spreadsheet. This is the value that Solver has predicted to optimize results. Figure 11-8 shows the skeleton and formulas that you should enter.

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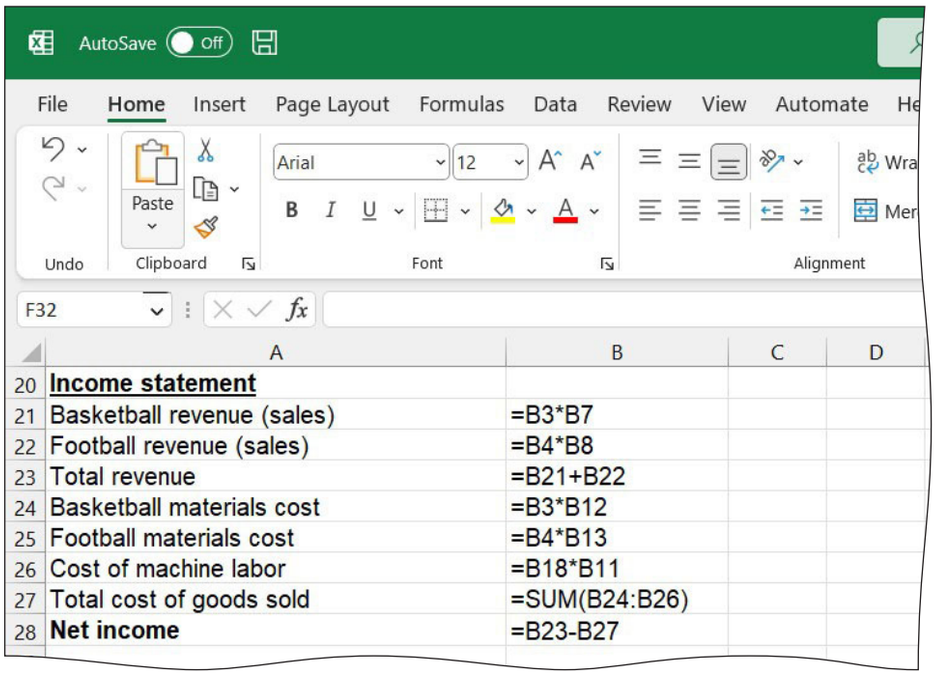
FIGURE 11-8: Cell formulas in the Income statement section

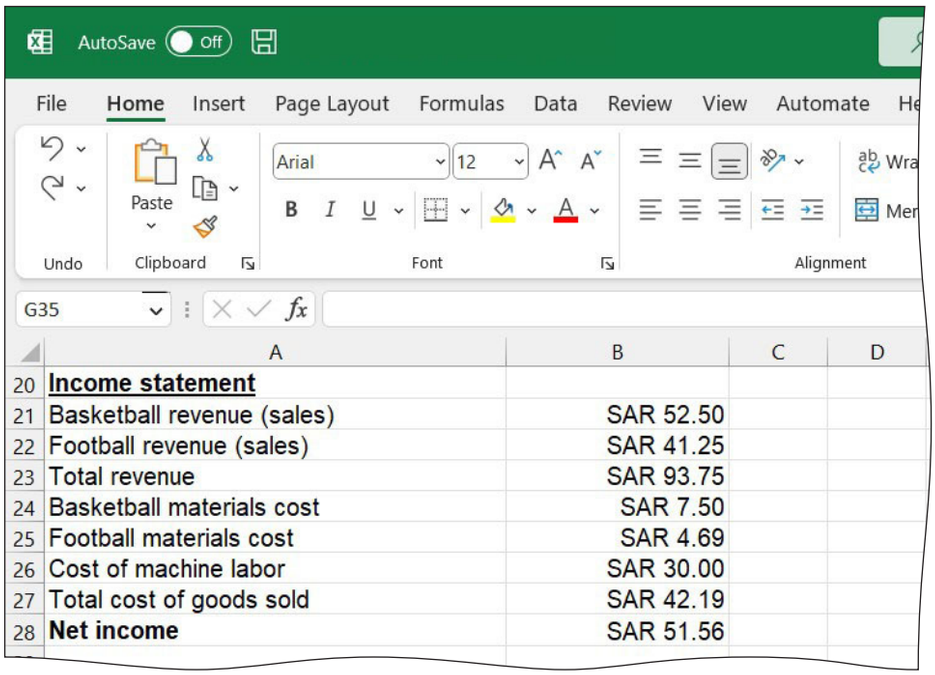


	A	B	C	D
20	**Income statement**			
21	Basketball revenue (sales)	=B3*B7		
22	Football revenue (sales)	=B4*B8		
23	Total revenue	=B21+B22		
24	Basketball materials cost	=B3*B12		
25	Football materials cost	=B4*B13		
26	Cost of machine labor	=B18*B11		
27	Total cost of goods sold	=SUM(B24:B26)		
28	**Net income**	=B23-B27		

- **Revenue:** The values in cells B21 and B22 equal the number of balls sold multiplied by the respective unit selling price. Therefore, the calculation for B21 is Number of basketballs sold × Basketball selling price (**B3*B7**), while the total for B22 is Number of footballs sold × Football selling price (**B4*B8**). The number of balls sold is shown in the Changing Cells section, and the selling prices are constants.
- **Total revenue:** The sum of basketball and football revenue.
- **Materials cost:** The values in cells B24 and B25 equal the number of units made multiplied by unit cost.
- **Cost of machine labor:** The calculated number of machine hours used for producing basketballs and footballs multiplied by the hourly labor rate for machine workers.
- **Total cost of goods sold:** The sum of the cost of materials and the cost of labor.
- **Net income:** Total revenue minus the total cost of production (**B23–B27**).

Excel evaluates the formulas. Figure 11-9 shows the results, assuming that 1s are in the changing cells.

FIGURE 11-9: Cell values in the Income Statement section



	A	B	C	D
20	**Income statement**			
21	Basketball revenue (sales)	SAR 52.50		
22	Football revenue (sales)	SAR 41.25		
23	Total revenue	SAR 93.75		
24	Basketball materials cost	SAR 7.50		
25	Football materials cost	SAR 4.69		
26	Cost of machine labor	SAR 30.00		
27	Total cost of goods sold	SAR 42.19		
28	**Net income**	SAR 51.56		

5. **Constraints**

Constraints are rules that Solver must observe when computing the optimal answer to a problem. Constraints need to refer to calculated values in the spreadsheet body.

There is no section in the main part of the spreadsheet for constraints. You'll add the constraints to the Solver Parameters window (Figure 11-10). Table 11-1 shows the Excel expressions for the constraints of the basketball and football production problem.

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FIGURE 11-10: Adding constraints in the Solver Parameters window

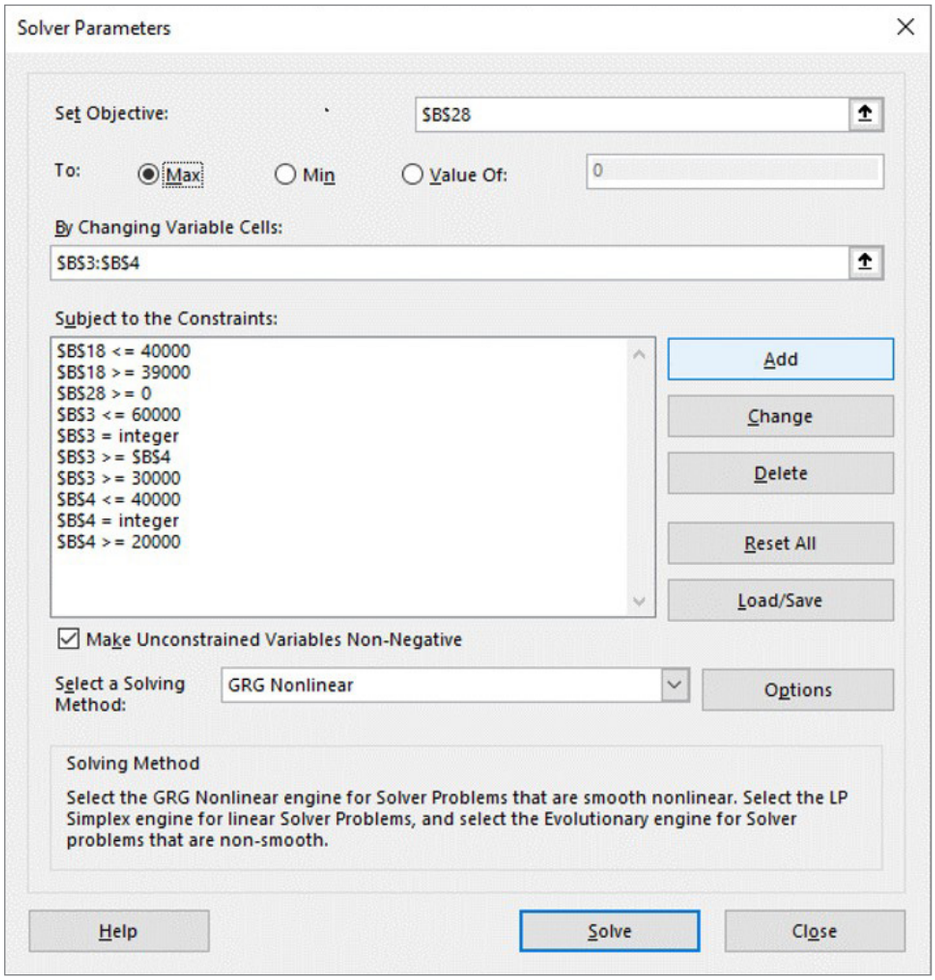

TABLE 11-1: Solver constraint expressions

Description of expression	Excel expression
1. TOTAL MACHINE HOURS >= 39000	B18 >= 39000
2. TOTAL MACHINE HOURS <= 40000	B18 <= 40000
3. MIN BASKETBALLS >= 30000	B3 >= 30000
4. MAX BASKETBALLS <= 60000	B3 <= 60000
5. MIN FOOTBALLS >= 20000	B4 >= 20000
6. MAX FOOTBALLS <= 40000	B4 <= 40000
7. AT LEAST AS MANY BASKETBALLS AS FOOTBALLS	B3 >= B4
8. NET INCOME MUST BE POSITIVE	B28 >= 0

QUICK TIP

Notice in Figure 11-8 that a cell address in a constraint expression can be a cell address in the Changing cells section, in the Constants section, in the Calculations section, or in the spreadsheet body.

When using Solver, you might need to set minimum and maximum boundaries for variables. For example, the number of basketballs (MIN and MAX) varies between 30,000 and 60,000.

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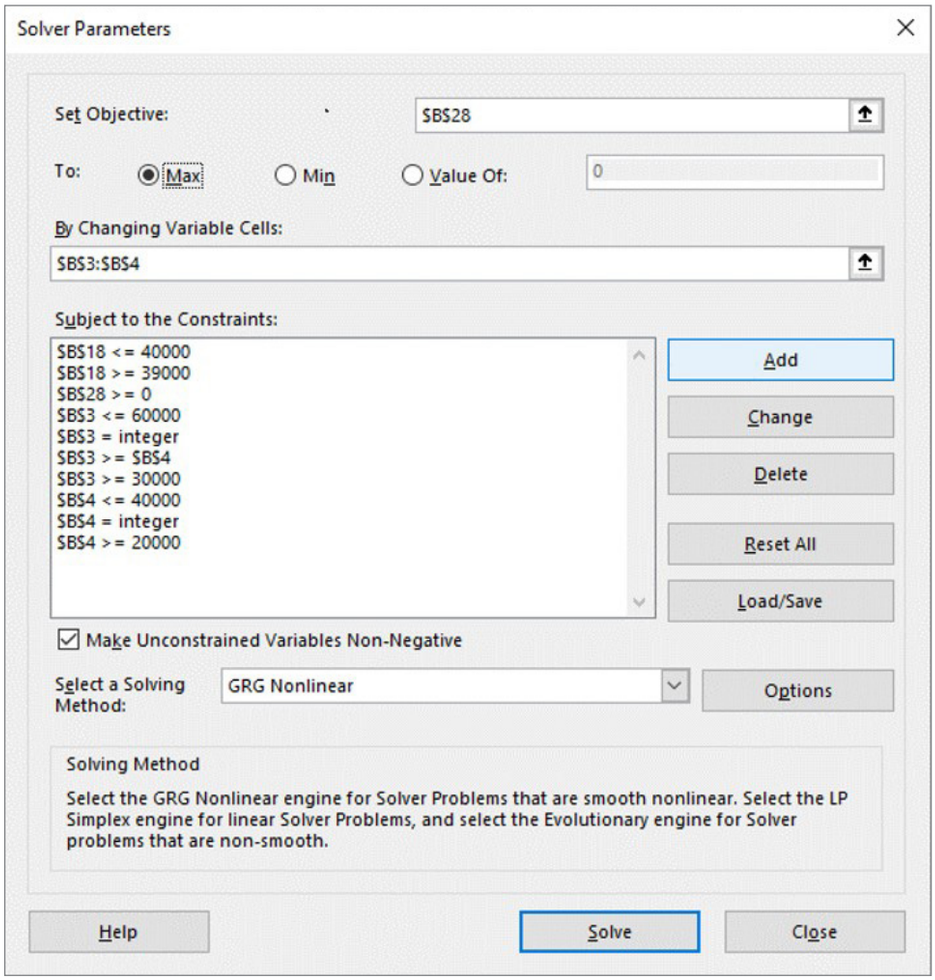
Often a boundary value is zero because you want Solver to find a non-negative result. In this example, you want only answers that yield a positive net income. You tell Solver that the amount in the net income cell must equal or exceed zero so Solver will not find an answer that produces a loss.

Machine hours must be shared between the two kinds of balls. The constraints for the shared resource are **B18 >= 39000** and **B18 <= 40000**, where cell B18 shows the total hours used to make both basketballs and footballs.

Marketing wants the company to make at least as many basketballs as footballs. The constraint **B3 >= B4** expresses this logic.

One other constraint arises out of common sense: Solver should not decide to make a partial ball. Solver will let you specify integer values for balls produced as shown in Figure 11-11.

FIGURE 11-11: You can add a constraint to make Solver use only integer values



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1-3 Running Solver: Mechanics

To set up Solver, you must tell it:

- the changing cell addresses
- the cell address of the "target" objective variable that you are trying to optimize
- the expressions for the constraints.

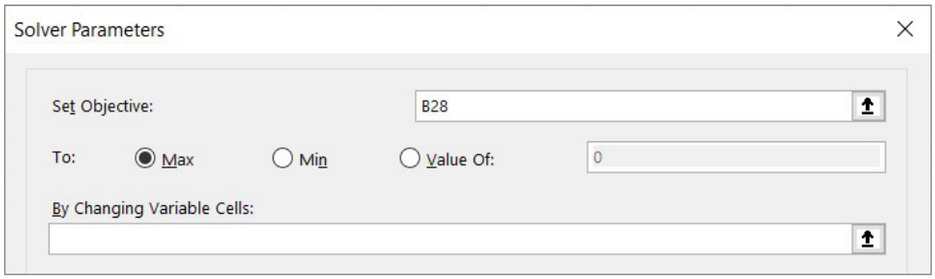
Solver will record its answers in the Variable Cells and in a separate worksheet.

1. **Beginning to Set Up Solver**

   - First select the Data tab. In the Analysis group, select Solver. The Solver Parameters window appears, as shown in Figure 11-12.

   - Use the Solver Parameters window to specify the objective cell, the changing cells, and the constraints.

FIGURE 11-12: Upper portion of the Solver Parameters window

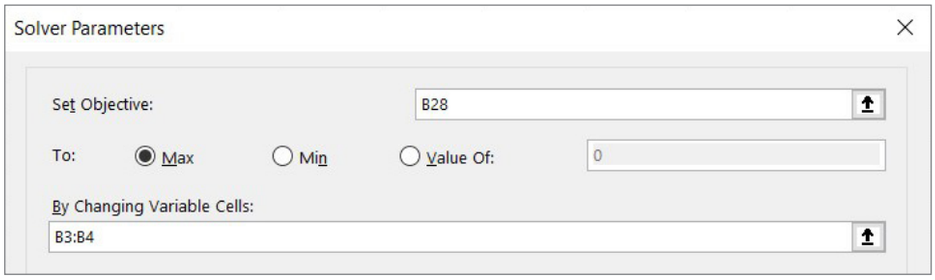


2. **Setting the Objective Cell**
   - To set an objective cell, use the following procedure:
     - Click the Set Objective box and enter B28, which is the cell for Net income.
     - Accept the default Max setting, which stands for "maximize".
     - Leave the Value Of: button unchecked. Do not press Enter when you finish. You'll navigate within this window by clicking in the next input box.

QUICK TIP
When you enter the cell address, Solver may insert dollar signs, as if for absolute addressing. Ignore them—do not try to delete them.

3. **Setting the Changing Variables Cells**
   The changing cells are the cells for the quantity of basketballs and footballs, which are in the range B3:B4. Click the By Changing Variable Cells box and type B3:B4, as shown in Figure 11-13. Do not press Enter.

FIGURE 11-13: Entering data in the By Changing Variable Cells box



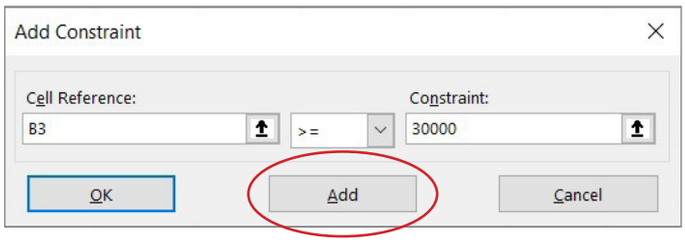
4. **Entering Constraints**

   You are now ready to enter the constraint formulas one by one.

STEP 1

- Click the Add button in the Solver Parameters window. As shown in Figure 11-14, you then see the Add Constraint window. Enter the constraint for minimum basketball production.

FIGURE 11-14: Entering data in the Add Constraint window



You should do the following when entering constraint expressions:

- Type the variable's cell address in the Cell Reference input box.
- Select the operator (<=, = , >=, or **Int**) in the smaller, middle box.
- Enter either a raw number or the cell address of a value in the Constraint box.
- Click Add to finish entering the constraint.
- If you change your mind about the expression and do not want to enter it, click Cancel.

STEP 2

- Enter the minimum basketball constraint now. Later, Solver will insert an equals sign in front of the 30000 and a dollar sign in the cell reference.
- After entering a constraint formula, click the Add button to add the constraint to the Solver model. The Add Constraint window stays open and allows you to enter other constraints.

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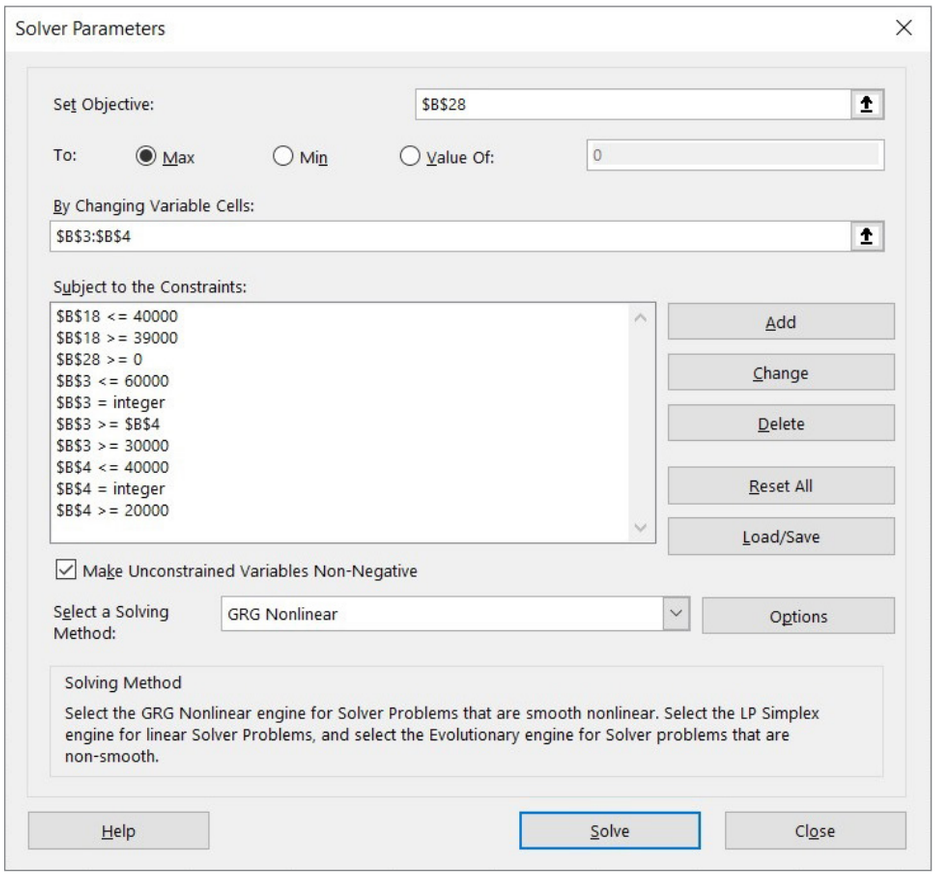
QUICK TIP
You should use the Int operator in the Add Constraint window to specify that B3 and B4 must be integer values.

- Enter the rest of the constraints. See Table 11-1 for the logic.
- When you're done entering constraints, click the Cancel button to return to the Solver Parameters window.

  In the Solver Parameters window, you will see that the constraints have been entered into the program. In some cases, not all constraints will appear due to the number of constraints and the size of the box, although that is not a problem here. The base case constraints are shown in Figure 11-15.

FIGURE 11-15: Constraints entered in the Solver Parameters window



5. **Selecting a Solving Method**

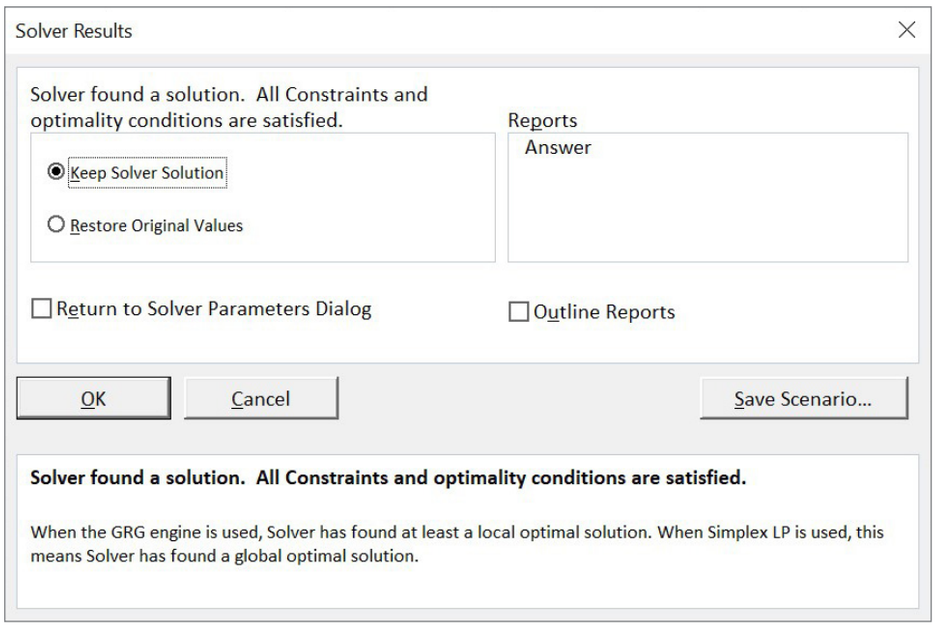
   Figure 11-15 shows the Select a Solving Method field. For this problem, choose GRG Nonlinear. The Make Unconstrained Variables Non-Negative box should be checked, as shown in Figure 11-15.

6. **Computing Solver's Answer**

STEP 1

- To have Solver calculate answers, click Solve in the lower-right corner of the Solver Parameters window. Solver does its work in the background—you do not see the internal calculations, but may notice a slight delay on your computer. Next you will see a Solver Results window, as shown in Figure 11-16.

FIGURE 11-16: Solver Results window



In the Solver Results window, Solver reports that it has found a solution and that the constraints and objectives were met. This is a very important message—you should always check for it.

Impossible constraints

Sometimes, your constraints might not allow Solver to find an answer. For example, imagine you had a constraint that said, "Net income must be at least a billion dollars."

That amount cannot be reached, given so few basketballs and footballs and the prices. Solver would report that no answer is possible. It might also report that it found an answer, but only by ignoring some constraints.

In either case, something is wrong with your model, and you would need to rework it.

There are two ways to see your answers. One way is to click OK in the Solver Results window, which lets you see the new changing cell values. A more

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formal and complete way is to click Answer in the Reports box and then click OK, which inserts detailed results into a new sheet in your Excel book. The new sheet is called an Answer Report. All Answer Reports are numbered sequentially as you run Solver.

STEP 2

- To see the Answer Report, click its tab, as shown in Figure 11-17. In this case, the tab is named Answer Report 1.

FIGURE 11-17: Answer Report sheet tab

32	$B$3	Number of basketballs sold	56000	$B$3>=30000	Not Binding	26000
33	$B$4	Number of footballs sold	40000	$B$4<=40000	Binding	0
34	$B$4	Number of footballs sold	40000	$B$4>=20000	Not Binding	20000
35	$B$3=Integer					
36	$B$4=Integer					
37						

Answer Report 1 | Sheet 1

The top portion of the report is shown in Figure 11-18.

FIGURE 11-18: Top portion of the Answer Report

Microsoft Excel 16.0 Answer Report
Worksheet:
Report Created:
Result: Solver found a solution. All Constraints and optimality conditions are satisfied.
Solver Engine
Engine: GRG Nonlinear
Solution Time: 0.047 Seconds.
Iterations: 3 Subproblems: 0
Solver Options
Max Time 100 sec, Iterations 100, Precision 0.000001
Convergence 0.0001, Population Size 100, Random Seed 0, Derivatives Central
Max Subproblems Unlimited, Max Integer Sols Unlimited, Integer Tolerance 0%, Assume NonNegative

Objective Cell (Max)

Cell	Name	Original Value	Final Value
$B$28	Net income	SAR 51.56	SAR 2,482,400.00

Variable Cells

Cell	Name	Original Value	Final Value	Integer
$B$3	Number of basketballs sold	1	56000	Integer
$B$4	Number of footballs sold	1	40000	Integer

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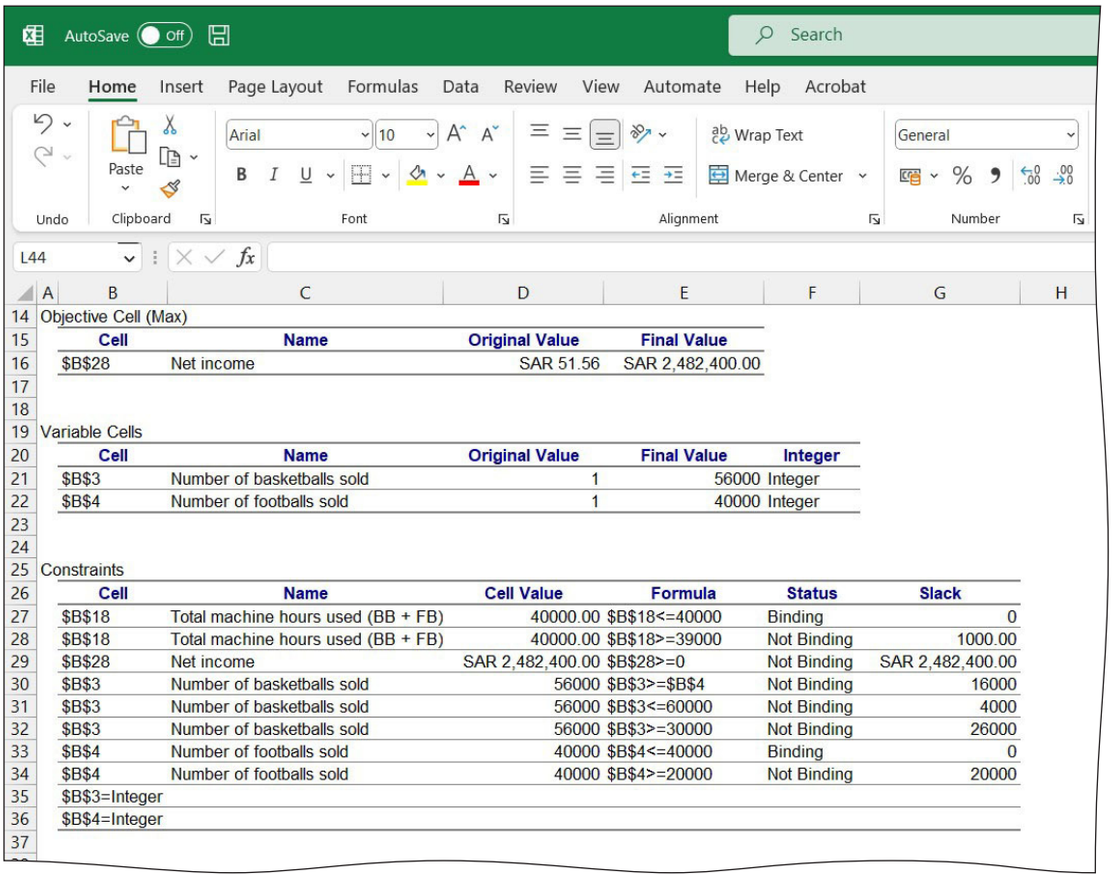
Figure 11-19 shows the remainder of the Answer Report.

FIGURE 11-19: Remainder of the Answer Report



Objective Cell (Max)

Cell	Name	Original Value	Final Value
$B$28	Net income	SAR 51.56	SAR 2,482,400.00

Variable Cells

Cell	Name	Original Value	Final Value	Integer
$B$3	Number of basketballs sold	1	56000	Integer
$B$4	Number of footballs sold	1	40000	Integer

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$B$18	Total machine hours used (BB + FB)	40000.00	$B$18<=40000	Binding	0
$B$18	Total machine hours used (BB + FB)	40000.00	$B$18>=39000	Not Binding	1000.00
$B$28	Net income	SAR 2,482,400.00	$B$28>=0	Not Binding	SAR 2,482,400.00
$B$3	Number of basketballs sold	56000	$B$3>=$B$4	Not Binding	16000
$B$3	Number of basketballs sold	56000	$B$3<=60000	Not Binding	4000
$B$3	Number of basketballs sold	56000	$B$3>=30000	Not Binding	26000
$B$4	Number of footballs sold	40000	$B$4<=40000	Binding	0
$B$4	Number of footballs sold	40000	$B$4>=20000	Not Binding	20000
$B$3=Integer					
$B$4=Integer					

At the beginning of this example, the changing cells had a value of 1, and the income was SAR 51.56 (the original value, with only one football and one basketball sold). The optimal solution values (the final value, with 56,000 basketballs and 40,00 footballs sold) are also shown: SAR 2,482,400 for net income (the target) and 56,000 basketballs and 40,000 footballs for the changing cells.

The report also shows details for the constraints: the constraint expression and the value of the variable in the optimal solution. Binding means the final answer caused Solver to bump up against the constraint.

For example, the maximum number of machine hours was 40,000, which is the value Solver used to find the answer. Not binding means the reverse. For example, the maximum limit of 60,000 basketballs did not constrain Solver.

The procedures you use to change or delete a constraint are discussed later in this chapter.

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Save the Excel file using the Save option in the File tab. Then use the Save As option in the File tab to create a new file named **Sports2.xlsx**, which you will use in the next section of this chapter.

1-4 Multiple Variables in Excel Solver

Next, you'll modify the sporting goods spreadsheet because management wants to know what net income would be if certain constraints were changed. In other words, management wants to do *"what if?"* analysis with certain constraints in the base case. The results of this second case are called the extension case. Here are the changes that are made to the original base case conditions:

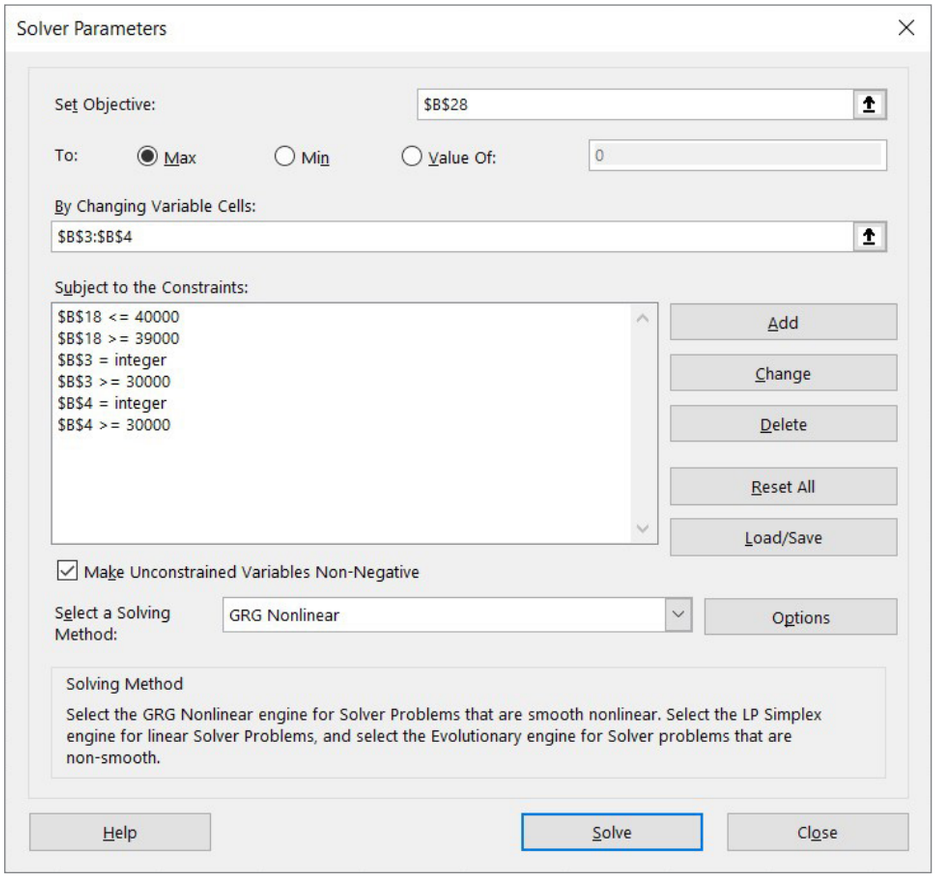
- Assume maximum production constraints will be removed.
- Similarly, the basketball-to-football production comparison (**B3 >= B4**) will be removed.
- There still will be minimum production constraints—assume that at least 30,000 basketballs and 30,000 footballs will be produced.
- The machine-hours shared resource imposes the same limits as in the base case.

STEP 1

- Begin by putting 1s in the changing cells.
- In the Solver Parameters window, click to highlight constraints that are no longer needed: the net income **>= 0** constraint, the maximum football and basketball constraints, and the basketball-to-football comparison constraint. Delete the constraints by clicking the Delete button.
- The minimum football constraint must be modified, not deleted. Select that constraint and then click Change to open the Add Constraint window. Edit the constraint so that 30,000 is the lower boundary.

When you are finished with the constraints, your Solver Parameters window should look like the one shown in Figure 11-20.

FIGURE 11-20: Solver Parameters window for the extension case



The constraints now apply only to the minimum production levels, the machine-hours shared resource, and the whole-number output.

STEP 2

- Set the Solver method to GRG Nonlinear in the Solver Parameters window. When Solver has ran, the values in the Answer Report should match those in Figure 11-21.

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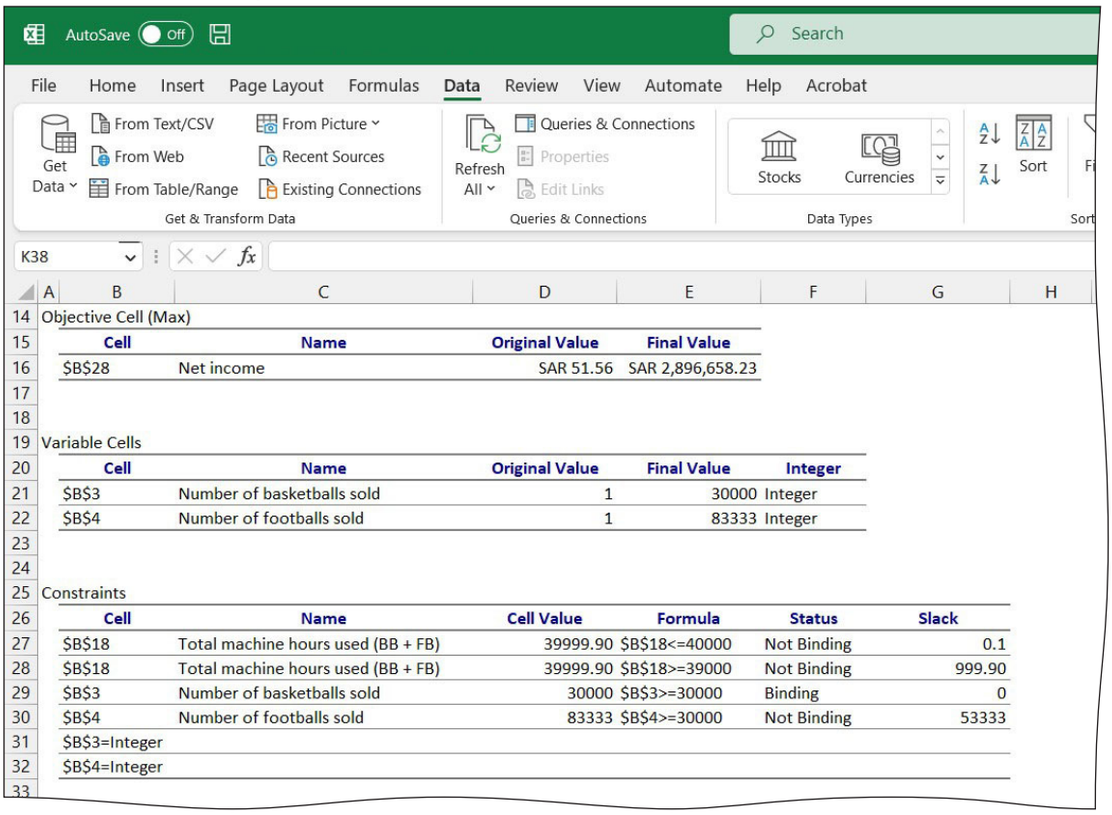
FIGURE 11-21: Answer Report for the extension case



Objective Cell (Max)

Cell	Name	Original Value	Final Value
$B$28	Net income	SAR 51.56	SAR 2,896,658.23

Variable Cells

Cell	Name	Original Value	Final Value	Integer
$B$3	Number of basketballs sold	1	30000	Integer
$B$4	Number of footballs sold	1	83333	Integer

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$B$18	Total machine hours used (BB + FB)	39999.90	$B$18<=40000	Not Binding	0.1
$B$18	Total machine hours used (BB + FB)	39999.90	$B$18>=39000	Not Binding	999.90
$B$3	Number of basketballs sold	30000	$B$3>=30000	Binding	0
$B$4	Number of footballs sold	83333	$B$4>=30000	Not Binding	53333
$B$3=Integer					
$B$4=Integer					

The answer for the extension case differs from the base case answer. Which production schedule should management use: the one that has maximum production limits or the one that has no such limits? This question is posed to get you to think about the purpose of using a DSS program. Solver's very different answers to the base case and the extension case are shown in Table 11-2.

TABLE 11-2: Solver's answers for the two cases

	Base case	Extension case
Basketballs	56,000	30,000
Footballs	40,000	83,333

Can you use this output alone to decide how many of each kind of ball to produce? No, you cannot. You must also refer to the case objective, which is to optimize net income. Table 11-3 shows the answers with net income data added.

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TABLE 11-3: Solver's answers for the two cases—with objective data

	Base case	Extension case
Basketballs	56,000	30,000
Footballs	40,000	83,333
Net income	SAR 2,482,400	SAR 2,896,658

When viewed this way, the extension case's production schedule looks better because it gives a higher target net income.

- Save the **Sports2.xlsx** file and then close it. Select Close from the File tab.

REVIEW QUESTIONS

1. **What is the purpose of optimization?**
   - **a.** To continually ensure that a system is working as well as possible to maximize profits
   - **b.** To ensure that most employees have work to do most of the time
   - **c.** To calculate how many breaks employees should be given during a working day
   - **d.** To design a marketing strategy for an existing product
2. **Which of the following is an example of a shared resource?**
   - **a.** Stationery such as notebooks and pens
   - **b.** The desktop computer each employee is using
   - **c.** The material that is used to make both bike tires and car tires in the same factory
   - **d.** The cell phones used by the sales team

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Lesson
2
Chapter 11

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Practicing with Solver

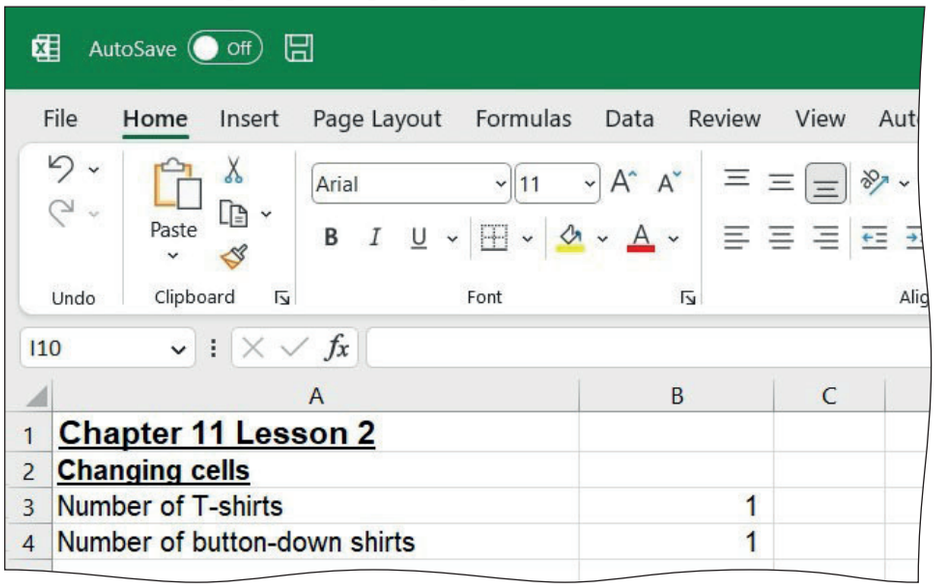
This lesson includes a short problem that lets you practice what you have learned about Excel Solver.

Assume that you run a clothing manufacturing company. You have two products: T-shirts with a buttoned pocket and button-down shirts. You must decide how many T-shirts and button-down shirts to make. Assume that you'll sell every item you make.

Use the file **Chapter 11 data file 2.xlxs**, which you can access by scanning the QR code.

1. **Changing Cells Section**
   Your Changing cells section should look like those in Figure 11-22.

FIGURE 11-22: Clothing manufacturing changing cells



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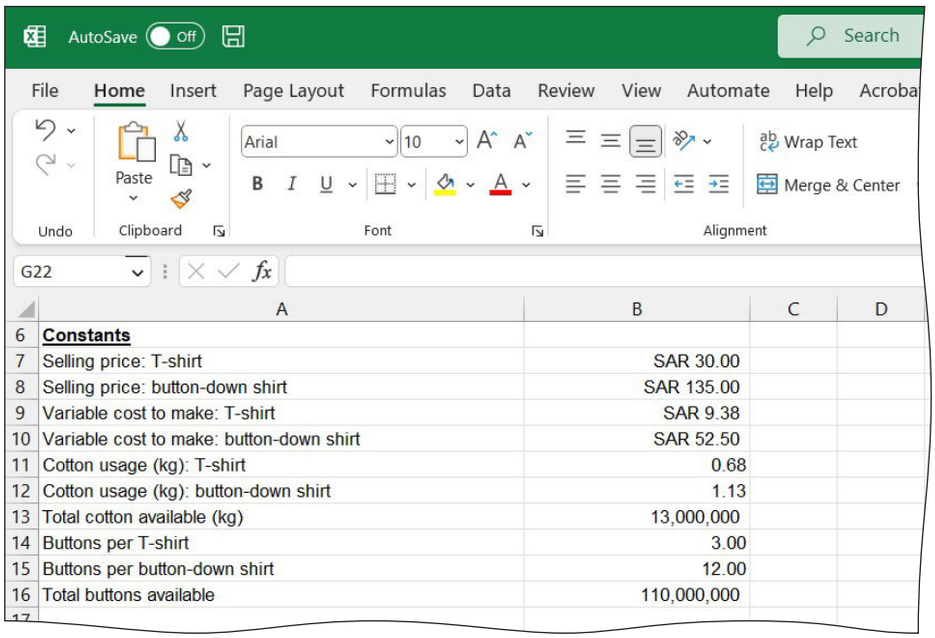
2. **Constants Section**

Your spreadsheet should contain the constants shown in Figure 11-23.

FIGURE 11-23: Clothing manufacturing constants



	A	B	C	D
6	**Constants**			
7	Selling price: T-shirt	SAR 30.00		
8	Selling price: button-down shirt	SAR 135.00		
9	Variable cost to make: T-shirt	SAR 9.38		
10	Variable cost to make: button-down shirt	SAR 52.50		
11	Cotton usage (kg): T-shirt	0.68		
12	Cotton usage (kg): button-down shirt	1.13		
13	Total cotton available (kg)	13,000,000		
14	Buttons per T-shirt	3.00		
15	Buttons per button-down shirt	12.00		
16	Total buttons available	110,000,000		

- **Selling price:** You sell T-shirts for SAR 30 and button-down shirts for SAR 135.
- **Variable cost to make:** It costs SAR 9.38 to make a T-shirt and SAR 52.50 to make a button-down shirt. These variable costs are for machine operator labor, cloth, buttons, and so on.
- **Cotton usage:** Each T-shirt uses 0.68 kilograms of cotton fabric. Each button-down shirt uses 1.13 kilograms of cotton fabric.
- **Total cotton available:** You have 13 million kilograms of cotton on hand to make all of the T-shirts and button-down shirts.
- **Buttons:** Each T-shirt has three buttons. By contrast, each button-down shirt has one button on each collar tip, eight buttons down the front, and one button on each cuff, for a total of 12 buttons.
- **Total buttons available:** You have 110 million buttons on hand to be used in making the shirts.

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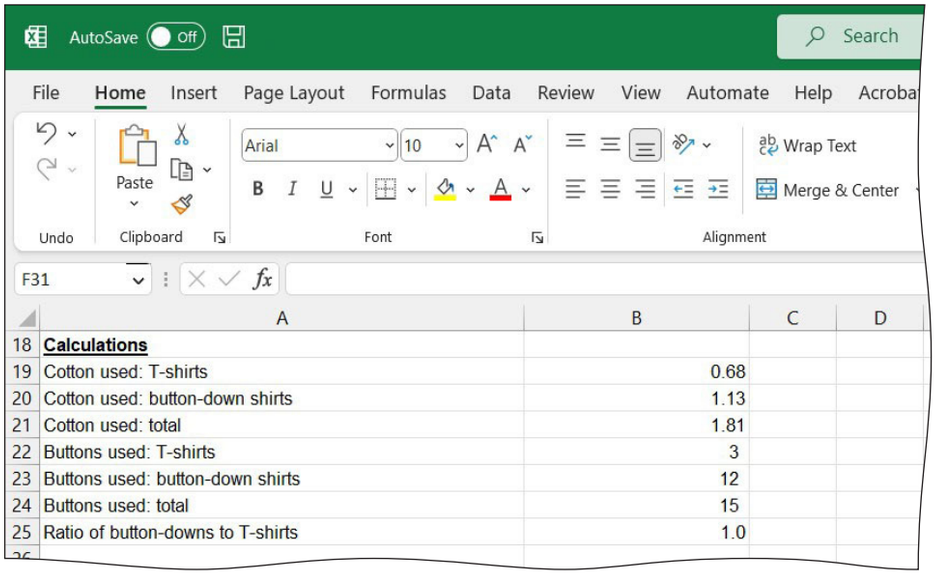
3. **Calculations Section**

Calculations and related business constraints are discussed next. Your spreadsheet should contain the calculations shown in Figure 11-24.

FIGURE 11-24: Clothing manufacturing calculations



	A	B	C	D
18	**Calculations**			
19	Cotton used: T-shirts	0.68		
20	Cotton used: button-down shirts	1.13		
21	Cotton used: total	1.81		
22	Buttons used: T-shirts	3		
23	Buttons used: button-down shirts	12		
24	Buttons used: total	15		
25	Ratio of button-downs to T-shirts	1.0		

- **Cotton used/buttons used:** You have a limited amount of cotton and buttons. The usage of each resource must be calculated and then used in constraints.
- **Ratio of button-down shirts to T-shirts:** You think you must make at least 2 million T-shirts and at least 2 million button-down shirts. You want to operate as a balanced shirt maker, so the ratio of button-down shirts to T-shirts should be no greater than 4:1. Thus, if you produced 9 million button-down shirts and 2 million T-shirts, the ratio would be too high (4:5:1).

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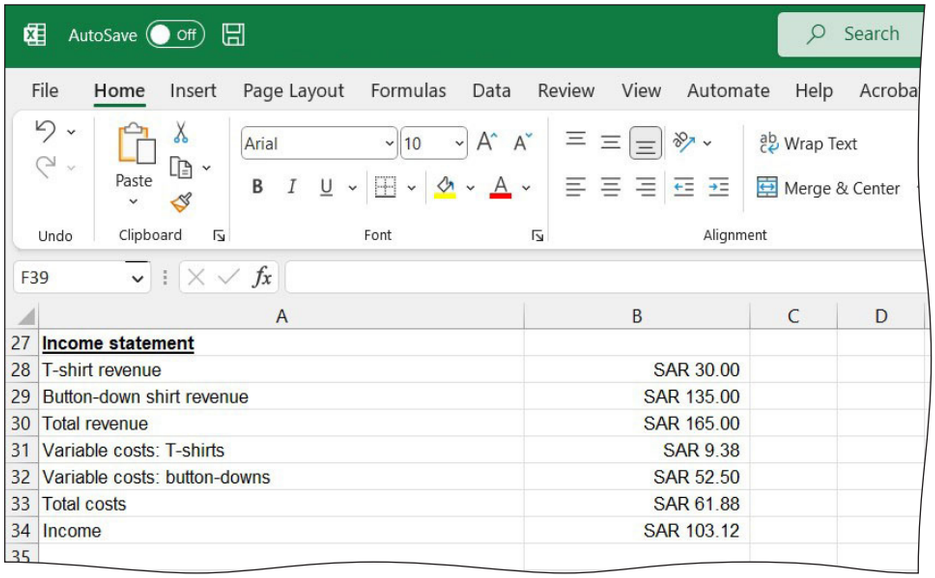
4. **Income Statement Section**

Your spreadsheet should have the Income statement section shown in Figure 11-25.

FIGURE 11-25: Line items in the clothing manufacturing Income statement



	A	B	C	D
27	**Income statement**			
28	T-shirt revenue	SAR 30.00		
29	Button-down shirt revenue	SAR 135.00		
30	Total revenue	SAR 165.00		
31	Variable costs: T-shirts	SAR 9.38		
32	Variable costs: button-downs	SAR 52.50		
33	Total costs	SAR 61.88		
34	Income	SAR 103.12		
35				

The meaning of the line items is similar to the sports example in Lesson 1. Refer to these examples for explanations.

Solver's objective is to optimize net income.

Use the table shown in Table 11-4 to hand-write the constraints before entering them into Solver.

TABLE 11-4: Logic of clothing manufacturing constraints

Expression	Fill in the Excel expression
Net income to revenue	___ = ___
Ratio of button-downs to T-shirts	___ = ___
Minimum T-shirts	___ = ___
Minimum button-downs	___ = ___
Usage of buttons	___ = ___

Before running Solver, set the method to GRG Nonlinear in the Solver Parameters window.

Remember, the model can only calculate values based on the inputs and constraints you have provided. The spreadsheet can't interpret the results or make recommendations based on them.

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You asked Solver to change the number of T-shirts and button-down shirts (with constraints) to maximize the company's income. In this instance, Solver is suggesting that you should produce four times as many button-downs as T-shirts.

When you are finished with the program, select Save from the File tab to save the file, and then select Close from the File tab to close the file.

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Scan the QR code to access a lesson that will help you to overcome problems with Solver. The lesson will also refresh your memory on basic file-handling procedures.

REVIEW QUESTIONS

1. **Which of the following would NOT be included in the Constants section of the Solver spreadsheet?**
   a. Selling price
   b. Variable cost to make an item
   c. Number of items
   d. Material usage
2. **If you are using Solver to optimize net income, which of the following should be included in the Income statement section?**
   a. Revenue of items being sold
   b. Total revenue
   c. Variable costs
   d. All of the above

Extra Practice

Critical Thinking Questions

1. Making footballs and basketballs yields different profit margins for the businesses. Should the company stop making the lower performing product? Give reasons for and against, and explain your decision.

2. The sports equipment business can only have a maximum of 1,000 hours of downtime per year if it is still to meet its production targets. List as many reasons that the business needs to have downtime as you can think of. Which is the most important, and why?

3. In Lesson 2, we learned that the clothing business produced button-down shirts and T-shirts because it wanted to be known as a "balanced shirt maker." Thinking about your answer to question 1, why do you think this balance is important for the business?

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Team Challenge

The profit margins for the footballs and basketballs are different. In the example, we are told that this is because they have different selling prices, different materials, and different inputs.

Discuss the different inputs and materials needed to produce footballs and basketballs. Consider the materials, labor, and machinery that might be used. Decide among your group which inputs and materials have the biggest impact on the selling price. When you have listed all of the inputs and materials you can think of, rank them in order of the impact you think they will have on the selling price.

Be the Critic

1. Many other businesses produce footballs and basketballs, often for different selling prices. Answer in detail why another company might be able to sell their products for higher prices, focusing only on the product itself.

2. Some companies will produce footballs and basketballs using the same or similar inputs and materials. The cost to produce the products may also be very similar. However, some of these companies will charge much more money for the products, and many of their customers will be happy to pay these higher prices. Why?

   Try to think of three possible reasons and write a short essay explaining each one. You may want to think about your own decision-making processes when shopping to help you.

Projects

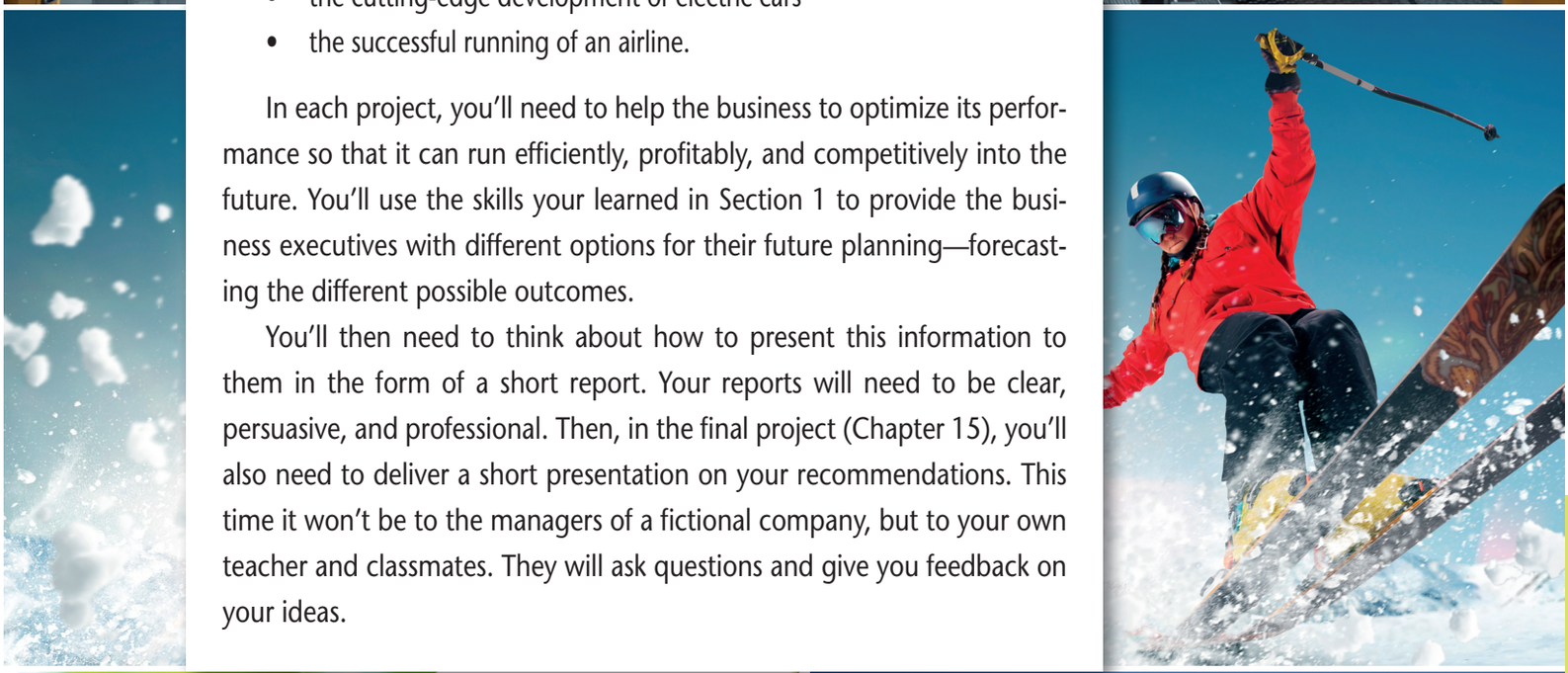
Now that you're familiar with the concepts and computer skills required for this semester, it's time to test them out! Section 2 presents a series of four real-world decision-making projects on which you can test and develop your skills.

You'll work on projects related to:

- the production of automobiles
- the management of a new, state of the art ski resort for Saudi Arabia
- the cutting-edge development of electric cars
- the successful running of an airline.

In each project, you'll need to help the business to optimize its performance so that it can run efficiently, profitably, and competitively into the future. You'll use the skills your learned in Section 1 to provide the business executives with different options for their future planning—forecasting the different possible outcomes.

You'll then need to think about how to present this information to them in the form of a short report. Your reports will need to be clear, persuasive, and professional. Then, in the final project (Chapter 15), you'll also need to deliver a short presentation on your recommendations. This time it won't be to the managers of a fictional company, but to your own teacher and classmates. They will ask questions and give you feedback on your ideas.



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Chapter 12

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The Car Production Project

Automobiles must improve their average fuel efficiency (the vehicles' kilometers per liter) in order to comply with new government regulations. The company you will work for in this project makes and sells different kinds of motorized vehicles, and each has different kilometers-per-liter ratings. In this case, you will use Excel Solver to determine the product mix needed to comply with the new regulations in a profitable way.

The Car Production Project will introduce you to the methods used to gather information for decision-making support. Information can come from many sources—it can be internal or external. Information can also be actual or predicted, depending on what type of information is needed.

This chapter will focus on identifying the types of information needed can be used in the project's decision-making exercises. Within your project you will begin to explore best- and worst-case scenarios, using the available data to predict likely future outcomes. While there will be variables that you are able to calculate confidently, there will be areas in which the data are projections only. With these forecasts, you will be able to explore various future options.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Describe the data gathering process
2. Explain the types of data required for business decision support
3. Highlight patterns and trends in data to make optimal decisions.
4. Analyze the impact of effective data gathering on business decision making
5. Determine the most likely outcome of the data analysis

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Car Production Background

Vehicles with an internal combustion engine burn gasoline for propulsion. In this process, carbon-laden fumes are released out of the tailpipe into the air. This discharge contributes to air pollution. The government requires automobile companies to produce vehicles that are fuel efficient in order to reduce air pollution.

A vehicle's fuel efficiency is expressed as its kilometers per liter (KPL)—the distance that can be covered by burning a liter of gasoline in the vehicle's engine. For example, if an automobile needs to burn 10 liters of gasoline in order to cover 100 kilometers, the vehicle's KPL would be 100km/10l = 10KPL. A vehicle that needs 20 liters to cover the same distance would have a KPL of 5 (100km/20l = 5KPL), and would be releasing twice as much carbon.

The government's regulations specify that new vehicles must operate at higher KPL levels. The regulation (a rule or law made and enforced by a government) applies to an automobile manufacturer's entire "fleet"—in other words, the KPL standards must be met by the average of its product mix (the range and proportions of products made by a company—see Table 3-1). This means that a company may have vehicles with a low KPL if they can balance them with other vehicles that have a higher KPL. If you assume that a company makes and sells 100,000 sedans that have a KPL of 10, and 50,000 trucks that have a KPL of 5, the fleet's average KPL would be a **weighted average** equal to the following:

QUICK TIP

A weighted average is the average of a set of numbers, each with different associated "weights" or values. To find a weighted average, multiply each number by its weight, then add the results.

$$((100{,}000 * 10) + (50{,}000 * 5)) / (100{,}000 + 50{,}000) = 8.33$$

In the example, if the government's requirement was a fleet average KPL of 8, then the company would be in compliance. But, if the requirement were 10, then the company would have to take steps to come into compliance. The company could work to increase the KPL of its vehicles, or it could decide to make and sell more of its higher-rated KPL vehicles and fewer of its lower-rated KPL models. Or, the company could try some combination of these options.

Periodically, the government increases the required KPL; recently it mandated that a car company's fleet average KPL must improve to 16 five years from now. Achieving this fleet **average** in five years will be a challenge.

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DEFINITIONS

Average: The average (or Mean) of a set of data is a value that is closely representative of the values in the set. It is calculated as the sum of all of the data values divided by the number of values in the set.

Weighted average: In a weighted average, each data point value is multiplied by the assigned weight, which is then summed and divided by the number of data points.

The company's trucks, SUVs, sedans, and compact cars all have internal combustion engines that burn gasoline. The company also makes electric vehicles that are battery powered, and the battery emits no carbon into the atmosphere. When the battery's charge drops very low, a small gasoline-powered engine runs briefly to boost the charge, and some carbon is emitted into the air.

The company's engineers have estimated how much it will cost to make and sell each type of vehicle five years from now, and the company has provided selling prices. These values are shown in Table 12-1.

TABLE 12-1: Expected selling prices and cost of manufacture in five years

Type of vehicle	Selling price	Cost of manufacture
Truck	SAR 225,000	SAR 112,500
SUV	SAR 206,250	SAR 105,000
Sedan	SAR 150,000	SAR 123,750
Compact	SAR 112,500	SAR 101,250
Electric	SAR 131,250	SAR 138,750

The difference between the selling price and the cost of manufacture is called the **gross margin**. We can express this as a percentage called the Gross Margin Percentage (GMP = Total revenue minus the Cost of Goods Sold, divided by Total revenue). You can see that the Gross Margin Percentage of trucks ((225,000–112,500)/225,000) × 100 = 50%) and SUVs (49%) are higher than the Gross Margin Percentage of sedans (17.5%), compacts (10%), and electric cars (–6%).

DEFINITION

Gross margin: The amount of money a company retains after incurring the direct costs associated with producing the goods it sells and the services it provides. The higher the gross margin, the more capital a company retains, which it can then use to pay other costs or satisfy debt obligations.

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You will notice that the gross margin of the electric cars is initially negative. This is because electric vehicles use new technology, and the initial costs of production are high. The company thinks that in the long run, it will sell more electric cars, which means the average cost of manufacture is expected to decline, the selling price will increase, and the company will eventually make a profit on them.

The company's marketing team has estimated how many of each type of vehicle they expect to sell five years from now. The company's engineers will set up the production lines to accommodate this estimate. The maximum annual production capacities in five years for each type of vehicle are shown in Table 12-2.

TABLE 12-2: Expected maximum production capacities in five years

Type of vehicle	Max production capacity
Truck	30,000
SUV	90,000
Sedan	50,000
Compact	20,000
Electric	10,000

These engineering capacity estimates are upper limits—they represent the maximum the company can make and sell of each type of vehicle. Even if customer demand was greater than these numbers, the company only has enough production lines to make the number of vehicles shown.

The company's engineers know how to improve KPL; for example, they can make the engines run more efficiently, use lighter-weight materials in the vehicle's body, and streamline the shape of the vehicles for less air resistance. The expected KPLs five years from now are shown in Table 12-3.

TABLE 12-3: Expected KPLs in five years

Type of vehicle	Expected KPL
Truck	10
SUV	12
Sedan	14
Compact	20
Electric	36

Some small emissions from electric cars are anticipated, depending on how the driver operates the vehicle and manages the battery's charge. The engineers have calculated that the KPL for Electrics is 36. However, the government allow-

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ance for driver behavior allows for a KPL of 50. Management decides to take advantage of this to help improve its overall fleet KPL.

The question for the company's marketing managers is: How many of each kind of vehicle should the company try to make and sell in five years to maximize profits while complying with regulations?

The company must meet the new KPL standard, but the company must be profitable as well—in fact, management wants the gross margin to be at least 30% of gross revenue in the coming years.

Several of the company's senior marketing executives think that the market will change significantly in the coming years. Here is a summary of how their thinking differs from the company's strategy as a whole:

- Younger people are much more environmentally conscious than drivers of previous generations.
- Younger people do not enjoy driving as much as their parents and grandparents do. They may prefer to hire a driver or taxi.
- Younger people have shown interest in driverless cars. When such cars become viable they will likely be electric, rather than gasoline powered.

All of these factors argue for more sales of electric cars and smaller cars than the majority of marketing managers think is warranted. The smaller group of managers would like to see further analysis that examines their point of view. This analysis, they think, might suggest a need for greater changes in the company.

Creating a Spreadsheet for Decision Support

In this lesson, you will produce a spreadsheet that models the production mix of vehicles needed to meet new air-pollution standards. First, you will create a spreadsheet to model the **base case**. Then, you will create a second spreadsheet to model the **extension case** (which will be the analysis for the smaller group of managers). You will then prepare a report detailing your data analysis and recommendations based on your findings.

Scan the QR code to access the workbook (**Chapter 12 data file.xlsx**) you'll be using for the rest of this lesson.

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DEFINITIONS

Base case: A model of future performance that is conservative, based on what is most likely to happen according to data already held.

Extension case: A way of modeling based on reasonable, informed speculation and prediction.

Your spreadsheets should include the cells explained in the following pages. You will set up the spreadsheets before entering cell formulas. Your spreadsheets will also include decision constraints, which you will enter using Solver. Your spreadsheets should have the following sections:

- Changing cells
- Constants
- Calculations
- Income statement.

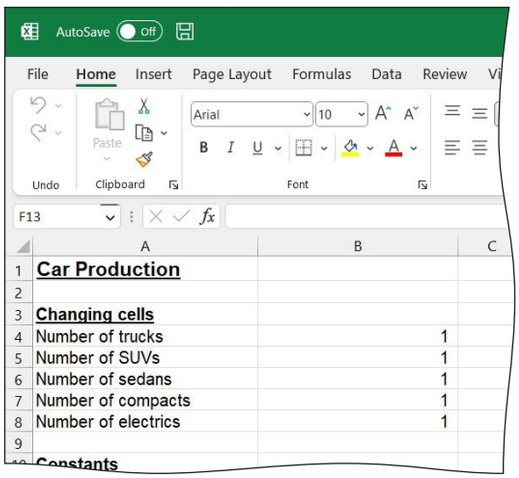
Creating the Spreadsheet for the Base Case

A discussion of each spreadsheet section follows. The discussion explains how to set up each section and explains the logic of the formulas in the section's cells. This time, you will need to set up the spreadsheet yourself.

1. **Changing Cells Section**

   Your spreadsheet should have the Changing cells shown in Figure 12-1. These show the number of vehicles that the company should plan to produce. Enter a "1" for each of these now. This will give Solver a starting point to calculate from. These values will change to show the recommended production quantities.

FIGURE 12-1: Changing cells section



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QUICK TIP

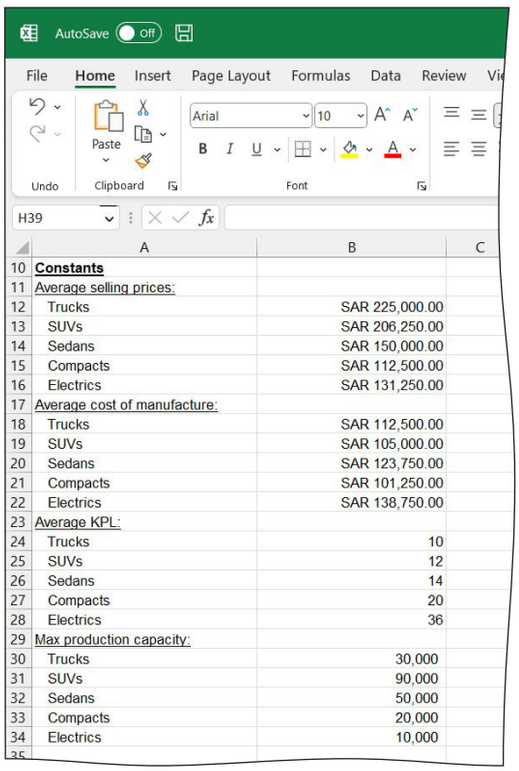
You can force Solver to solve with integer values when specifying the constraints by using the Int operator in the Add Constraint window.

You will ask Solver to compute how many of each type of vehicle to make and sell five years from now, in order to meet the KPL standard and to maximize gross profit.

2. **Constants Section**

   Enter the constants shown in Figure 12-2 into your worksheet. Use the same cell addresses so your worksheet is consistent with the examples shown in this chapter.

FIGURE 12-2: Constants section



	A	B	C
10	**Constants**		
11	Average selling prices:		
12	Trucks	SAR 225,000.00	
13	SUVs	SAR 206,250.00	
14	Sedans	SAR 150,000.00	
15	Compacts	SAR 112,500.00	
16	Electrics	SAR 131,250.00	
17	Average cost of manufacture:		
18	Trucks	SAR 112,500.00	
19	SUVs	SAR 105,000.00	
20	Sedans	SAR 123,750.00	
21	Compacts	SAR 101,250.00	
22	Electrics	SAR 138,750.00	
23	Average KPL:		
24	Trucks	10	
25	SUVs	12	
26	Sedans	14	
27	Compacts	20	
28	Electrics	36	
29	Max production capacity:		
30	Trucks	30,000	
31	SUVs	90,000	
32	Sedans	50,000	
33	Compacts	20,000	
34	Electrics	10,000	

- **Average selling prices:** The selling prices expected in five years are shown in Table 12-1.
- **Average cost of manufacture:** The costs of manufacture expected in five years are shown in Table 12-1.
- **Average KPL:** The expected KPLs for each type of vehicle in five years are shown in Table 12-3.
- **Max production capacity:** The production limits in five years are shown in Table 12-2.

QUICK TIP

When working with spreadsheets, numeric values should ONLY be entered in Constants and Inputs. All other cells must either calculate a value (using a formula) or echo a value (copy the value from another cell reference =F34).

3. Calculations Section

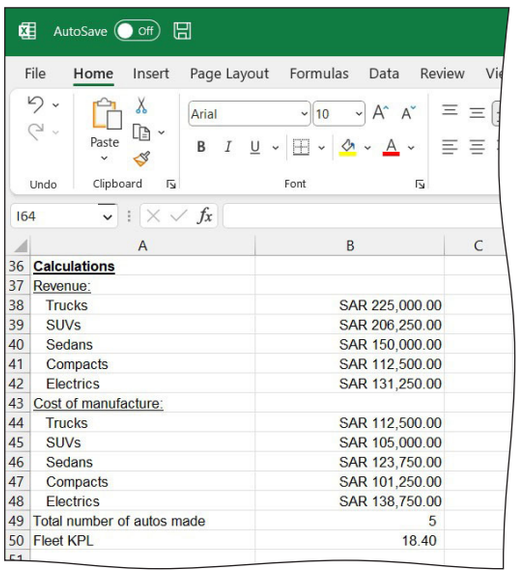
You will set your worksheet up to calculate values based on the inputs you've provided. Each of these calculations must use a formula—do not type numbers into cells B38:B50.

- **Revenue:** Revenue is the product of the number of vehicles sold and the expected selling price (Number of vehicle type sold × Selling price of the vehicle type).
- **Cost of manufacture:** Costs are the product of the number of each type of vehicle made and the expected cost of manufacture for that type of vehicle (Number of trucks made × Cost of manufacture$_{TRUCK}$).
- **Total number of autos made:** This value is the sum of all the vehicles made (B4:B8).
- **Fleet KPL:** This value is the weighted average KPL of all the vehicles made and sold (Number of trucks sold × Truck's average KPL) + (Number of SUVs sold × SUV's average KPL) + (Number of Sedans sold × Sedan's average KPL) + (Number of Compacts sold × Compact's average KPL) + (Number of Electric cars sold × Electric car's average KPL) / Total number of vehicles made (B4:B8).

CHECK YOUR PROGRESS

Your worksheet should calculate the values shown in Figure 12-3. If your worksheet shows different results, check your formulas carefully.

FIGURE 12-3: Calculations section



	A	B	C
36	**Calculations**		
37	Revenue:		
38	Trucks	SAR 225,000.00	
39	SUVs	SAR 206,250.00	
40	Sedans	SAR 150,000.00	
41	Compacts	SAR 112,500.00	
42	Electrics	SAR 131,250.00	
43	Cost of manufacture:		
44	Trucks	SAR 112,500.00	
45	SUVs	SAR 105,000.00	
46	Sedans	SAR 123,750.00	
47	Compacts	SAR 101,250.00	
48	Electrics	SAR 138,750.00	
49	Total number of autos made	5	
50	Fleet KPL	18.40	

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4. **Income Statement Section**

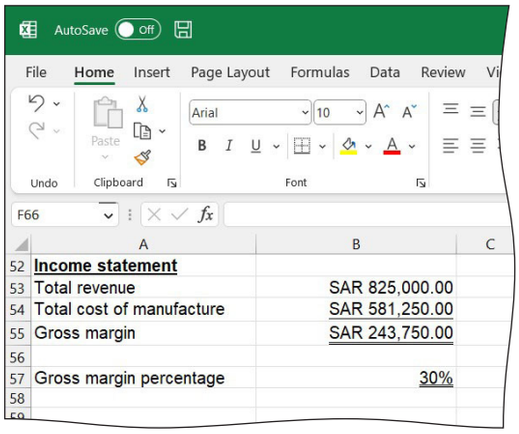
Next, you will create a basic income statement that shows your revenues, cost of production and the Gross margin. As with the other calculations, you must use a formula in cells B53:B55 and B57 (do not type in numbers). An explanation of the line items follows.

- **Total revenue:** This is the sum of the revenues for all vehicles sold. These revenues are values from the Calculations section (B38:B42).
- **Total cost of manufacture:** This is the sum of the costs of manufacture for all vehicles produced. These costs of manufacture are values from the Calculations section (B44:B48).
- **Gross margin:** This is the difference between total revenue and total cost of manufacture (**B53–B54**).
- **Gross margin percentage:** This is calculated as (Total Revenue – Total Cost of Manufacture) / Total Revenue (**B55/B53**). The company wants a gross margin of at least 30%.

CHECK YOUR PROGRESS

If you've set your calculations up properly, your Income Statement values should match those shown. If not, go back through this section and check your formulas and cell references carefully.

FIGURE 12-4: Income statement section



	A	B	C
52	**Income statement**		
53	Total revenue	SAR 825,000.00	
54	Total cost of manufacture	SAR 581,250.00	
55	Gross margin	SAR 243,750.00	
56			
57	Gross margin percentage	30%	
58			

5. **Constraints and Running Solver**

Next, you must determine the constraints for the model. The marketing managers think that 20,000 trucks, 20,000 SUVs, 20,000 sedans, 20,000 compacts, and 8,000 electric vehicles will be made and sold five years from now.

Before starting to build the model in Solver, work out the constraints by hand. You can create a simple table like the one shown in Table 12-4. You will need to figure out the cell reference, the relationship, and value for each constraint. Take your time and do this carefully. These constraints are a critical part of your decision model.

QUICK TIP

The marketing department's goals for vehicle sales should be included as constraints in your model. This way, Solver will try to find a solution that meets these objectives.

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QUICK TIP

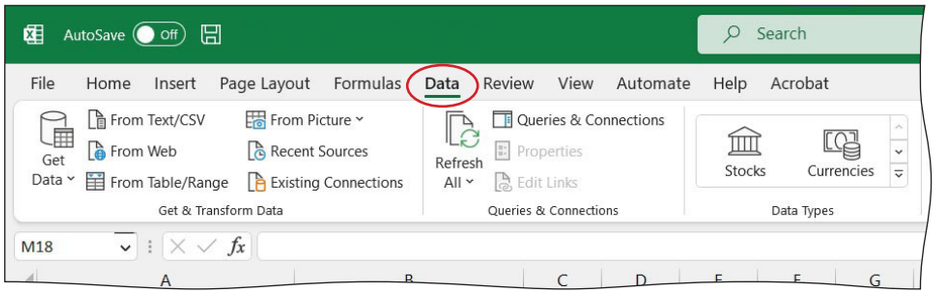
Remember that you do not want Solver to compute solutions that include a fraction of a vehicle.

TABLE 3-4: Table of base case constraints

Variable	Cell Reference	< = > Int	Constraint
Number of Trucks Sold			
Number of SUVs Sold			
Number of Sedans Sold			
Number of Compacts Sold			
Number of Electrics Sold			
Fleet KPL (per government regulation)			
Gross Profit Margin (target)			
Number of Trucks Made less than Truck Capacity			
Number of SUVs Made less than SUV Capacity			
Number of Sedans Made less than Sedan Capacity			
Number of Compacts Made less than Compact Cap			
Number of Electrics Made less than Electric Capacity			
Ensure Number of each vehicle made is Integer			

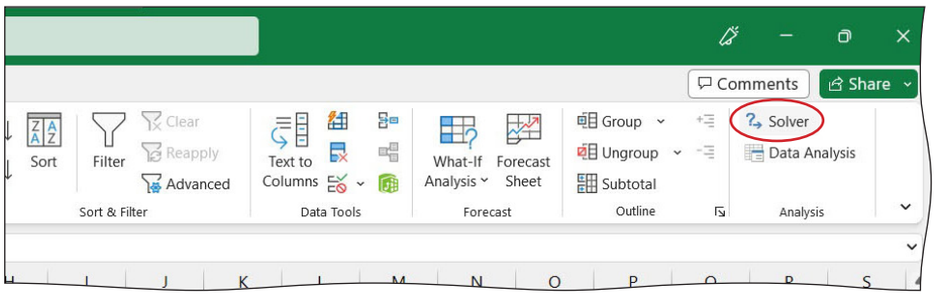
To start the Solver tool in Excel, first click the Data tab (see Figure 12-5).

FIGURE 12-5: Select the Data tab



Next, select Solver from the Analysis menu (see Figure 12-6).

FIGURE 12-6: Locate Solver in the Analysis menu



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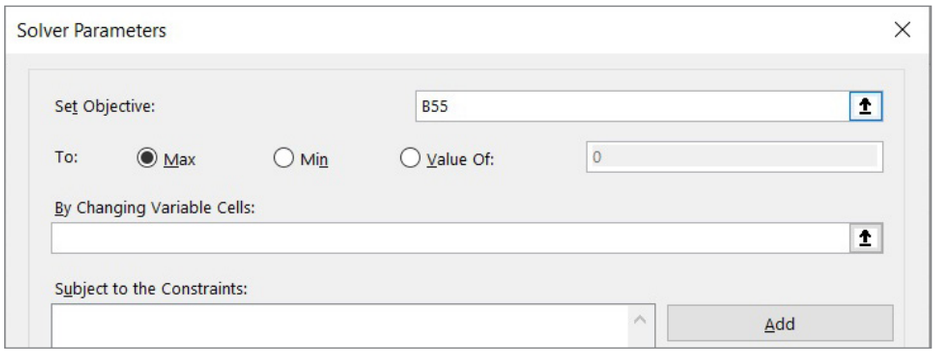
If the Solver option isn't visible, you may need to install it first. You can find out how to do this in Chapter 11.

Start by setting your objective. This is the key value that you want to maximize, minimize, or achieve. For this project, management wants to maximize its gross margin. Put the cell address for Gross margin (B55) in the Set Objective box (see Figure 12-7).

FIGURE 12-7: Enter the cell address for Gross margin

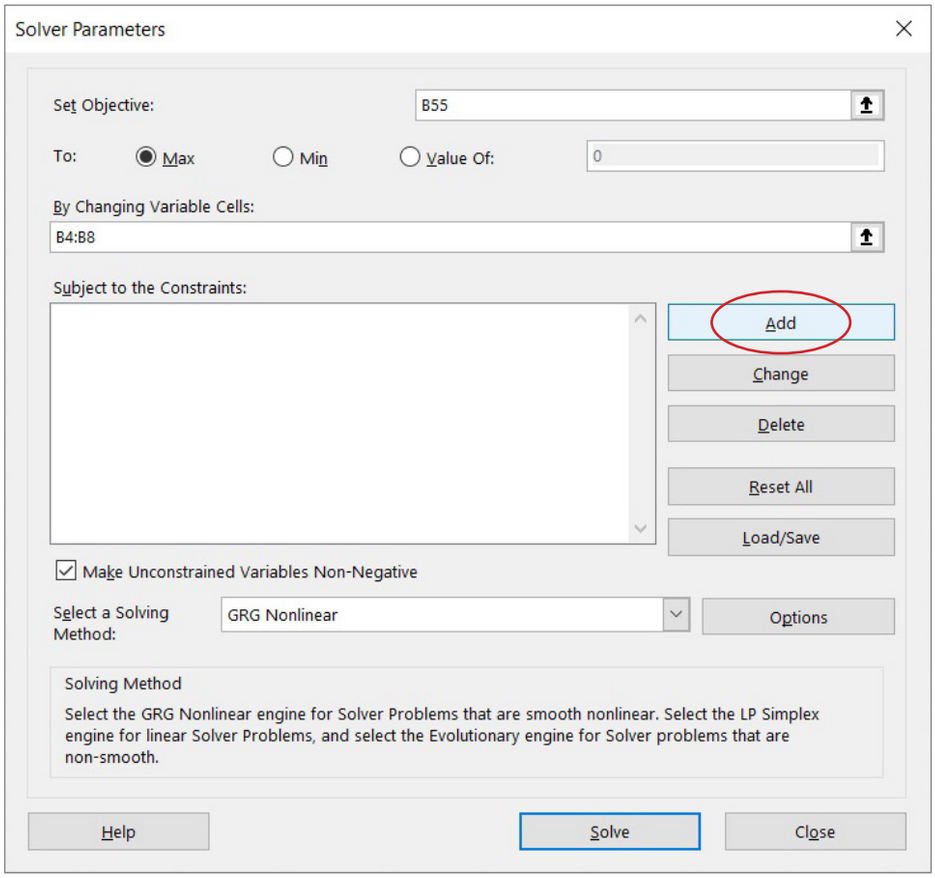


Click on the Max button.

Then, you need to enter the Changing Cell addresses in the box marked By Changing Variable Cells. For this project, the number of vehicles made and sold are going to change based on the constraints we set up. These appear at the top of your worksheet (B4:B8).

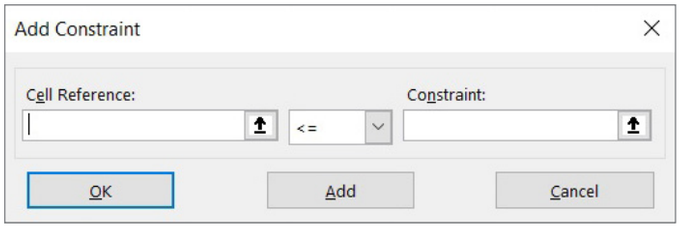
Under Subject to the Constraints, enter the constraints you identified in Table 12-4. You will enter each of your constraints individually. Start by clicking the 'Add' button (as shown in Figure 12-8).

FIGURE 12-8: The Solver Parameters window



A new dialog box will appear (see Figure 12-9 below). For each constraint you will need to enter the cell address, the operation, and the value of the constraint).

FIGURE 12-9: The Add Constraint dialog box



Let's start with the number of trucks (Figure 12-10). Management has set an objective of selling at least 20,000 trucks. To add this as a constraint enter the cell address for the number of trucks (B4) in the Cell Reference box. Because management wants this number to be at least 20,000 select the >= operation. Finally, type "20000" in the Constraint box.

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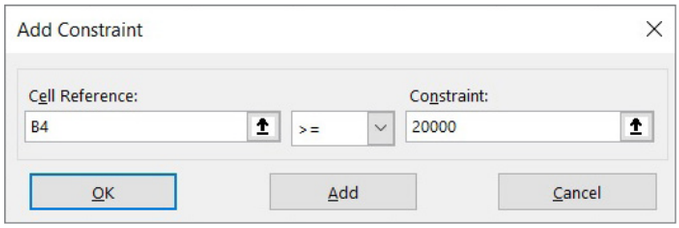
FIGURE 12-10: Adding the constraint to sell at least 20,000 trucks

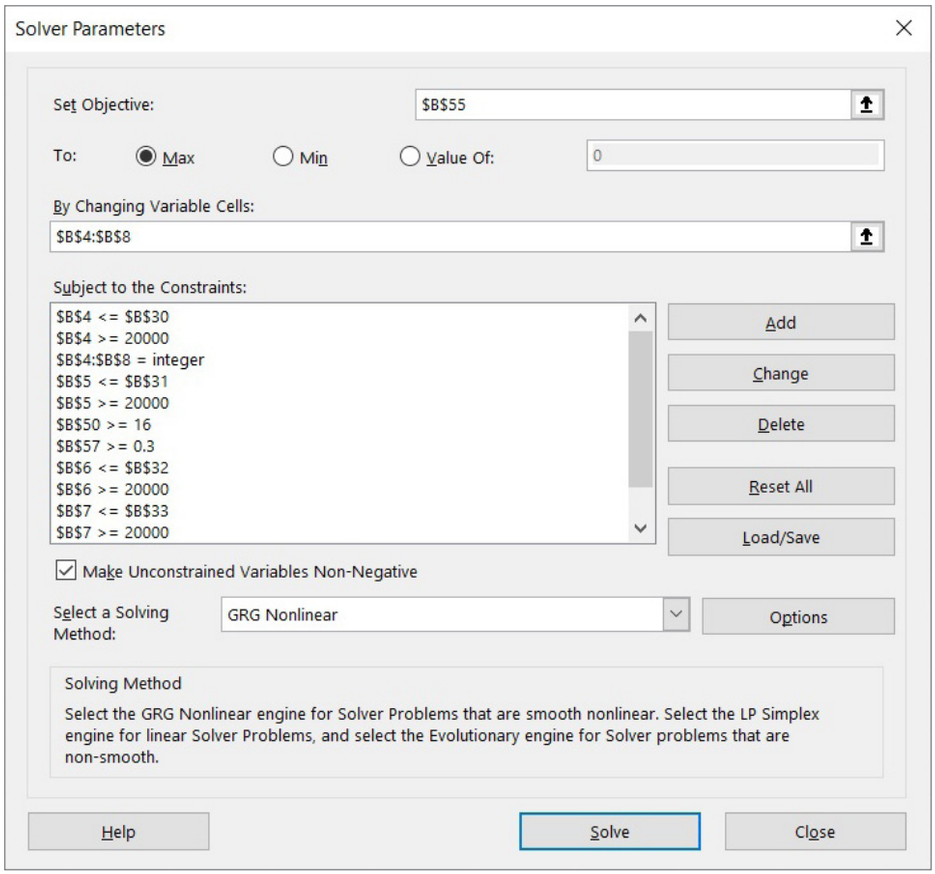


Because you have other constraints to enter, click the Add button. A new Add Constraint window will appear. Continue to add the constraints from Table 12-4. When you've entered the final one, click OK instead of Add. This let's Solver know that you've finished, and it will take you back to the main Solver window.

CHECK YOUR PROGRESS

Compare your constraints to the partial solution shown. Consider each constraint carefully. Are they set up the way you expected? If not, highlight the constraint you would like to change and click the Change button to edit it.

FIGURE 12-11: Complete setup for the Base Case Solver Model



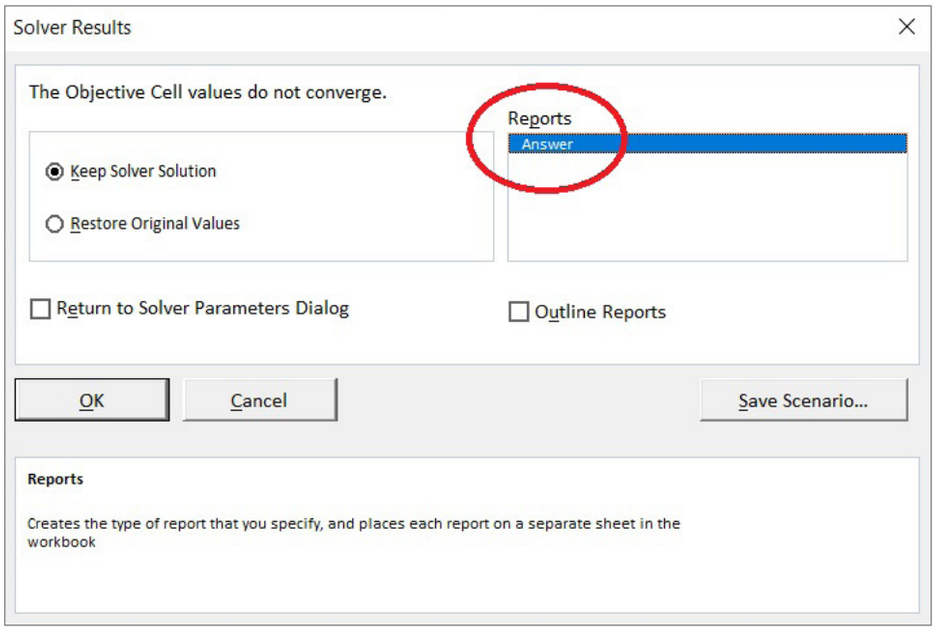
QUICK TIP

Use this setting because the solution is non-linear (the output is not proportional to the inputs).

Now you are ready to let Solver work out a solution. Check the Make Unconstrained Variables Non-Negative box. This tells Solver that you don't want a solution with a negative number of vehicles produced or a negative gross margin. Set Solver for GRG Nonlinear mode.

Click the Solve button to run Solver. It will quickly examine your worksheet and try to find a solution that meets your constraints. When it does, you will see the Solver Results window (below). Click on the Answer Report when Solver finds a solution, leave Keep Solver Solution checked, and click OK.

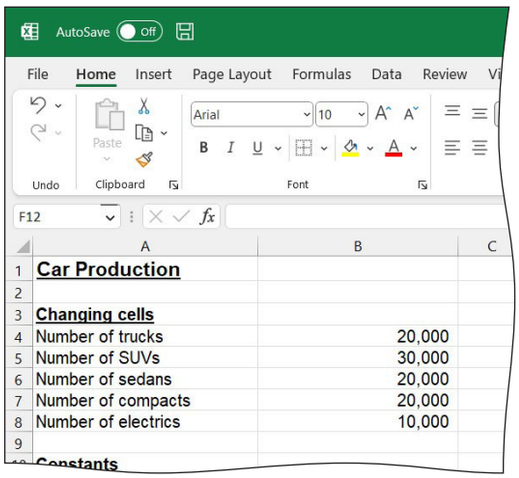
FIGURE 12-12: Ask for the Answer Report in the Solver Results window



CHECK YOUR PROGRESS

Figure 12-13 shows a partial solution for the Base Case Model. Compare your solution to these values. If yours differ significantly, go back through the case and check your work carefully. Most errors are due to inaccurate constraint settings in the Solver Parameters.

FIGURE 12-13: Partial solution for the Base Case Model



	A	B	C
1	**Car Production**		
2			
3	**Changing cells**		
4	Number of trucks	20,000	
5	Number of SUVs	30,000	
6	Number of sedans	20,000	
7	Number of compacts	20,000	
8	Number of electrics	10,000	
9			
	Constants		

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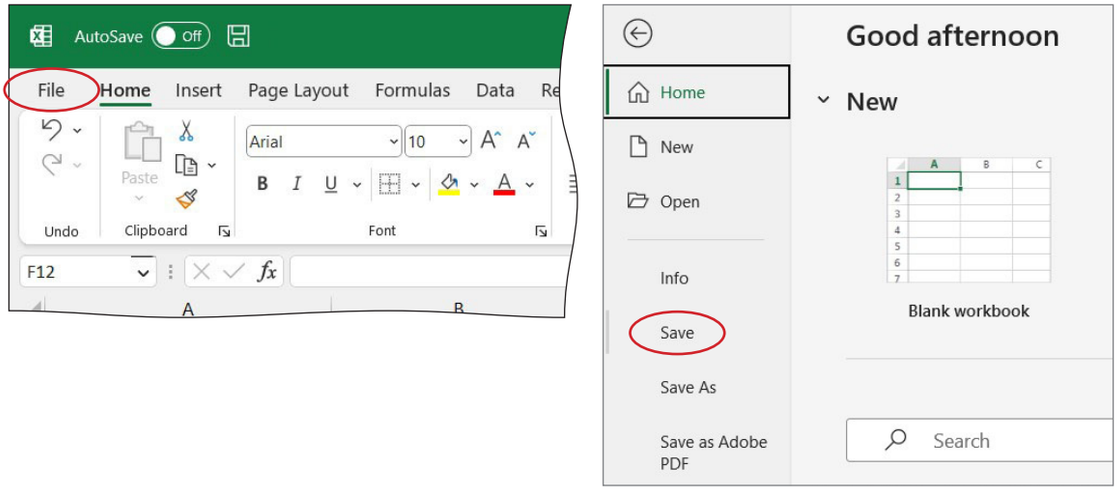
When you finish, print the entire spreadsheet and the Answer Report sheet. Save the file using the Save command in the File tab, using the format **YourName - CarProject.xlsx** (Figure 12-14).

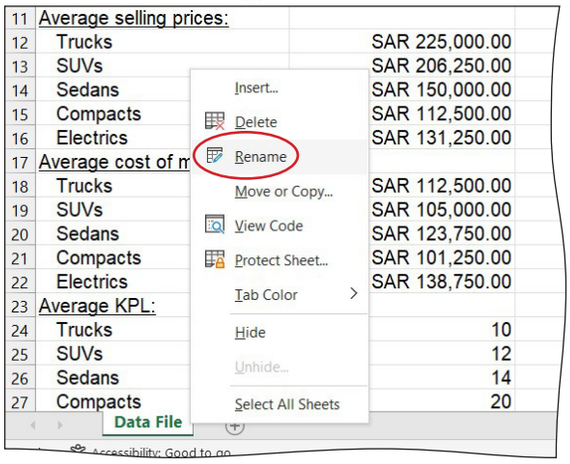
FIGURE 12-14: Saving your file



To prepare for the extension case you will create a copy of your base case worksheet. To do this:

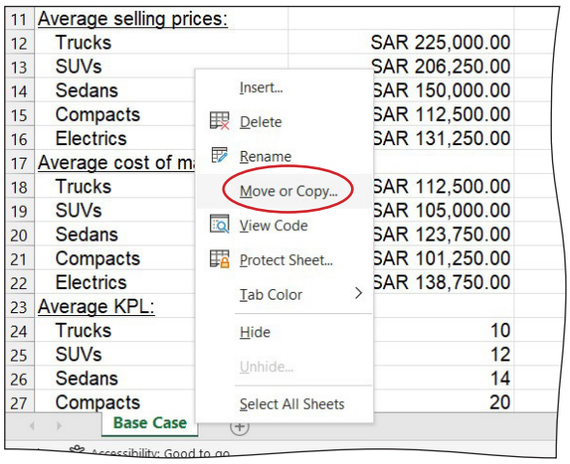
- Click on the tab at the bottom of your worksheet. Right-click (see Figure 12-15) and Rename your worksheet "Base Case".

FIGURE 12-15: Renaming your worksheet



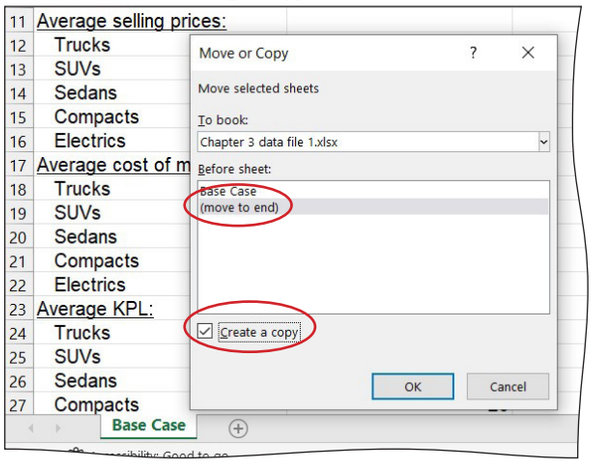
- Right-click the Base Case tab again, but this time select Move or Copy (as shown in Figure 12-16).

FIGURE 12-16: Select Move or Copy



- Select (move to end). This will put the new copy of your worksheet to the right of your existing sheet. Click on the Create a copy box, then press OK (see Figure 12-17).

FIGURE 12-17: Creating a copy of the Base Case worksheet



- A new worksheet named Base Case (2) will appear. This is a copy of your Base Case. Right-click this tab and rename the worksheet "Extension Case" (see Figure 12-18).

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FIGURE 12-18: Create the new worksheet

17	Average cost of manufacture:	
18	Trucks	SAR 112,500.00
19	SUVs	SAR 105,000.00
20	Sedans	SAR 123,750.00
21	Compacts	SAR 101,250.00
22	Electrics	SAR 138,750.00
23	Average KPL:	
24	Trucks	10
25	SUVs	12
26	Sedans	14
27	Compacts	20

Base Case | Base Case (2)

Accessibility: Good to go

FIGURE 12-19: Rename the new worksheet

17	Average cost of manufacture:	
18	Trucks	SAR 112,500.00
19	SUVs	SAR 105,000.00
20	Sedans	SAR 123,750.00
21	Compacts	SAR 101,250.00
22	Electrics	SAR 138,750.00
23	Average KPL:	
24	Trucks	10
25	SUVs	12
26	Sedans	14
27	Compacts	20

Base Case | Extension Case | Answer Report

Accessibility: Good to go

Creating the Spreadsheet for the Extension Case

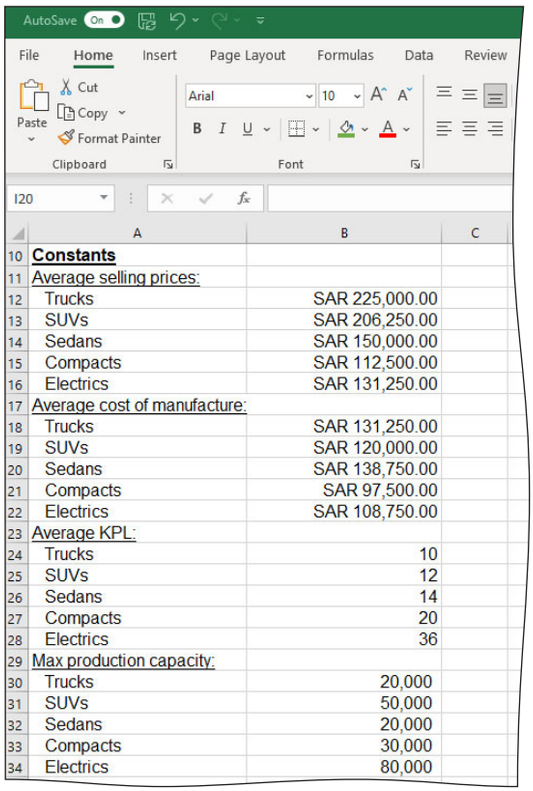
Next, you will work on the extension case (be sure that you've selected Extension Case tab at the bottom of the spreadsheet). A small group of the company's senior marketing executives think that compacts and electric cars will be more in demand in five years, and that production capacity should be set at 80,000 electric vehicles and 30,000 for compact cars. There are a fixed number of production lines, so this change would mean that fewer of the other kinds of vehicles could be made. The revised maximum capacities would be 20,000 for trucks, 50,000 for SUVs, and 20,000 for sedans.

The reduction in production capacities for trucks, SUVs, and sedans means that their associated fixed costs would be spread over a smaller number of cars being made. This would increase the expected unit cost of manufacture for these types of vehicles. The expected unit costs of manufacture would be SAR 131,250 for trucks, SAR 120,000 for SUVs, and SAR 138,750 for sedans. The effect would be the opposite for compacts and electric cars. As the number produced increases, the associated fixed costs are spread across a larger number of cars. The expected unit cost of manufacture for electric vehicles would decrease to SAR 108,750, and the unit cost for compacts would be SAR 97,500.

CHECK YOUR PROGRESS

With these changes, the Constants section should look like Figure 12-20.

FIGURE 12-20: Constants section for extension case



	A	B	C
10	**Constants**		
11	Average selling prices:		
12	Trucks	SAR 225,000.00	
13	SUVs	SAR 206,250.00	
14	Sedans	SAR 150,000.00	
15	Compacts	SAR 112,500.00	
16	Electrics	SAR 131,250.00	
17	Average cost of manufacture:		
18	Trucks	SAR 131,250.00	
19	SUVs	SAR 120,000.00	
20	Sedans	SAR 138,750.00	
21	Compacts	SAR 97,500.00	
22	Electrics	SAR 108,750.00	
23	Average KPL:		
24	Trucks	10	
25	SUVs	12	
26	Sedans	14	
27	Compacts	20	
28	Electrics	36	
29	Max production capacity:		
30	Trucks	20,000	
31	SUVs	50,000	
32	Sedans	20,000	
33	Compacts	30,000	
34	Electrics	80,000	

Expected selling prices and KPLs would remain the same. The gross margin percentage goal of 30% would remain the same.

As with the base case, before you start working with Solver you should work out the constraints by hand, using Table 12-5 as a guide. You will need to determine the cell reference, the relationship, and value for each constraint. As with the base case, these values will be used to build your Solver model.

TABLE 12-5: Extension case constraints

Variable	Cell Reference	< = > Int	Constraint
Number of Trucks Sold			
Number of SUVs Sold			
Number of Sedans Sold			
Number of Compacts Sold			
Number of Electrics Sold			
Fleet KPL (per government regulation)			
Gross Profit Margin (target)			
Trucks Made less than Truck Capacity			
SUVs Made less than SUV Capacity			
Sedans Made less than Sedan Capacity			
Compacts Made less than Compact Cap			
Electrics Made less than Electric Capacity			
Ensure Number of each vehicle made is Integer			

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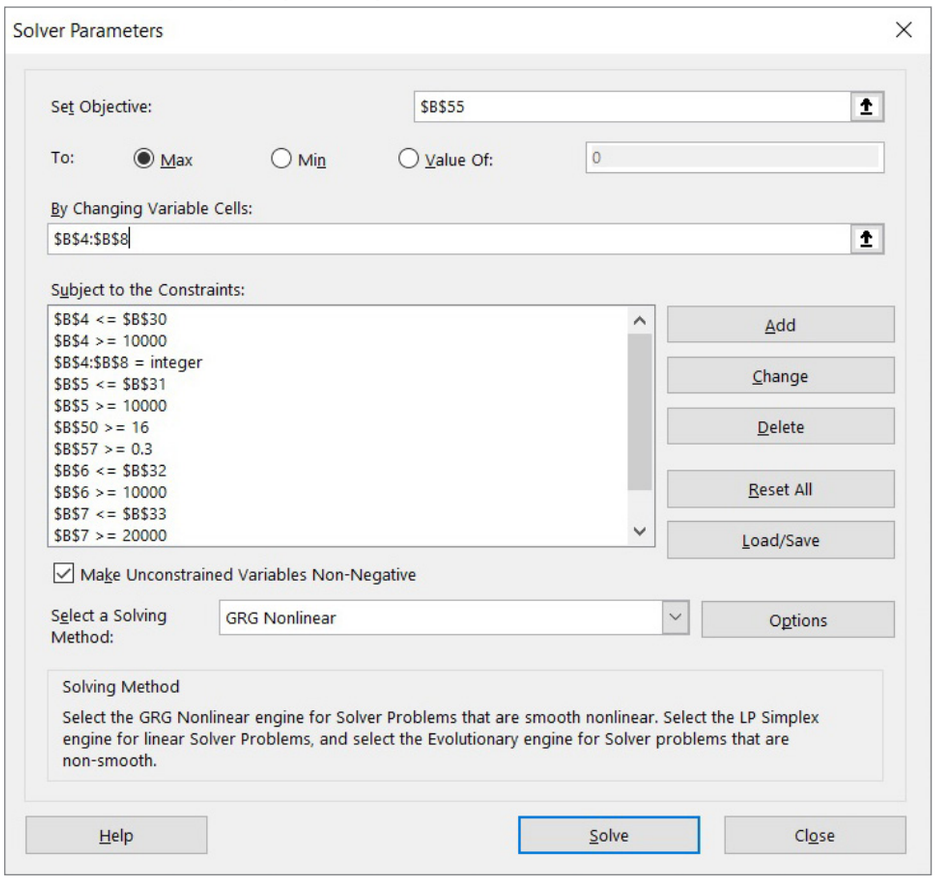
Start Solver in the Extension Case. Because this is a new set of data you will need to enter the constraints again (Solver will not copy the old constraints that you used in your Base Case). Follow the same steps that you did with the Base Case. Enter the constraints and check them carefully. Then, run Solver and ask for the Answer Report when Solver finds a solution that satisfies the constraints.

CHECK YOUR PROGRESS

Check your Solver constraints against the partial solution shown in Figure 12-21. If your values are different, carefully review your worksheet, cell addresses and constraints.

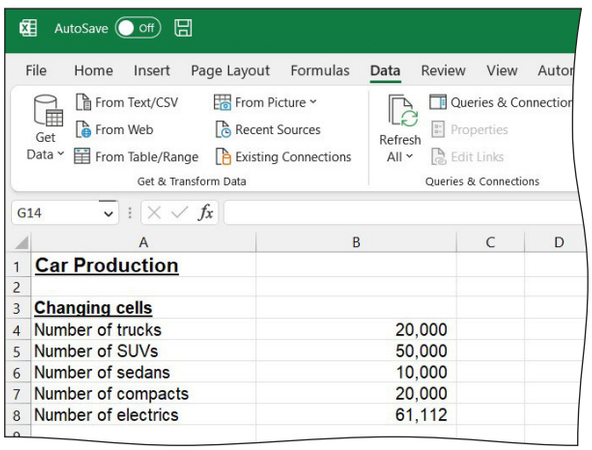
FIGURE 12-21: Partially complete setup for the Extension Case Solver model



CHECK YOUR PROGRESS

Check that your calculations for the Changing cells match the ones in Figure 12-22. If the values are different, carefully review your work so far and correct any errors.

FIGURE 12-22: Partial solution for the Extension Case Model



When you are finished, save your spreadsheet and exit Excel.

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REVIEW QUESTIONS

1. **Select the correct definition for the base case.**
   - **a.** A model of future performance that is conservative, based on what is most likely to happen according to data already held.
   - **b.** A model of present performance that is optimistic, based on what is happening according to data already held.
   - **c.** A model of future performance that is pessimistic, based on what is least likely to happen according to data already held.
   - **d.** A model of past performance that is realistic, based on what actually happened according to data already held.
2. **Which of the following should be included in the income statement section?**
   - **a.** Revenue
   - **b.** Average KPL
   - **c.** Gross margin
   - **d.** Max production capacity
3. **Which section should come first in your spreadsheets?**
   - **a.** Constants
   - **b.** Calculations
   - **c.** Income statement
   - **d.** Changing cells
4. **What is the correct order for the spreadsheets included in Solver?**
   - **a.** Constants, Calculations, Changing Cells, Income Statement
   - **b.** Changing cells, Constants, Calculations, Income Statement
   - **c.** Calculations, Income Statement, Constants, Changing Cells
   - **d.** Changing Cells, Constants, Income Statement, Calculations

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Car Production Deliverables

At the start of this project, you learned about the challenges associated with car production businesses who need to remain profitable, while also following the government's environmental regulations.

Companies must consider the impact of such regulations on how they plan their business activities. In this project, the car production company needs to decide how to best manage its product mix to achieve its cars' overall performance while maintaining a healthy profit margin.

To help them with this, you have produced a base case, modeling a conservative view of future performance, and an extension case to model a more ambitious prediction of how the business may perform in the future.

For each case, the marketing department wants to know:

- the number of each type of vehicle to make and sell
- the total gross profit
- the gross profit percentage.

The goal is to meet the KPL requirement and to maximize gross profit. You need to answer the following question:

> How many of each kind of vehicle should the company try to make and sell in five years?

You may find it useful to copy out Table 12-6 and fill in the missing information.

TABLE 12-6: Car Production Project results

		Base case	Extension case
Type of vehicle	Truck		
	SUV		
	Sedan		
	Compact		
	Electric		
Company data	Gross margin		
	Gross margin percentage		
	Fleet KPL		

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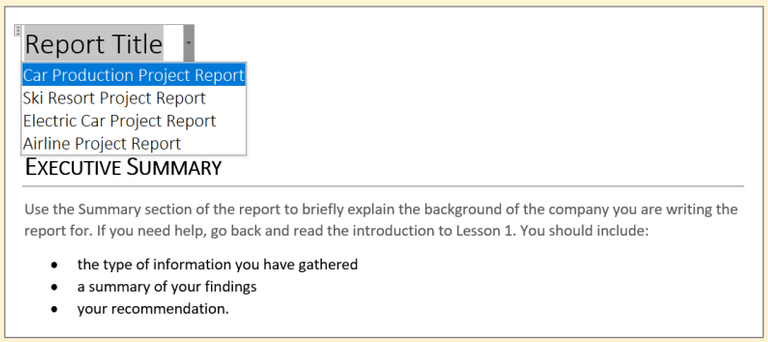
It is now time to present your findings to the marketing team in the form of a short report. Scan the QR code to access the report template (**Report template.dotx**). In this chapter, you will be guided through the report and asked to fill in some key details along the way. In future chapters, you will need to write the report on your own!

1. Start by scanning the QR code and opening the report template.
2. Click on the text "Report Title." Use the drop-down menu to select the report title. You can see the report title drop-down menu in Figure 12-23.

FIGURE 12-23: The report title drop-down menu



3. Click on the text "Your Name" and enter your full name.
4. Click on the text "Date." Use the calendar menu to select the correct date, as shown in Figure 12-24.

QUICK TIP
You can click on the "Today" button to automatically select today's date.

FIGURE 12-24: Entering the date

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5. First, complete the **Problem Statement** section.

DEFINITION

Problem statement: A brief explanation of a problem that needs to be solved.

To complete this section you need to explain, in your own words, the project you have been working on. You could say:

> The car production business needs to know how many vehicles of each type to make to maximize profit while following the government's environmental regulations.
>
> How many of each kind of vehicle should the company try to make and sell in five years? (see Figure 12-25).

FIGURE 12-25: The completed Problem Statement section

PROBLEM STATEMENT

The car production business needs to know how many vehicles of each type to make to maximize profit while following the government's environmental regulations.

How many of each kind of vehicle should the company try to make and sell in five years?

6. You now need to explain the techniques you used to get your results. Complete the **Methodology** section of the report.

DEFINITION

Methodology: A description of the techniques used to complete a task.

To complete this section you need to explain, in your own words, the project you have been working on (see Figure 12-26). You could say:

> I created two spreadsheets: one for the base case and another for the extension case. I used these to calculate:
>
> - an optimized product mix
> - gross margin and gross margin percentage
> - fleet KPL.

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FIGURE 12-26: The completed report Methodology section

> **METHODOLOGY**
>
> I created two spreadsheets: one for the base case and another for the extension case. I used these to calculate:
>
> - an optimized product mix
> - gross margin and gross margin percentage
> - fleet KPL.

7. Next, complete the Results section.

To complete this section (see Figure 12-27), enter the following text, filling in the blanks:

> According to the base case the company should produce _____ trucks. According to the extension case, the company should produce _____ sedans. According to the base case, the company should produce _____ compacts. According to the extension case, the company should produce _____ electric cars. The company's gross margin percentages would be _____% in the base case, and _____% in the extension case. The base case fleet KPL is _____, for the extension case it is _____.

FIGURE 12-27: Complete the Results section and fill in the blanks

> **RESULTS**
>
> According to the base case the company should produce _____ trucks. According to the extension case, the company should produce _____ sedans. According to the base case, the company should produce _____ compacts. According to the extension case, the company should produce _____ electric cars. The company's gross margin percentages would be _____% in the base case, and _____% in the extension case. The base case fleet KPL is _____, for the extension case it is _____.

8. Now, complete the Analysis section.

To complete this section you need to answer the question asked by the executives at the start of the project. This means you need to decide how many cars the company should try to make and sell in five years.

The easiest way to do this is to recommend that the company uses the base case or the extension case for their future plans. You could say:

> I recommend that the company uses the _____ case to model their production plans over the next five years.

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You will need to decide carefully which of the cases you want to recommend. Whatever you decide, you need to explain the reasons for your recommendation. You could say:

> I have chosen the base case because the company needs to protect itself from changes in the market and in consumer preferences.

or,

> I choose the Extension case because it yields the highest gross margin while still maintaining management's goal of a 30% margin percentage.

You should try to write one more sentence on your own, further explaining your choice.

FIGURE 12-28: Complete the Analysis section and fill in the blanks

ANALYSIS

I recommend that the company uses the _____ case to model their production plans over the next five years.

I have chosen the extension case because I think the company should choose an ambitious plan for the future, and work hard to achieve its goals.

Further, I think _____.

9. Now you have completed the body of the report, you can complete the Executive Summary section.

This section is placed at the top of the document, because sometimes company executives are so busy, they will only have time to read this part. Because of this, it needs to be brief, and include only the most important information (see Figure 12-29). You could write:

> This report contains:
>
> - conservative and speculative modeling for the company's next five years
> - evidence that the company's gross margin percentages could be either _____% or _____%
> - a recommendation that the marketing department chooses the _____ case in this project.

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FIGURE 12-29: Complete the Executive Summary section and fill in the blanks

EXECUTIVE SUMMARY

This report contains:

- conservative and speculative modeling for the company's next five years
- evidence that the company's gross margin percentages could be either _____% or _____%
- a recommendation that the marketing department chooses the _____ case in this project.

10. Your report is now complete, so don't forget to save it! Because the report template file is a template (.dotx) you will be prompted to save the report with a new file name automatically. Select Save from the file menu and use the file name format: **YourName - CarProduction - Report.docx**.

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Chapter
13

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The Ski Resort Project

In this project, you will use Microsoft Excel to help a new ski resort establish a budget for the next three years and decide whether to expand activities into the off-season.

The Ski Resort Project will introduce learners to the importance of budgeting and accurate financial modeling that will affect business decision making.

It is vital to identify and understand the impact of different variables on any decisions that are made and to determine the path that is best for the financial success of the project.

This chapter will use Solver to determine the impact of cost and revenue on budgets.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Describe the challenges faced by business owners
2. Explain the impacts of these challenges on small business owners
3. Represent information and highlight patterns and trends in data
4. Analyze the ways a new business can develop new revenue activities
5. Demonstrate the business generation activities that businesses should choose

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Ski Resort Background

Skiing is a new activity for Saudi Arabia. Despite the desert heat, ski resorts are being planned and built using renewable energy.

Outdoor skiing facilities have never been built in Saudi Arabia before. Trojena, opening in 2026, will provide tourists and citizens alike to participate in all manner of adventure and winter sports. It will host luxury accommodation and entertainment in the sustainable, state-of-the-art surroundings of NEOM.

Imagine that another ski resort is planned for a mountainous area in the northwest of the country. The resort will have capacity for about 5,000 skiers per day and needs to attract around 3,000 daily skiers to be able to operate profitably. The owners hope to sell around 500 season tickets per year to local enthusiasts. Season tickets (allowing the user to use a service multiple times for less than the cost of the same number of single-entry tickets) are sold at a significant discount compared with an equivalent number of daily tickets, but the management knows that season-ticket holders also spend money at the resort on food and drink.

The resort will generate income from ticket sales, but also from shops, ski lessons, restaurants, and equipment rentals. They expect most local skiers will rent equipment because skiing is new to Saudi Arabia, and many visitors will have never skied before. Meanwhile, those who have brought their own equipment may want to buy items they left at home, or to buy branded merchandise from the resort's ski store—such as goggles, ski masks, and gloves.

The business would like you to finish setting up their budget in a spreadsheet and run different scenarios. These scenarios would indicate the effects of changes in the number of skiers, different economic outlooks, and climate change. Then, the owners would like you to model a second scenario and add projected revenues from opening for summer operations to see how they might affect the key performance indicators (KPIs).

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FIGURE 13-1: Skiing is an exciting new activity for Saudi Arabia

The resort will be extremely expensive to build and operate so profit margin—KPI—must be maintained for the resort to be viable. So far, it is unclear if people from Saudi Arabia will embrace skiing, although the business' market research suggests people would like to see the sport come to the region.

A huge factor affecting the ski industry is climate change. The United States has seen higher temperatures and fluctuations in the amount of snowfall in recent years. These changes have affected skiing at their resorts. This could make sustainable resorts in Saudi Arabia more appealing to skiers (continued success and business growth while causing little or no negative environmental or societal impacts).

Finally, the state of the economy affects the ski industry. When potential skiers are out of work or underemployed, they do not have disposable income to spend on lift tickets, rentals, food, transportation, and accommodation. The owners of the resort are concerned about their profit margins, and wonder if they should keep the ski area open all year. Normally, ski resorts are only open during the coldest months of the year and remain closed in the off-season. Management wants you to model a scenario where the resort would stay open year-around and offer alternative tourist activities when it is too hot to ski.

Creating a Spreadsheet for Decision Support

Scan the QR code to access the workbook (**Chapter 13 data file.xlsx**) you'll be using for the rest of this lesson. You will produce a spreadsheet that models the resort's financial situation. Then you will run Scenario Manager twice (in-season only, and year-around) to explore the financial impact of your models and write a report that documents your analysis and findings.

Start by creating the worksheet representation of the ski resort's business model. This will cover the three years from 2026 to 2028. Set up each of the following spreadsheet components before entering cell formulas:

- Constants
- Inputs
- Summary of key results
- Calculations
- Income and Cash flow statements
- **Debt** owed.

DEFINITION

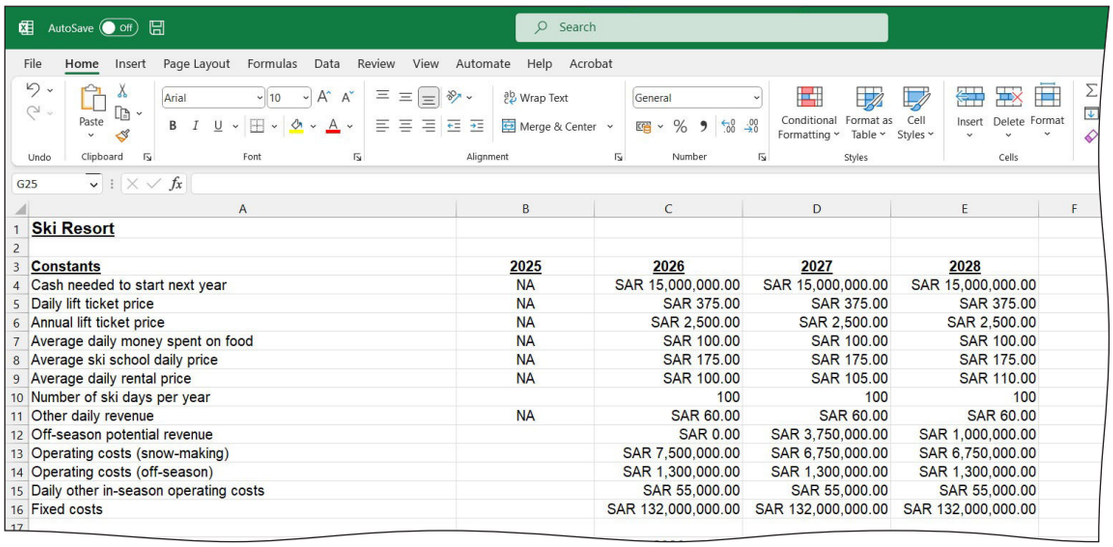
Debt: An amount of money that is due from a loan.

A discussion of each section follows.

Constants Section

Your spreadsheet should include the constants shown in Figure 13-2.

FIGURE 13-2: Constants section



	A	B	C	D	E
1	**Ski Resort**				
2					
3	**Constants**	**2025**	**2026**	**2027**	**2028**
4	Cash needed to start next year	NA	SAR 15,000,000.00	SAR 15,000,000.00	SAR 15,000,000.00
5	Daily lift ticket price	NA	SAR 375.00	SAR 375.00	SAR 375.00
6	Annual lift ticket price	NA	SAR 2,500.00	SAR 2,500.00	SAR 2,500.00
7	Average daily money spent on food	NA	SAR 100.00	SAR 100.00	SAR 100.00
8	Average ski school daily price	NA	SAR 175.00	SAR 175.00	SAR 175.00
9	Average daily rental price	NA	SAR 100.00	SAR 105.00	SAR 110.00
10	Number of ski days per year		100	100	100
11	Other daily revenue	NA	SAR 60.00	SAR 60.00	SAR 60.00
12	Off-season potential revenue		SAR 0.00	SAR 3,750,000.00	SAR 1,000,000.00
13	Operating costs (snow-making)		SAR 7,500,000.00	SAR 6,750,000.00	SAR 6,750,000.00
14	Operating costs (off-season)		SAR 1,300,000.00	SAR 1,300,000.00	SAR 1,300,000.00
15	Daily other in-season operating costs		SAR 55,000.00	SAR 55,000.00	SAR 55,000.00
16	Fixed costs		SAR 132,000,000.00	SAR 132,000,000.00	SAR 132,000,000.00

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QUICK TIP
Assume that the ski resort can always begin the new year with the needed amount.

- **Cash needed to start next year:** The government wants the resort to have at least SAR 15 million cash at the beginning of each year. This cash reserve is what the resort will use to operate the facility during the upcoming season.
- **Daily lift ticket price:** This is the amount that the resort will charge a customer to ski for an entire day at the resort.
- **Annual lift ticket price:** This is the amount (a one-time fee) that a skier will pay for an annual pass to the ski area. Skiers can then ski as many times as they choose during that year.
- **Average daily money spent on food:** This is the average amount of money that skiers will spend on food and drink in the concession stands and restaurants at the resort.
- **Average ski school daily price:** If skiers choose to take a ski lesson, this is the average price they will pay.
- **Average daily rental price:** If skiers rent equipment, such as boots, poles, skis, and helmets, this is the average price they will pay for one day's rental.
- **Number of ski days per year:** This is the average number of days in the main season. The resort is open for business for this number of days per year. The ski season is based on the temperatures in the north-western part of the country. Management has forecasted 100 days for the season each year.
- **Other daily revenue:** Skiers often forget, lose, or break equipment they need to make skiing pleasurable. The resort has a shop that supplies these items, along with souvenirs. This amount of other revenue is what the resort expects to earn each day.
- **Off-season potential revenue:** If the resort's management decides to remain open during the off-season, it can expect this amount of revenue. Management would develop other recreational activities to attract visitors during this time when it isn't practical to ski due to hotter temperatures.
- **Operating costs (snow-making):** Snow-making is a huge expense for the ski industry. However, snow-making equipment continues to become

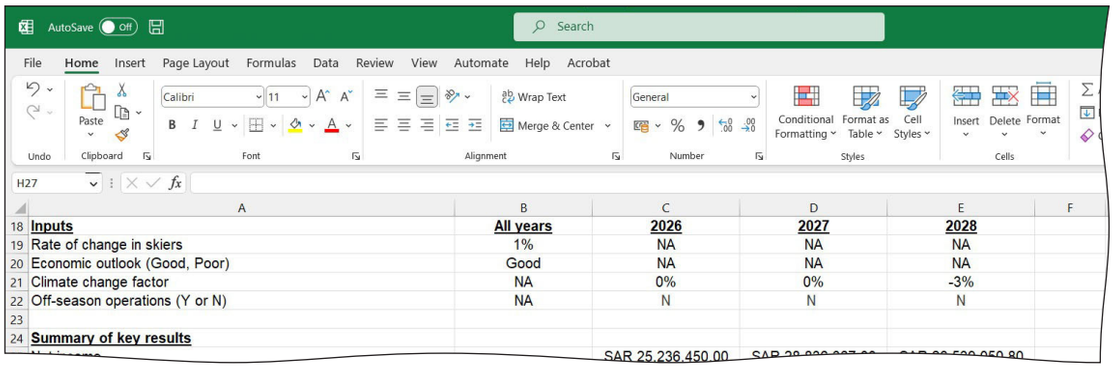
more efficient, so the costs are not expected to increase. Because Saudi Arabia does not have natural snowfall, this is not an optional expense for the ski resort.

- **Operating costs (off-season):** These are the expected costs that the resort will incur if it operates during the off-season. If management decides not to operate during the off-season, these costs will be zero.
- **Daily other in-season operating costs:** This is the additional daily cost of operating the resort in-season, beyond the major costs already noted.
- **Fixed costs:** This is the amount of fixed costs the resort has each year; this number is not a function of how many days the resort is open each year.

Inputs Section

Your spreadsheet should include the following inputs for the years 2026 to 2028, as shown in Figure 13-3.

FIGURE 13-3: Inputs section



	A	B	C	D	E
18	**Inputs**	**All years**	**2026**	**2027**	**2028**
19	Rate of change in skiers	1%	NA	NA	NA
20	Economic outlook (Good, Poor)	Good	NA	NA	NA
21	Climate change factor	NA	0%	0%	-3%
22	Off-season operations (Y or N)	NA	N	N	N
23					
24	**Summary of key results**				

- **Rate of change in skiers:** After the resort opens, management is hopeful that the number of skiers increases with time. The rate of change in skiers is a measure of the change in numbers from year to year. This percentage could be positive or negative, depending on how the resort thinks the number of future skiers will change. Format this cell as a percentage.
- **Economic outlook (Good, Poor):** If the economy is doing well and is expected to continue through the year, enter "Good" in the cell. If the economy is weak and is expected to be lackluster through the year, enter "Poor".

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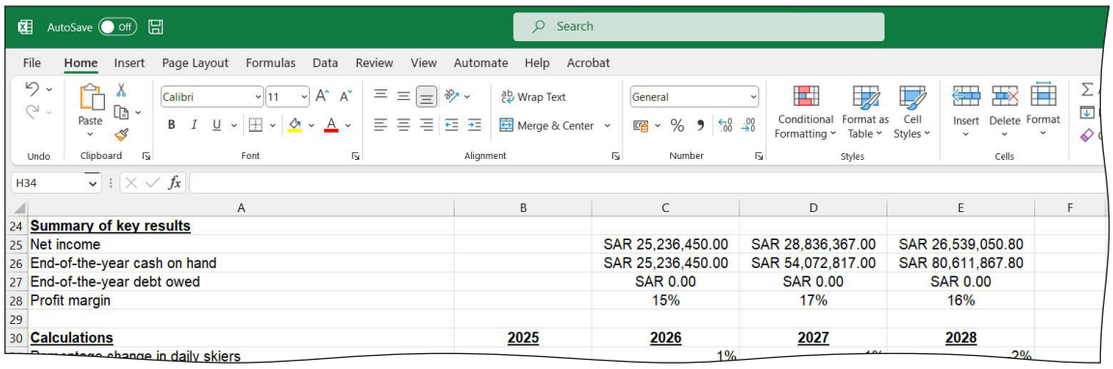
- **Climate change factor:** This percentage factor, expressed as a negative number, indicates the severity of climate change and its effect on the number of skiers. Format this cell as a percentage.
- **Off-season operations (Y or N):** If the resort decides to operate during the off-season, enter "Y" in this cell. If not, enter "N".

Summary of Key Results Section

Your spreadsheet should include the key results labels shown in Figure 13-4.

FIGURE 13-4: Summary of key results section



	A	B	C	D	E	F
24	**Summary of key results**					
25	Net income		SAR 25,236,450.00	SAR 28,836,367.00	SAR 26,539,050.80	
26	End-of-the-year cash on hand		SAR 25,236,450.00	SAR 54,072,817.00	SAR 80,611,867.80	
27	End-of-the-year debt owed		SAR 0.00	SAR 0.00	SAR 0.00	
28	Profit margin		15%	17%	16%	
29						
30	**Calculations**	**2025**	**2026**	**2027**	**2028**	
	Percentage change in daily skiers		1%		2%	

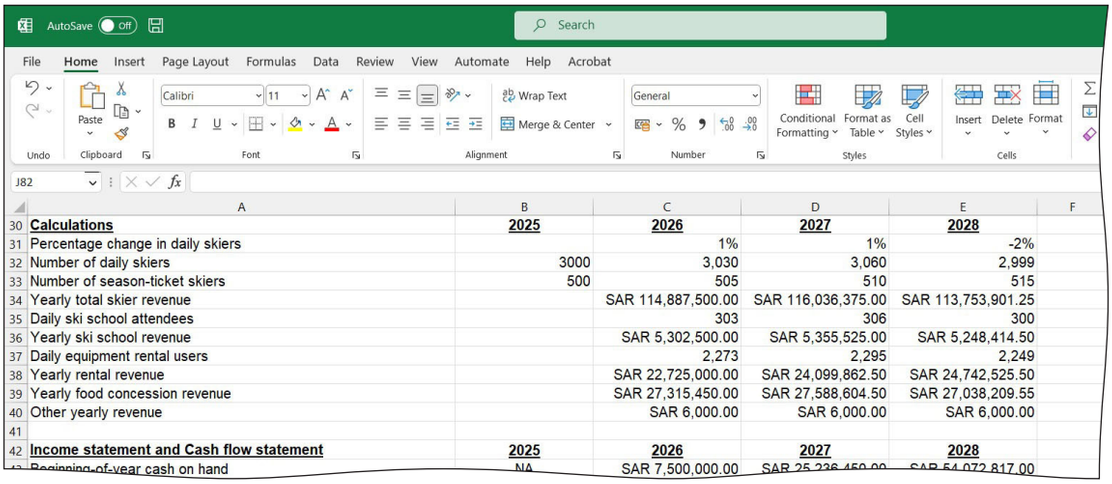
QUICK TIP
Cell formulas should not reference a cell with a value of "NA."

For each year, your spreadsheet should compute net income, cash on hand at the end of the year, debt owed at the end of the year, and profit margin. These values are computed elsewhere in the spreadsheet and should be echoed here for all years.

Calculations Section

You should calculate intermediate results that will be used in the Income and Cash flow statement that follows. The Calculations section is shown in Figure 13-5. When called for, use absolute cell references. Values must be computed by formulas in each of the cells. Do not type any numbers into cells C31:E40.

FIGURE 13-5: Calculations section



	A	B	C	D	E	F
30	**Calculations**	**2025**	**2026**	**2027**	**2028**	
31	Percentage change in daily skiers		1%	1%	-2%	
32	Number of daily skiers	3000	3,030	3,060	2,999	
33	Number of season-ticket skiers	500	505	510	515	
34	Yearly total skier revenue		SAR 114,887,500.00	SAR 116,036,375.00	SAR 113,753,901.25	
35	Daily ski school attendees		303	306	300	
36	Yearly ski school revenue		SAR 5,302,500.00	SAR 5,355,525.00	SAR 5,248,414.50	
37	Daily equipment rental users		2,273	2,295	2,249	
38	Yearly rental revenue		SAR 22,725,000.00	SAR 24,099,862.50	SAR 24,742,525.50	
39	Yearly food concession revenue		SAR 27,315,450.00	SAR 27,588,604.50	SAR 27,038,209.55	
40	Other yearly revenue		SAR 6,000.00	SAR 6,000.00	SAR 6,000.00	
41						
42	**Income statement and Cash flow statement**	**2025**	**2026**	**2027**	**2028**	
43	Beginning-of-year cash on hand	NA	SAR 7,500,000.00	SAR 25,236,450.00	SAR 54,072,817.00	

- **Percentage change in daily skiers:** This number is a function of the rate of change in skiers, the economic outlook, and the climate change factor. You will use an =IF statement to evaluate this cell. The climate change factor will be added to the rate of change in skiers to determine the Percentage change in daily skiers. For example, if the economic outlook is poor and the climate change factor is –3%, then the total percentage of change in skiers will be the rate of change in skiers minus 2% (for the poor economy) minus 3% (for climate change). If the economy is "Good" the percentage of change would only be the rate of change in skiers minus 3% (for climate change).

  – **Test:** If the economic outlook is "Good", then the Percentage change in daily skiers equals the Rate of change in skiers (B19) + Climate change factor (C21).

  – **Otherwise:** the Percentage change in daily skiers equals the (Rate of change in skiers – 2%) + Climate change factor.

QUICK TIP
=IF($B$20="Good", ($B$19+C21), (($B$19–0.02)+C21))

- **Number of daily skiers:** This number is the sum of the Percentage change in daily skiers and the previous year's Number of daily skiers. This year's Number of Daily Skiers = last year's Number of Daily Skiers + (last year's Number of Daily Skiers × Percentage Change in Daily Skiers.

QUICK TIP
=B32+(B32*C31)

- **Number of season-ticket skiers:** This number is on the sum of the Percentage change in daily skiers and the previous year's Number of season-ticket skiers. This year's Number of season-ticket skiers = last year's Number of season-ticket skiers + (last year's Number of season-ticket Skiers × Percentage change).

QUICK TIP
=B33+(B33*$B$19)

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QUICK TIP
=(C32*C10*C5)+(C33*C6)

- **Yearly total skier revenue:** This number is the product of the Number of daily skiers, the average lift ticket price, and the number of ski days per year, plus the product of the number of annual pass skiers and the annual lift ticket price.

- **Daily ski school attendees:** This number is a percentage of the Number of daily skiers (C32). Assume that 10% of the daily skiers will take ski school lessons. You may hard code this percentage into your formula for this cell.

QUICK TIP
=C35*C10*C8

- **Yearly ski school revenue:** This number is the product of the daily ski school attendees, the average ski school daily price, and the number of ski days per year.

- **Daily equipment rental users:** This number is forecasted to be 75% of the daily number of skiers. You may hard code this percentage into your formula for this cell.

QUICK TIP
=C37*C10*C9

- **Yearly rental revenue:** This number is the product of the daily equipment rental users, the average daily rental price, and the number of ski days per year.

QUICK TIP
=(C32*C10+C33)*C7*0.9

- **Yearly food concession revenue:** This number is the product of the total number of skiers per year and the average daily money spent on food. Assume that 90% of skiers buy food. The formula is as follows: (Number of daily skiers × number of Ski Days + Number of season skiers) × average daily money spent on food × 90%.

- **Other yearly revenue:** This number is the product of the other daily revenue (C11) and the number of ski days per year (C10).

Income and Cash Flow Statements

The forecast for net income and cash flow starts with the cash on hand at the beginning of the year. This value is followed by the income statement and the calculation of cash on hand at year's end. For readability, format cells in this section as currency with two decimals. Values must be computed by cell formula; hard-code numbers in formulas only if you are told to do so. Do not enter numbers directly into cells C43:E56. Cell formulas should not reference a cell with a value of "NA". Your spreadsheets should look like those in Figures 13-6 and 13-7.

- **Beginning-of-year cash on hand:** This value is the cash on hand at the end of the prior year (from B62).

- **Revenue (skiers):** This value is the Yearly total skier revenue and may be echoed here (from C34).
- **Revenue (ski school):** This value is the Yearly ski school revenue and may be echoed here (from C36).
- **Revenue (equipment rental):** This value is the Yearly rental revenue and may be echoed here (from C38).
- **Revenue (food concession):** This value is the Yearly food concession revenue and may be echoed here (from C39).
- **Revenue (other):** This value is the Other yearly revenue and may be echoed here (from C40).
- **Revenue (potential off-season):** If the resort decides to include off-season operations, then the value for the revenue is echoed here from Off-season potential revenue in the Constants section (from C12). If the resort chooses not to include off-season activities, then the value here is zero.
- **Total revenue:** This amount is the sum of the revenue from the skiers, the ski school, the equipment rental, the food concession, other revenue, and the off-season revenue C44:C49.
- **Operating costs (snow-making):** This value is echoed from the Constants section (from C13).
- **Off-season operating costs:** If the resort chooses to operate in the off-season, then this is echoed from Operating costs – off-season in the Constants section (from C14). You will need to use an =IF statement for this.
  - **Test:** If the Off-season operations is "Y" then use the value from C14 (Operating costs – off-season).
  - **Otherwise:** this value is zero. (If the resort chooses not to operate in the off-season, then they wouldn't have off-season expenses).
- **Yearly in-season operating costs:** This value is the product of the Daily other in-season operating costs (C15) and the Number of ski days per year (C16).
- **Fixed costs:** This value is echoed from the Constants section (from C16).

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CHECK YOUR PROGRESS
Compare your calculations to those shown. If the values differ, recheck your formulas and cell addresses.

- **Total costs:** This is the sum of the operating costs of snow-making, the off-season operating costs, the yearly in-season operating costs, and the fixed costs C51:C54.
- **Net income:** This is the difference between the total revenue and the total costs.

FIGURE 13-6: Income and cash flow statements section

	A	B	C	D	E	F
42	**Income statement and Cash flow statement**	**2025**	**2026**	**2027**	**2028**	
43	Beginning-of-year cash on hand	NA	SAR 7,500,000.00	SAR 25,236,450.00	SAR 54,072,817.00	
44	Revenue (skiers)	NA	SAR 114,887,500.00	SAR 116,036,375.00	SAR 113,753,901.25	
45	Revenue (ski school)	NA	SAR 5,302,500.00	SAR 5,355,525.00	SAR 5,248,414.50	
46	Revenue (equipment rental)	NA	SAR 22,725,000.00	SAR 24,099,862.50	SAR 24,742,525.50	
47	Revenue (food concession)	NA	SAR 27,315,450.00	SAR 27,588,604.50	SAR 27,038,209.55	
48	Revenue (other)	NA	SAR 6,000.00	SAR 6,000.00	SAR 6,000.00	
49	Revenue (potential off-season)	NA	SAR 0.00	SAR 0.00	SAR 0.00	
50	Total revenue	NA	SAR 170,236,450.00	SAR 173,086,367.00	SAR 170,789,050.80	
51	Operating costs (snow-making)	NA	SAR 7,500,000.00	SAR 6,750,000.00	SAR 6,750,000.00	
52	Off-season operating costs	NA	SAR 0.00	SAR 0.00	SAR 0.00	
53	Yearly in-season operating costs	NA	SAR 5,500,000.00	SAR 5,500,000.00	SAR 5,500,000.00	
54	Fixed costs	NA	SAR 132,000,000.00	SAR 132,000,000.00	SAR 132,000,000.00	
55	Total costs	NA	SAR 145,000,000.00	SAR 144,250,000.00	SAR 144,250,000.00	
56	Net income	NA	SAR 25,236,450.00	SAR 28,836,367.00	SAR 26,539,050.80	
57						
58		**2025**	**2026**	**2027**	**2028**	

We will extend the income statement to also include the resort's Net cash position and any borrowing from or repayment to the bank.

- **Net Cash Position (NCP) before borrowing and repayment of debt:** This amount is the sum of the Beginning-of-year cash on hand (C43) and Net income (C56).

QUICK TIP
=IF(C59<C4,C4-C59,0)

- **Add (Borrowing from bank):** Assume that the resort can borrow from bankers at the end of the year to reach the minimum cash needed to start the next year; this minimum is a value in the Constants section (from C4). You will use an =IF statement in this cell.
  - **Test:** If the NCP is less than the minimum cash needed amount, then the resort would borrow enough to start the next year with the minimum. This amount would be the minimum cash needed—NCP.
  - **Otherwise:** If the NCP is greater than this minimum, the resort would not borrow any money.

QUICK TIP

The syntax for a nested =IF statement is:

=IF(Test1,Result1,IF(Test2, Result2,IF(Test3,Result3, Result if false)))

Result1 is the value if Test1 is true.

Result if false is the value if all Tests are false (“*Otherwise*”).

- **Less (Repayment to bank):** The resort will use any excess cash at year’s end to pay off as much debt as possible without going below the minimum cash threshold. Excess cash is the NCP minus the minimum cash required to start the year. Amounts that exceed the minimum are available to repay debt. The resort wants to repay as much as it can if it has any money available.
  - **Test 1:** If the Beginning-of-year debt owed is zero, then no repayment is needed. This value is 0.
  - **Test 2:** If the NCP < minimum cash needed, then no repayment can be made. This value is 0.
  - **Test 3:** If the difference between the NCP and minimum cash needed is greater than, or equal to, the Beginning-of-year debt owed, the resort will pay off the Beginning-of-year debt in full.

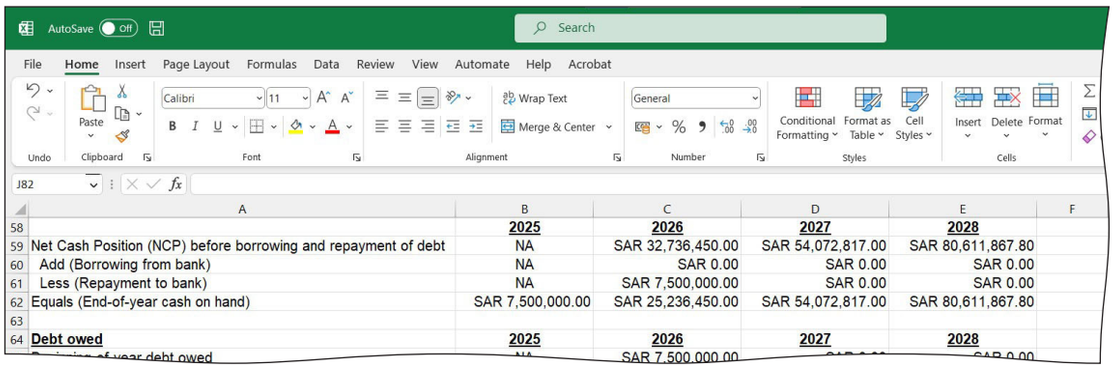
QUICK TIP

=IF(C65=0,0,IF(C59<C4,0, IF(C59–C4>=C65,C65, C59–C4)))

Otherwise, the resort will pay off an amount equal to the difference between the NCP and Minimum Cash Needed.

- **Equals (End-of-year cash on hand):** This amount is the NCP plus any bank borrowing minus any repayments to the bank.

FIGURE 13-7: End-of-year cash on hand section



	A	B	C	D	E
58		2025	2026	2027	2028
59	Net Cash Position (NCP) before borrowing and repayment of debt	NA	SAR 32,736,450.00	SAR 54,072,817.00	SAR 80,611,867.80
60	Add (Borrowing from bank)	NA	SAR 0.00	SAR 0.00	SAR 0.00
61	Less (Repayment to bank)	NA	SAR 7,500,000.00	SAR 0.00	SAR 0.00
62	Equals (End-of-year cash on hand)	SAR 7,500,000.00	SAR 25,236,450.00	SAR 54,072,817.00	SAR 80,611,867.80
63					
64	Debt owed	2025	2026	2027	2028
	Beginning of year debt owed	NA	SAR 7,500,000.00	[illegible]	SAR 0.00

CHECK YOUR PROGRESS

Compare your results with the values shown. If yours are different, carefully re-check your formulas and cell addresses.

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Debt Owed Section

This section shows a calculation of debt owed at the end of a year (see Figure 13-8). Year 2025 values are NA except for End-of-year debt owed, which is SAR 7.5 million.

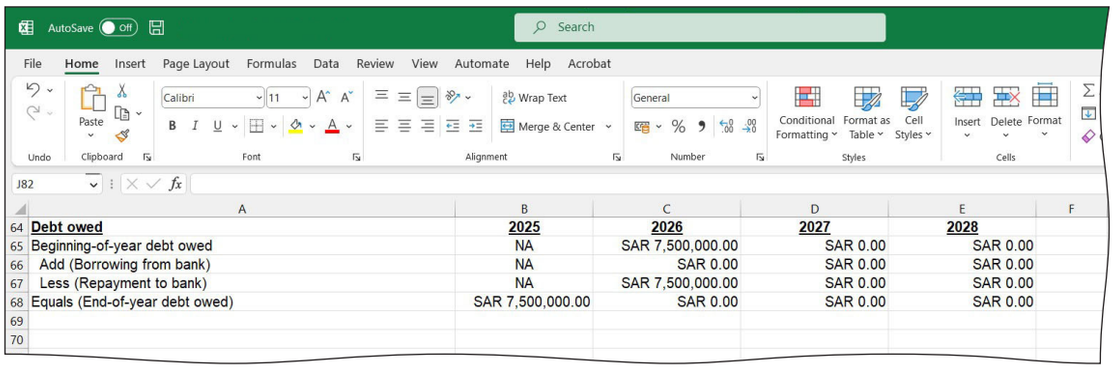
Values must be computed by cell formula. Cell formulas should not reference a cell with a value of "NA".

- **Beginning-of-year debt owed:** This amount is the debt owed at the beginning of the year and equals the debt owed at the end of the prior year (from B68).
- **Add (Borrowing from bank):** This amount is echoed from the Add: Borrowing from bank (from C60). Borrowing increases the amount of debt owed.
- **Less (Repayment to bank):** This amount is echoed from the Less: Repayment to the the bank (from C61). Repayments reduce the amount of debt owed.

QUICK TIP
=C65+C66–C67

- **Equals (End-of-year debt owed):** This is the amount owed at the beginning of a year, plus borrowing from the bank during the year, minus repayments to the bank during the year.

FIGURE 13-8: Debt owed section



	A	B	C	D	E	F
64	**Debt owed**	**2025**	**2026**	**2027**	**2028**	
65	Beginning-of-year debt owed	NA	SAR 7,500,000.00	SAR 0.00	SAR 0.00	
66	Add (Borrowing from bank)	NA	SAR 0.00	SAR 0.00	SAR 0.00	
67	Less (Repayment to bank)	NA	SAR 7,500,000.00	SAR 0.00	SAR 0.00	
68	Equals (End-of-year debt owed)	SAR 7,500,000.00	SAR 0.00	SAR 0.00	SAR 0.00	
69						
70						

CHECK YOUR PROGRESS
Compare your results with those shown. What does this tell you about the resort's ability to pay its debt?

Copy all the formulas from column C (2026) to column D (2027) and column E (2028).

REVIEW QUESTIONS

1. **Season tickets offer benefits to:**
   - **a.** the customer
   - **b.** the business
   - **c.** the customer and the business
   - **d.** neither the customer nor the business
2. **For the new ski resort to be sustainable, it should be:**
   - **a.** profitable
   - **b.** growing in popularity each year
   - **c.** safe
   - **d.** all of the above
3. **In 2027, how much would it cost a visitor to the ski resort to buy a lift ticket, spend an average amount of money on food, attend a ski lesson, and spend the average amount of money on renting equipment?**
   - **a.** SAR 655
   - **b.** SAR 755
   - **c.** SAR 855
   - **d.** SAR 955
4. **What is the percentage change in the cost of the services from question 3, between 2027 and 2028? Round your answer to one decimal place.**
   - **a.** 0.7%
   - **b.** 0.8%
   - **c.** 0.9%
   - **d.** 1.0%

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Ski Resort Deliverables

The exciting new ski resort business needs to carefully manage its profit margins to ensure its success. This is important for any business (and therefore a common KPI), but especially important for a business that is trying to establish itself in a country where skiing is so unusual. As we have seen, the situation can be even more complicated when we consider the effects of climate change and the global economy.

Your task is to create a spreadsheet that will help to support the decision making of the ski resort's executives, so you can help them to explore different financial models before making a recommendation. It is now time to model those scenarios so you can compile your report.

The managers of the ski resort would like you to explore three scenarios with optimistic, neutral, and pessimistic outlooks. They will receive all of your data, but they only want to see the profit margin projections in your report. The managers would like you to explore each of these three scenarios twice: once where the business is closed in the off-season, and again where the business is open all year round. However, the business will not be ready to run in the off-season until 2028, so the results will be the same, except for in 2028.

You will need to run Scenario Manager for each of the three scenarios. Set up Scenario Manager by entering the input values for the desired scenario before you run the tool. The first time you run Scenario Manager, make sure the input value for Off-Season Operations are all set to "N", and enter the inputs for the Optimistic scenario (described below). As you work through each successive scenario, start by setting the input values. The input values you will use are as follows:

- **Optimistic:** The number of skiers will increase each year by 1%, and the economic outlook is good. The climate change factor will be zero in 2026 and 2027, and will be –3% in 2028.
- **Neutral:** The number of skiers will remain the same (no percentage increase or decrease), and the economic outlook is good. The climate change factor will be –2% in 2026 and 2027, and will be –6% in 2028.
- **Pessimistic:** The number of skiers will decrease each year by 3%, and the economic outlook is poor. The climate change factor will be –8% in 2026, 2027, and 2028.

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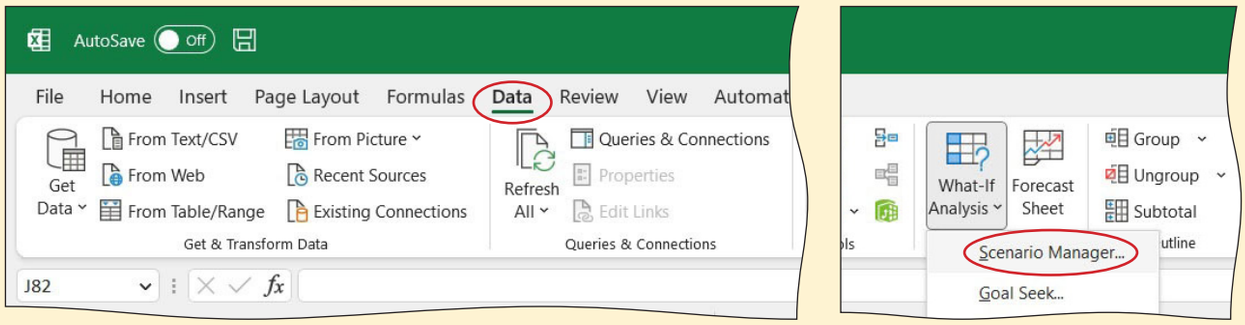
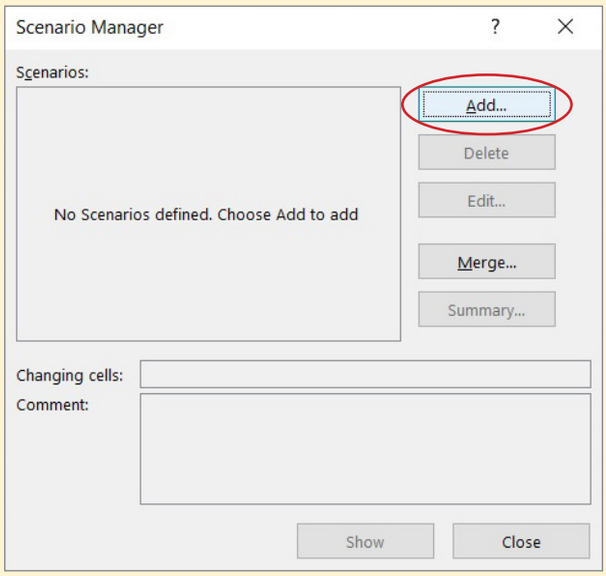
Start Scenario Manager by first clicking the Data tab on the ribbon. Then, select the What-If Analysis tab and choose Scenario Manager (Figure 13-9).

FIGURE 13-9: Select Scenario Manager



The Scenario Manager window will pop up (see Figure 13-10). Click on the Add button to add your first scenario.

FIGURE 13-10: Click the Add button to add a scenario



Enter "Optimistic" in the Scenario Name box. Enter the range of your changing cells. Note the range highlighted in yellow in Figure 13-11. As you can see, the changing cells are noncontiguous, so you will enter the two ranges separated by a comma (as shown in Figure 13-12).

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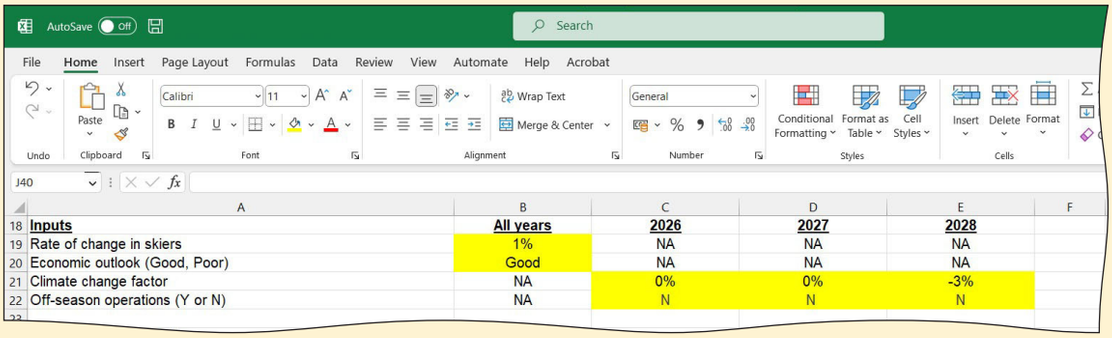
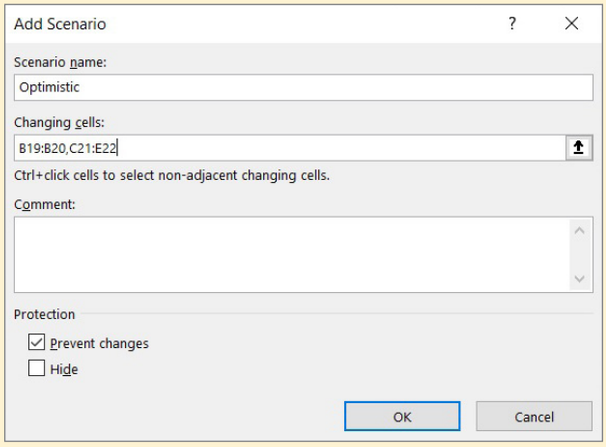
FIGURE 13-11: Use the data in the highlighted cells to create the Optimistic scenario



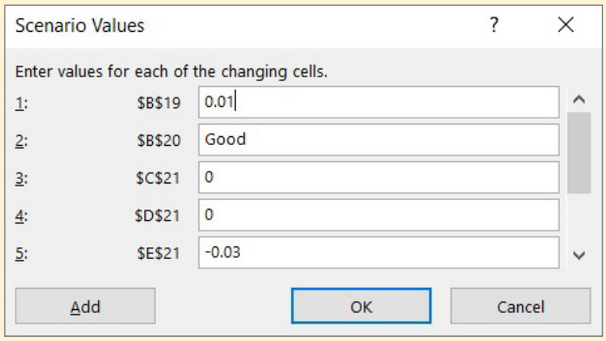
	A	B	C	D	E
18	**Inputs**	**All years**	**2026**	**2027**	**2028**
19	Rate of change in skiers	1%	NA	NA	NA
20	Economic outlook (Good, Poor)	Good	NA	NA	NA
21	Climate change factor	NA	0%	0%	-3%
22	Off-season operations (Y or N)	NA	N	N	N

FIGURE 13-12: Enter the two ranges separated by a comma



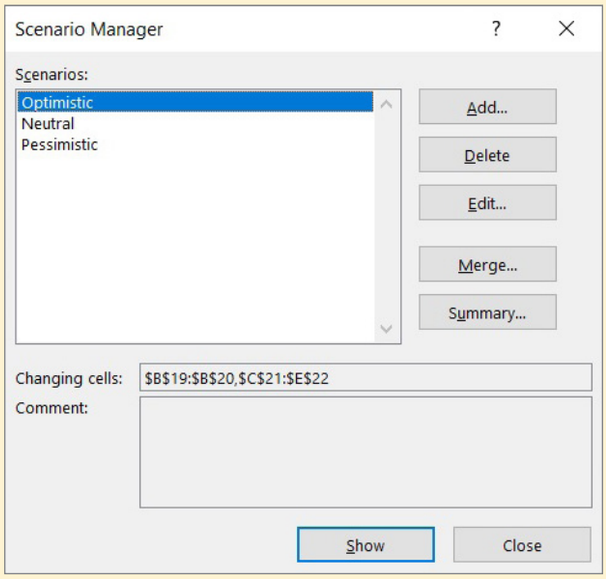
Scenario Manager will fill in the values of the changing cells from the values it finds in your worksheet (Figure 13-13). This is why you should enter the appropriate input values for each scenario before running Scenario Manager. Check each of these values carefully and make corrections if necessary. Click OK to save the scenario.

FIGURE 13-13: Check the Scenario Values carefully



Repeat the process for the Neutral and Pessimistic scenarios (see Figure 13-14). Remember to update the original Input values for each scenario before creating the next scenario in Scenario Manager.

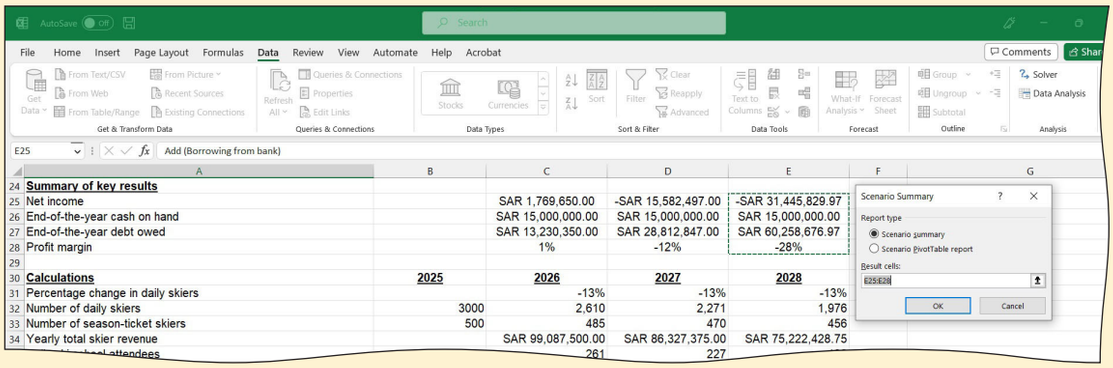
FIGURE 13-14: Enter the correct values for the other scenarios



You can check your work by selecting one of the three scenarios in the Scenario Manager window and clicking Show. Look at the Inputs on your worksheet. When you click Optimistic, they should change to the Optimistic values. Click Pessimistic and they will change to the Pessimistic values. If all appears to be correct, click the Summary button.

Scenario Manager will display the Scenario Summary windows. Click Scenario Summary for the Report Type. Then, enter the Summary of Key Results values you are interested in. As management wants to know what their net income, cash on hand, debt owed, and profit margins will be in 2028, select the cell range E25:E28 (Figure 13-15).

FIGURE 13-15: Enter the correct cell range in the Scenario Summary window



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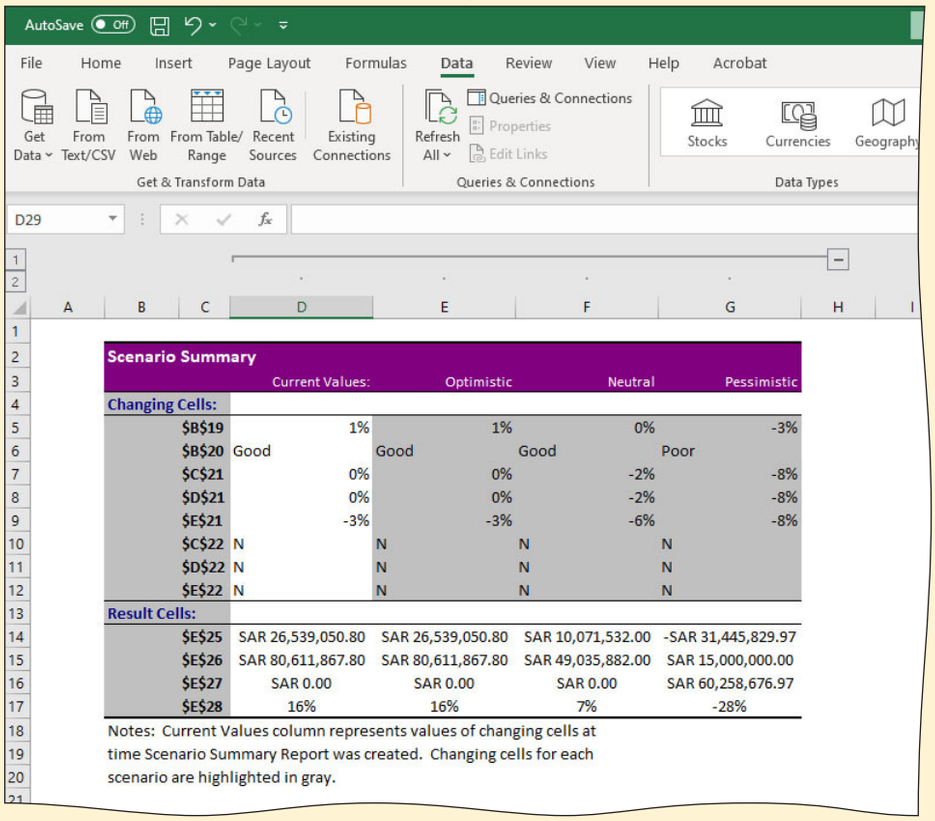
Scenario Manager will create a new worksheet named "Scenario Summary". Right-click on this tab and rename it "In-Season". The Scenario Summary shows the results for the Optimistic, Neutral, and Pessimistic conditions.

The summary could benefit from some polishing. Highlight Column D, right-click, and delete it. Highlight rows 19–21, right-click, and Clear Contents. Highlight the cell range D3:G18 and center the text. Highlight cells C15:C18, right-click, and select Clear Contents. Copy and paste the descriptive labels from your worksheet into cells B15:B18. You may need to adjust the column widths of columns B and C to fit the descriptive labels. Your finished summary should look like the one shown in Figure 13-17. Figures 13-16 and 13-17 show the Before and After of this polishing.

FIGURE 13-16: The unpolished Scenario Summary



Scenario Summary				
	Current Values:	Optimistic	Neutral	Pessimistic
Changing Cells:				
$B$19	1%	1%	0%	-3%
$B$20	Good	Good	Good	Poor
$C$21	0%	0%	-2%	-8%
$D$21	0%	0%	-2%	-8%
$E$21	-3%	-3%	-6%	-8%
$C$22	N	N	N	N
$D$22	N	N	N	N
$E$22	N	N	N	N
Result Cells:				
$E$25	SAR 26,539,050.80	SAR 26,539,050.80	SAR 10,071,532.00	-SAR 31,445,829.97
$E$26	SAR 80,611,867.80	SAR 80,611,867.80	SAR 49,035,882.00	SAR 15,000,000.00
$E$27	SAR 0.00	SAR 0.00	SAR 0.00	SAR 60,258,676.97
$E$28	16%	16%	7%	-28%

Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

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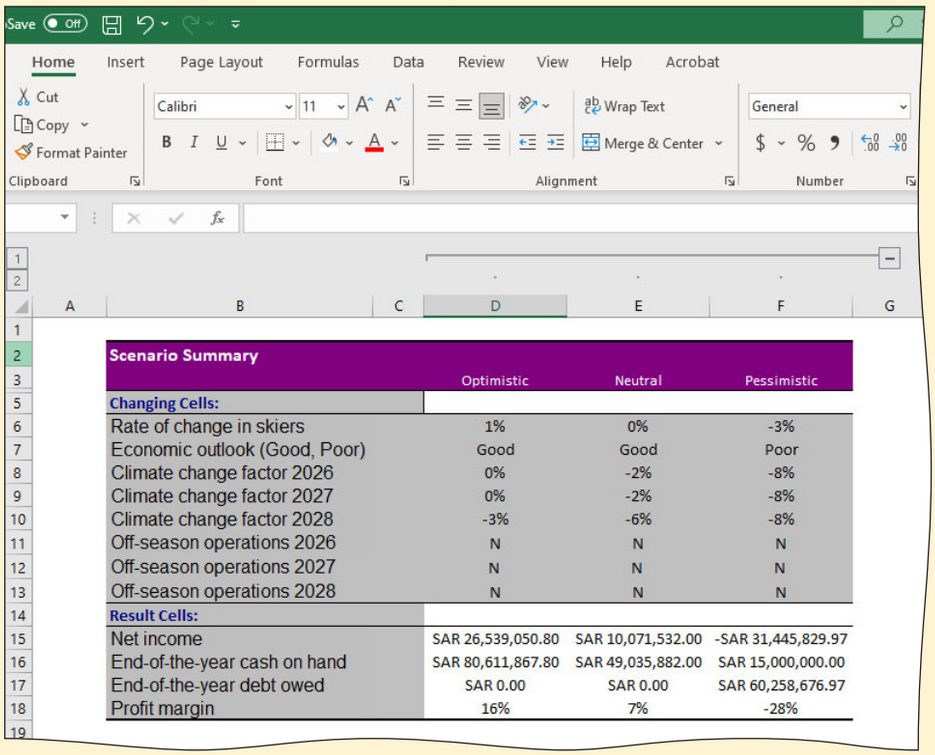
FIGURE 13-17: The polished Scenario Summary



Scenario Summary	Optimistic	Neutral	Pessimistic
Changing Cells:			
Rate of change in skiers	1%	0%	-3%
Economic outlook (Good, Poor)	Good	Good	Poor
Climate change factor 2026	0%	-2%	-8%
Climate change factor 2027	0%	-2%	-8%
Climate change factor 2028	-3%	-6%	-8%
Off-season operations 2026	N	N	N
Off-season operations 2027	N	N	N
Off-season operations 2028	N	N	N
Result Cells:			
Net income	SAR 26,539,050.80	SAR 10,071,532.00	-SAR 31,445,829.97
End-of-the-year cash on hand	SAR 80,611,867.80	SAR 49,035,882.00	SAR 15,000,000.00
End-of-the-year debt owed	SAR 0.00	SAR 0.00	SAR 60,258,676.97
Profit margin	16%	7%	-28%

This set of scenarios forecasts key results for operation only during ski season. Management would like a second set of scenarios where the resort is open year-around. Remember that the resort will need to set up for off-season operation and will not be able to open off season until 2028.

Repeat the entire process for the year-round operation. Modify your scenarios (Optimistic, Neutral, and Pessimistic) with a "Y" for Off-season operations in 2028. Carefully check all of your scenario parameters. When all appears to be correct, click on the Summary button. Scenario Manager will create a new worksheet. As before, rename this by right-clicking the tab and changing the name of the worksheet to "Year-Round". Repeat the same steps you did above to polish the look of the summary report.

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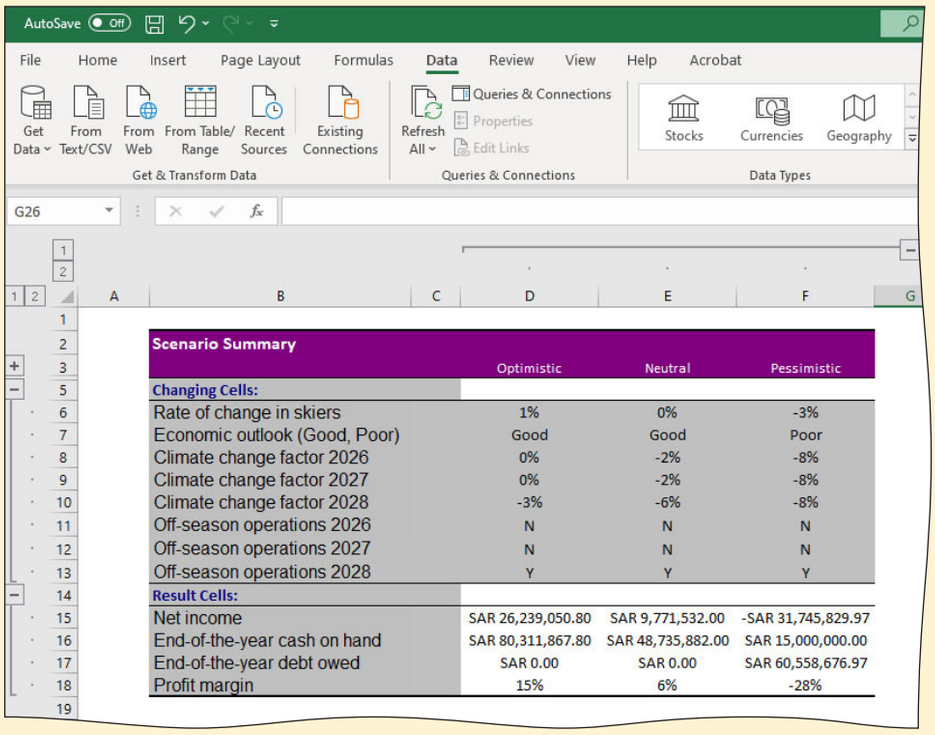
FIGURE 13-18: The polished Scenario Summary for year-round operations



Scenario Summary	Optimistic	Neutral	Pessimistic
Changing Cells:			
Rate of change in skiers	1%	0%	-3%
Economic outlook (Good, Poor)	Good	Good	Poor
Climate change factor 2026	0%	-2%	-8%
Climate change factor 2027	0%	-2%	-8%
Climate change factor 2028	-3%	-6%	-8%
Off-season operations 2026	N	N	N
Off-season operations 2027	N	N	N
Off-season operations 2028	Y	Y	Y
Result Cells:			
Net income	SAR 26,239,050.80	SAR 9,771,532.00	-SAR 31,745,829.97
End-of-the-year cash on hand	SAR 80,311,867.80	SAR 48,735,882.00	SAR 15,000,000.00
End-of-the-year debt owed	SAR 0.00	SAR 0.00	SAR 60,558,676.97
Profit margin	15%	6%	-28%

You might find it useful to copy out Table 13-1 to record the results.

TABLE 13-1: Ski Resort Project results

	Optimistic	Neutral	Pessimistic
2025			
2026			
2027			
2028 (Off-season)			
2028 (Year-round)			

It is now time to present your findings to the ski resort's management in the form of a short report. Scan the QR code to access the report template (**Report template.dotx**).

1. Start by scanning the QR code and opening the report template.
2. Click on the text "Report Title." Use the drop-down menu to select the report title.
3. Click on the text "Your Name" and enter your full name.
4. Click on the text "Date." Use the calendar menu to select the correct date.

5. First, complete the Problem Statement section. Go back to the beginning of this chapter to refresh your memory, then try to state the problem as briefly as possible and in your own words.

6. Explain the techniques you used to get your results in the Methodology section. Think about how you built your spreadsheet, calculated data, and used Scenario Manager.

7. Next, complete the Results section. It isn't necessary to present all of your results to the management team—instead, copy out the following sentences and fill in the blanks with the correct information:

> The neutral profit margin for 2026 is _____.
>
> The pessimistic profit margin for 2027 is _____.
>
> The optimistic profit margin for 2028, if the business closes for the off-season, is _____.
>
> The pessimistic profit margin for 2028, if the business stays open all year round, is _____.

8. As we expected, the optimistic scenario produces the best results for the company's profit margins. But because some of the factors are out of our control, we don't know whether the reality will match the optimistic, neutral, or pessimistic outlooks.

   Complete the Analysis section by answering the following question:

   Should the business close during the off-season, or should it stay open all year round?

   In your answer, consider all of the data for each scenario, including your results for net income, cash on hand, debt owed, and profit margin. Give a detailed response of at least one paragraph.

9. Now you have completed the body of the report, you can complete the Executive Summary section by following the guidance in the report template. Remember to keep it brief, but informative.

10. Your report is now complete. Save it by selecting Save from the file menu, and use the file name format: **YourName - SkiResort - Report.docx.**

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Chapter 14

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The Electric Car Project

In this project, you will use Microsoft Excel to see if the Electric Car Company has enough cash to get through the next three years without needing external financing.

This project will introduce some key factors that affect businesses which need to constantly develop their products while remaining profitable.

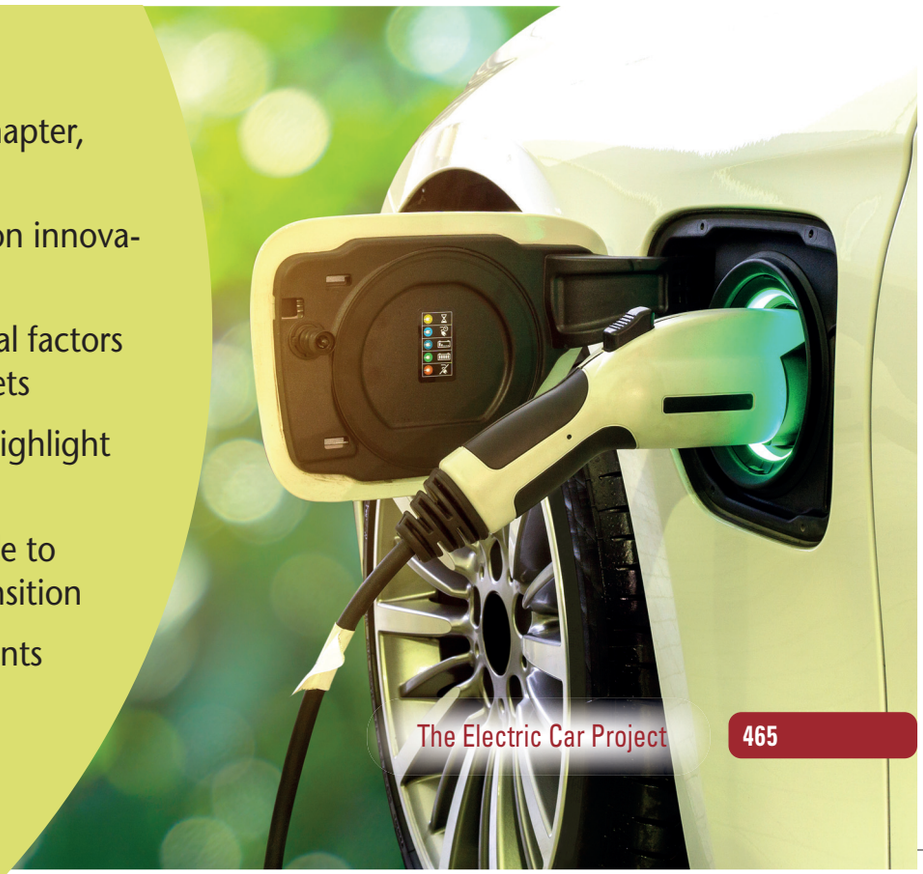
It is vital to understand the company's planned phases, and how they can gradually improve their products over time in a competitive market.

This chapter will have you focus on three economic scenarios that the company may face. You will need to use the skills you've learned so far to see how the company can meet its financial targets in each scenario.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Identify factors that impact on innovative companies
2. Explain the impact of external factors on business' changing markets
3. Represent information and highlight patterns and trends in data
4. Evaluate the support available to businesses in a period of transition
5. Create a report that documents your analysis and findings



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Electric Car Background

Twenty years ago, Ahmad was the vice president of engineering for one of the Kingdom of Saudi Arabia's major automobile manufacturers. However, Ahmad was worried about the harmful effects of burning gasoline inside internal combustion engines. He was convinced that eventually, these engines would become unpopular because of their environmental impact. He wanted the company to start making battery-powered vehicles, but after much debate, management decided against the move.

Frustrated, Ahmad left the company and started his own business. He and a few young engineers started a company, which they named Electric Car. Ahmad and his team were sure they could make an attractive vehicle that would achieve high speeds while running solely on battery power. They were sure they could sell the car to an increasingly wealthy public who, over time, would become more concerned about environmental issues and would look for alternatives to fossil fuels.

FIGURE 14-1: Ahmad's company, Electric Car, has reached a crucial time in its operations

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Electric Car's three-phase strategy

1. In the first phase, the company would develop an expensive sports car. This might not be profitable, but it would establish the company's brand.
2. In the second phase, they would introduce a more affordable car that would have a broader appeal. This sedan would firmly establish Electric Car as a successful automobile company that would be in business for a long time.
3. In the third phase, the company would modify the roofs of its cars to generate solar power that would continuously recharge the vehicle's battery.

The first- and second-phase cars would not burn gasoline. However, their batteries would need to be charged occasionally, which means a power plant somewhere in the country would have to discharge hydrocarbons into the air to create electricity for recharging. This process would be cleaner than burning gasoline inside a car engine, but Ahmad and his team wanted to be able to say their cars required no burning of hydrocarbons and generated no pollution.

In the third phase of its strategy, the company would modify the roofs of its cars to include solar panels which would generate solar power that continuously recharges the batteries. This could potentially eliminate the need for the vehicles to use any gasoline. Ahmad wants to be certain that the company is financially stable before making the investments that will be needed for this next phase.

At first, Electric Car invested a substantial amount of money. Major expenditures included:

- building a factory
- research and development (R&D)—a process businesses go through to develop new products and improve existing products
- creating a network of charging stations
- sports car trade-in guarantees—an agreement that Electric Car will discount a certain amount (or percentage of the car's value) in years to come when the buyer wishes to replace their electric vehicle with a newer model.

Electric Car's sports car sold well immediately because of its sleek lines, quick acceleration, and their generous trade-in option. In the plan, a buyer was guaranteed that the sports car would be guaranteed a good trade-in value for eight years towards the purchase of a new car.

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For example, a sports car purchased in 2015 from Electric Car for SAR 240,000 would be guaranteed to be worth SAR 188,000 in 2022, SAR 180,000 in 2023, and SAR 172,000 in 2024.

The trade-in program helped to persuade prospective buyers in the company's early years. There were some initial claims against Electric Car, but the program has not been a great financial drain on the company in recent years. However, the company's accountants say that a liability must be recorded for potential claims, which are estimated to be SAR 3.75 billion at most. Management thinks the trade-in program is no longer needed and has discontinued it for future years, but the potential liability for older sales still exists.

Electric Car has reached the end of the first phase of its strategy and is looking forward to the second phase. Two major developments in recent years will require capital expenditures in the future:

- Electric Car engineers have designed and learned to build a reasonably priced family sedan, which they plan to start selling next year. As sales increase, the production lines will be expanded accordingly.
- Through their R&D, company engineers have learned to make a better battery that will increase travel distance between recharges. This gives them a marketing advantage for the future. They have entered into a joint venture with their battery supplier to put their R&D to best use. A joint venture is when two businesses enter into a mutually beneficial agreement to deliver a product or service that would be difficult—or impossible—to do independently. They will build their own plant to make next-generation car batteries, which will ensure a stable supply of batteries at more controllable costs.

This is an important time for the company. Management hopes that family sedan sales will be enough to establish profitability within the next three years. If Electric Car can achieve these profit goals, management believes the company will be in the car business for the long run. At this point the company has SAR 33.75 billion in cash, but management knows that much of this money will be spent in the next three years. Here is the key financial question for management:

> How likely is it that the company can make it through 2025 without having to borrow any new capital?

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Creating a Spreadsheet for Decision Support

You will produce a spreadsheet that models Electric Car's financial situation. Then, you will use the spreadsheet for decision support and write a report that documents your analysis and findings.

First, you will create the spreadsheet model of the decision. The model covers the three years from 2023 to 2025. This section helps you set up each of the following spreadsheet components before entering cell formulas:

- Constants
- Inputs
- Summary of key results
- Calculations
- Income and cash flow statements
- Debt owed.

A discussion of each section follows.

Scan the QR code to access the workbook (**Chapter 14 data file.xlsx**) you'll be using for the rest of this lesson.

Constants Section

Your spreadsheet should include the following constants (see Figure 14-2):

- **Minimum cash needed to start year:** The company wants to have at least SAR 3.75 billion in cash at the beginning of each year (C4:E4). This will provide them with sufficient working capital to manage their operations through the year. Assume that the company could borrow from a bank at the end of a year in order to begin the next year with this required amount.
- **Projected capital costs:** The company expects to spend SAR 7.5 billion a year on the expanded manufacturing line, battery factory, and other projects (C5:E5).
- **Research and development costs:** R&D is ongoing at an expected SAR 1.875 billion a year (C6:E6).
- **Fixed costs:** Expenses for the year, such as sales and administrative costs, are expected to be SAR 1.875 billion a year (C7:E7).
- **Cost of operating a charger station yearly:** Expenses associated with each charger station average SAR 375,000 a year (C8:E8).

QUICK TIP

For currency, remember to change the number format to currency, SAR. For this exercise, numbers should contain two decimal places.

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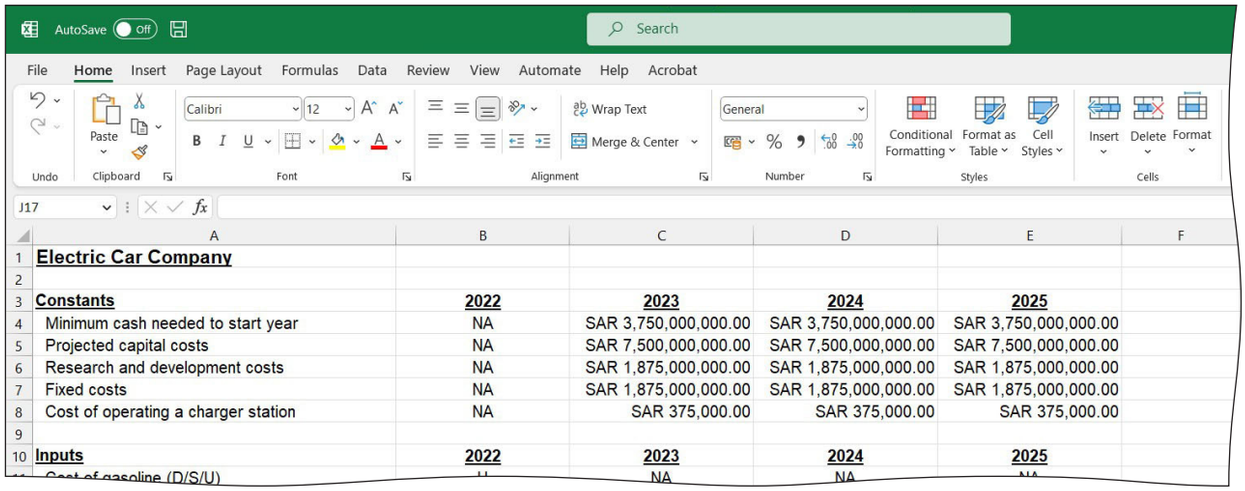
FIGURE 14-2: The completed Constants section



	A	B	C	D	E	F
1	**Electric Car Company**					
2						
3	**Constants**	**2022**	**2023**	**2024**	**2025**	
4	Minimum cash needed to start year	NA	SAR 3,750,000,000.00	SAR 3,750,000,000.00	SAR 3,750,000,000.00	
5	Projected capital costs	NA	SAR 7,500,000,000.00	SAR 7,500,000,000.00	SAR 7,500,000,000.00	
6	Research and development costs	NA	SAR 1,875,000,000.00	SAR 1,875,000,000.00	SAR 1,875,000,000.00	
7	Fixed costs	NA	SAR 1,875,000,000.00	SAR 1,875,000,000.00	SAR 1,875,000,000.00	
8	Cost of operating a charger station	NA	SAR 375,000.00	SAR 375,000.00	SAR 375,000.00	
9						
10	**Inputs**	**2022**	**2023**	**2024**	**2025**	
11	Cost of gasoline (D/S/U)	U	NA	NA	NA	

Inputs Section

Your spreadsheet should include the following inputs for the years 2023 to 2025 (see Figure 14-3).

- **Cost of gasoline (D/S/U):** The cost of a liter of gasoline has an effect on electric car sales and selling prices. When the cost of fuel goes up, more electric cars are sold, and for a higher price. When the cost of fuel goes down, the effects are the opposite. Thus, Electric Car management hopes for higher gas prices in the coming years. Enter "D" if the price of gasoline is expected to go down, "U" if the price is expected to go up, and "S" if the price is expected to be stable. The entry applies to all years. Put a "U" in B11 for now.
- **Guarantee claim rate:** What percentage of the possible SAR 3.75 billion liability will be claimed? The company expects it to be 1% each year, so enter "0.01" in C12:E12. Format these cells as percentages.
- **Unit cost reduction factor:** As the company learns more about making cars and modernizes its plant, the unit cost of a car should decline. If you expect a 1% decline each year, for example, enter "0.01" in C13:E13. Format these cells as percentages.
- **Number of new charger locations:** As a marketing tool, the company needs to keep expanding the number of locations. As an initial value, 30 new locations each year in C14:E14.

QUICK TIP

To format the values of a cell, right-click the cell, select Format Cell, and choose the format you want to apply (Number, Currency, etc.) Or, at the top of the main ribbon you can click on the appropriate symbol to quickly set the format.

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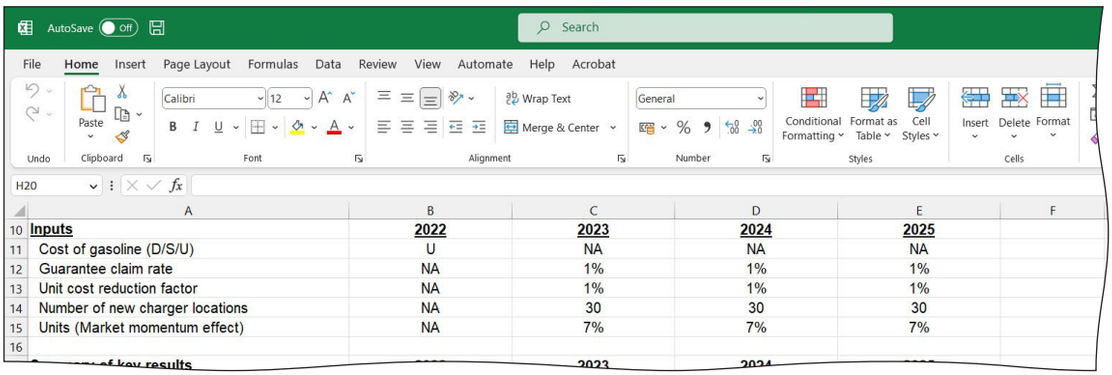
- **Units (market momentum effect) (percentage points):** Management thinks that time is on its side: Over time, buying an electric car will be seen as the progressive thing to do, and car sales will increase as a result. Management calls this the **market momentum effect**—each year the market will move the company's way to a certain extent, regardless of other economic factors. If you expect the number of cars sold to increase by 7% in a year, for example, enter "0.07" Enter this value in cells C15:E15 initially. Format these cells as percentages.

DEFINITION

Market momentum effect: The expectation that, once a trend has been established, the market will move in the same general direction—only the rate will change.

FIGURE 14-3: The completed Inputs section



	A	B	C	D	E	F
10	**Inputs**	**2022**	**2023**	**2024**	**2025**	
11	Cost of gasoline (D/S/U)	U	NA	NA	NA	
12	Guarantee claim rate	NA	1%	1%	1%	
13	Unit cost reduction factor	NA	1%	1%	1%	
14	Number of new charger locations	NA	30	30	30	
15	Units (Market momentum effect)	NA	7%	7%	7%	
16						

Summary of Key Results Section

QUICK TIP

To echo a value from one cell in a worksheet to another, use =*CellReference*. For example, to echo the contents of cell M65 in cell C12, you would type =M65 in cell C12. The value in M65 will be echoed.

For each year, your spreadsheet should compute net income, cash on hand at the end of the year, and debt owed (to noteholders and the bank) at the end of the year. You will calculate these values later in your spreadsheet and then echo those values here (see Figure 14-4). For example, the value for Net Income in 2023 is calculated in cell C56. So, type **=C56** in cell C18 to echo the value in this summary section.

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FIGURE 14-4: The completed Summary of key results section

	A	B	C	D	E	F	G
17	**Summary of key results**	**2022**	**2023**	**2024**	**2025**		
18	Net income	NA	SAR 1,841,106,000.00	SAR 1,447,688,215.20	SAR 5,962,053,751.11		
19	End-of-year cash on hand	NA	SAR 3,750,000,000.00	SAR 3,750,000,000.00	SAR 3,750,000,000.00		
20	End-of-year debt owed	NA	SAR 20,591,106,000.00	SAR 26,643,417,784.80	SAR 28,181,364,033.69		
21							
22	**Calculations**	**2022**	**2023**	**2024**	**2025**		
23	Charger locations	600	630	660	690		
24	Change in units sold (%)	NA					
25	Market momentum effect	NA	7%	7%	7%		
26	Gas price effect	NA	5%	5%	5%		

Calculations Section

You should calculate intermediate results (see Figure 14-5) that will be used in the income and cash flow statements that follow. Use absolute cell referencing when necessary. Values must be computed by cell formula; hard-code numbers in formulas only when you are told to do so. Cell formulas should not reference a cell with a value of "NA."

FIGURE 14-5: The skeleton of the Calculations section

	A	B	C	D	E	F	G
22	**Calculations**	**2022**	**2023**	**2024**	**2025**		
23	Charger locations	600					
24	Change in units sold (%)	NA					
25	Market momentum effect	NA					
26	Gas price effect	NA					
27	New charger location effect	NA					
28	Total change	NA					
29	Units sold (Sport)	53,000					
30	Units sold (Family)	0					
31	Change in selling price (%)	NA					
32	Market momentum effect	NA					
33	Gas price effect	NA					
34	New charger location effect	NA					
35	Total change	NA					
36	Selling price (Sport)	SAR 280,000.00					
37	Selling price (Family)	SAR 0.00					
38	Unit cost (Sport)	SAR 290,000.00					
39	Unit cost (Family)	SAR 0.00					
40							
41	**Income statement and Cash flow statement**	**2022**	**2023**	**2024**	**2025**		
42	Beginning-of-year cash on hand	NA					

- **Charger locations:** There were 600 locations at the end of 2022. The number of locations will increase each year by the number in the Inputs section (from C14). You will populate these values later in the project when you create models for different scenarios.

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- **Change in units sold (%):** Three factors will affect the number of sports cars and family sedans sold in a year—the market momentum effect, the cost of gasoline, and the number of new charger locations.
- **Market momentum effect:** This percentage increase is echoed from the Inputs section (from C15).
- **Gas price effect:** The direction of the price of gas is a value from the Inputs section. Use a nested =IF formula to determine this value.
  - **Test 1:** If the price is expected to drop, the effect is –5% (in other words, unit sales will decline by 5% in the year).
  - **Test 2:** If the price is expected to increase, the effect is +5% (unit sales will increase by 5% in the year).
- Otherwise, if prices are expected to be stable, there is no effect ('0').

QUICK TIP
=IF($B$11="U",0.05,IF($B$11="D",-0.05,0))

- **New charger location effect:** Use a nested =IF function to determine this value.
  - **Test 1:** If there are more than 100 new charger locations, the expected effect on units sold is +5%.
  - **Test 2:** If there are more than 75 new charger locations, the expected effect is +3%.
  - **Test 3:** If there are more than 25 new charger locations, the expected effect is +2%.
  - Otherwise, there will be no effect ("0").

QUICK TIP
=IF(C14>100,0.05,IF(C14>75,0.03,IF(C14>25,0.02,0)))

- **Total change:** The total expected percentage change in units sold is the sum of the Market momentum effect, the Gas price effect, and the New charger location effect C25:C27.
- **Units sold (Sport):** The number of sports cars sold in a year is the sum of the number sold in the prior year and the total percentage change in units expected (C28). For example, if 53,000 sports cars were sold in 2022 and a 10% increase was expected in 2023, the number of units sold would be (1+0.10) × 53,000 = 58,300.

QUICK TIP
The formula for this would be 53,000 + (53,000 × 0.10). Mathematically, we can simplify this equation to (1+0.10) × 53,000, which is B29*(1+C28).

- **Units sold (Family):** No family sedans were sold in 2022. Management thinks 20,000 will be sold in 2023, plus or minus the expected change in units sold. Thus, if a 10% increase was expected in 2023, the number of

QUICK TIP
Hard code 20,000 in the formula in C30, =20000*(1+C28). In D30:E30 use the Units Sold in the previous year in the formula.

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units sold would be (1+0.10) × 20,000 = 22,000. In succeeding years, the number of units sold will be the sum of the number sold in the prior year and the total percentage change in units expected.

- **Change in selling price (%):** Three factors will affect the selling price of sports cars and family sedans sold in a year—the Market momentum effect, the cost of gasoline, and the number of new charger locations.
- **Market momentum effect:** This value is echoed from the Inputs section (from C15).

QUICK TIP
=IF($B$11="U",0.03,0)

- **Gas price effect:** Use an =IF statement to calculate the effect of gas prices.
  - **Test:** If gas prices are expected to go Up, sports car and sedan selling prices will increase by 3% each year.
  - Otherwise, there will be no effect on selling prices.
- **New charger location effect:** Use an =IF statement to calculate the effect that new chargers will have.
  - **Test:** If the number of new charger locations exceeds 25, sports car and sedan selling prices will increase by 1% in the year.
  - Otherwise, there will be no effect on selling prices.

QUICK TIP
=IF(C14>25,0.01,0)

- **Total change:** The total expected percentage change in sports car and family sedan selling prices is the sum of the Market momentum, the Gas price, and the New charger location effects C32:C34.
- **Selling price (Sport):** The selling price in a year is a function of the prior year's price and the total percentage change expected (C35). For example, in 2022 the selling price was SAR 280,000. If a 5% total change was expected, the 2023 selling price would be (1+0.05) × SAR 280,000 = SAR 294,000.

QUICK TIP
You may hard code 130000 in the formula in cell C37, =130000*(1+C35). The formulas for cells D37:E37 should use the prior year's price in the formula.

- **Selling price (Family):** No family sedans were sold in 2022, so there is no 2022 selling price. Management thinks SAR 130,000, plus or minus the expected change, should be the selling price in 2023. Thus, if a 5% increase was expected in 2023, the selling price would be (1+0.05) × SAR 130,000 = SAR 136,500. In succeeding years, the price will be the sum of the price in the prior year and the total percentage change expected.

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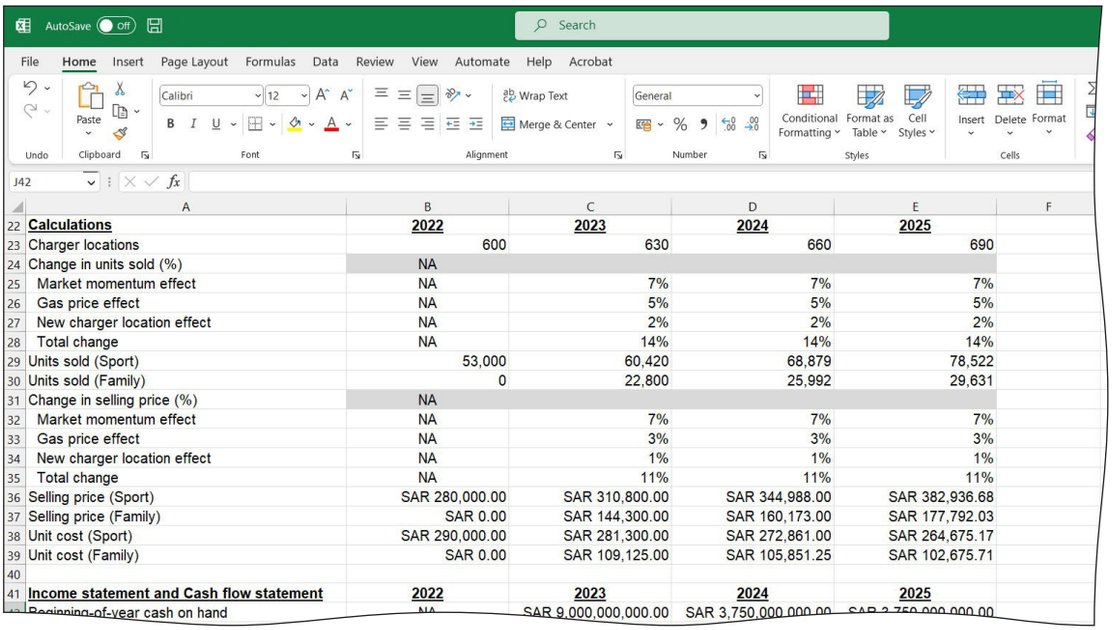
- **Unit cost (Sport):** The unit cost of production in a year is the prior year's cost minus the cost reduction factor, which is a value from the Inputs section (C13). For example, the unit cost in 2022 was SAR 290,000. If a 2% decrease was expected in 2023, the unit cost would be (1–0.02) × SAR 290,000, or SAR 284,200.

- **Unit cost (Family):** No family sedans were made for sale in 2022. Management estimates a unit cost of SAR 112,500 in 2023, minus the effect of any cost reduction factor (from C13). Thus, if a 2% decrease was expected in 2023, the unit cost would be (1–0.02) × SAR 112,500, or SAR 110,250. In succeeding years, the unit cost will be the cost in the prior year minus the cost reduction factor expected in the year.

FIGURE 14-6: The completed Calculations section



	A	B	C	D	E
22	**Calculations**	**2022**	**2023**	**2024**	**2025**
23	Charger locations	600	630	660	690
24	Change in units sold (%)	NA			
25	Market momentum effect	NA	7%	7%	7%
26	Gas price effect	NA	5%	5%	5%
27	New charger location effect	NA	2%	2%	2%
28	Total change	NA	14%	14%	14%
29	Units sold (Sport)	53,000	60,420	68,879	78,522
30	Units sold (Family)	0	22,800	25,992	29,631
31	Change in selling price (%)	NA			
32	Market momentum effect	NA	7%	7%	7%
33	Gas price effect	NA	3%	3%	3%
34	New charger location effect	NA	1%	1%	1%
35	Total change	NA	11%	11%	11%
36	Selling price (Sport)	SAR 280,000.00	SAR 310,800.00	SAR 344,988.00	SAR 382,936.68
37	Selling price (Family)	SAR 0.00	SAR 144,300.00	SAR 160,173.00	SAR 177,792.03
38	Unit cost (Sport)	SAR 290,000.00	SAR 281,300.00	SAR 272,861.00	SAR 264,675.17
39	Unit cost (Family)	SAR 0.00	SAR 109,125.00	SAR 105,851.25	SAR 102,675.71
40					
41	**Income statement and Cash flow statement**	**2022**	**2023**	**2024**	**2025**
42	Beginning-of-year cash on hand	NA	SAR 9,000,000,000.00	SAR 3,750,000,000.00	SAR 3,750,000,000.00

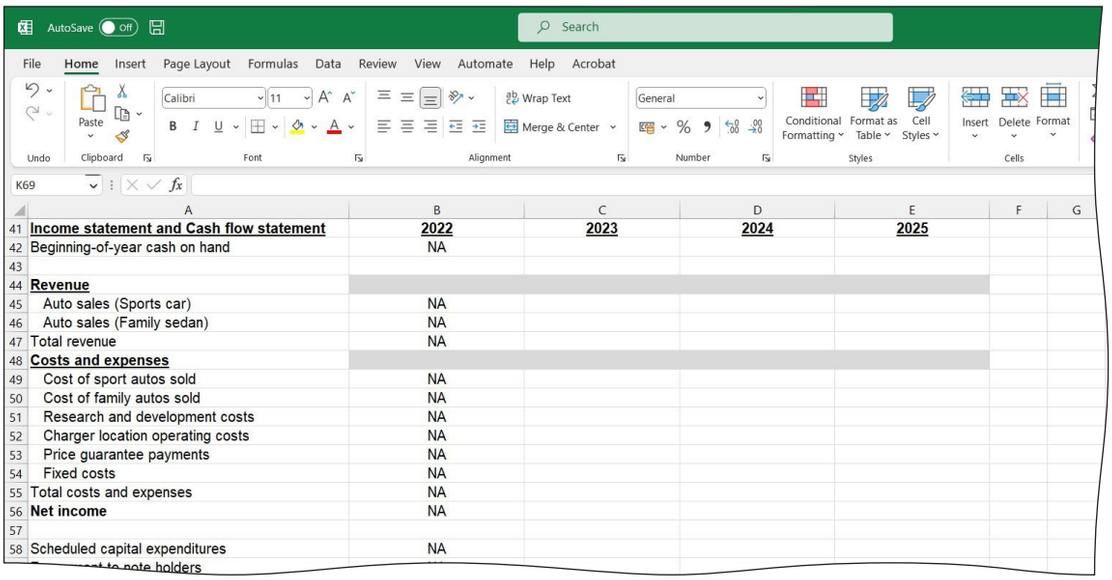
CHECK YOUR PROGRESS

Compare your calculation results with the values shown. If yours are different, carefully re-check your formulas and cell addresses.

Income and Cash Flow Statements

The forecast for net income and cash flow starts with the cash on hand at the beginning of the year. This value is followed by the income statement and the calculation of cash on hand at year's end. For readability, format cells in this section as currency with zero decimals. Values must be computed by cell formula; hard-code numbers in formulas only if you are told to do so. Cell formulas should not reference a cell with a value of "NA." Your spreadsheets should look like those shown in Figures 14-7 and 14-8. A discussion of each item in the section follows each figure.

FIGURE 14-7: The skeleton of the Income and Cash flow statements section



	A	B	C	D	E	F	G
41	**Income statement and Cash flow statement**	**2022**	**2023**	**2024**	**2025**		
42	Beginning-of-year cash on hand	NA					
43							
44	**Revenue**						
45	Auto sales (Sports car)	NA					
46	Auto sales (Family sedan)	NA					
47	Total revenue	NA					
48	**Costs and expenses**						
49	Cost of sport autos sold	NA					
50	Cost of family autos sold	NA					
51	Research and development costs	NA					
52	Charger location operating costs	NA					
53	Price guarantee payments	NA					
54	Fixed costs	NA					
55	Total costs and expenses	NA					
56	**Net income**	NA					
57							
58	Scheduled capital expenditures	NA					

- **Beginning-of-year cash on hand:** This value is the cash on hand at the end of the prior year (B42).
- **Auto sales:** Sports car and family sedan revenues are the product of the units sold and the selling price, which are values from the Calculations section (C29:C30 and C36:C37).
- **Total revenue:** This value is the sum of sports car and family sedan revenues C45:C46.
- **Cost of sport and family autos sold:** These values are the product of the units sold and the unit cost, which are taken from the Calculations section C29:C30 and C38:C39.
- **Research and development costs:** This value is echoed from the Constants section (from C6).
- **Charger location operating costs:** This amount is the product of the number of charger locations (from C23 in the Calculations section) and the charger station operating cost (from C8 in the Constants section).
- **Price guarantee payments:** This amount for 2023 is a function of the guarantee claim rate for the year (from C12 in the Inputs section) and the assumed SAR 3.75 billion liability (= Guarantee Claim Rate × Liability). You should hard-code SAR 3.75 billion into your formula for 2023. In succeeding years, the amount is the product of the guarantee claim rate

QUICK TIP

Some of the data you need for this section can be found elsewhere in your spreadsheet. Remember not to hard-code data unless you're told to; using = followed by the cell reference to echo the information. Go back to Chapter 10 if you need to refresh your memory.

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for the year and the remaining liability, which is SAR 3.75 billion minus any claims paid in prior years (= Guarantee claim rate × (Liability$_{2023}$ – Payment$_{2023}$)). For example, if SAR 375 million in claims are paid in 2023, the assumed liability would be reduced to SAR 3.375 billion in 2024. In 2025, the Liability Claim Rate$_{2025}$ × would be (SAR 3.75 billion – (Payment$_{2023}$ + Payment$_{2024}$)).

QUICK TIP
In 2024 =D12*(3750000000-(C53))
In 2025 =E12*(3750000000-(C53+D53))

- **Fixed costs:** This value is echoed from the Constants section (C7).
- **Total costs and expenses:** This value is the sum of the cost of all cars sold, R&D costs, charger location operating costs, price guarantee payments, and fixed costs (C49:C54).
- **Net income:** This value is the difference between Total revenue and Total costs and expenses, **C47–C55**.

Line items for the year-end cash calculation are shown in Figure 14-10. In the figure, column B represents 2022, column C is for 2023, and so on. Year 2022 values are NA except for end-of-year cash on hand, which is SAR 9 billion.

Values must be computed by cell formula; hard-code numbers in formulas only when you are told to do so. Cell formulas should not reference a cell with a value of "NA."

FIGURE 14-8: The completed Income statement and Cash flow statement

	A	B	C	D	E	F
41	**Income statement and Cash flow statement**	**2022**	**2023**	**2024**	**2025**	
42	Beginning-of-year cash on hand	NA	SAR 9,000,000,000.00	SAR 3,750,000,000.00	SAR 3,750,000,000.00	
43						
44	**Revenue**					
45	Auto sales (Sports car)	NA	SAR 18,778,536,000.00	SAR 23,762,359,454.40	SAR 30,068,889,653.60	
46	Auto sales (Family sedan)	NA	SAR 3,290,040,000.00	SAR 4,163,216,616.00	SAR 5,268,134,305.89	
47	Total revenue	NA	SAR 22,068,576,000.00	SAR 27,925,576,070.40	SAR 35,337,023,959.48	
48	**Costs and expenses**					
49	Cost of sport autos sold	NA	SAR 16,996,146,000.00	SAR 18,794,338,246.80	SAR 20,782,779,233.31	
50	Cost of family autos sold	NA	SAR 2,488,050,000.00	SAR 2,751,285,690.00	SAR 3,042,371,716.00	
51	Research and development costs	NA	SAR 1,875,000,000.00	SAR 1,875,000,000.00	SAR 1,875,000,000.00	
52	Charger location operating costs	NA	SAR 236,250,000.00	SAR 247,500,000.00	SAR 258,750,000.00	
53	Price guarantee payments	NA	SAR 37,500,000.00	SAR 37,125,000.00	SAR 36,753,750.00	
54	Fixed costs	NA	SAR 1,875,000,000.00	SAR 1,875,000,000.00	SAR 1,875,000,000.00	
55	Total costs and expenses	NA	SAR 23,507,946,000.00	SAR 25,580,248,936.80	SAR 27,870,654,699.31	
56	**Net income**	NA	SAR 1,439,370,000.00	SAR 2,345,327,133.60	SAR 7,466,369,260.17	
57						
58	Scheduled capital expenditures	NA	SAR 7,500,000,000.00	SAR 7,500,000,000.00	SAR 7,500,000,000.00	

CHECK YOUR PROGRESS
Compare your calculation results with the values shown. If yours are different, carefully re-check your formulas and cell addresses.

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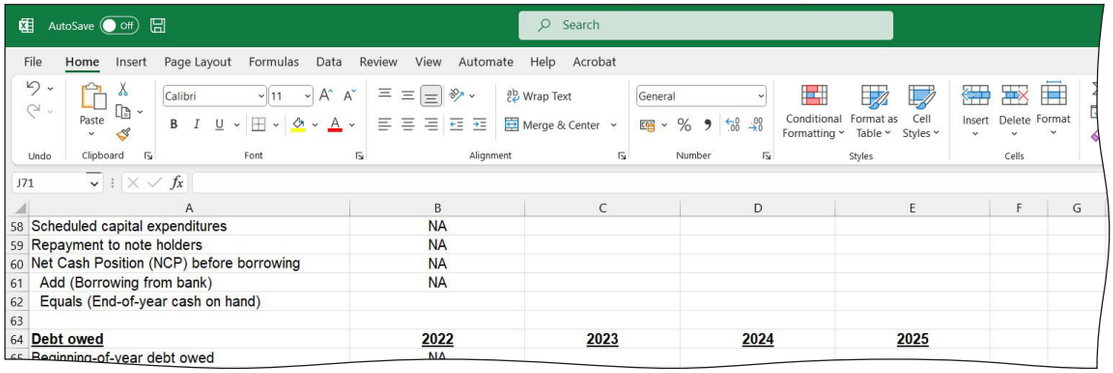
End-of-Year Cash on Hand Section

FIGURE 14-9: The skeleton of the End-of-year cash on hand section



	A	B	C	D	E
58	Scheduled capital expenditures	NA			
59	Repayment to note holders	NA			
60	Net Cash Position (NCP) before borrowing	NA			
61	Add (Borrowing from bank)	NA			
62	Equals (End-of-year cash on hand)				
63					
64	**Debt owed**	**2022**	**2023**	**2024**	**2025**
65	Beginning-of-year debt owed	NA			

- **Scheduled capital expenditures:** These outlays are echoed from the Projected capital costs in the Constants section (C5). They reduce cash on hand.
- **Repayment to note holders:** SAR 11.25 billion is owed to noteholders at the end of 2022, with five years remaining on the debt. SAR 2.25 billion must be repaid each year to noteholders. You can hard-code the amount for each year.

QUICK TIP
=C4+C56-C58-C59

- **Net Cash Position (NCP):** This amount equals cash at the beginning of the year plus the year's net income, minus scheduled capital expenditures and minus payments to noteholders.

QUICK TIP
=IF(C60<C4,C4-C60,0)

- **Add (Borrowing from bank):** If the company doesn't have the minimum cash needed to start the next year, it can borrow from a bank. You will use an =IF statement to calculate this.
  - **Test:** If NCP before borrowing < Minimum cash needed,
  - **Then:** borrow from the bank (Min. Cash Needed - NCP),
  - **Otherwise:** nothing is borrowed ("0")
- **Equals (End-of-year cash on hand):** This amount is the NCP plus any bank borrowing, C60+C61.

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FIGURE 14-10: The completed End-of-year cash on hand section

	A	B	C	D	E	F
58	Scheduled capital expenditures	NA	SAR 7,500,000,000.00	SAR 7,500,000,000.00	SAR 7,500,000,000.00	
59	Repayment to note holders	NA	SAR 2,250,000,000.00	SAR 2,250,000,000.00	SAR 2,250,000,000.00	
60	Net Cash Position (NCP) before borrowing	NA	SAR 7,439,370,000.00	SAR 3,654,672,866.40	SAR 1,466,369,260.17	
61	Add (Borrowing from bank)	NA	SAR 11,189,370,000.00	SAR 7,404,672,866.40	SAR 2,283,630,739.83	
62	Equals (End-of-year cash on hand)	SAR 9,000,000,000.00	SAR 3,750,000,000.00	SAR 3,750,000,000.00	SAR 3,750,000,000.00	
63						

CHECK YOUR PROGRESS

Compare your calculation results with the values shown. If yours are different, carefully re-check your formulas and cell addresses.

Debt Owed Section

This section shows a calculation of debt owed to noteholders and to the bank, as shown in Figure 14-11. Year 2022 values are NA except for End-of-year debt owed, which is SAR 11.25 billion for the remaining notes payable (shown in Figure 14-12).

FIGURE 14-11: The skeleton of the Debt owed section

	A	B	C	D	E	F	G
64	**Debt owed**	**2022**	**2023**	**2024**	**2025**		
65	Beginning-of-year debt owed	NA					
66	Add (Borrowing from bank)	NA					
67	Less (Repayment to noteholders)	NA					
68	Equals (End-of-year debt owed)	SAR 11,250,000,000.00					
69							
70							

Values must be computed by cell formula; hard-code numbers in formulas only when you are told to do so. Cell formulas should not reference a cell with a value of "NA."

- **Beginning-of-year debt owed:** Debt owed at the beginning of a year (C65) equals the debt owed at the end of the prior year (B68).
- **Add (Borrowing from bank):** This amount is echoed from the Borrowing from bank section (C61). Borrowing increases the amount of debt owed.
- **Less (Repayment to noteholders):** This amount is echoed from the repayment to note holders (C59). Repayments reduce the amount of debt owed.

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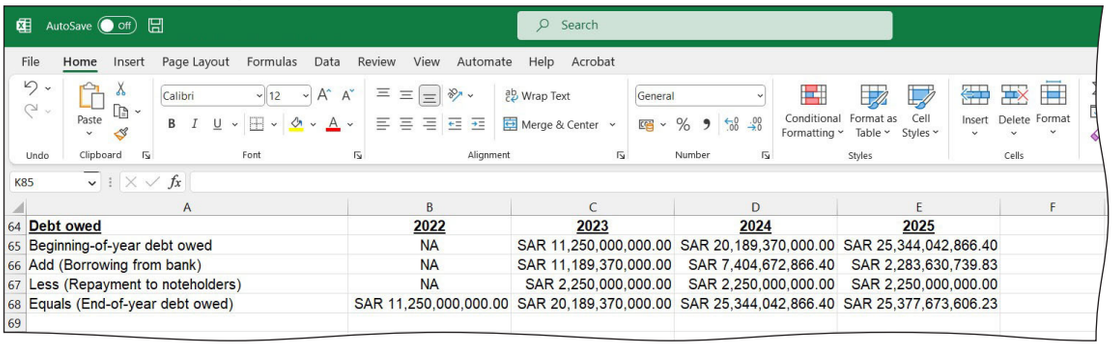
- **Equals (End-of-Year debt owed):** This is the amount owed at the beginning of a year plus borrowing during the year, minus repayments to noteholders during the year.

FIGURE 14-12: The completed Debt owed section



	A	B	C	D	E	F
64	**Debt owed**	**2022**	**2023**	**2024**	**2025**	
65	Beginning-of-year debt owed	NA	SAR 11,250,000,000.00	SAR 20,189,370,000.00	SAR 25,344,042,866.40	
66	Add (Borrowing from bank)	NA	SAR 11,189,370,000.00	SAR 7,404,672,866.40	SAR 2,283,630,739.83	
67	Less (Repayment to noteholders)	NA	SAR 2,250,000,000.00	SAR 2,250,000,000.00	SAR 2,250,000,000.00	
68	Equals (End-of-year debt owed)	SAR 11,250,000,000.00	SAR 20,189,370,000.00	SAR 25,344,042,866.40	SAR 25,377,673,606.23	
69						

CHECK YOUR PROGRESS
Compare your calculation results with the values shown. If yours are different, carefully re-check your formulas and cell addresses.

Copy all formulas from column C (2023) to column D (2024) and column E (2025).

REVIEW QUESTIONS

1. **If the buy-back program were to continue, how much would a used sports car from Electric Car be re-purchased for in 2024?**
   a. SAR 162,000
   b. SAR 169,000
   c. SAR 166,000
   d. SAR 172,000
2. **Which two groups are most likely to enter into a joint venture?**
   a. Customer and supplier
   b. Supplier and manufacturer
   c. Business and competitor
   d. Bank and customer
3. **What is the Net Cash Position (NPC)?**
   a. Cash at the beginning of the year + the year's net income – scheduled capital expenditures – payments to noteholders
   b. Cash at the end of the year + the year's net income – scheduled capital expenditures + payments to noteholders
   c. Cash at the beginning of the year – the year's net income + scheduled capital expenditures – payments to note holders
   d. Cash at the end of the year – the year's net income + scheduled capital expenditures + payments to note holders

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Electric Car Deliverables

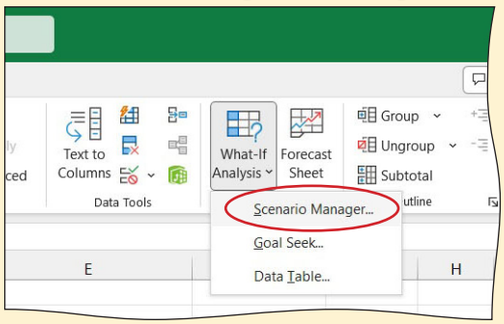
Ahmad wants to get through the next three years without incurring significant debt. In three years, the current notes payable will be nearly paid off, and Ahmad hopes the company will be profitable enough to start Phase 3 of its plan.

Ahmad asks you to consider three scenarios for the three-year period from 2023 to 2025: Optimistic, Pessimistic, and Stable. The input values (B11, C12:E15) for these scenarios are as follows:

- **Optimistic:** The cost of gasoline is Up, the claim rate in each of the three years is 1%, the cost reduction factor in each of the three years is 3%, there are 30 new charger locations each year, and the momentum effect each year is 7%.
- **Neutral:** The cost of gasoline is Stable, the claim rate in each of the three years is 5%, the cost reduction factor for each year is 2%, there are 20 new charger locations each year, and the momentum effect each year is 4%.
- **Pessimistic:** The cost of gasoline is Down, the claim rate in each of the three years is 10%, the cost reduction factor for each year is 1%, there are no new charger locations each year, and the momentum effect each year is 2%.

You will use the Scenario Manager tool to evaluate these sets of inputs. You can access Scenario Manager by clicking on Scenario Manager under What-If Analysis on the Data ribbon (see Figure 14-13).

FIGURE 14-13: Accessing Scenario Manager from the Data ribbon



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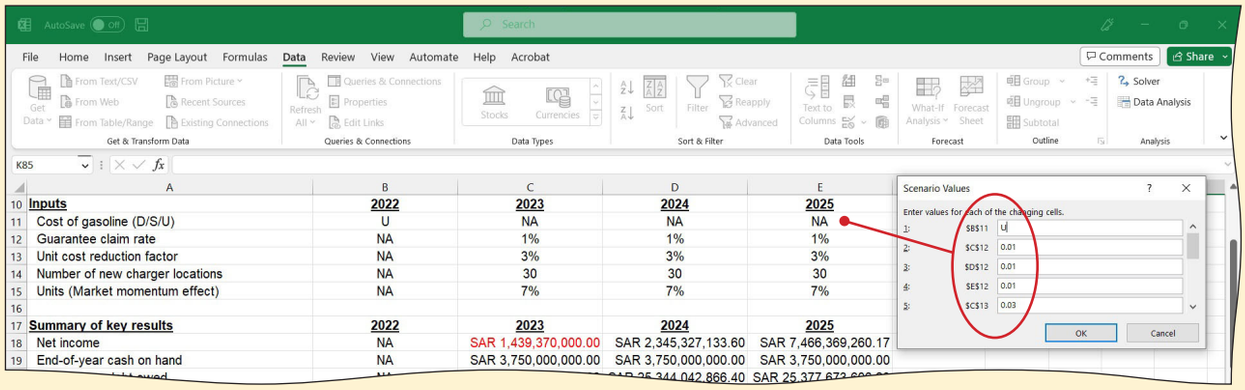
Follow the same process that you used in Chapter 13 to build Optimistic, Neutral, and Pessimistic scenarios. Use B11, C12:E15 as your Changing cells. Remember to enter the Input values for each scenario into these cells on your worksheet before building the scenario. This way, Scenario Manager will populate the Scenario Values for you. Update the input values in the worksheet to the next scenario (see Figure 14-14) and repeat.

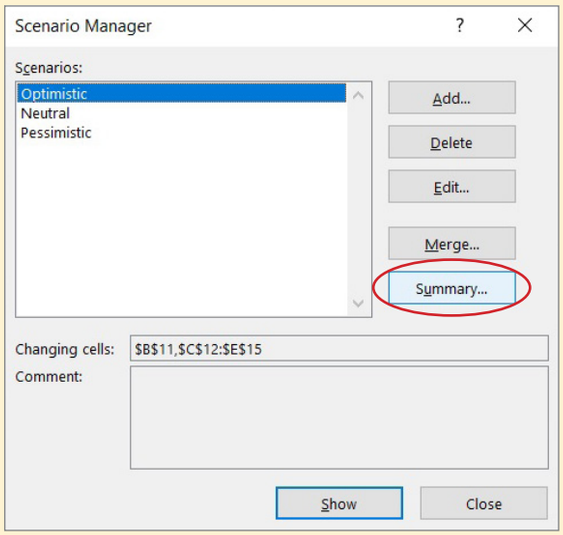
FIGURE 14-14: Updating the input values in the worksheet



	A	B	C	D	E
10	**Inputs**	**2022**	**2023**	**2024**	**2025**
11	Cost of gasoline (D/S/U)	U	NA	NA	NA
12	Guarantee claim rate	NA	1%	1%	1%
13	Unit cost reduction factor	NA	3%	3%	3%
14	Number of new charger locations	NA	30	30	30
15	Units (Market momentum effect)	NA	7%	7%	7%
16					
17	**Summary of key results**	**2022**	**2023**	**2024**	**2025**
18	Net income	NA	SAR 1,439,370,000.00	SAR 2,345,327,133.60	SAR 7,466,369,260.17
19	End-of-year cash on hand	NA	SAR 3,750,000,000.00	SAR 3,750,000,000.00	SAR 3,750,000,000.00

Carefully review these values for each of the three scenarios (Click the Show button to populate the Inputs section with the values in the scenario). Click Summary to generate a Scenario Summary worksheet (see Figure 14-15).

FIGURE 14-15: Click Summary to generate the worksheet



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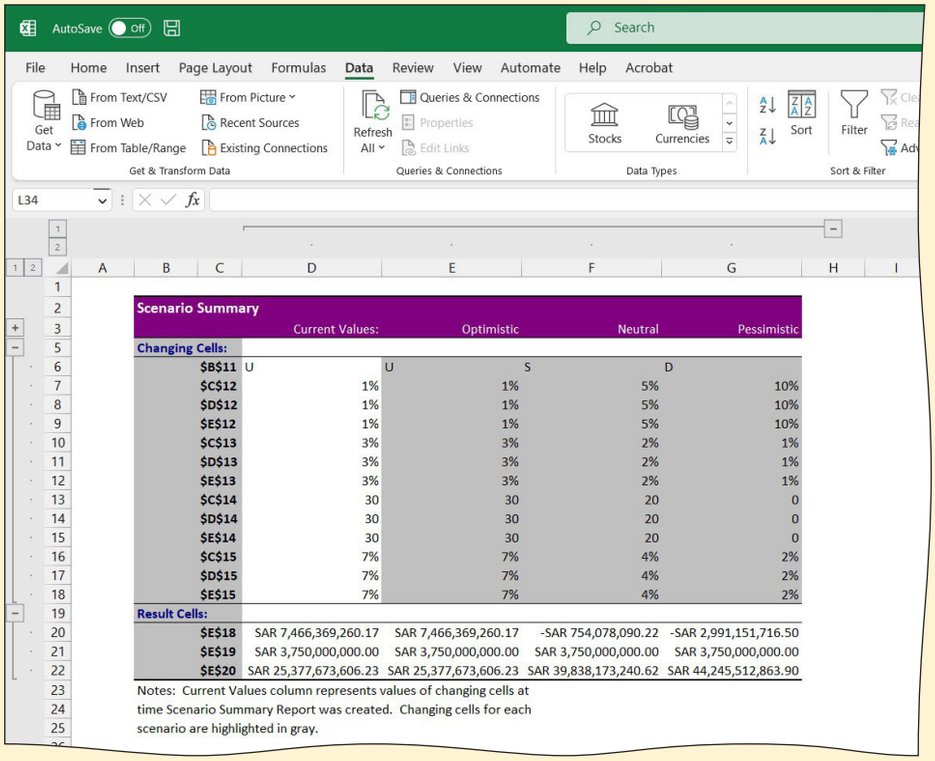
Follow the same steps that you used in Chapter 13 to polish the data shown in your Scenario Summary report. See the before (Figure 14-16) and after (Figure 14-17) examples below.

FIGURE 14-16: The unpolished Scenario Summary



Scenario Summary	Current Values:	Optimistic	Neutral	Pessimistic
Changing Cells:				
$B$11	U	U	S	D
$C$12	1%	1%	5%	10%
$D$12	1%	1%	5%	10%
$E$12	1%	1%	5%	10%
$C$13	3%	3%	2%	1%
$D$13	3%	3%	2%	1%
$E$13	3%	3%	2%	1%
$C$14	30	30	20	0
$D$14	30	30	20	0
$E$14	30	30	20	0
$C$15	7%	7%	4%	2%
$D$15	7%	7%	4%	2%
$E$15	7%	7%	4%	2%
Result Cells:				
$E$18	SAR 7,466,369,260.17	SAR 7,466,369,260.17	-SAR 754,078,090.22	-SAR 2,991,151,716.50
$E$19	SAR 3,750,000,000.00	SAR 3,750,000,000.00	SAR 3,750,000,000.00	SAR 3,750,000,000.00
$E$20	SAR 25,377,673,606.23	SAR 25,377,673,606.23	SAR 39,838,173,240.62	SAR 44,245,512,863.90

Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

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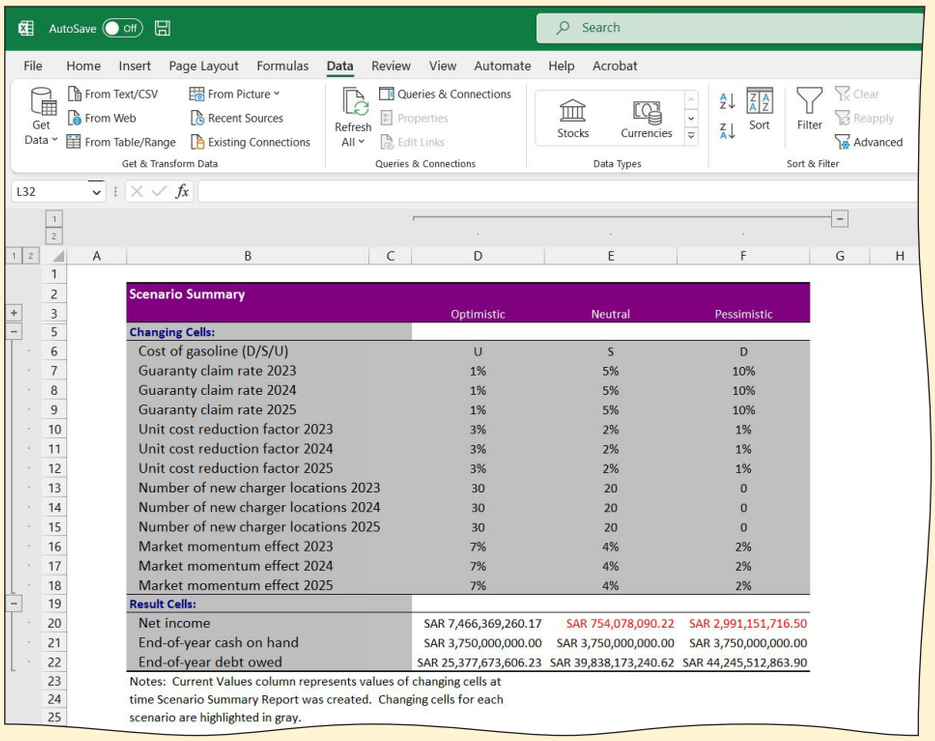
FIGURE 14-17: The polished Scenario Summary



Scenario Summary	Optimistic	Neutral	Pessimistic
Changing Cells:			
Cost of gasoline (D/S/U)	U	S	D
Guaranty claim rate 2023	1%	5%	10%
Guaranty claim rate 2024	1%	5%	10%
Guaranty claim rate 2025	1%	5%	10%
Unit cost reduction factor 2023	3%	2%	1%
Unit cost reduction factor 2024	3%	2%	1%
Unit cost reduction factor 2025	3%	2%	1%
Number of new charger locations 2023	30	20	0
Number of new charger locations 2024	30	20	0
Number of new charger locations 2025	30	20	0
Market momentum effect 2023	7%	4%	2%
Market momentum effect 2024	7%	4%	2%
Market momentum effect 2025	7%	4%	2%
Result Cells:			
Net income	SAR 7,466,369,260.17	SAR 754,078,090.22	SAR 2,991,151,716.50
End-of-year cash on hand	SAR 3,750,000,000.00	SAR 3,750,000,000.00	SAR 3,750,000,000.00
End-of-year debt owed	SAR 25,377,673,606.23	SAR 39,838,173,240.62	SAR 44,245,512,863.90

Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

You might find it useful to copy out Table 14-1 to record the results.

TABLE 14-1: Electric Car Project results

		Optimistic	Neutral	Pessimistic
2023	Net income			
	Debt to bank			
	Cash on hand			
2024	Net income			
	Debt to bank			
	Cash on hand			
2025	Net income			
	Debt to bank			
	Cash on hand			

By 2025, Electric Car wants:

- to see a positive net income for the year
- to owe nothing to the bank
- the company's cash on hand to exceed SAR 3.75 billion.

This outcome would tell Ahmad that the three-phase plan is still viable.

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If this isn't possible, Ahmad could accept some amount owed to the bank, as long as the company was making money in 2025. Management would conclude that the company still has a good chance of succeeding.

It is now time to present your findings to Ahmad in the form of a short report. Scan the QR code to access the report template (**Report template.dotx**).

1. Start by scanning the QR code and opening the report template.
2. Click on the text "Report Title." Use the drop-down menu to select the report title.
3. Click on the text "Your Name" and enter your full name.
4. Click on the text "Date." Use the calendar menu to select the correct date.
5. First, complete the Problem Statement section. Go back to the beginning of this chapter to refresh your memory, then try to state the problem as briefly as possible and in your own words.
6. Explain the techniques you used to get your results in the Methodology section. Think about how you built your spreadsheet, calculated data, and used Scenario Manager.
7. Next, complete the Results section. It isn't necessary to present all of your results to the management team—instead, copy out the following sentences and fill in the blanks with the correct information.

   In 2023, the optimistic cash on hand figure will be _____.

   In 2024, the stable debt to bank figure will be _____.

   In 2025, the pessimistic net income figure will be _____.

8. There are two stages of analysis for you to complete in your report. First, answer the following question:

   In your opinion, is Ahmad's three-phase plan still viable?

   In your answer, consider all of the data for each scenario.

   If the plan isn't viable, Ahmad could accept some amount owed to the bank, as long as the company is making money in 2025. Management would conclude that the company still has a good chance of succeeding.

With this information in mind, answer the following question:

How likely is it that the company can make it through 2025 without having to raise or borrow any new capital?

Provide a detailed answer of at least one paragraph, explaining your reasoning using evidence based on your results.

9. Now you have completed the body of the report, you can complete the Executive Summary section by following the guidance in the report template. Remember to keep it brief, but informative.

10. Your report is now complete. Save it by selecting Save from the file menu, and use the file name format: **YourName - ElectricCar - Report.docx**.

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Chapter 15

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The Airline Project

In this project, you will use Microsoft Excel to build a decision support model and determine how to best allocate an airline's fleet of aircraft to various destinations.

This project will introduce the key factors that affect resource allocation decision making. It is vital to understand company aims and objectives in order to ensure that any decisions made about resource allocation meet strategic requirements.

This chapter will focus on using Solver to determine the effects of resource allocation decisions on company objectives. You will explore how calculations can be used to minimize costs and maximize resource usage and effects on profit margins. You will be able to change the data to optimize the profit the airline is able to make.

Finally, you will produce an analytical report that summarizes the data and provides evidence to support a professional recommendation to senior management. This time, you will need to complete this independently, with minimal guidance from the book or your teacher. You will also need to prepare a short presentation explaining your findings. This will show your skill in understanding company objectives and resources, and creating professional presentations using different communication methods.

LEARNING OBJECTIVES

Once you have completed this chapter, you should be able to:

1. Classify the types of variables when allocating resources
2. Apply variables to complex business settings
3. Represent information and highlight patterns and trends in data
4. Construct a a DSS model used to assign scarce resources
5. Recommend the best model to meet company objectives

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Airline Background

Airline Company provides passenger transportation services and small-parcel logistics to major metropolitan areas in the Saudi Arabia region. The company operates in a hub-and-spoke fashion with the headquarters in Riyadh, serving the following cities: Jeddah, Medina, Dammam, Rafha, Yanbu, Abha, and Najran. A hub-and-spoke system routes air traffic from a group of smaller airports through one major airport (the hub). This means travelers and cargo going from one small airport to another will need to transfer to another aircraft at the larger airport in order to reach their destinations.

Considering the huge competition that the airline industry has seen in recent years, management has determined that the current manual scheduling system can no longer produce the most cost-effective plane allocation to the various routes.

You have been hired as a new consultant to develop a DSS model for Airline Company. Your completed model will be used to assign the plane fleet to its seven destinations while minimizing costs.

The model requires the following data, which the management team has compiled for you:

- data for the four different types of planes in the fleet:
  - passenger capacity
  - cargo space
  - operating cost per kilometer (includes fuel, labor, and overhead)
  - number of available planes.
- ticket pricing to each destination
- cargo pricing to each destination
- distance from Riyadh to each destination.

In addition, the operations department has given you information about the passenger and cargo demand for each city.

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FIGURE 15-1: Airlines need to monitor and manage their resources carefully to maximize profitability

To satisfy passenger requirements and cargo demand, your Solver model will assign planes by number and type to each destination. The model will also calculate daily revenues from both passenger service and cargo shipment, as well as the total daily operating cost. The results of these calculations will be used to create a daily gross profit statement. You will run Solver first to minimize the total operating cost. Next, you will run the modified model to maximize daily gross profits. You will need to make recommendations to management about scheduling strategies that will meet either, or both, of these objectives.

Airline Company Fleet

The company's fleet consists of 50 planes made up of four different models:

- Boeing 717
- Bombardier CRJ700
- Embraer E170
- Airbus A220.

Creating a Spreadsheet for Decision Support

In this section, you will create a spreadsheet that models the business decision the Airline Company is seeking. Here, you will need to put to use all of the skills you have learned in this book.

QUICK TIP

Once you have completed Tasks 2 and 3, running Solver can take a long time. Make sure you plan ahead for this by completing the work you need to do in one lesson and running Solver at the start of the next lesson. Solver will work more quickly if you are not performing other computer tasks at the same time.

Your tasks

1. You will create a spreadsheet and attempt to assign the planes manually to minimize the total operating cost.
2. You will copy the data to a new worksheet, and then set up and run Solver to minimize the total operating cost.
3. You will copy the first Solver worksheet to a new worksheet and run Solver to maximize daily gross profit.

This section helps you set up each of the following spreadsheet components before entering the cell formulas:

- Constants
- Calculations and results
- Income statement.

The Calculations and results section is the heart of the decision model. You will set up columns for travel distance, daily demand, plane assignment by type, plane use, and operating costs. The spreadsheet rows will represent destination cities. The Plane assignment section will be the range of changing cells for Solver to manipulate.

A discussion of each spreadsheet section follows.

Scan the QR code to access the workbook (**Chapter 15 data file.xlsx**) you'll be using for the rest of this lesson.

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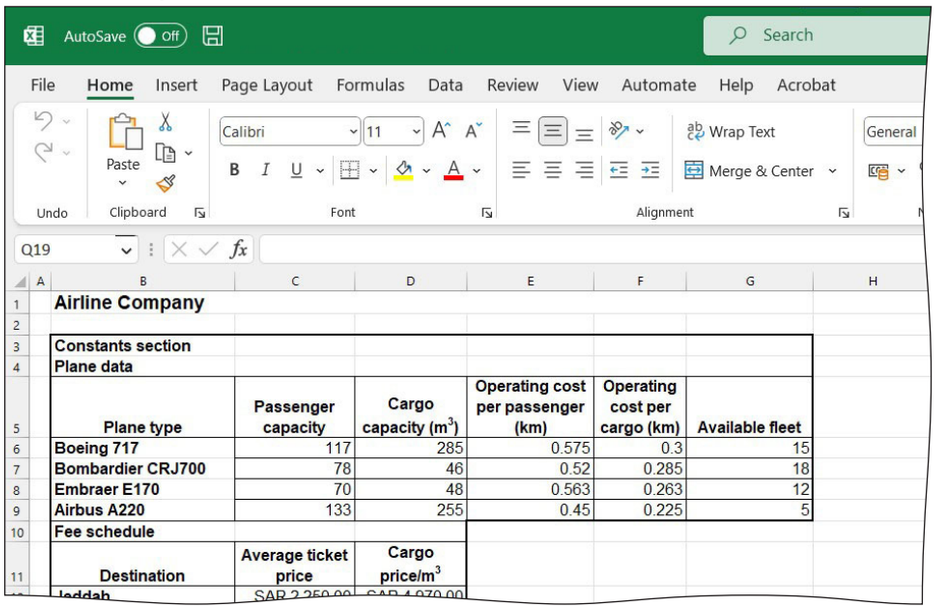
Constants Section

First, build the skeleton of your worksheet. Set up the worksheet title and Constants section as shown in Figure 15-2.

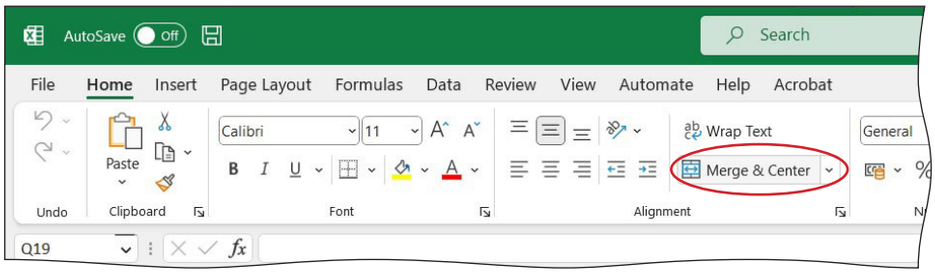
FIGURE 15-2: Spreadsheet title and Constants section



	B	C	D	E	F	G
1	Airline Company					
2						
3	Constants section					
4	Plane data					
5	Plane type	Passenger capacity	Cargo capacity (m^3)	Operating cost per passenger (km)	Operating cost per cargo (km)	Available fleet
6	Boeing 717	117	285	0.575	0.3	15
7	Bombardier CRJ700	78	46	0.52	0.285	18
8	Embraer E170	70	48	0.563	0.263	12
9	Airbus A220	133	255	0.45	0.225	5
10	Fee schedule					
11	Destination	Average ticket price	Cargo price/m^3			
	Jeddah	SAR 2,250.00	SAR 4,970.00			

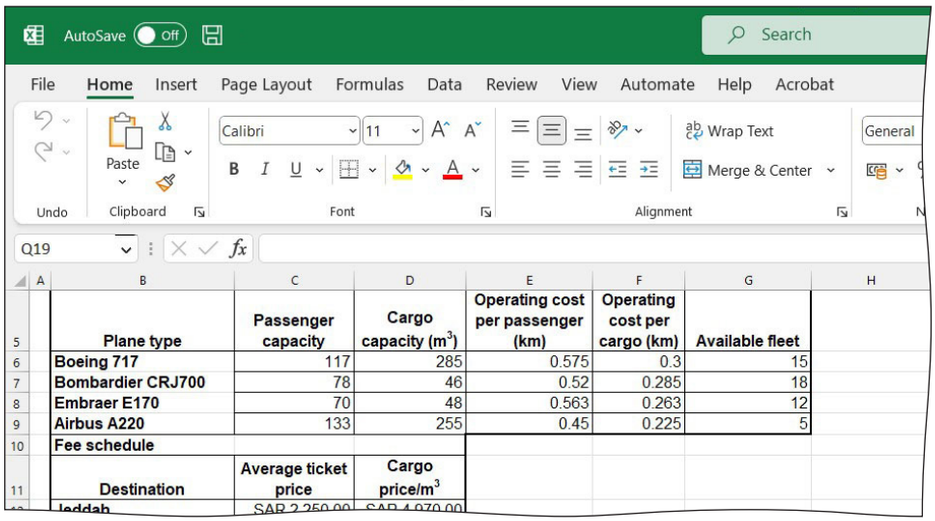
- **Worksheet title:** Enter the worksheet title in cell B1 and then highlight cells B1:G1 and merge and center them (see Figure 15-3).

FIGURE 15-3: The Merge & Center button



- **Constants section, Plane data table:** Enter the column headings shown in cells B5:G5 (see Figure 15-4).

FIGURE 15-4: Constants section column headings



	Plane type	Passenger capacity	Cargo capacity (m^3)	Operating cost per passenger (km)	Operating cost per cargo (km)	Available fleet
6	Boeing 717	117	285	0.575	0.3	15
7	Bombardier CRJ700	78	46	0.52	0.285	18
8	Embraer E170	70	48	0.563	0.263	12
9	Airbus A220	133	255	0.45	0.225	5
10	Fee schedule					
11	Destination	Average ticket price	Cargo price/m^3			
	Jeddah	SAR 2,250.00	SAR 4,970.00			

- **Plane type:** Enter each of the four planes listed in cells B6 through B9.
- **Passenger capacity:** Enter each of the four passenger capacities listed in cells C6:C9.
- **Cargo capacity (m^3):** Enter each of the four cargo capacities listed in cells D6:D9. The capacity of an area is calculated by multiplying the length × width × height of cargo space that is available in each model of plane. This shows the maximum volume available for use.
- **Operating cost per passenger (km):** Enter each of the four operating costs per kilometer listed in cells E6:E9.
- **Operating cost per cargo (km):** Enter each of the four operating costs per kilometer listed in cells F6:F9.
- **Available fleet:** This value is the number of planes of each type that Airline Company keeps in service. Enter these numbers in cells G6:G9.
- **Constants section, Fee schedule table:** Enter the column headings shown in cells B11:D11 (see Figure 15-5).

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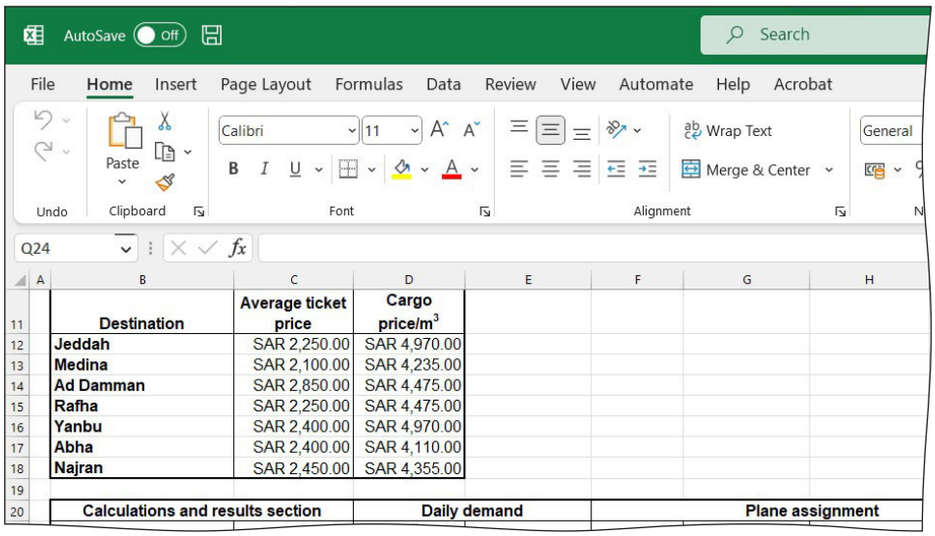
FIGURE 15-5: Column headings for the fee schedule

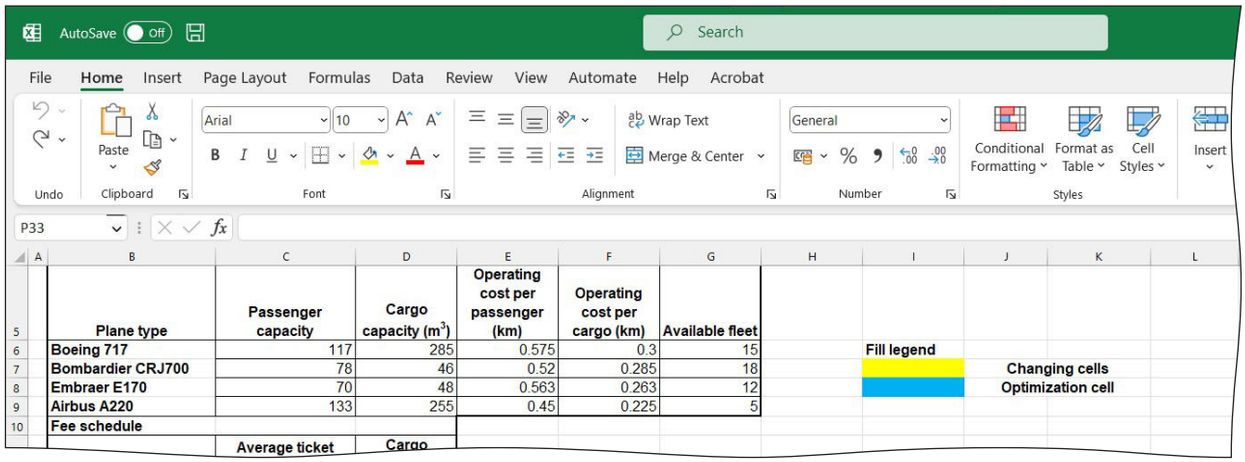


Destination	Average ticket price	Cargo price/m³
Jeddah	SAR 2,250.00	SAR 4,970.00
Medina	SAR 2,100.00	SAR 4,235.00
Ad Damman	SAR 2,850.00	SAR 4,475.00
Rafha	SAR 2,250.00	SAR 4,475.00
Yanbu	SAR 2,400.00	SAR 4,970.00
Abha	SAR 2,400.00	SAR 4,110.00
Najran	SAR 2,450.00	SAR 4,355.00

Calculations and results section | Daily demand | Plane assignment

- **Destination:** Enter the seven destination cities in cells B12:B18.
- **Average ticket price:** Enter the average passenger ticket prices for the seven destinations in cells C12:C18.
- **Cargo (price/m³):** Enter the cargo price per cubic meter for the seven destinations in cells D12:D18.
- **Fill legend:** This section is adjacent to the Constants section. Enter "Fill legend" in cell I6, fill cell I7 in yellow and fill cell I8 in blue. Enter "Changing cells" in cell J7, highlight J7 and K7 and click Merge & Center. Enter "Optimization cell" in cell J8, highlight J8 and K8 and click Merge & Center (see Figure 15-6).

FIGURE 15-6: The Fill legend



Plane type	Passenger capacity	Cargo capacity (m³)	Operating cost per passenger (km)	Operating cost per cargo (km)	Available fleet
Boeing 717	117	285	0.575	0.3	15
Bombardier CRJ700	78	46	0.52	0.285	18
Embraer E170	70	48	0.563	0.263	12
Airbus A220	133	255	0.45	0.225	5
Fee schedule					
	Average ticket	Cargo			

Fill legend: Changing cells; Optimization cell

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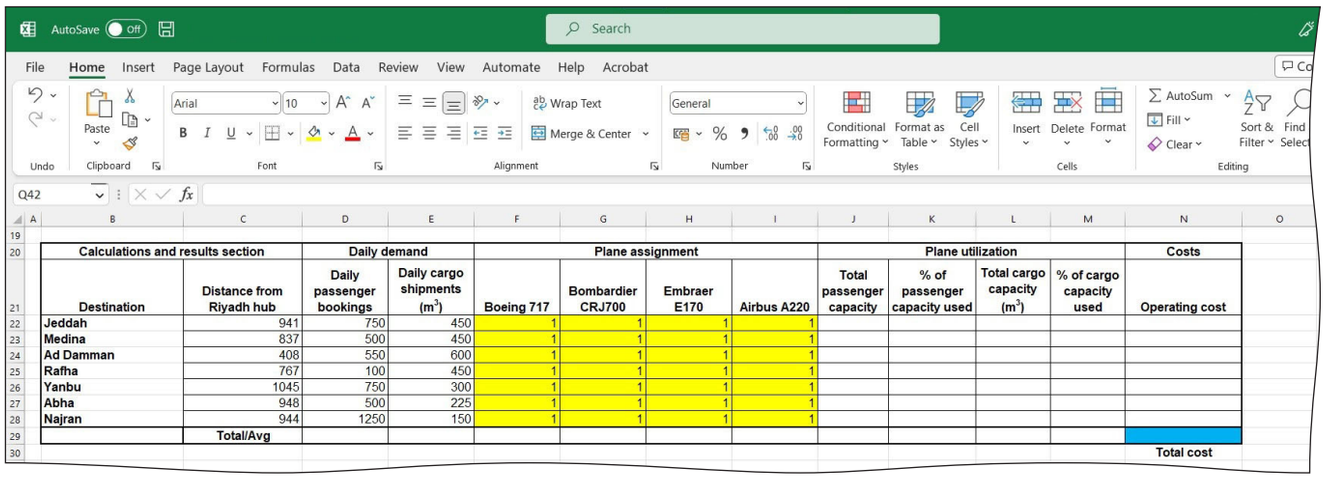
Calculations and Results Section

The Calculations and results section (see Figure 15-7) contains travel distances, daily passenger bookings, and daily cargo shipment data obtained from the operations department. Although these values are constants, keeping them in the Calculations and results section facilitates writing and copying formulas in the Plane utilization, and Costs columns. This section also includes the Plane assignment table, which contains the changing cells and calculations for plane usage, costs, and additional cargo.

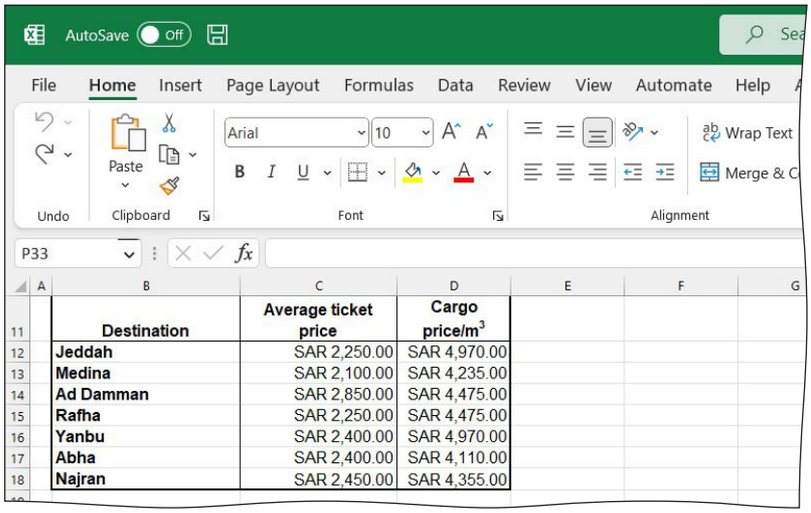
FIGURE 15-7: Calculations and results section



Calculations and results section		Daily demand		Plane assignment				Plane utilization				Costs
Destination	Distance from Riyadh hub	Daily passenger bookings	Daily cargo shipments (m^3)	Boeing 717	Bombardier CRJ700	Embraer E170	Airbus A220	Total passenger capacity	% of passenger capacity used	Total cargo capacity (m^3)	% of cargo capacity used	Operating cost
Jeddah	941	750	450	1	1	1	1					
Medina	837	500	450	1	1	1	1					
Ad Damman	408	550	600	1	1	1	1					
Rafha	767	100	450	1	1	1	1					
Yanbu	1045	750	300	1	1	1	1					
Abha	948	500	225	1	1	1	1					
Najran	944	1250	150	1	1	1	1					
	Total/Avg											
												Total cost

- **Table headings:** If you did not use the spreadsheet skeleton, enter the column headings shown in cells B20 through N21 in Figure 15-7.
- **Destination:** Cells B22 through B28 hold the seven cities serviced daily by Airline Company (see Figure 15-8).

FIGURE 15-8: The Destination section of the spreadsheet



Destination	Average ticket price	Cargo price/m^3
Jeddah	SAR 2,250.00	SAR 4,970.00
Medina	SAR 2,100.00	SAR 4,235.00
Ad Damman	SAR 2,850.00	SAR 4,475.00
Rafha	SAR 2,250.00	SAR 4,475.00
Yanbu	SAR 2,400.00	SAR 4,970.00
Abha	SAR 2,400.00	SAR 4,110.00
Najran	SAR 2,450.00	SAR 4,355.00

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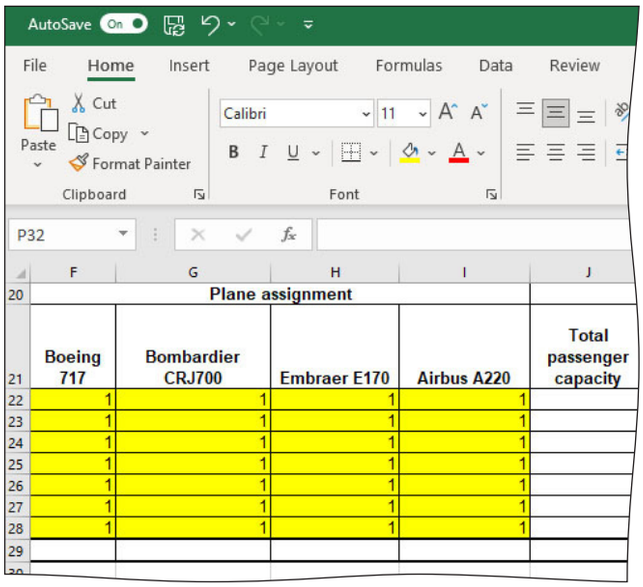
- **Distance from Riyadh hub:** Cells C22 through C28 contain the route distances in kilometers to each of the seven destinations.
- **Daily passenger bookings:** Cells D22 through D28 contain the average number of passenger tickets booked each day.
- **Daily cargo shipments (m^3):** Cells E22 through E28 contain the average number of cubic feet of cargo shipped daily.

QUICK TIP

You should fill the cells with a background color to indicate that they are the changing cells for Solver. To fill the cells, select them and then click the Fill Color button in the Font group on the Home tab. In the spreadsheet skeleton, the cells are yellow.

- **Plane assignment section:** Cells F22 through I28 are the heart of the Solver model—the changing cells. The cells contain the amounts of each of the four aircraft types that Solver will assign to the seven destinations. Enter "1" in each of these cells for now (see Figure 15-9).

FIGURE 15-9: The Plane Assignment section



	F	G	H	I	J
20	Plane assignment				
21	Boeing 717	Bombardier CRJ700	Embraer E170	Airbus A220	Total passenger capacity
22	1	1	1	1	
23	1	1	1	1	
24	1	1	1	1	
25	1	1	1	1	
26	1	1	1	1	
27	1	1	1	1	
28	1	1	1	1	
29					

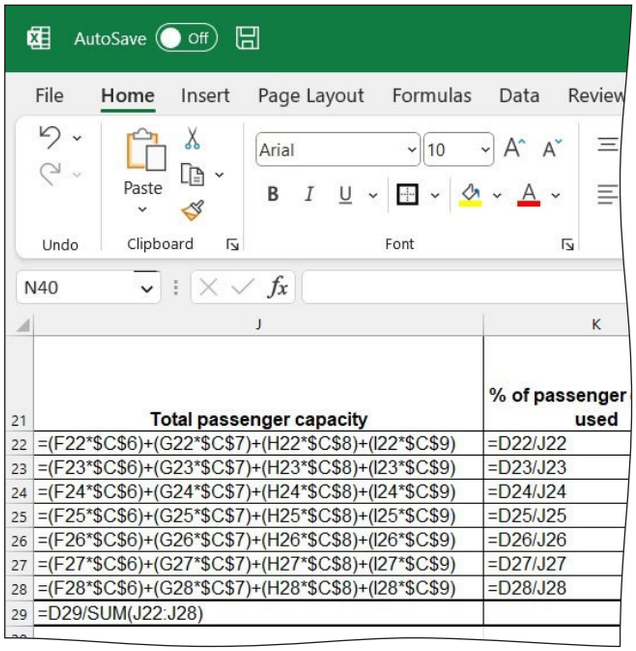
QUICK TIP

=(F22*$C$6)+(G22*$C$7)+(H22*$C$8)+(I22*$C$9)

- **Total passenger capacity:** Cells J22 through J28 hold the total passenger capacity for each destination. The capacity is calculated by multiplying the number of each assigned plane type by its passenger capacity, which is taken from cells C6 through C9 of the Constants section. Next, calculate the sum of the total capacities for the four types of planes assigned. For example, the Total Passenger Capacity to Jeddah is: (Number of $\text{Boeing}_{\text{Jeddah}}$ x Pass. $\text{Capacity}_{\text{Boeing}}$) + (Number of $\text{Bombardier}_{\text{Jeddah}}$ x Pass. $\text{Capacity}_{\text{Bombadier}}$) + (Number of $\text{Embraer}_{\text{Jeddah}}$ x Pass. $\text{Capacity}_{\text{Embraer}}$) + (Number of $\text{Airbus}_{\text{Jeddah}}$ x Pass. $\text{Capacity}_{\text{AirBus}}$).

- Be sure to use absolute cell references for the passenger capacity values from the Constants (C6:C9) section so that you have to write the formula only for the first cell (J22); then you can copy the formula to cells J23 through J28 (see Figure 15-10).

FIGURE 15-10: Calculations and results section



	J	K
21	Total passenger capacity	% of passenger used
22	=(F22*$C$6)+(G22*$C$7)+(H22*$C$8)+(I22*$C$9)	=D22/J22
23	=(F23*$C$6)+(G23*$C$7)+(H23*$C$8)+(I23*$C$9)	=D23/J23
24	=(F24*$C$6)+(G24*$C$7)+(H24*$C$8)+(I24*$C$9)	=D24/J24
25	=(F25*$C$6)+(G25*$C$7)+(H25*$C$8)+(I25*$C$9)	=D25/J25
26	=(F26*$C$6)+(G26*$C$7)+(H26*$C$8)+(I26*$C$9)	=D26/J26
27	=(F27*$C$6)+(G27*$C$7)+(H27*$C$8)+(I27*$C$9)	=D27/J27
28	=(F28*$C$6)+(G28*$C$7)+(H28*$C$8)+(I28*$C$9)	=D28/J28
29	=D29/SUM(J22:J28)	

- **Percentage of passenger capacity used:** Cells K22 through K28 hold the percentage of passenger capacity used for each destination. The value is calculated by dividing Daily passenger bookings by Total passenger capacity. Also shown in Figure 15-10 above.

QUICK TIP
=(F22*$D$6)+(G22*$D$7)+(H22*$D$8)+(I22*$D$9)

- **Total cargo capacity:** Cells L22 through L28 hold the total cargo capacity for each destination. Use the same formula that you developed for Total Passenger Capacity except that you will use the cargo capacity for each plane type, which is taken from cells D6 through D9 of the Constants section. Again, you should use absolute cell references for the freight capacity values from the Constants section so that you only have to write the formula for the first cell (L22); then you can copy the formula to the other six cells.

- **Percentage of cargo capacity used:** Cells M22 through M28 hold the percentage of cargo capacity used. The percentage is calculated by dividing the Daily cargo shipments by the Total cargo capacity for each Destination (L22:L28).

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- **Operating cost:** Cells N22 through N28 contain the operating costs for each plane type to each destination. The cost is calculated by the following formula:

Total operating cost (Destination) = Total passenger cost + Total cargo cost

Where:

Total passenger cost (Destination) = Distance (Destination) x Daily passenger bookings (Destination) x Total operating cost per passenger-km

+

Total cargo cost (Destination) = Distance (Destination) x Daily cargo shipments (Destination) x Total operating cost per cargo-km

Try to work this formula out from the description provided above for Jeddah. Use a pencil and paper and try to list the cell addresses of the variables shown. Take your time and work through it carefully. Analysis problems often have one or two significant formulas that have to be developed. This is a good opportunity to practice this.

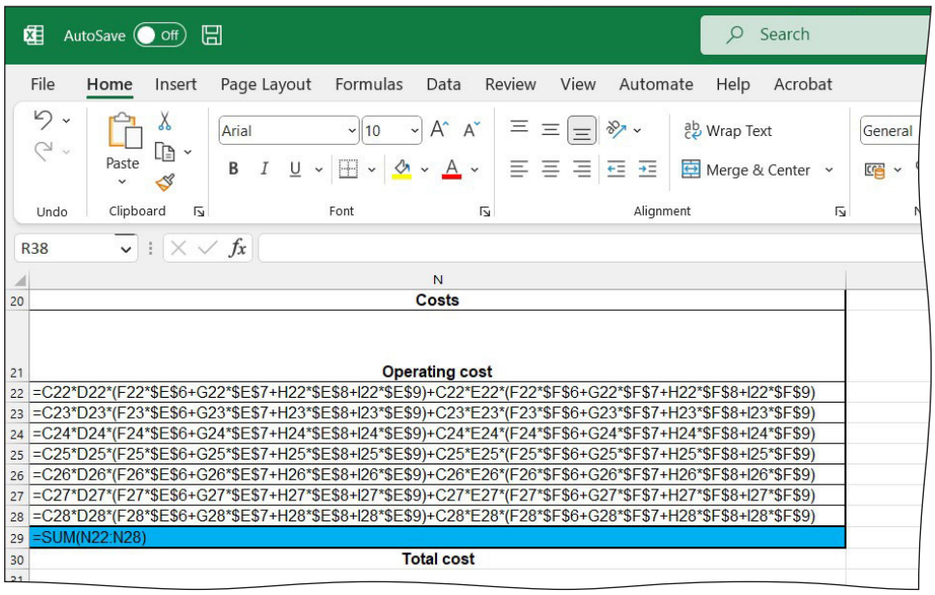
When you have a solution worked out, compare it to the sample solution:

For Jeddah, the Operating cost would be:

=C22*D22*(F22*$E$6+G22*$E$7+H22*$E$8+I22*$E$9)+C22*E22*(F22*$F$6+G22*$F$7+H22*$F$8+I22*$F$9)

Copy the formula for Jeddah (cell N22) to the other destinations (N23:N28). Did the formulas transfer correctly? The proper use of absolute cell references (for cells E6:F9) is key. Check your work against the solution in Figure 15-11:

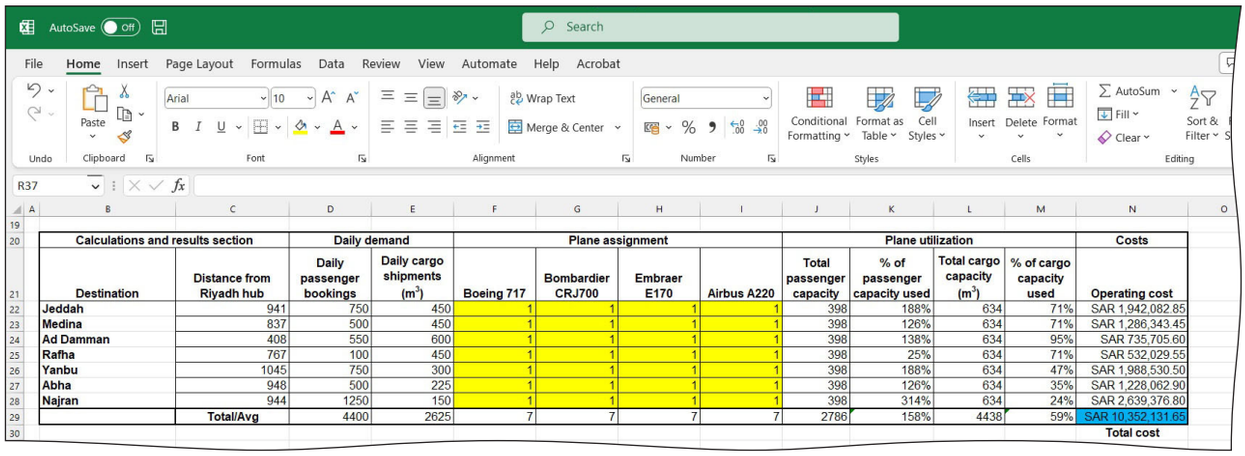
FIGURE 15-11: The formulas for calculating the operating costs



	N
20	Costs
21	Operating cost
22	=C22*D22*(F22*$E$6+G22*$E$7+H22*$E$8+I22*$E$9)+C22*E22*(F22*$F$6+G22*$F$7+H22*$F$8+I22*$F$9)
23	=C23*D23*(F23*$E$6+G23*$E$7+H23*$E$8+I23*$E$9)+C23*E23*(F23*$F$6+G23*$F$7+H23*$F$8+I23*$F$9)
24	=C24*D24*(F24*$E$6+G24*$E$7+H24*$E$8+I24*$E$9)+C24*E24*(F24*$F$6+G24*$F$7+H24*$F$8+I24*$F$9)
25	=C25*D25*(F25*$E$6+G25*$E$7+H25*$E$8+I25*$E$9)+C25*E25*(F25*$F$6+G25*$F$7+H25*$F$8+I25*$F$9)
26	=C26*D26*(F26*$E$6+G26*$E$7+H26*$E$8+I26*$E$9)+C26*E26*(F26*$F$6+G26*$F$7+H26*$F$8+I26*$F$9)
27	=C27*D27*(F27*$E$6+G27*$E$7+H27*$E$8+I27*$E$9)+C27*E27*(F27*$F$6+G27*$F$7+H27*$F$8+I27*$F$9)
28	=C28*D28*(F28*$E$6+G28*$E$7+H28*$E$8+I28*$E$9)+C28*E28*(F28*$F$6+G28*$F$7+H28*$F$8+I28*$F$9)
29	=SUM(N22:N28)
30	Total cost

The Operating costs for each of the seven destinations are added to determine the Total operating cost in cell N29 (see Figure 15-12). Cell N29 is blue because it is an Optimization cell.

FIGURE 15-12: Calculations and results section



Calculations and results section		Daily demand		Plane assignment				Plane utilization				Costs
Destination	Distance from Riyadh hub	Daily passenger bookings	Daily cargo shipments (m^3)	Boeing 717	Bombardier CRJ700	Embraer E170	Airbus A220	Total passenger capacity	% of passenger capacity used	Total cargo capacity (m^3)	% of cargo capacity used	Operating cost
Jeddah	941	750	450	1	1	1	1	398	188%	634	71%	SAR 1,942,082.85
Medina	837	500	450	1	1	1	1	398	126%	634	71%	SAR 1,286,343.45
Ad Damman	408	550	600	1	1	1	1	398	138%	634	95%	SAR 735,705.60
Rafha	767	100	450	1	1	1	1	398	25%	634	71%	SAR 532,029.55
Yanbu	1045	750	300	1	1	1	1	398	188%	634	47%	SAR 1,988,530.50
Abha	948	500	225	1	1	1	1	398	126%	634	35%	SAR 1,228,062.90
Najran	944	1250	150	1	1	1	1	398	314%	634	24%	SAR 2,639,376.80
	Total/Avg	4400	2625	7	7	7	7	2786	158%	4438	59%	SAR 10,352,131.65
												Total cost

CHECK YOUR PROGRESS

Compare your calculation results with the values shown. If yours are different, carefully re-check your formulas and cell addresses.

Income Statement Section

The Income statement section (see Figure 15-13) is a projection of daily gross profits and is based on the mix of planes that will be assigned either manually or by Solver.

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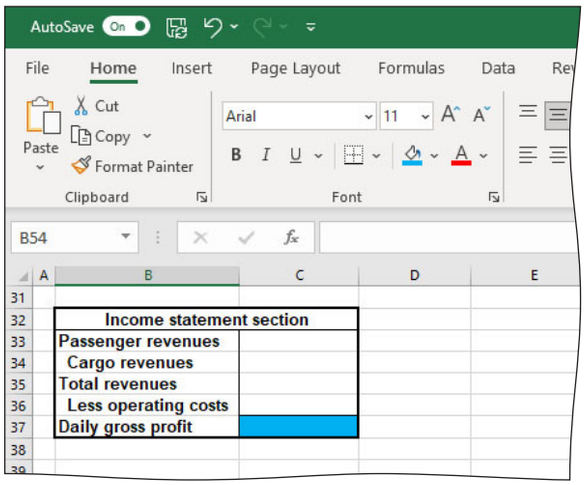
FIGURE 15-13: Income statement section



- **Passenger revenues:** This value is calculated by multiplying the passenger tickets booked for each destination (cells D22:D28) by their respective average ticket prices (cells C12:C18), and then totaling the ticket revenues for the seven destinations.

  =$C$12*D22+$C$13*D23+$C$14*D24+$C$15*D25+$C$16*D26+$C$17*D27+$C$18*D28

- **Cargo revenues:** This value is calculated by multiplying the daily cargo shipments for each destination (cells E22:E28) by their respective air freight prices (cells D12:D18), and then totaling the cargo revenues for the seven destinations.

  =(E22*$D$12)+(E23*$D$13)+(E24*$D$14)+(E25*$D$15)+(E26*$D$16)+(E27*$D$17)+(E28*$D$18)

- **Total revenues:** This value is the total of Passenger revenues, and Cargo revenues, (**C33+C34**).

- **Less operating costs:** This value is the Total cost from cell N29.

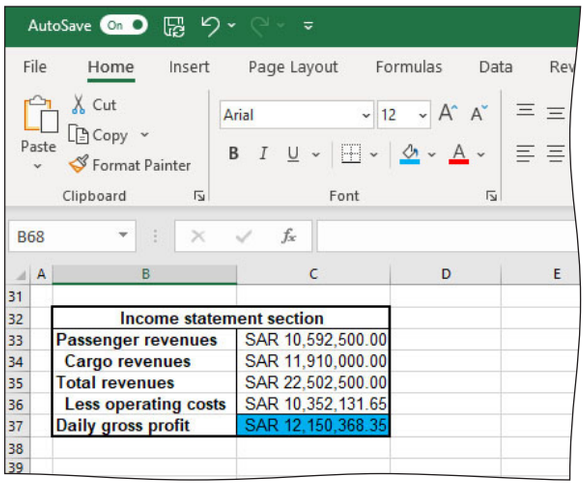
- **Daily gross profit:** This value is the Total revenues minus the Operating costs (C35–C36). Cell C37 should be given a blue fill color because it is an Optimization cell.

If your formulas are correct, the initial Income statement section will appear as shown in Figure 15-14.

CHECK YOUR PROGRESS

Compare your calculation results with the values shown. If yours are different, carefully re-check your formulas and cell addresses.

FIGURE 15-14: Completed Income statement section



Income statement section	
Passenger revenues	SAR 10,592,500.00
Cargo revenues	SAR 11,910,000.00
Total revenues	SAR 22,502,500.00
Less operating costs	SAR 10,352,131.65
Daily gross profit	SAR 12,150,368.35

The initial Income statement correctly reflects the revenues expected from the passenger and cargo bookings, but the operating costs are not correct because the planes required to transport the passengers and cargo have not been assigned yet. Initially, you entered "1" for the number of plane assignments. We now need to estimate how many planes will be assigned to serve each of the company's destinations.

Attempting a Manual Solution

Start by assigning your plane fleet manually in the spreadsheet. Change the "1" values to numbers that seem more reasonable to you. You have several good reasons for doing this. First, you can make sure your model is working correctly before you set up Solver to run. As you change the plane assignments your spreadsheet should automatically update other related cells. Second, assigning the plane fleet manually will demonstrate which constraints you must meet in solving the problem.

For instance, if a passenger or cargo utilization rate is over 100%, you have not assigned enough planes to carry all the passengers and cargo to a particular destination. Therefore, one constraint is that the Total passenger capacity for the planes assigned to a destination must be greater than or equal to the passenger bookings. Adjust your plane assignments to improve the percentage passenger and percentage capacities. Do this by entering different values for each of the plane assignments and watch the change in the % Passenger capacity. Start with Boeing and change the "1" to different values. Then move on and change the Bombardier, Embraer, and Airbus values. Don't worry if you make a mistake; you will change these values multiple times. Try to assign the planes in such a way as

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to maximize the % Passenger capacity without exceeding 100%. Remember that you don't need to assign all the plane types to each destination. You could assign zero Airbus A220s to Yanbu and Abha. You should change your assignments until you think you've maximized your % Passenger capacity.

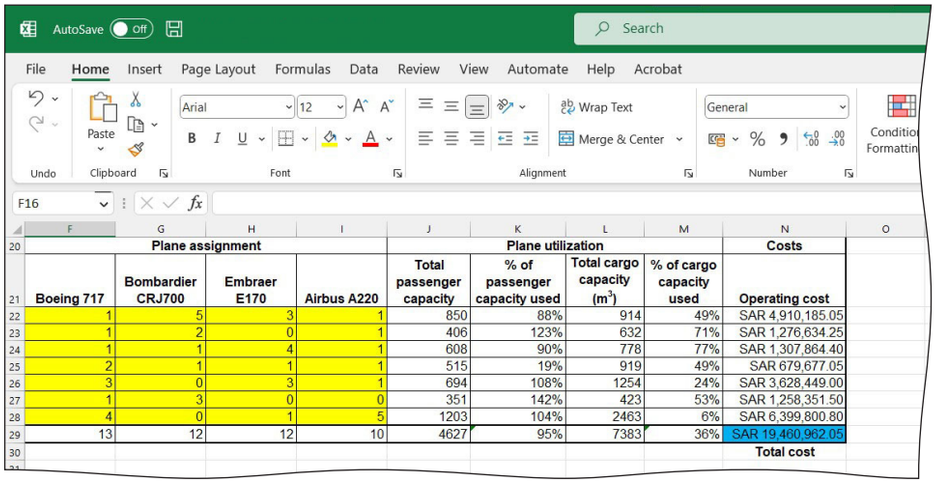
QUICK TIP

The Solver optimization tool should give you a better solution than assigning the fleet manually.

Another constraint is that the Total cargo capacity for the planes assigned must be greater than the cargo shipments booked. Given the fleet size, you can probably assign the fleet manually and meet all of your constraints, but will your total operating cost be the least expensive solution? Repeat the process you followed above and try to maximize the % Cargo capacity. Keep an eye on the % Passenger though.

Figure 15-15 shows a sample manual solution. Note the number of Airbus A220 exceeds the number available. The Total passenger capacity is below 100%, but the capacity at several destinations exceeds 100%. This manual analysis needs to be reworked.

FIGURE 15-15: Sample manual solution



	Plane assignment				Plane utilization				Costs
	Boeing 717	Bombardier CRJ700	Embraer E170	Airbus A220	Total passenger capacity	% of passenger capacity used	Total cargo capacity (m^3)	% of cargo capacity used	Operating cost
22	1	5	3	1	850	88%	914	49%	SAR 4,910,185.05
23	1	2	0	1	406	123%	632	71%	SAR 1,276,634.25
24	1	1	4	1	608	90%	778	77%	SAR 1,307,864.40
25	2	1	1	1	515	19%	919	49%	SAR 679,677.05
26	3	0	3	1	694	108%	1254	24%	SAR 3,628,449.00
27	1	3	0	0	351	142%	423	53%	SAR 1,258,351.50
28	4	0	1	5	1203	104%	2463	6%	SAR 6,399,800.80
29	13	12	12	10	4627	95%	7383	36%	SAR 19,460,962.05
30									Total cost

When attempting to assign the planes manually in the Plane assignment section (the changing cells), you must satisfy both the passenger and cargo demands for each destination. In other words, the Total passenger capacity values in cells J22 through J28, and the Total cargo capacity values in cells L22:L28 must be equal to or greater than the Daily demand values in cells D22:D28. If you have satisfied the passenger and air freight demands correctly, none of the utilization rates in cells K22:K28 and M22:M28 will exceed 100%. In addition, the total planes assigned for each type (cells F29:I29) cannot exceed the available number of each plane type (cells G6:G9). Working the problem out manually will provide an initial operating cost to which you can compare your Solver solution later.

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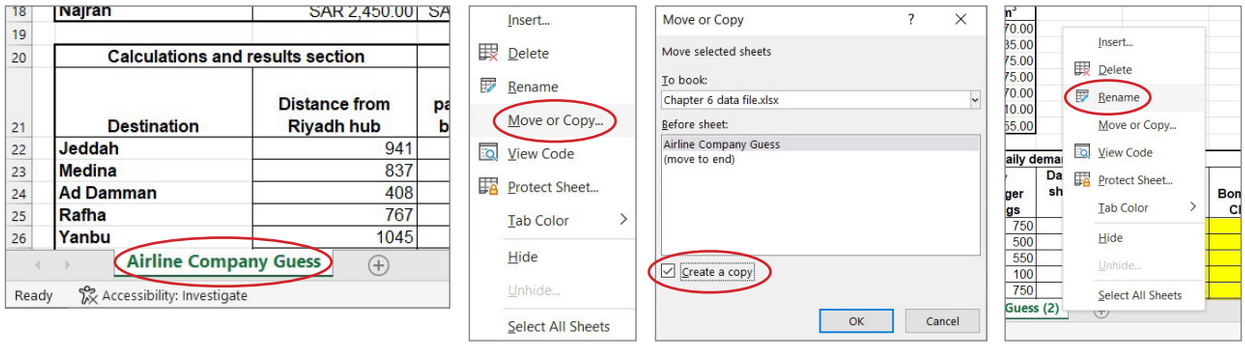
Once you reach a solution that satisfies the preceding constraints, save your workbook. Name the worksheet **Airline Company Guess**. Then, right-click the worksheet name tab, click Move or Copy, and check Create a Copy to copy the worksheet. Right-click the tab of your new worksheet and rename it (see Figure 15-16) **Airline Company Solver**. You will use the new worksheet to complete the next part of the lesson.

FIGURE 15-16: Copying and renaming the worksheet



Setting Up and Running Solver

Now, begin working in the spreadsheet you just created. Before using the Solver Parameters window, you should make notes of the parameters you must define and their cell addresses. For this project, you should identify the following:

- The cell you want to minimize (Total cost, cell N29, which has a blue fill color).
- The cells you want Solver to manipulate to obtain the optimal solution (Plane assignment, cells F22:I28).
- The constraints you must define:
  - All the Plane assignment cells must be non-negative integers.
  - The total number of each type of plane assigned (cells F29:I29) For this project, you should identify the following: the number of available planes of each type (cells G6:G9).
  - The Total passenger capacity to each destination (cells J22:J28) must be equal to or greater than the total passenger bookings for each destination (cells D22:D28).
  - The Total cargo capacity to each destination (cells L22:L28) must be equal to or greater than the total cargo shipment for each destination (cells E22:E28).

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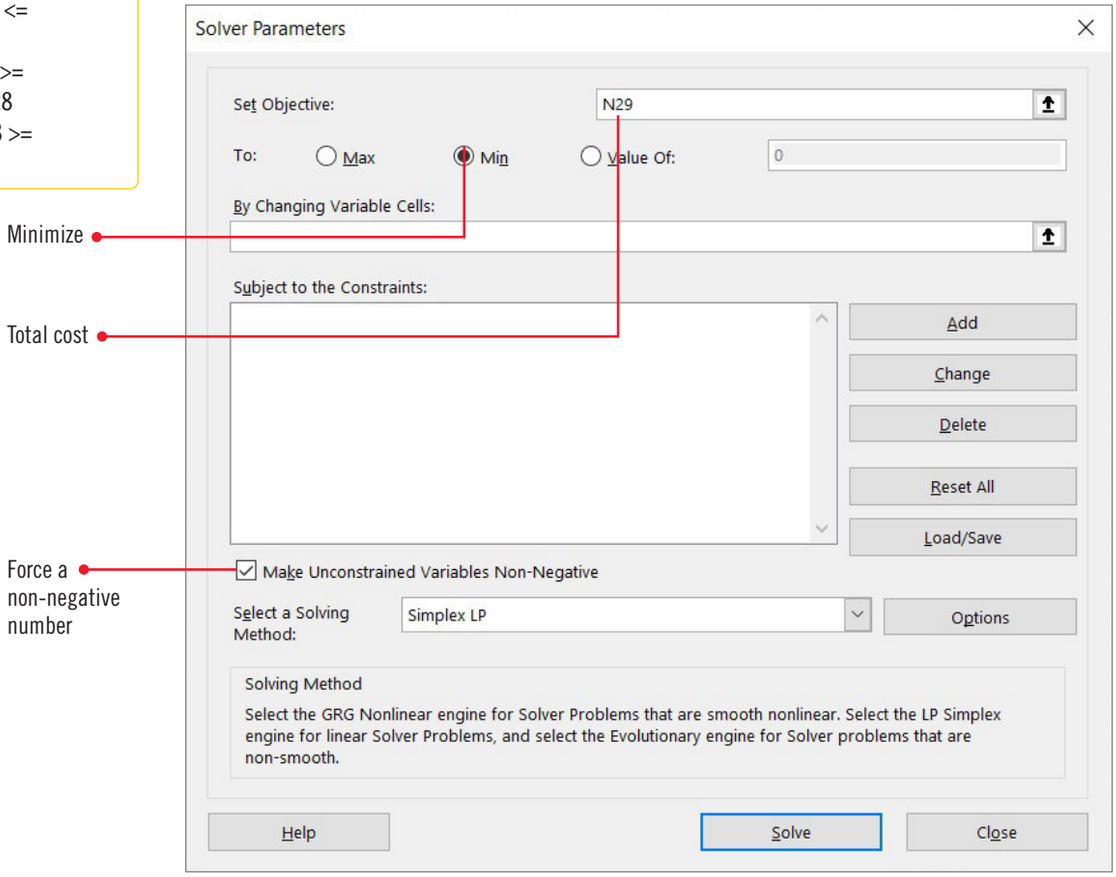
CHECK YOUR PROGRESS
Your constraints should look like:
$F$22:$I$28 = integer
$F$22:$I$28 >= 0
$F$29:$I$29 <= $G$6:$G$9
$J$22:$J$28 >= $D$22:$D$28
$L$22:$L$28 >= $E22:$E$28

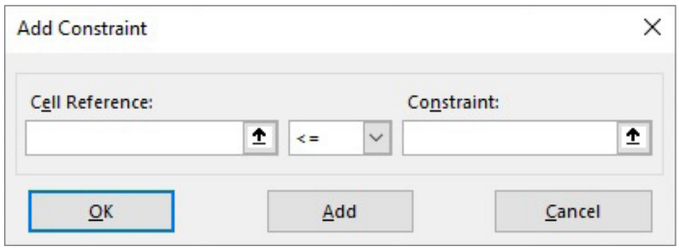
Next, set up your problem. In the Analysis group on the Data tab, click Solver; the Solver Parameters window will appear, as shown in Figure 15-17.

FIGURE 15-17: The Solver Parameters window



Enter the cell address (N29) that contains the Total cost in the box. Then click the Min button to specify that the goal is to minimize the Total operating cost. Enter your Changing cells (cells F22:I28) into the By Changing Variable Cells box. Finally, add the constraints from the preceding list in the Add Constraints window (see Figure 15-18).

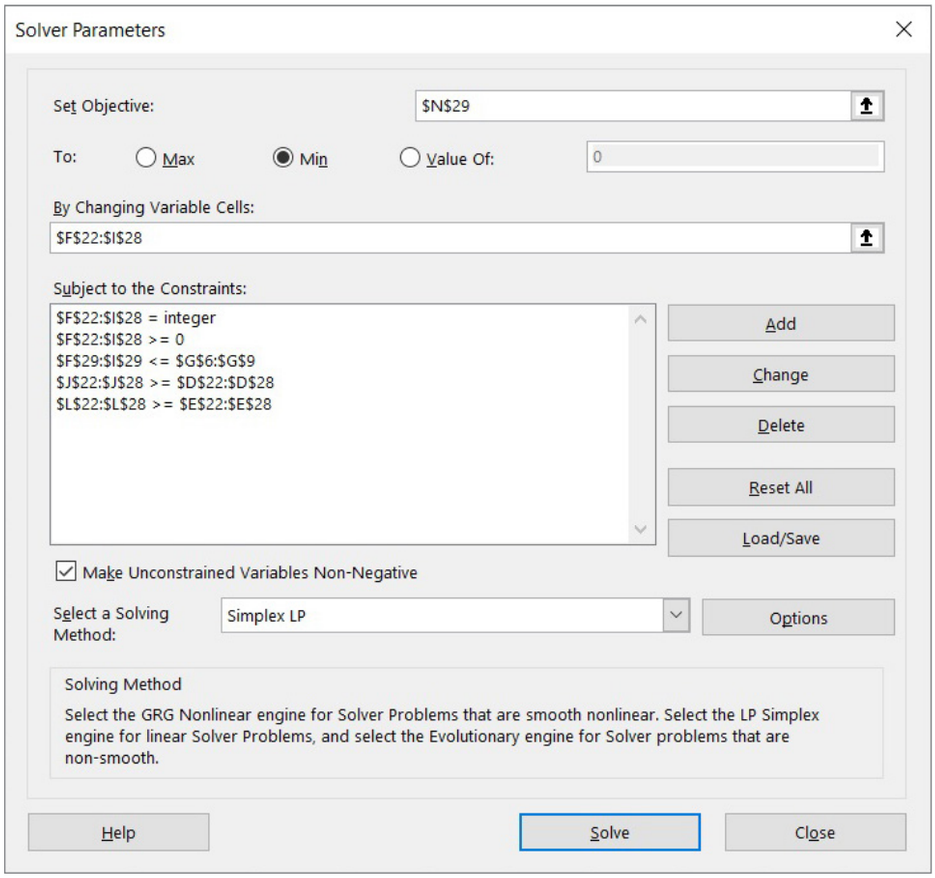
FIGURE 15-18: Add your constraints one at a time



Click the Add button to enter the constraints one at a time. Click the OK button

after entering the last constraint. Select the Simplex LP solving method. If you need help defining your constraints, refer to Chapter 11. Your Solver Parameters window should now match the one in Figure 15-19.

FIGURE 15-19: The Solver Parameters window after the data has been entered



Next, you should click the Options button and check the Options window that appears (see Figure 15-20). The default Integer Optimality is 5%; change it to 1% to get a better answer. Make sure the Constraint Precision is set to the default value of 0.000001 and that the Use Automatic Scaling option is checked. When you have set the options, click OK to return to the Solver Parameters window.

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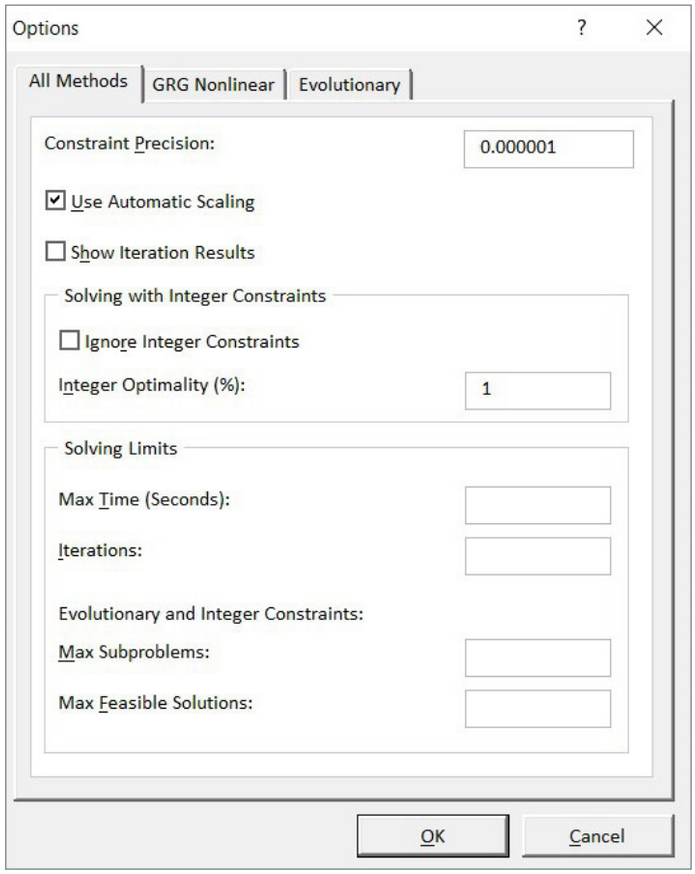
FIGURE 15-20: The Solver Options window



QUICK TIP
If you set up Solver correctly, you should see a reduction in total cost from your manual assignment.

Run Solver and click Answer Report when Solver finds a solution that satisfies the constraints. When you finish, print the entire workbook, including the Solver Answer Report Sheet. For the rest of the case, continue copying and renaming the worksheets. Before continuing, examine the plane assignments that Solver chose for minimizing the total cost.

What if, instead of minimizing costs, you were interested in maximizing revenues? In other words, is gross profit greater than that in the earlier solutions?

Rerunning Solver to Maximize Gross Profit

You now have a lot of experience working with DSS and Solver. So, before you run Solver a final time to maximize gross profit, ask yourself: What result do I expect to produce?

Then, copy the worksheet that contains the solution for minimum operating costs, and rename the new worksheet **Airline Company Solver Max Daily Profit**. Click Solver to open the Solver Parameters window, and then change the value in the Set Objective box to $C$37 (the blue cell that contains Daily gross

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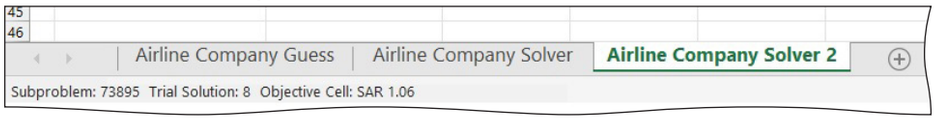
profit). Click the Max button to maximize the Set Objective value, as shown in Figure 15-17 earlier, and then run Solver. Click Answer Report and then click OK to create a second Answer Report.

As with the prior Solver model, this solution will take some time to complete. Be patient as Excel works through the various sub-problems and trial solutions. You will see these calculations scrolling in the bottom-left corner of your screen (Figure 15-21):

FIGURE 15-21: Answer Report calculations



Examine the reports and solutions that Solver generated to see if maximizing daily gross revenues provides a better plane assignment solution than the solutions that minimized total operating costs.

Was the result the same, or different, from the one you expected? Why do you think that is?

REVIEW QUESTIONS

1. **Which is the best way for the airline to measure passenger capacity?**
   - **a.** Number of passengers
   - **b.** Number of seats
   - **c.** Number of tickets sold
   - **d.** Number of bags
2. **Which is the best way for the airline to measure cargo capacity?**
   - **a.** Number of bags
   - **b.** Number of passengers
   - **c.** Volume of cargo
   - **d.** Duration of flight

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Airline Deliverables

You have built a series of worksheets to determine the best plane assignments with which to maximize profits and minimize costs.

1. As you have done with the other cases in this book, you now need to present your findings to Airline Company's executives in the form of a short report. Scan the QR code to access the report template (**Report template.dotx**).

   You should now be familiar with how to fill out the report, and the kind of information you need to include.

2. In the Results section, you will need to explain whether you think the current plane assignment method is still profitable, providing evidence to support your decision.

3. In the Analysis section, look again at your Airline Company Guess and your Airline Company Solver worksheets. Write a paragraph comparing the results in each, discussing how accurate your guess was at predicting the results found in Solver. Consider the following questions:

   What can you learn from this difference?

   How important is the use of DSS in the process of optimization?

4. When your report is complete, save it by selecting Save from the file menu, and use the file name format: **YourName - Airline - Report.docx**.

5. Summarize your report in an oral presentation to your class.

   Prepare a 5-minute presentation for your class explaining your findings.

   You might want to use PowerPoint slides, and perhaps even print out copies of your report to distribute to your class. Be prepared to take questions at the end.

   Your role as a presenter is to provide clear and accurate information, and explain your analysis and recommendations. Your role as an audience member is to imagine you are one of Airline Company's executives, and to ask the presenter about anything you think they need to explain further.

6. Congratulations! You have completed this semester's work on Business Decision Making.

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Glossary

5 Whys A problem-solving approach that involves looking at a problem and asking "why?" or "what was the cause of this situation?" at least five times.

Action plan A plan that summarizes the activities the group and other members of the organization agree to perform to make sure the project succeeds.

Adaptive techniques An alternative method for solving problems. Instead of gathering data, analyzing it, and exploring alternatives systematically, most adaptive techniques involve a combination of intuition, logic, and common sense.

Agenda An outline or a list of topics that will be discussed during the meeting.

Agility The ability and willingness to adapt to what's happening around you and go "above and beyond" to ensure that tasks are completed on time and to a high standard.

Analytical reports A type of report that presents data, analysis, and a conclusion by providing different options, identifying pros and cons for alternatives, and including specific recommendations.

Argument (1) A set of one or more claims that supports a particular conclusion. (2) A value or cell reference that a function uses in its calculations.

Arithmetic mean The value of a set of data that is usually referred to as the average. The mean is a single value and describes the data in general by showing its central tendency.

Assumption A proposition or claim that is taken for granted as though it were known to be valid.

Autosum Function in a spreadsheet that lets you calculate sums, the average, the number of items, or the maximum or minimum value of a range.

Benefits What an organization, it's employees, customers, or stakeholders gain from the production of an item or the provision of a service.

Blog An interactive online journal. Short for Weblog.

Brainstorming A creativity tool for generating ideas and alternatives. A brainstorming session usually starts by defining a problem, and then listing possible solutions as they occur to you, whether they are obvious, impractical, or far-fetched. The goal is quantity, not quality.

Business ethics A collection of principles and rules that define right and wrong conduct for an organization.

Cause The reason for or the origin (root) of a change, such as customers being unable to afford travel vacations.

Cell The intersection of a row and a column in a spreadsheet.

Cell reference The combination of column letter and row number that identifies a cell on a worksheet.

Channel The medium by which a message is sent, such as a phone call, blog, or text message.

Channel richness The amount of information that can be transmitted during a communication episode.

Chart Information in the form of a table, graph, or diagram.

Claim A statement that someone says or writes about a topic.

Cluster sampling Involves dividing the population of interest into non-overlapping subgroups, or clusters, and clusters are then selected at random.

Collaboration Collaboration is similar to cooperation, but the achievement is shared between all parties.

Collective wisdom The shared knowledge and experience a group of people can apply to a problem.

Command-and-control The process by which information is exchanged and understood by two or more people, usually with the intent to influence or motivate behavior.

Communication climate The social tone of a relationship. How people interact with each other within their relationships.

Conflict An antagonistic interaction in which one party attempts to block the intentions or goals of another.

Confounding variable A variable that is related to both how the experimental groups were formed and the response variable of interest.

Constant A data point in a DSS that is known in advance and will not change, or that the decision maker has no influence over. For example, Lease Payments—these are already established and so are a constant for the purposes of the decision.

Continuous data Data that can take any value, such as height, weight, temperature.

Convenience sampling Using an easily available or convenient group to form a sample.

Convergent thinking Thought processes or methods that narrow options to a manageable set.

Cooperation The act of working together to achieve something for the benefit of one or more of the parties involved.

Costs The value of what an organization spends, in time, money or both, to produce an item, provide a service, or carry out an item of work.

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Critical thinking The thoughtful, deliberate process of deciding whether you should accept, reject, or reserve judgment about a particular idea. The goal of critical thinking is often to improve choices and reduce the risk of adopting or acting on a flawed assumption.

Cross-functional team A team made up of employees from about the same hierarchical level, but from different areas of expertise.

Crowdsourcing A way of using groups to solve problems. The groups are usually online communities, such as members of a blog or visitors to a Web site, called a crowd. An organization broadcasts a problem to the crowd as an open call for solutions. The crowd submits solutions, and then the organization sorts through them, finding the best ones. The organization selects and owns the ultimate solution, and sometimes rewards members of the crowd.

Culture The customs, beliefs, values, and patterns of behavior of the people of a country or organization.

Dashboard A window that graphically summarizes information about how a business is operating.

Data A collection of uninterpreted information

Data analysis The different methods used to interpret data.

Debt An amount of money that is due from a loan.

Decentralized network A communication structure in which team members freely communicate with one another and arrive at decisions together.

Decision A choice you make when faced with a set of options or alternatives.

Decision balance sheet A formal way of organizing an idea's costs and benefits.

Decision maker A person within a business, often in management, who is responsible for making key decisions or assigning tasks to employees.

Decision model One or more formulas that includes all of the relevant variables and calculates a result.

Decision support system (DSS) Interactive software designed to help you compile useful information from raw data, documents, and business knowledge.

Decision tree A support tool that models decisions using a tree-like diagram. Each branch of the tree represents a different option and its associated benefits, costs, and likelihood.

Decode To interpret a message or understand it.

Delphi method A structured technique involving stages of individual input from members of an expert group, followed by evaluation, then more individual input based on this evaluation, until a resolution is reached.

Deviations from the mean The n deviations from the sample mean are the differences

$(x_1 - \bar{x}), (x_2 - \bar{x}), \ldots, (x_n - \bar{x})$

Discrete data Where values are whole; or yes/no.

Distributive negotiation A competitive and adversarial approach in which each party strives to get as much as it can, usually at the expense of the other party.

Divergent thinking Thought processes or methods used to generate ideas.

Downward communication channel Refers to messages sent from top management down to subordinates.

Electronic brainstorming A technique that brings people together in an interactive group over a computer network rather than meeting face to face.

Encoding Selecting symbols with which to compose a message and selecting a communication channel.

Evaluation criteria The variables that drive your decisions.

Executive management A top-level manager who spends almost all of his or her time on management functions and decisions that affect the entire company.

Experiment A study that investigates how a response variable behaves when one or more explanatory variables are manipulated. The goal is to determine the effect of the explanatory variables on the response variable.

Extension case A way of modeling based on reasonable, informed speculation and prediction.

External proposals A proposal written for an audience that is outside of your organization.

Fact A claim that is considered to be true.

Factual matter A claim about which you can collect and analyze data. This term suggests that you are not certain the claim is a fact, but could prove or disprove if necessary.

Fatal flaw An aspect of an idea that would make it unacceptable for some reason.

Feedback The response of the reader to the sender's communication with a return message.

Fishbone diagram A diagram, which looks like the skeleton of a fish, showing the causes that contribute to a problem.

Forecast A way to predict a future outcome, using relevant data to inform your prediction.

Formal communications channel A communication channel that flows within the chain of command or task responsibility defined by the organization.

Formula A mathematical expression of a calculation that your spreadsheet software will complete for you.

Function The purpose or objective of a particular job or group of jobs carried out by a team.

Function (for spreadsheets) A pre-defined set of formulas that work together to calculate a commonly-used operation. For example, =Average(), to calculate the mean of a set of values. The function is much simpler than using all of the individual formulas that would be required to find the average.

Functional team A team composed of a manager and his or her subordinates in the formal chain of command.

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Global team A group made up of employees who come from, and whose activities span, multiple countries.

Grapevine Carries workplace gossip, a dominant force in workplace communication when official channels are not functioning effectively.

Gross margin The amount of money a company retains after incurring the direct costs associated with producing the goods it sells and the services it provides. The higher the gross margin, the more capital a company retains, which it can then use to pay other costs or satisfy debt obligations.

Group Two or more people who interact with each other, share expectations and obligations, and develop a common identity as a group.

Group dynamics The way that people work and interact with each other.

Groupthink When groups become so cohesive that the members minimize conflict and support consensus without critically considering the merits of ideas and decisions.

Hashtag A slogan or phrase—with no spaces between the words—attached to a post so that users can find related information quickly.

Heterogeneous team A diverse team made up of members with a variety of skills, knowledge, experience, and social backgrounds.

Hierarchy A system of organizing people into different ranks or levels of importance, for example, in society or in a company.

Homogeneous team A team made up of people with the same types of skills, knowledge, experience, and social backgrounds.

IF statement An IF statement is a programming conditional statement that, if proved true, performs a function or displays information.

Impact analysis A way of evaluating the effects of an idea or alternative.

Information Data that has been organized, analyzed, or visualized in a way that makes it more valuable.

Informational reports A type of report that presents information in a clear, objective format, and is appropriate when you want to provide a written summary of a subject for your reader.

Innovative technique A problem-solving approach involving a new idea, or a new implementation of an existing idea.

Input variable A data point that the decision maker can change or influence. For example, the quantity of raw materials purchased, etc.

Instant messaging (IM) A technology that involves communication between two people who type text messages to one another using a computer, mobile phone, or other device connected to the Internet.

Integrative negotiation A collaborative approach, whereby the parties want to come up with a creative solution that benefits both sides of the conflict.

Internal proposals A type of proposal that recommends how to solve problems within an organization.

Interquartile range (IQR) A measure of variability that is not as sensitive to the presence of outliers as the standard deviation. The IQR is calculated as IQR = upper quartile – lower quartile

Intuition Your knowledge of something without having to discover or learn it; typically your first reaction to a problem or question. When you solve a problem intuitively, you react immediately and instinctively, without following a particular procedure.

Issue Any challenging subject that you discuss, dispute, or review. An issue is different from a simple topic of conversation because it raises questions or concerns.

Jargon The special words or expressions used by a profession or group that are difficult for others to understand.

Key Performance Indicator (KPI) A measure used to evaluate the success of an organization in achieving its planned objectives.

Leadership The ability to influence individuals and groups to cooperatively achieve common goals.

Listening The skill of understanding both facts and feelings to interpret a message's genuine meaning.

Lower quartile Median of the lower half of the sample.

Market momentum effect The expectation that, once a trend has been established, the market will move in the same general direction—only the rate will change.

Mashup A Web application that combines features or information from more than one source.

Measure of center A summary measure that attempts to describe a whole set of data with a single value that represents the middle or center of its distribution.

Median The value of a set of data that separates the higher values from the lower values.

Meetings Three or more people get together at a common time to discuss, debate, decide, plan, and solve problems related to a company goal.

Message The information sent from one person to another by the use of speech, writing, actions, or symbols. A message is the content of the communication process.

Microblog A very short way of conveying information in real time, often used to engage with consumers or provide live updates.

Mode The value in a set of data that occurs most frequently. The mode does not have to be a unique number.

Model (*n.*) A collection of information that shows how an organisation is working, or could be working in the future; (*v.*) to produce such a collection of information.

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Negative correlation Also called an "inverse relationship"; two related variables move in opposite directions. For example, a higher number of school absences will likely result in lower grades.

Negotiation A conflict management strategy whereby people engage in give-and-take discussions and consider various alternatives to reach a joint decision that is acceptable to both parties.

Networking The process of interacting with others to exchange information and develop professional or social contact.

Nominal group technique (NGT) A structured approach to brainstorming, in which all participate in generating ideas which are ranked and voted on to reach a quick decision.

Nonverbal (communication) Messages sent through human actions and behavior rather than through words.

Normalization A way to make all of the data consistent with your decision model.

Observational study A study in which characteristics of a sample selected from one or more existing populations are observed. The goal is to draw conclusions about the corresponding population or about differences between two or more populations.

Open communication Sharing all types of information throughout the organization and across functional and hierarchical boundaries.

Opinion A claim that someone believes is true.

Optimism The belief or hope that things that happen in the future will be good, positive, and useful.

Optimization A continuous process of identifying the best possible outcomes given a particular set of inputs and constraints.

Ordinal scale Where data is organized in a particular order or sequence.

Organizational memory The history and culture that a group must function in, including the various processes, personalities, and subtleties of how the organization operates.

Organizational problem A problem within a business or organization which affects many different departments.

Organizational structure The structure of an organization, explaining job classifications, and the reporting of relationships among the organization's personnel.

Outlier A piece of data in a set that is much larger or smaller than the other values in the data set, or an experience that is extremely good or bad.

Output variable A value in the results that could change if the decision variables change.

Pareto principle Also called the 80/20 law, the Pareto principle states that 80% of outcomes come from 20% of causes.

Pecking order A hierarchy; the organization of people at different ranks in an administrative body.

Pension A regular payment received by retired people to support living costs.

Personal communication channels Channels that exist outside formally authorized channels and connect people across boundaries for sharing information and accomplishing tasks.

Personal networks Acquiring and cultivating personal relationships that cross departmental, hierarchical, and even organizational boundaries.

Pessimism The opposite of optimism; the belief that events in the future will be bad, unhelpful, and negative.

Pie chart A graph of a frequency distribution for a categorical data set. Each category is represented by a slice of the pie, and the area of the slice is proportional to the corresponding frequency or relative frequency.

Population Any finite or infinite collection of items under discussion.

Positive correlation A relationship between two variables that move in the same direction, like a person's height and weight.

Premise What you claim or contend.

Problem In an organization, an obstacle that stands in the way of achieving a desired goal. In short, a problem is the difference between the current state and where you want to be.

Problem owner The person who has a problem that needs to be solved.

Problem statement A clear, concise description of the problem and the effect you expect from the solution.

Professional networking Practices for creating and cultivating business friendships.

Proposal A written document designed to persuade and inform. A proposal provides information about a produce, service, or idea and tries to convince the reader to adopt the recommended solution.

Range The range of a data set is defined as Range = Largest Value – Smallest Value.

Relationships conflict Conflict that results from interpersonal incompatibility that creates tension and personal animosity among people.

Report A written document designed to communicate information about a particular subject. Reports are written objectively, though some can include analysis or recommendations.

Risk An exposure to a chance of loss or damage.

Root-cause analysis A study that determines the real basis for the problems that you solve.

Sample mean The sample mean of a sample consisting of numerical observations $x_1, x_2, \ldots, x_n$ is denoted by $\bar{x}$, and its formula is given by

$$\bar{x} = \frac{\text{sum of all observations in the sample}}{\text{number of observations in the sample}} = \frac{x_1 + x_2 + \ldots + x_n}{n} = \frac{\Sigma x}{n}$$

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Sample median The sample median is obtained by first ordering the n observations from smallest to largest (with any repeated values included, so that every sample observation appears in the ordered list). Then sample median = the single middle value if n is odd, the average of the middle two values if n is even.

Sample standard deviation The sample standard deviation is the positive square root of the sample variance and is denoted by s.

Sample variance The sample variance, denoted by s^2, is the sum of squared deviations from the mean divided by $n - 1$. That is,

$$s^2 = \frac{\Sigma(x - \bar{x})^2}{n - 1}$$

Scenario A set of values that collectively represent a particular situation in a spreadsheet that can be saved and then used for modeling the outcomes of business decisions. (For example: higher or lower profits).

Self-managed team A team consisting of multiskilled employees who rotate jobs to produce an entire product or service, often led by an elected team member.

Simple random sample A sample chosen using a method that ensures that each different possible sample of the desired size has an equal chance of being chosen.

Shared resource A component part of a product, or something needed to make a product, that is also a part or is used in the production of another product.

Social conditioning Conditioning that encourages you to accept the traditions and values of your social group. Social conditioning helps you feel part of the greater whole, but it can also prevent you from considering unpopular alternatives.

Social facilitation The tendency for the presence of other people to influence an individual's motivation and performance.

Social media A group of Internet based applications that allow the creation and exchange of user generated content.

Social network Virtual community that allows users to post information about themselves and share that information with others.

Special-purpose team A team created outside the formal structure to undertake a project of special importance, such as developing a new product.

Spreadsheet An electronic file used to arrange data in a grid, which can then be used in calculations.

Stakeholder A person who is affected by a problem or decision, or whose involvement you need to resolve the matter.

Standard deviation A measure of the variability of a set of data.

Statistics The collection and analysis of numerical data.

Symbol An object, act, or event that conveys meaning to others.

Symptom Evidence of a change, such as a decrease in revenue.

Synergy When two or more people work together to produce something greater than the sum of their individual efforts.

Syntax In Excel, syntax is the layout of a function. Functions need to be presented precisely or they will not work.

Systematic Doing something such as solving a problem in a methodical and organized manner. Systematic problem solving takes a reasoned, rational approach and is appropriate for larger, more complicated problems or situations that involve a lot of risk.

Systematic sampling A way to randomly select a sample from a population to avoid sampling error.

Systematic technique Systematic techniques rely on existing practices, information, and strategies, using data and rigorous planning to resolve problems.

Tacit culture The customs, beliefs, values, and patterns of behavior of the people of a country or organization.

Task conflict Conflict that results from disagreements about the goals to be achieved or the content of the tasks to be performed.

Team Unit of two or more people who interact and coordinate their work to accomplish a goal to which they are committed and hold themselves mutually accountable.

Three-pile method A technique for reducing ideas to a manageable number.

Upper quartile Median of the upper half of the sample (if n is odd, the median of the entire sample is excluded from both halves when calculating quartiles).

Upward communication channel Includes messages that flow from the lower to the higher levels in the organization's hierarchy.

Variability The extent to which individual data elements in the data set are different from one another.

Variable Any characteristic (of a population) whose value may change from one individual to another.

Virtual team A team made up of members who are geographically or organizationally dispersed, rarely meet face to face, and interact to accomplish their work primarily using advanced information and telecommunications technologies.

Voluntary response sampling A form of convenience sampling. Relies on individuals who volunteer to be part of the sample, e.g., by completing an online survey.

Wiki A Web site that many users can contribute to by creating and editing the content.

Weighted average In a weighted average, each data point value is multiplied by the assigned weight, which is then summed and divided by the number of data points.

Worksheet The basic element of a spreadsheet, made up of rows and columns.

Worst-case scenario A situation or conclusion that could not be any worse; the worst possible outcome.

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