Business Mathematics

13TH EDITION

Gary Clendenen Stanley A. Salzman

Business Mathematics

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THIRTEENTH EDITION

Gary Clendenen

Siena College

Stanley A. Salzman

American River College

PEARSON

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Preface

FROM THE AUTHORS

The thirteenth edition of *Business Mathematics* has been revised to improve readability and currency and to motivate students by using interesting examples from business and personal finance. Additional focus has been placed on real-world business applications. A different, well-known company is highlighted at the beginning of each chapter and used throughout that chapter in discussions, examples, exercises, and a case. Each chapter ends with two business application cases that help students integrate the concepts using a business setting. Numerous new graphs, news clippings, and photographs have been added to increase the relevance of the material to the world that students know, and discussion of the recent financial crisis has been added to help students better understand what has happened. The globalization of our society is also emphasized through examples and exercises that highlight foreign countries and international topics.

This text teaches math calculations in the context of business applications. An important goal of the text is to develop students' understanding of both to the point where they can figure out which calculations apply when presented with an unfamiliar situation. In this sense, we seek to develop a level of business "intuition" by having them work through the integrative cases, a wide-range of application exercises, writing and investigative questions, and discussions about current and relevant data. Additionally, we also seek to help students develop intuition related to business by discussing topics such as global supply chains, inventory, the financial crisis, debt, etc. These topics are widely discussed in advanced courses in four year programs at colleges and universities throughout the world.

The new edition reflects the extensive business and teaching experience of the authors, college faculty who have previously worked in and owned businesses. It also incorporates ideas for improvement from reviewers nationwide as well as students who have taken the course. We focus on providing solid, practical, and up-to-date coverage of business mathematics topics beginning with a brief review of basic mathematics, and go on to introduce key business topics, such as bank services, payroll, business discounts and markups, simple and compound interest, stocks and bonds, consumer loans, taxes and insurance, depreciation, financial statements, and business statistics. Two appendices have been added to this edition for those who have requested more algebra and/or who have an interest in graphs.

The traditional concept of learning has evolved based on knowledge that students learn in a variety of ways and that many classes are at least partly taught online or in labs. To support student learning in this multidimensional world, we have developed an outstanding supplemental learning package of print and digital products including the industry-leading MyMathLab. Numerous studies have shown that MyMathLab can greatly increase student learning and retention by presenting material in a variety of formats to suit all types of student learning styles.

Our state-of-the-art supplements package includes revised video lectures, case study videos, an enhanced PowerPoint package, student's solutions manual, an extensive instructor's manual, printed quick reference tables, and a wealth of online resources for instructors and students including MathXL online and MyMathLab. We hope this text and package satisfies all of your classroom needs. Please feel free to contact us with any questions or concerns. Use "Business Math" in the regarding line.

Gary Clendenen
gclendenen@yahoo.com
Stanley Salzman
stan.salzman@comcast.net

The Business Mathematics, 13th Edition, Learning System

This textbook has evolved over the years as thousands of students and hundreds of instructors have used the book and told us what works and what doesn't. *Business Mathematics*, 13th edition, Learning System is the result of this process of refinement that informs both the printed textbook and our new MathXL and MyMathLab applications for online. The goal of this textbook is for students to develop the computational skills they will need to be successful in the world of business along with a better understanding of business concepts and situations that require a mathematical solution. Each chapter is set up to teach a math concept and its applications in the following pattern:

1. A **'Case in Point' company profile** introduces the student to a company and a situation that requires math calculations.
2. A **clear explanation** of the math concept is presented, followed by **examples with detailed solutions**.
3. Students immediately apply the math concept to a similar problem in a **Quick-Check problem** to test their understanding.
4. **Solution steps,** detailing how to solve problems, are summarized in a shaded box.
5. **Quick Tips** provide students with helpful tips and cautions.
6. **Business applications** are found in examples, exercises, cases and discussion, and features such as Numbers in the News and newspaper clippings providing business and economic information.
7. **An Exercise Set** follows each section of the book providing a wealth of practice opportunities to develop computational skills. The exercises are paired, graded from simple to more complex, and conclude with numerous titled application word problems. Each type of exercise is preceded with a **Quick Start** worked example to help get students started.
8. **Additional Problem Sets** and **Supplementary Exercises** are embedded in select chapters for topics that students find difficult and typically require additional work.
9. A **Quick Review** section at the end of the chapter presents students with an overview of the math concepts covered in the chapter.
10. Two case studies require students to use math concepts to solve business problems in real companies. The first **Case Study** is a shorter case application, while the second **Case in Point Summary Exercise** revisits the chapter opening company with a more in-depth application. Both cases end with Discussion or Investigate questions that encourage further thinking.
11. Finally, a chapter concluding **Test** allows students to gauge their mastery of all chapter concepts and applications.
12. **Cumulative Review Problem Sets** appear every 2–4 chapters. These problems cover all math concepts covered in the preceding chapters and help students retain math concepts throughout the course.

BUILDING CALCULATOR SKILLS

This text provides the following resources to help students build calculator skills:

Calculator Solutions Calculator solutions, identified with the calculator symbol, appear after selected examples. These solutions show students the keystrokes needed to solve the problem in the Example.

Basic Calculator Instruction in Appendix B presents detailed coverage of basic calculators for professors who allow students to use calculators.

Financial Calculator Instruction in Appendix C reviews the basic functions of financial calculators using present value and future value. The financial calculator solutions are shown in shaded boxes along with the for some examples in the text.

NEW CONTENT HIGHLIGHTS

Many changes have been made in the 13th edition. Here is a list of the changes by chapter:

- Chapters 1 through 3 have been reworked and several examples have been updated. The figures in Chapter 3 (Percents) related to increase and decrease problems have been modified to improve student learning.
- Chapter 4 (Equations and Formulas) has been updated and significant additional material related to algebra has been added with the addition of Appendix D (Exponents and Order of Operations) and Appendix E (Graphing Equations). Appendix E can be used, in combination with the many figures and charts throughout the book, to improve students' abilities to interpret data.
- Chapter 5 (Bank Services) has been extensively reworked to bring it up-to-date in the continually changing world of banking in a global, wired world. Discussion has been added explaining how electronic banking is a backbone for business. Discussion about how important it is to control costs in business as well as how internet transactions have reduced costs for businesses has been included.
- Chapter 6 (Payroll) has been updated and includes the most recent information related to Social Security, Medicare, and income tax withholding. Figures in the chapter show percent of workers living on the edge due to insufficient savings, the value of higher education, average salaries for various sales careers, and a chart listing the median wage of a wide range of workers by job/career. The history of Social Security and Medicare are outlined. The Case in Point Summary exercise asks students to take on the role of a manager preparing a payroll at a Starbucks.
- Chapter 7: Mathematics of Buying introduces e-commerce and the resulting changes in business operations. A new topic is introduced: the retail supply chain. Students are encouraged to think as managers about invoices and discounts based on the amount purchased or the timing of payments. The importance of controlling costs is emphasized in the chapter and in the case on managing inventory at Bed, Bath and Beyond.
- Chapter 8: Mathematics of Selling is introduced using Recreational Equipment, Inc. (REI) which is one of the premier sporting goods and mountaineering stores in the country. To enhance student understanding of supply chain issues in retail, the discussion on tracking inventory has been expanded and data showing the growth of online retail sales is included. Figures have also been changed to enhance student understanding.
- Chapter 9: Simple Interest has been updated to reflect current interest rates. Rather than just giving formulas and calculations, this chapter was written to help students gain insights about the importance of interest rates in business and life. For example, a graph showing housing starts and interest rates is included along with a discussion of why high interest rates usually result in lower housing starts. Also, an explanation is given about how the government uses interest rates to help control the growth rate of the economy which in turn affects the number of jobs. The company highlighted is Apple, Inc.
- Chapter 10: Compound Interest and Inflation shows the benefits of compounding interest over periods of time. Inflation is defined and examples are included to show the effect of inflation on earning power. Deflation is also defined since it is a topic currently in the news. One of the cases at the end of the chapter describes the serious financial effects of the recent collapse in real estate prices on a home builder.
- Chapter 11: Annuities, Stocks, and Bonds uses both examples and exercises to emphasize the value of long-term saving for students and businesses. It includes descriptions of the basic types of retirement accounts and explains how divorced couples can use annuities for alimony and child support payments. The chapter highlights a recent graduate that works for a community college as he makes choices about the retirement plan offered by his employer. It also discusses stocks and bonds as investments.
- Chapter 12: Business and Consumer Loans now has a greater emphasis on student debt. The sections on Credit Cards, Installment Loans, and Real Estate Loans will be of special interest to students. A discussion of FICO score has been added and tips are given to help students improve their own score which will improve their ability to obtain credit. One of the cases at the end of the chapter shows how a family reduces monthly payments by refinancing. The second case highlights a family that is "under water" on their home, meaning that the debt on the home is greater than its market value.
- In Chapter 13: Taxes and Insurance, additional discussion has been added showing students where tax dollars go and all personal income tax applications have been updated using the most current tax laws. A new figure shows where the government gets its money from and where it goes. All personal income tax applications have been updated using the most current tax laws. The company highlighted in the chapter Mattel Inc., has significant international sales. Discussion has been added showing the effects of the recent financial crisis on the budget in a local school district.
- Chapter 14: Depreciation contains the most recent federal laws and guidelines.
- Chapter 15: Financial Statements and Ratios features Apple, Inc. Recent financial statements from the company are shown so that students can learn based on a company they know and from which they buy products.
- Many of the problems in Chapter 16: Business Statistics have been changed. It includes numerous graphs with data related to business or the economy, including average credit card debt, states with serious budget problems, top tax rates, and average costs of medical treatment. Concepts are introduced throughout the chapter using a deli and highlighted in a case related to cooking show host Bobby Flay in a case at the end of the chapter.

Student and Instructor Supplements

RESOURCES FOR STUDENTS

Classroom Lectures and Case Studies contain a comprehensive lecture for each section of the text, along with case study videos that profile real companies from the in-text Case Studies. These videos are available in MyMathLab.

Student's Solutions Manual This supplement contains the complete, worked-out solutions to all of the odd-numbered exercises in the text. This manual can be ordered alone or packaged with the textbook for an additional cost. ISBN: 0-321-95870-5

RESOURCES FOR INSTRUCTORS

Online Instructor's Solutions Manual (Download only) This supplement contains the complete, worked-out solutions to all of the exercises in the text. Available for download in MyMathLab and the Instructor's Resource Center. ISBN: 0-321-95872-1

Online Instructor's Resource Manual (Download only) contains teaching suggestions; two pretests—one in basic mathematics and one in business mathematics; six different test forms for each chapter (four short answer and two multiple choice); two final examinations; numerous application exercises (test items) for each chapter; answers to all test materials; suggested answers to the writing questions in the text; and a selection of tables from the text. Available for download in MyMathLab and the Instructor's Resource Center. ISBN: 0-321-95871-3

MEDIA RESOURCES

MYMATHLAB® ONLINE COURSE (ACCESS CODE REQUIRED)

MyMathLab from Pearson is the world's leading online resource in mathematics, integrating interactive homework, assessment, and media in a flexible, easy to use format. MyMathLab delivers **proven results** in helping individual students succeed. It provides **engaging experiences** that personalize, stimulate, and measure learning for each student. And, it comes from an **experienced partner** with educational expertise and an eye on the future.

To learn more about how MyMathLab combines proven learning applications with powerful assessment, visit **www.mymathlab.com** or contact your Pearson representative.

MYMATHLAB® READY TO GO COURSE (ACCESS CODE REQUIRED)

These new Ready to Go courses provide students with all the same great MyMathLab features, but make it easier for instructors to get started. Each course includes preassigned homework and quizzes to make creating a course even simpler. Ask your Pearson representative about the details for this particular course or to see a copy of this course.

MATHXL® ONLINE COURSE (ACCESS CODE REQUIRED)

MathXL® is the homework and assessment engine that runs MyMathLab.
(MyMathLab is MathXL plus a learning management system.)

With MathXL, instructors can:

- Create, edit, and assign online homework and tests using algorithmically generated exercises correlated at the objective level to the textbook.
- Create and assign their own online exercises and import TestGen tests for added flexibility.
- Maintain records of all student work tracked in MathXL's online gradebook.

With MathXL, students can:

- Take chapter tests in MathXL and receive personalized study plans and/or personalized homework assignments based on their test results.
- Use the study plan and/or the homework to link directly to tutorial exercises for the objectives they need to study.
- Access supplemental animations and video clips directly from selected exercises.

MathXL is available to qualified adopters. For more information, visit our website at www.mathxl.com, or contact your Pearson representative.

TESTGEN®

TestGen® (www.pearsoned.com/testgen) enables instructors to build, edit, print, and administer tests using a computerized bank of questions developed to cover all the objectives of the text. TestGen is algorithmically based, allowing instructors to create multiple but equivalent versions of the same question or test with the click of a button. Instructors can also modify test bank questions or add new questions. The software and testbank are available for download from Pearson Education's online catalog.

POWERPOINT® LECTURE SLIDES

The PowerPoint Lecture Slides contain coverage of all chapter concepts illustrated with new problems not found in the book and many of the even numbered exercises from the exercise set.

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We would like to thank the many users of the thirteenth edition for their insightful observations and suggestions for improving this book. We also wish to express our appreciation and thanks to the following reviewers of this and previous editions for their contributions:

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As an author team, we are committed to providing the best possible text to help instructors teach and students succeed. As we continue to work toward this goal, we would welcome any comments or suggestions you might have via e-mail to gclendenen@yahoo.com. Please use "Business Math" in the regarding line.

Gary Clendenen
Stanley A. Salzman

About the Authors

Gary Clendenen received bachelor's and master's degrees in mathematics before going into business for himself in the oil industry. He returned to academia and earned his Ph.D. in Business Management in 1993 and has been a faculty member since then. His business experience includes working as an actuary for an insurance company and owning commercial real estate. He has published papers in numerous refereed journals and does volunteer work with several organizations. His hobbies include long bicycle rides, traveling, and reading on diverse topics such as the history of the Apache Indians of the Southwest, economics, and issues related to potential shortages of energy, water, and minerals. He has two sons and several grandchildren.

Stanley A. Salzman has taught Business Math, Marketing, and Real Estate courses at American River College in Sacramento for 35 years. He says, "Some of my greatest moments in teaching have been seeing the look on the face of a student who understands a business math concept or idea for the first time." Stan and his wife have four children and eight grandchildren. Stan likes outdoor activities, exercising, and collecting antique toy trains.

Charles D. Miller (deceased) was instrumental in writing the early editions of this book as well as several other books. We continue to find inspiration and guidance in his passion for excellence.

Learning Tips for Students

SUCCESS IN BUSINESS MATHEMATICS

This text applies mathematics to solve problems in business. Your success in future business courses and pursuits will be enhanced by the knowledge and skills you will gain in this course. It is very important to realize that your future employer is far more interested in your ability to solve problems than whether you remember a particular formula or how to work one type of problem. So, the goal of this book is both to educate you about business mathematics and importantly to also help you become a better problem solver.

Studying business mathematics is different from studying subjects like English or history. The key to success is *regular practice*. This should not be surprising. After all, can you learn to ski or play a guitar without regular practice? The same is true for learning mathematics. Working problems nearly every day *is the key to becoming successful*. Here are some suggestions to help you succeed in business mathematics.

1. **Attend class regularly. Try to pay careful attention and take notes.** In particular, write down the problems the instructor works on the board.
2. **Ask questions in class.** It is not a sign of weakness, but of strength. There are always other students with the same question who are too shy to ask.
3. **Read the book carefully, maybe twice, and spend time using the online materials.** Studying each topic will help you solve the homework problems. Most exercises are keyed to specific examples or objectives that will explain the procedure for working them.
4. **Before doing your homework, look at the problems the teacher worked in class.** This will reinforce what you have learned. Many students say, "I understand it perfectly when you do it, but I get stuck when I try to work the problem myself."
5. **Read the section and review your notes before starting your homework.** Check your work against the answers in the back of the book. If you get a problem wrong and are unable to understand why, mark that problem and ask your instructor about it. Then practice working additional problems of the same type to reinforce what you have learned.
6. **Work as neatly as you can using a pencil, and organize your work carefully.** Write your symbols clearly, and make sure the problems are clearly separated from each other. Working neatly will help you to think clearly and also make it easier to review the homework before a test.
7. **After you complete a homework assignment, look over the text again.** Try to identify the main ideas that are in the lesson. Often they are clearly highlighted or boxed in the text.
8. **Use the chapter test at the end of each chapter as a practice test.** Work through the problems under test conditions, without referring to the text or the answers until you are finished. You may want to time yourself to see how long it takes you. When you finish, check your answers against those in the back of the book, and study the problems you missed.
9. **Keep all quizzes and tests that are returned to you, and use them when you study for future tests and the final exam.** These quizzes and tests indicate what concepts your instructor considers to be most important. Be sure to correct any problems on these tests that you missed so you will have the corrected work to study.
10. **Don't worry if you do not understand a new topic right away.** As you read more about it and work through the problems, you will gain understanding. Each time you review a topic, you will understand it a little better. Few people understand each topic completely right from the start.

Business Mathematics Pretest

This pretest will help you determine your areas of strength and weakness in the business mathematics presented in this book.

1. Round 5.46 to the nearest tenth. **1.** _____

2. Round $.064 to the nearest cent. **2.** _____

3. Round $399.49 to the nearest dollar. **3.** _____

4. Multiply: $\begin{array}{r} 7801 \\ \times\ 1758 \\ \hline \end{array}$ **4.** _____

5. Divide: $35\overline{)11{,}032}$ **5.** _____

6. Change $8\frac{7}{8}$ to an improper fraction. **6.** _____

7. Change $\frac{40}{26}$ to a mixed number. **7.** _____

8. Write $\frac{15}{21}$ in lowest terms. **8.** _____

9. Add: $\begin{array}{r} \frac{3}{4} \\ \frac{1}{2} \\ +\ \frac{7}{8} \\ \hline \end{array}$ **9.** _____

10. Add: $\begin{array}{r} 2\frac{2}{3} \\ 7\frac{1}{4} \\ +\ 10\frac{1}{2} \\ \hline \end{array}$ **10.** _____

11. Subtract: $\frac{3}{8} - \frac{7}{24}$ **11.** _____

12. Subtract: $\begin{array}{r} 83\frac{3}{4} \\ -21\frac{2}{5} \\ \hline \end{array}$ **12.** _____

13. Multiply: $\frac{3}{8} \times \frac{3}{5}$ **13.** _____

14. Divide: $15\frac{1}{4} \div 5\frac{1}{8}$ **14.** _____

15. Express .625 as a common fraction. **15.** _____

16. Express $\frac{3}{5}$ as a decimal. **16.** _____

17. Subtract: $\begin{array}{r} 598.316 \\ -\ 79.839 \\ \hline \end{array}$ **17.** _____

18. Multiply: $\begin{array}{r} 30.67 \\ \times\ \ 5.39 \\ \hline \end{array}$ **18.** _____

19. Divide: $1.2\overline{)309.6}$ **19.** _____

20. Express $\frac{7}{8}$ as a percent. **20.** _____

21. Intelnet spent 5.2% of its sales on advertising. If sales amounted to $864,250, what amount was spent on advertising? **21.** _____

22. What annual rate of return is needed to receive $930 in one year on an investment of $18,600? **22.** _____

23. Home Entertainment Systems offers a 60-inch LCD HDTV at a list price of $2459 less trade discounts of 20/10. What is the net cost? **23.** _____

24. A department head at Old Navy is paid $16.80 per hour with time and a half for all hours over 40 in a week. Find the employee's gross pay if she worked 43 hours in one week. **24.** _____

25. How long will it take an investment of $12,500 to earn $125 in interest at 4% per year? (*Hint:* Use Bankers Interest, i.e., assume 360 day year.) **25.** _____

26. An invoice from Collier Windows amounting to $20,250 is dated October 6 and offers terms of 3/10, n/30. If the invoice is paid on October 14, what amount is due? **26.** _____

27. Find the percent of markup based on selling price if some home exercise equipment costing $1584 is sold for $1980. **27.** _____

28. Find the single discount equivalent to a series discount of 30/20. **28.** _____

29. Using the straight-line method of depreciation, find the annual depreciation on a Bobcat loader that has a cost of $18,750, an estimated life of six years, and a scrap value of $750. **29.** _____

30. Whiting's Oak Furniture sells a dining room set for $1462.98 after deducting 26% from the original price. Find the original price. **30.** _____

Index of Applications

Business Mathematics

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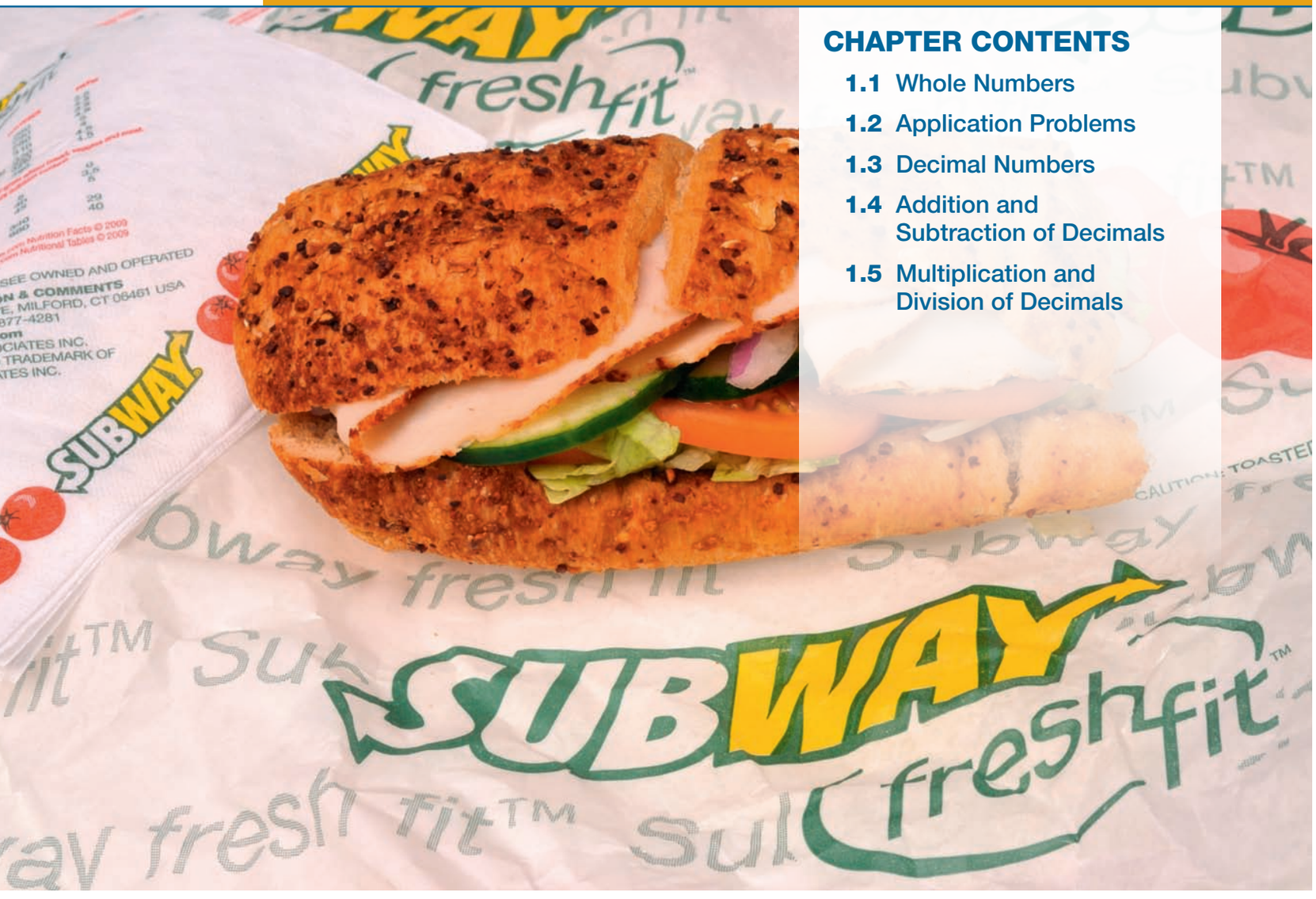
1 Whole Numbers and Decimals



CHAPTER CONTENTS

CASE IN POINT

JESSICA FERNANDEZ worked part time for SUBWAY when taking classes at a local community college, but she is now a manager that oversees 18 employees. She looks for employees that have a good work ethic, are honest and friendly, and who can work with numbers. She uses numbers daily to schedule employees, compute sales, figure sales taxes, complete the payroll, and order inventory.

This text will improve your ability to work with numbers which is important! It also teaches you important concepts that relate to your personal life (debt, savings, investment, home mortgages, insurance, and taxes) and the workplace (markup, markdown, bank services, payroll, and simple interest). You will use the concepts covered in this book throughout your life.

1.1 Whole Numbers

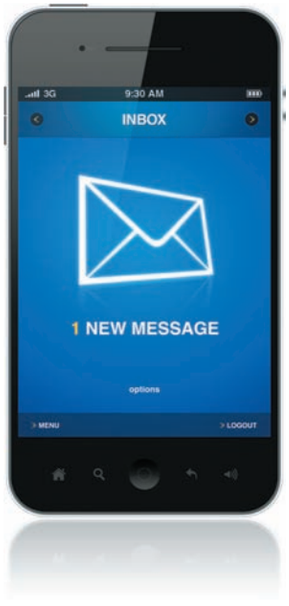
OBJECTIVES

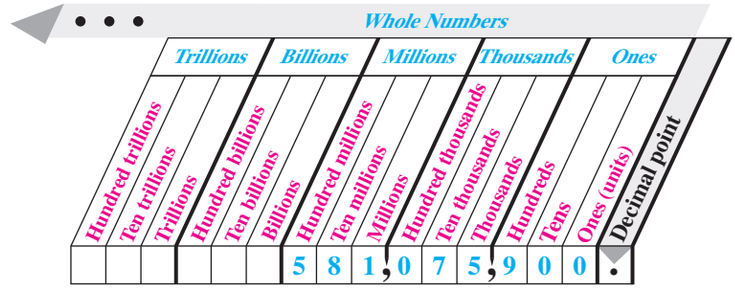
1. Define whole numbers.
2. Round whole numbers.
3. Add whole numbers.
4. Round numbers to estimate an answer.
5. Subtract whole numbers.
6. Multiply whole numbers.
7. Multiply by omitting zeros.
8. Divide whole numbers.

CASE IN POINT To improve the efficiency of workers at the SUBWAY store she manages, Jessica Fernandez cross-trains each employee so that she can do several tasks, including food preparation, cleanup, and operating the cash register. After watching an employee give a customer too much change for a second time, a frustrated Jessica Fernandez decided that any new hire must pass a basic math test.

OBJECTIVE 1 Define whole numbers. The **decimal system** uses the ten one-place **digits:** 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. Combinations of these digits represent any number needed. The starting point of this system is the **decimal point (.)**. This section considers only the numbers made up of digits to the left of the decimal point—the **whole numbers**. The following diagram names the first fifteen places held by the digits to the left of the decimal point.

A researcher estimated that 581,075,900 smart phones will be sold in 2015. Use a **comma** to work with numbers this large. Starting at the decimal place and moving to the left, place a comma between each group of three digits. Although commas are always used when writing numbers, they are not shown on some calculators. Commas are not required for numbers with four digits such as 8475.





The number 581,075,900 is read as

five hundred eighty-one million, seventy-five thousand, nine hundred.

Notice that the word "*and*" is not used with whole numbers. The word "*and*" is used for the decimal place, as discussed in Section 1.3.

Expressing Whole Numbers in Words

EXAMPLE 1 Write the following numbers in words.

(a) 7835 **(b)** 111,356,075 **(c)** 17,000,017,000

SOLUTION

(a) seven thousand, eight hundred thirty-five

(b) one hundred eleven million, three hundred fifty-six thousand, seventy-five

(c) seventeen billion, seventeen thousand

Quick TIP

Do not use the word "*and*" when reading or writing a whole number.

QUICK CHECK 1

At one point in 2013, the national debt of the United States was $16,810,680,391,540. Write the number in words.

OBJECTIVE 2 Round whole numbers. Business applications often require **rounding** numbers. For example, money amounts are often rounded to the nearest thousand or million dollars. Use these steps to **round whole numbers**.

Rounding Whole Numbers

Step 1 Locate the **place** to which the number is to be rounded. Draw a line under that place.

Step 2 If the first digit to the *right* of the underlined place is **5 or more, increase** the digit in the place to which you are rounding by 1.

If the digit is **4 or less, do not change**.

Step 3 **Change** all digits to the right of the underlined digit to zeros.

Rounding Whole Numbers

EXAMPLE 2

Round each number as indicated.

(a) 579 to nearest ten

(b) 34,127 to nearest thousand

(c) 475,871 to the nearest ten thousand

(d) 79,625 to nearest thousand

SOLUTION

(a) **Step 1** Locate the tens place and underline.

$$5\underline{7}9$$

Round to this place.

Step 2 The first digit to the right of the underlined digit is 9, which is greater than 5. Therefore, increase the digit in the tens place from 7 to 8.

Step 3 Change all digits to the right of the tens place to zero. In other words, change the 9 in the ones place to a zero.

579 rounded to the nearest ten is 580.

Quick TIP

When rounding a number, look at the first digit to the right of the digit being rounded. Do not look beyond this digit.

(b) **Step 1** Locate the thousands place and underline. 3$\underline{4}$,127

Step 2 Since the digit to the right of the thousands place is 1 (less than 5), do not change the 4 in the thousands place.

Step 3 Change all digits to the right of the thousands place to zeros.

34,127 rounded to the nearest thousand is 34,000

(c) **Step 1** Locate the ten thousands place and underline. 4$\underline{7}$5,871

Step 2 Since the digit to the right of the ten thousands place is 5, which falls in the category of 5 or more, increase the 7 to an 8.

Step 3 Change all digits to the right of the tens thousands place to zeros: **480,000**

(d) **Step 1** Locate the thousands place and underline. 7$\underline{9}$,625

Step 2 The number to the right of the underlined number 9 above is 5, which falls in the 5 or more category. Thus, increase the 9 by 1 to 10. Place a 0 in the thousands place and carry 1 to the ten thousands place changing the 7 to an 8.

Step 3 Change all digits to the right of the thousands place to zeros: **80,000**

QUICK CHECK 2

Round each number.

(a) 653,781 to the nearest ten thousand

(b) 6,578,321 to the nearest million

(c) 499,100 to the nearest thousand

(d) 499,100 to the nearest hundred thousand

We will now review four basic **operations** with whole numbers: **addition**, **subtraction**, **multiplication**, and **division**.

OBJECTIVE 3 **Add whole numbers.** In **addition**, the numbers being added are **addends**, and the answer is the **sum**, or **total**, or **amount**.

$$\begin{array}{r} 8 \\ +\ 9 \\ \hline 17 \end{array}$$

8 addend

9 addend

17 sum (answer)

Add numbers by arranging them in a column with units above units, tens above tens, hundreds above hundreds, thousands above thousands, and so on. Use the decimal point as a reference for arranging the numbers. If a number does not include a decimal point, the decimal point is assumed to be at the far right. For example, $85 = 85.$ and $527 = 527.$

Adding with Checking **EXAMPLE 3**

To find the one-day total amount of purchases at the SUBWAY store, manager Jessica Fernandez needed to add the following amounts.

Quick TIP
Always be sure to check your work.

$$\begin{array}{r} \$4028 \\ \$738 \\ 63 \\ 125 \\ 2617 \\ +\ 485 \\ \hline \$4028 \end{array}$$

First, add down the columns ↓ ↑ **Then, check by adding up.**

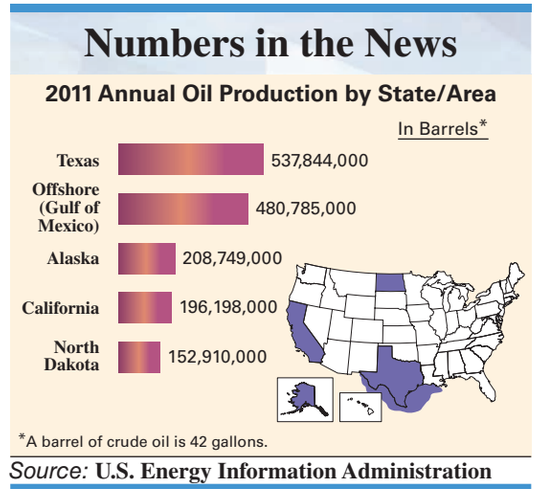
Adding from the top down results in an answer of $4028. Check for accuracy by adding again—this time from the bottom up. If the answers are the same, the sum is probably correct. If the answers are different, there is an error in either adding down or adding up, and the problem should be reworked. Both answers agree in this example, so the sum is correct.

QUICK CHECK 3
Find the total of the following expenses: $2805 + $871 + $28 + $169 + $1196

OBJECTIVE 4 **Round numbers to estimate an answer.** Answers can be quickly estimated using **front-end rounding**. This requires the first number to be rounded and all the following digits to be changed to zero. Only one nonzero digit remains.

Using Front-end Rounding to Estimate an Answer **EXAMPLE 4**

The graphic shows the top oil producing areas in the U.S. Notice that a lot of oil is produced offshore in the Gulf of Mexico. Apply front-end rounding to estimate total oil production from these areas.



Quick TIP
In front-end rounding, only one nonzero digit (first digit) remains. All digits to the right are zeros.

SOLUTION

	Actual		Front-end Rounded
Texas	537,844,000	→	500,000,000
Offshore (Gulf)	480,785,000	→	500,000,000
Alaska	208,749,000	→	200,000,000
California	196,198,000	→	200,000,000
North Dakota	152,910,000	→	200,000,000
	Estimated Total		1,600,000,000 barrels of oil

Oil consumption in the U.S. is about 7,000,000,000 barrels. The U.S. must buy the difference between what is consumed and what is produced in the U.S. It buys oil from Canada, Saudi Arabia and other oil exporting nations.

QUICK CHECK 4

Use front-end rounding to estimate the total of the following numbers.

621,150; 38,400; 9682; 27,451; 435,620

OBJECTIVE 5 **Subtract whole numbers.** A subtraction problem is set up much like an addition problem. The top number is the **minuend**, the number being subtracted is the **subtrahend**, and the answer is the **difference**.

$$\begin{array}{rl} 23 & \text{minuend} \\ -\ 7 & \text{subtrahend} \\ \hline 16 & \text{difference} \end{array}$$

Subtract one number from another by placing the subtrahend directly under the minuend with columns aligned. Begin the subtraction from the right-most column. When a digit in the subtrahend is *larger* than the corresponding digit in the minuend, **borrow** as shown in the next example.

Subtracting with Borrowing **EXAMPLE 5**

Subtract 2894 SUBWAY drink cups from 3783 SUBWAY drink cups in inventory. First, write the problem as follows.

$$\begin{array}{r} 3783 \\ -2894 \\ \hline \end{array}$$

In the ones (units) column, subtract 4 from 3 by borrowing a 1 from the tens column in the minuend to get 1 ten + 3, or 13, in the units column with 7 now in the tens column. Then subtract 4 from 13 for a result of 9. Complete the subtraction as follows.

$$\begin{array}{rrrrl} & \mathbf{2} & \mathbf{16} & \mathbf{17} & \mathbf{13} \\ & \not{3} & \not{7} & \not{8} & \not{3} \\ -\ & 2 & 8 & 9 & 4 \\ \hline & & 8 & 8 & 9 \end{array} \quad \text{drink cups}$$

In this example, the tens are borrowed from the hundreds column, and the hundreds are borrowed from the thousands column.

QUICK CHECK 5

Subtract 7832 customers from 9511 customers.

Check the answer to a subtraction problem by adding the answer (difference) to the subtrahend. The result should equal the minuend.

Subtracting with Checking **EXAMPLE 6**

Subtract 1635 from 5383 and check the answer.

Quick TIP

Do not change the order of the numbers when subtracting. For example, (9 − 5) is not the same thing as (5 − 9).

Problem

Problem (subtract down) ↓

$$\begin{array}{rl} 5383 & \text{minuend} \\ -\ 1635 & \text{subtrahend} \\ \hline 3748 & \textbf{difference} \end{array}$$

Check

$$\begin{array}{rl} 5383 & \uparrow \text{ This result should equal the minuend.} \\ +\ 1635 & \\ \hline 3748 & \text{Check (add up)} \end{array}$$

QUICK CHECK 6

Subtract 2374 from 4165, and check the answer.

OBJECTIVE 6 **Multiply whole numbers.** Multiplication is actually a quick method of addition. For example, 3 × 4 can be found by adding 3 a total of 4 times, since 3 × 4 means 3 + 3 + 3 + 3 = 12. However, it is not practical to use the addition method for large numbers. For example, 103 × 92 would be found by adding 103 a total of 92 times. Instead, find

Quick TIP

It is okay to change the order when multiplying two numbers. For example, $8 \cdot 5 = 5 \cdot 8$.

this result with multiplication. The multiplication of 103 by 92 can be written in any of the following ways:

$$103 \times 92 = 103 \cdot 92 = 103 \cdot 92 = (103)(92)$$

The number being multiplied is the **multiplicand**, the number doing the multiplying is the **multiplier**, and the answer is the **product**.

$$\begin{array}{rl} 3 & \text{multiplicand} \\ \times\ 4 & \text{multiplier} \\ \hline 12 & \text{product} \end{array}$$

When the multiplier contains more than one digit, **partial products** must be used, as in the next example, which shows the product of 25 and 34.

Multiplying Whole Numbers **EXAMPLE 7**

Multiply 25×34 by first multiplying 25 by the 4 in the ones place as shown in Step 1. Then multiply 25 by 3 in the tens place as shown in Step 2, before adding to find the answer in Step 3.

Problem	Step 1	Step 2	Step 3	
25	25	25	25	multiplicand
$\times$ 34	$\times$ 34	$\times$ 34	$\times$ 34	multiplier
	100	100	100	partial product (25×4)
		75	+ 75	partial product (25×3)
			850	product

Step 1 Multiply 25 by 4 and write 100 aligning ones places.

Step 2 Multiply 25 by 3 and write 75 one position to the left since 3 is in the tenths place. The 5 in 75 will be in the ten's place.

Step 3 Add the two partial products to get the answer.

QUICK CHECK 7

Multiply 18 telemarketers by 36 phone calls per telemarketer per hour to estimate the number of calls made in one hour.

OBJECTIVE 7 **Multiply by omitting zeros.** If the multiplier or multiplicand end in zero, first omit any zeros at the right of the numbers and then replace omitted zeros at the right of the final answer. For example, find the product of 240 and 13 as follows.

$$\begin{array}{rl} 240 & \text{Omit the zero in the calculation.} \\ \times\ 13 & \\ \hline 72 & \\ 24 & \text{Replace the omitted zero at the right of} \\ \hline 3120 & \text{312 for a final answer (product) of 3120.} \end{array}$$

Multiplying, Omitting Zeros **EXAMPLE 8**

In the following multiplication problems, omit zeros in the calculation and then replace omitted zeros to obtain the product.

(a)

$$\begin{array}{rrl} 150 & 15 & \leftarrow \text{omit zeros} \\ \times\ 70 & \times\ 7 & \\ & 105 & \\ & 10{,}500 & \leftarrow \text{attach 2 zeros; answer} \end{array}$$

(b)

$$\begin{array}{rrl} 300 & 3 & \leftarrow \text{omit zeros} \\ \times\ 90 & \times\ 9 & \\ & 27 & \\ & 27{,}000 & \leftarrow \text{attach 3 zeros; answer} \end{array}$$

QUICK CHECK 8

Multiply 400 by 50. Omit zeros in the calculation and replace them in the product.

Quick TIP

A shortcut for multiplying by 10, 100, 1000, and so on is to just attach the number of zeros to the number being multiplied. For example,

$33 \times 10 = 33$ and 1 zero $= 330$

$56 \times 100 = 56$ and 2 zeros $= 5600$

$732 \times 1000 = 732$ and 3 zeros $= 732{,}000$

OBJECTIVE 8 **Divide whole numbers.** The **dividend** is the number being divided, the **divisor** is the number doing the dividing, and the **quotient** is the answer. **Division** is indicated in any of the following ways.

$$\underset{\text{dividend}}{15} \div \underset{\text{divisor}}{5} = \underset{\text{quotient}}{3} \qquad \text{divisor } 5\overline{)15} \text{ dividend}, \quad \text{quotient } 3$$

$$\frac{\text{dividend } 15}{\text{divisor } 5} = 3 \text{ quotient}$$

Dividing Whole Numbers **EXAMPLE 9**

To divide 1095 baseball cards evenly among 73 collectors, divide 1095 by 73 as follows.

$$73\overline{)1095}$$

Since 73 is larger than 1 or 10, but smaller than 109, begin by dividing 73 into 109. There is one 73 in 109, so place 1 *over the digit 9* in the dividend as shown. Then multiply 1 and 73.

$$\begin{array}{r} 1 \\ 73\overline{)1095} \\ \underline{73} \\ 36 \end{array} \qquad 1 \times 73 = 73$$

Subtract 73 from 109 to get 36. The next step is to bring down the 5 from the dividend, placing it next to the remainder 36. This gives the number 365. The divisor, 73, is then divided into 365 with a result of 5, which is placed to the right of the 1 in the quotient. Since 73 divides into 365 exactly 5 times, the final answer (quotient) is exactly 15.

$$\begin{array}{r} 15 \\ 73\overline{)1095} \\ \underline{73} \\ 365 \\ \underline{365} \\ 0 \end{array}$$

Check the answer by multiplying.

$$\begin{array}{r} 73 \\ \times\ 15 \\ \hline 365 \\ \underline{73} \\ 1095 \end{array}$$

Since this is the original number of cards, the answer checks.

QUICK CHECK 9

Divide \$7506 evenly among 18 winners. How much will each receive?

Often, the divisor does not divide evenly into the dividend, leaving a remainder. The next example shows that remainders can be also be written using fractions or decimals. Fractions and decimals are covered in the next chapter. For now, write a remainder of 6 as R6.

Dividing with a Remainder in the Answer

EXAMPLE 10 Divide 126 by 24. Express the remainder in each of the three forms.

Remainder	Fraction	Decimal
5 R6	$5\frac{6}{24}$	5.25
$24\overline{)126}$	$24\overline{)126}$	$24\overline{)126.00}$
120	120	120
6	6	60
		48
		120
		120
		0

QUICK CHECK 10

Divide 19 by 5.

If a divisor contains zeros at the far right, first drop the zeros in the divisor and then move the decimal point in the dividend the same number of places to the left as there were zeros dropped from the divisor.

$900\overline{)108{,}000}$ becomes $9\overline{)1080}$

Drop 2 zeros. Move decimal point 2 places left.

Dropping Zeros to Divide

EXAMPLE 11 To divide 108,000 by 900, first drop two zeros from each number. Then divide.

$$9\overline{)1080}\quad\begin{array}{r}120\\ 9\\ \hline 18\\ 18\\ \hline 0\\ 0\\ \hline\end{array}$$

Check Answer

$$\begin{array}{r}120\\ \times\ 9\\ \hline 1080\end{array}$$ so the division is correct

You must change 9 back to 900 and multiply by 120 to get the original dividend of 108,000.

Quick TIP

After dropping zeros and dividing, do not add trailing zeros back to the answer.

Therefore, $108{,}000 \div 900 = 120$.

QUICK CHECK 11

First drop zeros, and then divide $19{,}200 \div 300$.

Checking Division Problems with Remainders

EXAMPLE 12 In a division problem, check the answer by multiplying the quotient (answer) and the divisor. Then add any remainder. If the result is not the same as the dividend, an error exists and the problem should be reworked. Check the following division problems.

(a)

$$716\overline{)26{,}495}\quad\begin{array}{r}37\text{ R3}\\ 21\,48\\ \hline 5\,015\\ 5\,012\\ \hline 3\end{array}$$

remainder

(b)

$$418\overline{)35{,}536}\quad\begin{array}{r}85\text{ R6}\\ 33\,44\\ \hline 2\,096\\ 2\,090\\ \hline 6\end{array}$$

remainder

Quick TIP

Be sure to add the remainder to the product when checking a division problems with a remainder.

SOLUTION

(a)

$$\begin{array}{r} 716 \\ \times\ 37 \\ \hline 5012 \\ 2148 \\ \hline 26{,}492 \\ +\ \ 3 \\ \hline 26{,}495 \end{array}$$

add remainder

correct

(b)

$$\begin{array}{r} 418 \\ \times\ 85 \\ \hline 2090 \\ 3344 \\ \hline 35{,}530 \\ +\ \ 6 \\ \hline 35{,}536 \end{array}$$

add remainder

correct

QUICK CHECK 12

Divide 9897 by 215. Check the answer by multiplying the quotient (answer) by the divisor.

1.1 Exercises

MyMathLab®

The shaded sections below contain solutions to help you get a **QUICK START** *on the various types of exercises.*

Write the following numbers in words. (See Example 1.)

1. 7040 seven thousand, forty

2. 5310 five thousand, three hundred ten

3. 37,901 _____

4. 725,069 _____

5. 4,650,015 _____

6. 3,765,041,000 _____

Round each of the following numbers first to the nearest ten, then to the nearest hundred, and finally to the nearest thousand. Go back to the ***original number*** *each time before rounding to the next position. (See Example 2.)*

	Nearest Ten	*Nearest Hundred*	*Nearest Thousand*
7. 2065	**2070**	**2100**	**2000**
8. 8385	**8390**	**8400**	**8000**
9. 46,231			
10. 55,175			
11. 106,054			
12. 359,874			

13. Explain the three steps needed to round a number when the digit to the right of the place to which you are rounding is 5 or more. (See Objective 2.)

14. Explain the three steps needed to round a number when the digit to the right of the place to which you are rounding is 4 or less. (See Objective 2.)