

14th Edition

# Business MATHEMATICS

Gary Clendenen  
Stanley A. Salzman



# Business Mathematics

FOURTEENTH EDITION

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# Contents

*Preface* vi

*The Business Mathematics, 14th Edition, Learning System* vii

*Learning Tips for Students* xiv

*Business Mathematics Pretest* xv

*Index of Applications* xvi

## Chapter 1

### Whole Numbers and Decimals 1

- 1.1 Whole Numbers 2
- 1.2 Application Problems 14
- 1.3 Decimal Numbers 20
- 1.4 Addition and Subtraction of Decimals 24
- 1.5 Multiplication and Division of Decimals 28
  - Chapter 1 Quick Review 35
  - Chapter Terms 35
  - Case Study: Cost of Getting Married 37
  - Case in Point Summary Exercise: Subway 38
  - Chapter 1 Test 39

## Chapter 2

### Fractions 41

- 2.1 Fractions 42
- 2.2 Addition and Subtraction of Fractions 48
- 2.3 Addition and Subtraction of Mixed Numbers 56
- 2.4 Multiplication and Division of Fractions 60
- 2.5 Converting Decimals to Fractions and Fractions to Decimals 68
  - Chapter 2 Quick Review 72
  - Chapter Terms 72
  - Case Study: Operating Expenses at Woodline Moldings and Trim 74
  - Case in Point Summary Exercise: The Home Depot 75
  - Chapter 2 Test 76

## Chapter 3

### Percents 79

- 3.1 Writing Decimals and Fractions as Percents 80
- 3.2 Finding Part 87
- 3.3 Finding Base 94
  - Supplementary Application Exercises on Base and Part 98
- 3.4 Finding Rate 100
  - Supplementary Application Exercises on Base, Rate, and Part 104
- 3.5 Increase and Decrease Problems 108
  - Chapter 3 Quick Review 115
  - Chapter Terms 115

Case Study: Self Employed Retirement Plan 117

Case in Point Summary Exercise: Century 21 118

Chapter 3 Test 119

## Chapter 4

### Equations and Formulas 121

- 4.1 Solving Equations 122
- 4.2 Applications of Equations 130
- 4.3 Business Formulas 139
- 4.4 Ratio and Proportion 148
  - Chapter 4 Quick Review 157
  - Chapter Terms 157
  - Case Study: Forecasting Sales at Alcorn's Boutique 159
  - Case in Point Summary Exercise: General Motors 160
  - Chapter 4 Test 162
  - Chapters 1–4 Cumulative Review 166

## Chapter 5

### Bank Services 171

- 5.1 Banking, Checking Accounts, and Check Registers 172
- 5.2 Checking Services and Credit-Card Transactions 182
- 5.3 Bank Statement Reconciliation 188
  - Chapter 5 Quick Review 197
  - Chapter Terms 197
  - Case Study: Banking Activities of a Retailer 199
  - Case in Point Summary Exercise: Jackson & Perkins 200
  - Chapter 5 Test 202

## Chapter 6

### Payroll 204

- 6.1 Gross Earnings: Wages and Salaries 205
- 6.2 Gross Earnings: Piecework and Commissions 214
- 6.3 Social Security, Medicare, and Other Taxes 222
- 6.4 Income Tax Withholding 228
  - Chapter 6 Quick Review 239
  - Chapter Terms 239
  - Case Study: Payroll: Finding Your Take-Home Pay 242
  - Case in Point Summary Exercise: Payroll at Starbucks 243
  - Chapter 6 Test 244

## Chapter 7

### Mathematics of Buying 246

- 7.1 Invoices and Trade Discounts 247
- 7.2 Series Discounts and Single Discount Equivalents 257



- 7.3** Cash Discounts: Ordinary Dating Methods 261
- 7.4** Cash Discounts: Other Dating Methods 267
- Chapter 7 Quick Review** 274
- Chapter Terms** 274
- Case Study: George Foreman** 276
- Case in Point Summary Exercise: Discounts at Bed Bath & Beyond** 277
- Chapter 7 Test** 278

## Chapter 8

### Mathematics of Selling 280

- 8.1** Markup on Cost 281
- 8.2** Markup on Selling Price 288
- Supplementary Application Exercises on Markup** 296
- 8.3** Markdown 298
- 8.4** Turnover and Valuation of Inventory 304
- Chapter 8 Quick Review** 313
- Chapter Terms** 313
- Case Study: Markdown: Reducing Prices to Move Merchandise** 317
- Case in Point Summary Exercise: Recreational Equipment Inc. (REI)** 318
- Chapter 8 Test** 319
- Chapters 5–8 Cumulative Review** 321

## Chapter 9

### Simple Interest 323

- 9.1** Basics of Simple Interest 324
- 9.2** Finding Principal, Rate, and Time 335
- 9.3** Simple Discount Notes 343
- 9.4** Discounting a Note Before Maturity 352
- Supplementary Application Exercises on Simple Interest and Simple Discount** 360
- Chapter 9 Quick Review** 364
- Chapter Terms** 364
- Case Study: Banking in a Global World: How Do Large Banks Make Money?** 368
- Case in Point Summary Exercise: Apple, Inc.** 369
- Chapter 9 Test** 370

## Chapter 10

### Compound Interest and Inflation 372

- 10.1** Compound Interest 373
- 10.2** Interest-Bearing Bank Accounts and Inflation 384
- 10.3** Present Value and Future Value 394
- Chapter 10 Quick Review** 399
- Chapter Terms** 399
- Case Study: Valuing a Chain of McDonald's Restaurants** 401
- Case in Point Summary Exercise: Bank of America** 402
- Chapter 10 Test** 403
- Chapters 9–10 Cumulative Review** 405

## Chapter 11

### Annuities, Stocks, and Bonds 407

- 11.1** Annuities and Retirement Accounts 408
- 11.2** Present Value of an Ordinary Annuity 416
- 11.3** Sinking Funds (Finding Annuity Payments) 424
- Supplementary Application Exercises on Annuities and Sinking Funds** 431
- 11.4** Stocks and Mutual Funds 433
- 11.5** Bonds 443
- Chapter 11 Quick Review** 449
- Chapter Terms** 449
- Case Study: Financial Planning** 452
- Case in Point Summary Exercise** 453
- Chapter 11 Test** 454

## Chapter 12

### Business and Consumer Loans 456

- 12.1** Open-End Credit and Charge Cards 457
- 12.2** Installment Loans 467
- 12.3** Early Payoffs of Loans 475
- 12.4** Personal Property Loans 482
- 12.5** Real Estate Loans 490
- Chapter 12 Quick Review** 497
- Chapter Terms** 497
- Case Study: Consolidating Loans** 501
- Case in Point Summary Exercise: Underwater on a Home** 503
- Chapter 12 Test** 505
- Chapters 11–12 Cumulative Review** 507

## Chapter 13

### Taxes and Insurance 510

- 13.1** Property Tax 511
- 13.2** Personal Income Tax 518
- 13.3** Fire Insurance 532
- 13.4** Motor-Vehicle Insurance 541
- 13.5** Life Insurance 549
- Chapter 13 Quick Review** 556
- Chapter Terms** 556
- Case Study: Financial Planning for Property Taxes and Insurance** 559
- Case in Point Summary Exercise: Mattel Inc.—Taxes and Insurance** 560
- Chapter 13 Test** 562

## Chapter 14

### Depreciation 564

- 14.1** Straight-Line Method 565
- 14.2** Declining-Balance Method 573
- 14.3** Sum-of-the-Years'-Digits Method 580
- Supplementary Application Exercises on Depreciation** 587

- 14.4** Units-of-Production Method 591
- 14.5** Modified Accelerated Cost Recovery System 596
  - Chapter 14 Quick Review 604
  - Chapter Terms 604
  - Case Study: Comparing Depreciation Methods 606
  - Case in Point Summary Exercise: Ford Motor Company 607
  - Chapter 14 Test 608

## Chapter 15

### Financial Statements and Ratios 610

- 15.1** The Income Statement 611
- 15.2** Analyzing the Income Statement 616
- 15.3** The Balance Sheet 623
- 15.4** Analyzing the Balance Sheet 627
  - Chapter 15 Quick Review 635
  - Chapter Terms 635
  - Case Study: Bicycle Shop 638
  - Case in Point Summary Exercise: Apple, Inc. 640
  - Chapter 15 Test 642

## Chapter 16

### Budgeting and Business Statistics 644

- 16.1** Planning and Budgeting 645
- 16.2** Frequency Distributions and Graphs 654
- 16.3** Mean, Median, and Mode 666
  - Chapter 16 Quick Review 674

- Chapter Terms 674
- Case Study: Watching a Small Business Grow 677
- Case in Point Summary Exercise: Bobby Flay 678
- Chapter 16 Test 679

## Appendix A

### The Metric System A-1

## Appendix B

### Basic Calculators B-1

## Appendix C

### Financial Calculators C-1

## Appendix D

### Exponents and the Order of Operations D-1

## Appendix E

### Graphing Equations E-1

- Answers to Selected Exercises AN-1
- Glossary G-1
- Index I-1
- Photo Credits P-1

## FROM THE AUTHORS

The fourteenth edition of *Business Mathematics* has been significantly revised to update the text, improve the discussions, and make the material more relevant to students. The focus on real-world applications has been sharpened. A different well-known company is highlighted at the beginning of each chapter and used throughout the chapter in examples, discussions, exercises, and a case at the end. Each chapter ends with two business application cases that will help students integrate concepts from the chapter. This edition is full of data, examples, graphs, photographs, and news clippings that will help students understand the relevance of the material as it teaches them to interpret data and information. A global perspective is emphasized through examples and exercises that highlight issues in other countries.

This book shows students how to use math to solve a wide variety of problems in business and also within families. Primary goals are to develop students' understanding of business, increase their ability to figure out how to work many different kinds of business problems, and motivate them using many actual business applications to which they can relate.

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, recessions, 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. A new section called Planning and Budgeting has been added as Section 16.1. It both emphasizes the value of planning and budgeting in a business and in a family. Appendices expand material covered in the book to include the use of financial calculators, additional material on algebra related to exponents and order of operations, and the construction and use of graphs, a vitally important topic in today's world.

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 MyLab Math. Numerous studies have shown that MyLab Math 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, new Case-in-Point 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 MyLab Math. 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 subject line.

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# The Business Mathematics, 14th Edition, Learning System

This textbook has evolved over the years as many thousands of students and hundreds of instructors have used the book and told us what works and what doesn't. *Business Mathematics*, 14th edition, Learning System is the result of this process of refinement that informs both the printed textbook and our MathXL and MyLab Math applications 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.

A feature titled **Learning Catalytics** at the beginning of each chapter can be used to either introduce the topic quickly to students or test whether they have read the material.


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.

| Chapter | Case-in-Point Companies       |
|---------|-------------------------------|
| 1       | Subway                        |
| 2       | Home Depot                    |
| 3       | Century 21                    |
| 4       | General Motors                |
| 5       | Rose Gardens                  |
| 6       | Starbucks                     |
| 7       | Bed, Bath & Beyond            |
| 8       | REI (sporting goods)          |
| 9       | Apple, Inc.                   |
| 10      | Bank of America               |
| 11      | Mayo Clinic                   |
| 12      | Citigroup                     |
| 13      | The Doll House (entrepreneur) |
| 14      | Capital Curb & Concrete       |
| 15      | Apple, Inc.                   |
| 16      | Bev's Deli                    |




## 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 Example.

**Basic Calculator Instruction** in Appendix B presents detailed coverage of basic 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.

## NEW CONTENT HIGHLIGHTS

The fourteenth edition has far more changes than is possible to list, but here are many important changes listed by chapter(s).

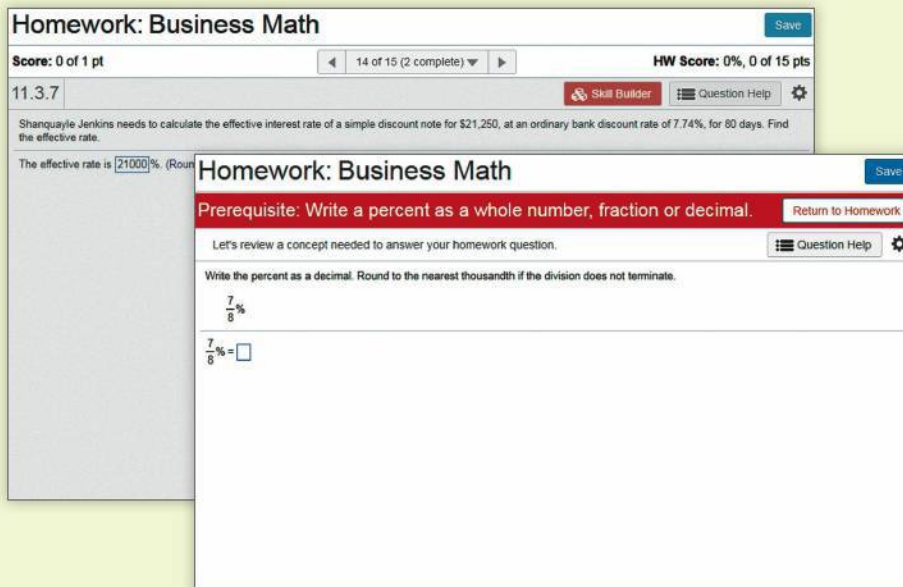
- Chapters 1 through 4 have been revised and examples updated. If desired, the material in Chapter 4 on Equations and Formulas can be supplemented with additional material on Exponents and Order of Operations found in Appendix D and Graphing Equations found in Appendix E.
- Chapter 5 (**Bank Services**) has been completely revised to better align with today's reality. Students will begin to learn how banks operate in this chapter, which is then reinforced in Chapters 7, 8, 9, and 10. The ever-increasing role of Internet and mobile banking is emphasized.
- Chapter 6 (**Payroll**) has been extensively updated and includes the most recent information on Social Security, Medicare, and income tax withholding. Graphs and tables in the chapter show cost of living in different cities, average income and unemployment rate by level of education, and median income for a large number and wide range of careers.
- Chapter 8 (**Mathematics of Selling**) has been revised to better align with business practices, with slightly more focus on competition and the need to sometimes discount dated merchandise to move it out of inventory. Graphs included show annual sales at ten retail giants, percent of people who feel euphoric after making purchases of certain items (which helps drive sales), and cost comparisons across countries.
- Chapter 9 (**Simple Interest**) has been expanded and helps students understand the importance of interest rates. It includes a graph that shows how interest rates on consumer loans have greatly varied through the years and a discussion of how the government manipulates interest rates to help the economy grow or slow down depending on what it thinks the economy needs.
- Chapter 10 (**Compound Interest and Inflation**) discusses at length the benefits of compound interest over time including through the use of company-funded retirement plans. Inflation is defined and examples and exercises emphasize the effect of inflation on a family's income. Deflation is also described and discussed in terms of the Great Depression. The equation for finding compound interest is slightly more prominent in the chapter, along with a discussion of how to use the equation for those interested in a more algebraic approach.
- Chapter 11 (**Annuities, Stocks, and Bonds**) emphasizes the value of compound interest in long-term savings both for individuals using corporate-sponsored retirement plans and for businesses with a large expected expense coming up at some point. All of the material on stocks and bonds has been updated, and is discussed from the perspective of both corporations raising funds and investors.
- Chapter 12 (**Business and Consumer Loans**) has been extensively revised, and discusses the importance of loans for families, businesses, and the federal government. The chapter discusses many topics of interest to students: credit-card loans, student loans, FICO scores, consumer loans, business loans, and real estate loans. It highlights strategies for coping with debt by discussing refinancing and through a case highlighting a family that is "under water" or owes more on their home than it is worth.
- Chapter 13 (**Taxes and Insurance**) discusses taxes and insurance in terms of an entrepreneur. It gives students a sense of the tax and insurance complexity (property taxes, sales taxes, income taxes, payroll taxes, building insurance, and automobile insurance) that families and businesses face.
- Chapter 15 (**Financial Statements and Ratios**) discusses financial statements and ratios in terms of a company loved by students: Apple, Inc. The discussion on ratios has been expanded and examples are shown of other companies as well.
- Chapter 16 (**Budgeting and Business Statistics**) includes a **NEW SECTION** on planning and budgeting. First it discusses planning and budgeting for a family, with its known recurring expenses, and includes a discussion on how to plan for and deal with unexpected expenses. It then goes on to discuss planning and budgeting for a company called Bev's Deli, which is highlighted through the chapter. The inclusion of this new section will help students synthesize many topics from across the course, including: choosing a career and level of education to work toward, controlling costs, planning for expected and unexpected expenses, thinking long-term, managing debt, reflecting on the costs of insurance and taxes, and saving or investing. The remainder of the chapter discusses frequency distributions and graphs as well as measures of central tendency (mean, median, and mode). The material on graphs can be enhanced using Appendix E (Graphing Equations) for those interested.



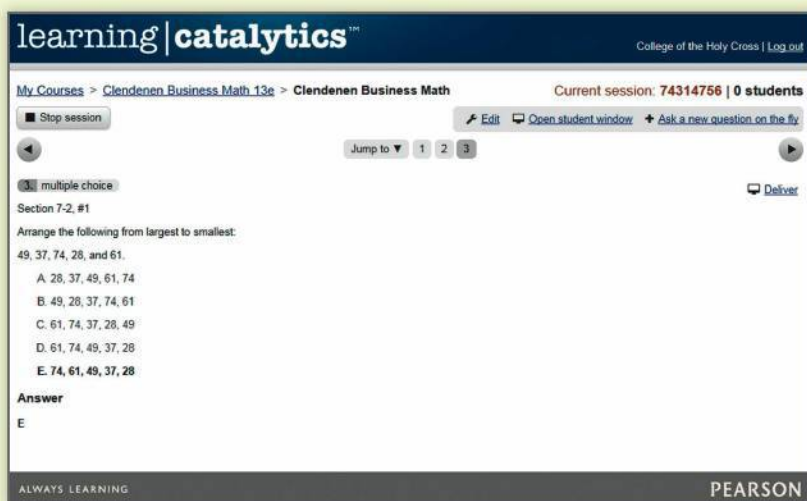
# Get the Most out of MyLab Math for Business

Mathematics by Clendenen and Salzman

Used by over 2 million students a year, MyLab™ Math is the world’s leading online program for teaching and learning mathematics. MyLab Math delivers assessment, tutorials, and multimedia resources that provide engaging and personalized experiences for each student, so learning can happen in any environment. Each course is developed to accompany Pearson’s best-selling content, authored by thought leaders across the math curriculum, and can be easily customized to fit any course format. (Access code required.)

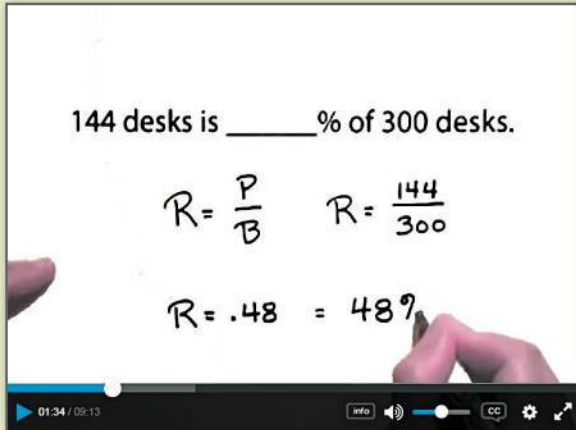


**New! Skill Builder** offers adaptive practice that is designed to increase students’ ability to complete their assignments. By monitoring student performance on their homework, Skill Builder adapts to each student’s needs and provides just-in-time, in-assignment practice to help them improve their proficiency of key learning objectives - including prerequisite skills if needed.



## Learning Catalytics

Generate class discussion, guide your lecture, and promote peer-to-peer learning with real-time analytics. MyLab™ Math now provides Learning Catalytics—an interactive student response tool that uses students’ smartphones, tablets, or laptops to engage them in more sophisticated tasks and thinking. MyLab™ Math access required.



### Updated Video Program

A variety of videos have been updated and added to the Clendenen Business Math course to walk students through concepts from every section of the text, giving them support when they need it - at home, in the lab, or on the go.

### Case-in-point Videos

16 new videos, based off the Case-in-point feature at the end of each chapter, bring Business Math to life. From case studies on the cost of getting married to calculating your take home pay, students gain insight into the practical and day-to-day applications of their course.

### Section Lecture Videos

Section Lecture Videos have been updated to reflect new content in the 14th edition, including the new section 16.1 on Planning & Budgeting.

### MathXL<sup>®</sup> Online Course

With MathXL, instructors can create, edit, and assign online homework and tests using algorithmically generated exercises correlated at the objective level to *Business Mathematics*. Instructors can also import TestGen tests for added flexibility, and maintain records of all student work tracked in MathXL's online gradebook. (Access code required.)

### Trade Application Library

Clendenen Business Math will be available with a library of MathXL applications focused on vocations and trades, allowing instructors to create assignments geared toward practical on-the-job applications.



# Resources for Success

## Instructor Resources

### Instructor's Resource Manual

This manual contains suggestions for pacing the course and creating homework assignments. It discusses how to incorporate technology and how to structure project assignments. The manual also contains section-by-section suggestions for presenting lectures and for undertaking the explorations in the text.

### PowerPoints

Available through [www.pearson.com](http://www.pearson.com) or inside your MyLab Math course, these fully editable lecture slides include definitions, key concepts, and examples for use in a lecture setting and are available for each section of the text.

### Instructor's Solutions Manual

This free online manual includes complete solutions to the even-numbered exercises in the homework sections of the text.

### TestGen

TestGen enables instructors to build, edit, print, and administer tests by 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. Tests can be printed or administered online. The software and test bank are available for free download from Pearson Education's online catalogue.

## Student Resources

### Student Solutions Manual

Fully worked solutions to odd-numbered exercises are available free online in MyLab<sup>®</sup> Math.

# Acknowledgments

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](mailto:gclendenen@yahoo.com). Please use “Business Math” in the subject line.

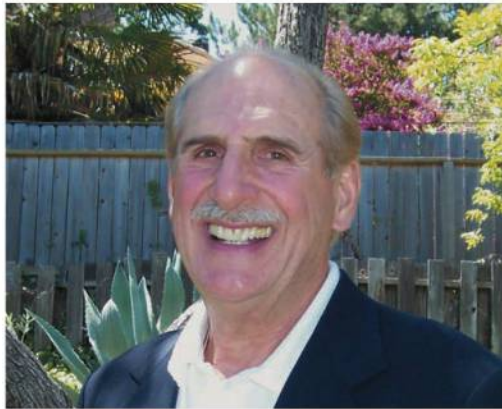
Gary Clendenen  
Stanley A. Salzman



# 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 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, swimming, and reading on a wide variety of topics including history, economics, and natural resources. He has two sons and several grandchildren, and he and his wife “use miniature horses to encourage kids to read.” Meet Hot Dog (brown) and Thor (gray).



**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 eleven grandchildren. Stan likes outdoor activities, exercising, and collecting antique toy trains.

# Learning Tips for Students



## SUCCESS IN BUSINESS MATHEMATICS

This book focuses on using math to solve business problems. In the process, it will give you a better framework to understand business concepts related to payroll, supply chains, taxes, insurance, interest, debt, saving, financial statements, etc. It will teach you how to use math to solve a very wide variety of problems in business; yet it gives enough information to help you deal with personal financial issues. You will be using many of the concepts in this book throughout your life, so we encourage you to really understand the concepts well. Another goal of this book is to make you a better problem solver, which is what managers are looking for in the people they hire.

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.**
- 2. Ask questions in class.** It is not a sign of weakness, but of strength.
- 3. Read the book carefully, maybe twice, and spend time using the online materials.** Studying each topic will help you solve the homework problems.
- 4. Before doing your homework, look at the problems the teacher worked in class.** This will reinforce what you have learned.
- 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.
- 6. Carefully organize your work.** This will help you think clearly and understand better.
- 7. After you complete a homework assignment, quickly review the main concepts to reinforce what you have learned.**
- 8. Use the chapter test at the end of each chapter as a practice test.** Carefully review any problem or concept 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.** Correct any problems missed and look again at concepts related to that topic.
- 10. Try not to worry if you do not understand a topic right away, and don't get stressed over tests.** No one understands all the concepts immediately! It takes time for every one of us to understand something new. If you understand the concepts well, have carefully looked at all examples both in the book and from your instructor, and done several exercises, you will probably do reasonably well on a test. Talk to your teacher if you have a lot of anxiety about tests.

# 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.  | 5. Divide: $35 \overline{)11,032}$  | 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. _____  |
| 6. Change $8\frac{7}{8}$ to an improper fraction.  |   | 5. _____  |
| 7. Change $\frac{40}{26}$ to a mixed number.   |   | 6. _____  |
| 8. Write $\frac{15}{21}$ in lowest terms.  |   | 7. _____  |
| 9. Add: $\begin{array}{r} \frac{3}{4} \\ + \frac{1}{2} \\ + \frac{7}{8} \\ \hline \end{array}$   | 10. Add: $\begin{array}{r} 2\frac{2}{3} \\ 7\frac{1}{4} \\ + 10\frac{1}{2} \\ \hline \end{array}$ | 8. _____  |
| 11. Subtract: $\frac{3}{8} - \frac{7}{24}$   | 12. Subtract: $\begin{array}{r} 83\frac{3}{4} \\ - 21\frac{2}{5} \\ \hline \end{array}$           | 9. _____  |
| 13. Multiply: $\frac{3}{8} \times \frac{3}{5}$   | 14. Divide: $15\frac{1}{4} \div 5\frac{1}{8}$   | 10. _____ |
| 15. Express .625 as a common fraction.   | 16. Express $\frac{3}{5}$ as a decimal.   | 11. _____ |
| 17. Subtract: $\begin{array}{r} 598.316 \\ - 79.839 \\ \hline \end{array}$   | 18. Multiply: $\begin{array}{r} 30.67 \\ \times 5.39 \\ \hline \end{array}$                       | 12. _____ |
| 19. Divide: $1.2 \overline{)309.6}$  | 20. Express $\frac{7}{8}$ as a percent.   | 13. _____ |
| 21. Intelnet spent 5.2% of its sales on advertising. If sales amounted to \$864,250, what amount was spent on advertising?   |   | 14. _____ |
| 22. What annual rate of return is needed to receive \$930 in one year on an investment of \$18,600?  |   | 15. _____ |
| 23. Home Entertainment Systems offers an 80-inch LCD HDTV at a list price of \$2459 less trade discounts of 20/10. What is the net cost?   |   | 16. _____ |
| 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.           |   | 17. _____ |
| 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.)                                       |   | 18. _____ |
| 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?                       |   | 19. _____ |
| 27. Find the percent of markup based on selling price if some home exercise equipment costing \$1584 is sold for \$1980.   |   | 20. _____ |
| 28. Find the single discount equivalent to a series discount of 30/20.   |   | 21. _____ |
| 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. |   | 22. _____ |
| 30. Whiting's Oak Furniture sells a dining room set for \$1462.98 after deducting 26% from the original price. Find the original price.  |   | 23. _____ |
|  |   | 24. _____ |
|  |   | 25. _____ |
|  |   | 26. _____ |
|  |   | 27. _____ |
|  |   | 28. _____ |
|  |   | 29. _____ |
|  |   | 30. _____ |

# Index of Applications

## A

### Agriculture

- Alligator hunting, 428
- Christmas tree farm, 349
- Commercial fertilizer, 66
- Commercial fishing boats, 578–579, 603
- Egg production, 13
- Farmland prices, 112
- Forestry operations, 487
- Gardening, 53
- Land area, 18
- Land sale, 429
- Landscaping, 479
- Long-stemmed roses, 297
- Pecan trees, 473
- Race horses, 350
- Trucks & sprayers, 349

### Automotive/Transportation

- Antilock brakes, 112
- Automotive, 273
- Auto parts startup, 146
- Auto production, 155
- Auto repair, 53, 138, 633
- Auto sales, 113
- Camaros and Mustangs, 98
- Car emissions, 18
- Car seats, 303
- Chrome rims, 33
- Company vehicles, 601
- Diesel tractor, 589
- Driving distractions, 91
- Driving tests, 97
- Fire truck, 430
- Fuel consumption, 67
- Garbage truck, 481
- Harley Davidson, 138
- Heavy-duty truck, 595
- Hybrid Toyota, 33
- Map reading, 154
- Miles driven, 17
- Motorcycles, 303, 516
- Motorcycle safety, 104
- Mustang, 145
- New Toyota, 287
- Petroleum transport, 53
- Police cruisers, 265
- Shuttle van, 588
- Ski boat, 473
- Tesla, 92
- Toyota, 473
- Tractor parts, 287
- Tractor purchase, 358, 473, 487
- Trailer load, 58
- Transmission, 54
- Transmission repair, 633
- Truck accessories, 303
- Vehicle depreciation, 571
- Weighing freight, 18
- Wheels with bling, 272
- Yard Maintenance, 19

## B

### Banking

- Accumulating \$1,000,000, 428
- Amortizing a loan, 488
- Amount due, 273
- Amount owed the IRS, 237
- Appliance repair loan, 488

- Bad credit history, 350
- Bank balances, 180–181
- Bank loan, 340
- Benefit increase, 106
- Budgeting, 106
- Capital improvement, 333
- Checking account records, 27
- Check processing, 18
- Commission with returns, 220
- Completing check stubs, 179
- Compound interest, 391
- Corporate finance, 333, 382
- Corporate savings, 392
- Credit-card balance, 464–466
- Credit-card deposits, 185–186
- Credit union, 381
- Emergency cash, 392
- Financing college expenses, 397
- Finding interest, 146
- Finding time, 146
- Home loan, 496
- Inflation and retirement, 392
- Inheritance, 147, 392
- Interest earnings, 341
- Interest rate, 341
- International finance, 350, 381, 382
- Loan amount, 147
- Loan collateral, 391
- Loan qualification, 97
- Loans between banks, 333
- Loans to minorities, 114
- Loan to an uncle, 146
- Maintaining bank records, 178–179
- Maturity value, 146
- Maximizing profit, 382
- Partial invoice payment, 273
- Partial payment, 479
- Payment due, 273
- Penalty on late payment, 341
- Poor credit, 349
- Promissory note, 341
- Putting up collateral, 392
- Reconciling checking accounts, 193–196
- Retirement account, 98, 341
- Retirement funds, 448
- Retirement income, 392
- Retirement planning, 415
- Salary plus commission, 221
- Saving for a home, 415
- Saving for retirement, 340
- Savings, 146, 381
- Savings account, 391
- Short-term savings, 340
- Student loan, 146
- Time of deposit, 341, 342, 391
- Time or rate?, 382
- United Kingdom, 381
- Variable-commission payment, 220
- Writing a will, 441

### Business

- Abbreviations on invoices, 253
- Advertising expenses, 102, 103
- Automotive supplies, 296
- Barge depreciation, 572
- Battery store, 358
- Best Buy, 213
- Book publishing, 664
- Bridal shop, 145
- Business expansion, 398

- Business fixtures, 571
- Business ownership, 93
- Business safe, 588
- Cadillac dealer, 632
- Calculation gross earnings, 32–33
- Call center, 19
- Catering company, 265
- Clothing shop, 154
- Clothing store, 144
- Coffee shop, 603, 620
- Commercial carpeting, 66
- Comparing discounts, 260
- Convenience store, 517
- Corporate profits, 91
- Cost after markdown, 104
- As of dating, 266
- Dental-supply company, 615
- Discount dates, 272
- Distribution center, 587
- Drilling equipment, 602
- Electrical supplies, 265
- Entrepreneur, E-12
- Evaluating inventory, 312
- Expanding manufacturing operations, 398
- Finding discount dates, 266
- Flower shop, 620
- Food inflation, 112
- Gift shop, 614
- Global trade, 350
- Grocery chain, 625
- Grocery store, 423
- Guitar shop, 620
- Hardware store, 349
- Hotel room costs, 18
- Ice cream shop, 614
- International business, 333
- International shipments, 137
- Inventory, 332, 480
- Inventory purchase, 342
- Juice company, 632
- Lawsuit, 349
- Luxury hotels, 18
- Managerial earnings, 33
- Natural-foods store, 54
- Netflix, 112
- New product failure, 92
- New showroom, 429
- Nike, 113
- Oil profits, 155
- Opening a restaurant, 487
- Paint store, 334
- Paper products manufacturing, 113
- Partial invoice payment, 272
- Partnership profits, 154
- Print shop, 391
- Product purchases, 10
- Quality, E-11
- Retail giants, 13
- Ship building, 137
- Shopping center, 603
- Soft-drink bottling, 590
- Spray-paint inventory, 311
- Stock turnover at cost, 310
- Stock turnover at retail, 310
- Stock value, 114
- Using invoices, 252–253
- Value of a business, 398
- Walmart Supercenter, 516
- Women in business, 11



## Business equipment

Business signage, 588  
 Canning machine, 473  
 Car-wash machinery, 589  
 Commercial fishing boats, 578–579, 603  
 Commercial freezer, 585  
 Commercial tile, 586  
 Communication equipment, 297  
 Company vehicles, 601  
 Deep fryer, 595  
 Dental office furniture, 603  
 Depreciating equipment, 572  
 Depreciating machinery, 572  
 Depreciating office equipment, 584  
 Double-pane windows, 297  
 Drilling rig, 572  
 Electronic equipment, 488  
 English soccer equipment, 272  
 Engraving, 587  
 Factory, 584  
 Forklift depreciation, 585  
 George Foreman grill, 266  
 Hospital equipment, 586  
 Industrial forklift, 589  
 Jewelry display cases, 588  
 Kitchen equipment, 19  
 Laboratory equipment, 571  
 Machinery depreciation, 570  
 Oak desk, 302  
 Printer, 487  
 Refrigerated display case, 590  
 Scuba equipment, 489  
 Storage tank, 601  
 Surplus-equipment auction, 113  
 Woodworking machinery, 587  
 X-ray equipment, 428

## C

## Construction

Airplane hangar, 538  
 Asphalt crumb, 481  
 Cabinet installation, 53, 54  
 Commercial building, 137, 430, 538  
 Concrete footings, 67  
 Construction power tools, 579  
 Conveyor system, 578  
 Delivering concrete, 59  
 Drilling equipment, 602  
 Elderly housing, 496  
 Financing construction, 358  
 Finish carpentry, 54  
 Forklift depreciation, 585  
 Home construction, 342  
 Landscape equipment, 586, 587  
 New roof, 430  
 Office complex, 516  
 Parking lot fencing, 59  
 Perimeter of fencing, 55  
 Remodeling, 472, 480  
 Restaurant kitchen, 430  
 Road paving, 333  
 Rock crusher, 357  
 Security fencing, 59  
 Stainless steel grill, 260  
 Theater renovation, 19  
 Triplex, 539  
 Weather stripping, 67  
 Window installation, 58  
 Yacht construction, 631

## D

## Domestic

Electricity rates, 65  
 Fabric, 33  
 Home beverage fountains, 255

Household lubricant, 98  
 Lights out, 104  
 Material, 137  
 Personal budgeting, 97  
 Tailored clothing, 59

## E

## Education

College bookstore, 185  
 College enrollment, 96, 113  
 College expenses, 113, 422, 423  
 College textbooks, 18, 145  
 Educational consultant, 213  
 Exchange program, 137  
 High school dropouts, 105  
 Saving for college, 430  
 School equipment, 579  
 Student time management, 54  
 Student union, 428  
 Textbooks, 287  
 University fees, 114  
 Vocabulary, 103  
 Employment/Employee benefits  
 Agricultural workers, 219  
 Aiding disabled employees, 99  
 Computer consultant, 479  
 Earnings calculation, 65  
 Educational consultant, 213  
 Employee net pay, 236  
 Employee population base, 96  
 Female lawyers, 91  
 Guaranteed hourly work, 220  
 Heating-company representative, 238  
 Hiring, 97  
 Insurance office manager, 212  
 Job cuts, 102  
 Key employee insurance, 555  
 Layoff alternative, 105  
 Managerial earnings, 33  
 Marketing representative, 237  
 Nurses, 92  
 Nursing, 103  
 Office assistant, 212  
 Part-time work, 58  
 Payroll, 340  
 Payroll deductions, 225, 226  
 Piecework with overtime, 220  
 Retail employment, 212  
 Retirement, 415  
 River raft manager, 238  
 Self-employment deductions, 226, 397  
 Starbucks district manager, 237  
 Store manager, 213  
 Women in the military, 102  
 Women in the Navy, 91  
 Working in China, 156

## Entertainment/Sports

Athletic shoes, 311  
 Bowling equipment, 297  
 Carnival, 144  
 Casino, 349  
 Competitive cyclist training, 17  
 Dance shoes, 255  
 Drums, 296  
 Eating out, 112  
 Elliptical trainer, 302  
 Exercycle, 286  
 Fishing boat, 18  
 Fly-fishing, 296  
 Gambling payback, 97  
 Gaming, 145  
 Golf clubs, 287, 296  
 Home-workout equipment, 295  
 Kayak, 302  
 Lost overboard, 104

Motorcyclists, 103  
 Mountain bike, 297  
 Movie projectors, 481  
 Movies, 145  
 Musical instruments, 144  
 New auditorium, 428  
 NY Yankees, 91  
 Parachute jumps, 11  
 Piano repair, 312  
 Recreation equipment, 588  
 Rock concert, 155  
 Scuba diving, 428  
 Scuba equipment, 489  
 Scuba shoppe, 620  
 Ski jackets, 286  
 Snowboard, 296  
 Sports complex, 429  
 Sportswear, 297  
 Sprint training, 54  
 Super Bowl advertising, 92  
 Swimming, 153  
 Swimming pool pump, 295  
 Table-tennis tables, 287  
 Tanning salon, 103, 358  
 Theater seating, 588  
 T-shirts, 311  
 Vacation, E-13  
 Vacation mistakes, 104  
 Virtual reality, 254  
 Water skis, 137  
 White water rafting, 12–13  
 Wool socks, 311  
 Yachts, 632  
 Youth soccer, 19

## Environment

Alaska wilderness, 67  
 Carbon dioxide, 18  
 Car emissions, 18  
 Climate change, 154  
 Earthquake damage, 350  
 Flooding, E-10  
 Global warming, 104  
 Hurricane Katrina, 12  
 Recycling, 219  
 Sea levels, 154  
 Water scarcity, 107  
 Winter-wheat planting, 113

## F

## Family

Alimony, 26  
 Child-care payments, 415  
 Child support, 98  
 Divorce settlement, 397  
 Family budget, 92  
 Family restaurant, 112  
 Family size, 97  
 Head of household, 531  
 Married, 531  
 Saving to buy a home, 106  
 Food service industry  
 Bakery, 398  
 Beef/turkey cost, 26  
 Biscuits, 153  
 Cake recipe, 54  
 Campus vending machines, 12  
 Chicken noodle soup, 106  
 Coffee shop, 603, 620  
 Fast-food restaurants, 586  
 Food products, 271  
 Frozen yogurt, 272  
 Goat cheese, 474  
 Health food, 333  
 Hershey Kisses, 12  
 Hershey mini chips, 12



## xviii Index of Applications

- Kitchen island, 255
  - McDonald's, E-10
  - Pizza, 145, 350
  - Restaurant tables, 590
  - Sales of health food, 154
  - Selling bananas, 295
  - Strawberry cheesecake, 66
  - Subway sandwiches, 17
  - Tiger food, 153
  - Wine, 296
- G**
- General interest
- Airport improvements, 429
  - Antiques, 147, 303
  - Apparel, 614
  - Bar soap, 91
  - Bed in a bag, 296
  - Beer consumption, 103
  - Blouses, 295
  - Christmas wreaths, 65
  - Crystal from Ireland, 272
  - Custom-made jewelry, 287
  - Dogs, 97
  - Engagement ring, 480
  - Fires, 114
  - Furniture, 663
  - Gold, 47
  - Iceberg volume, 155
  - Island area, 155
  - Japanese Yen, 156
  - Jewelry, 358
  - Lawsuit, 349
  - Liquid fertilizer, 255
  - Making jewelry, 67
  - Native-American jewelry, 55
  - Population forecasts, 105–106
  - Rare stamps, 429
  - Responder backpack, 286
  - Restaurant tips, 26
  - Sewer drain service, 586
  - Shampoo ingredients, 98
  - Social Security, 423
  - Songbird migration, 155
- Government
- American Chiropractic Association, 104
  - Biker helmet laws, 105
  - Criminal justice, 334
  - Disaster relief, 422
  - Gross national product, 11
  - Injury lawsuit, 422
  - Law enforcement, 340
  - Salvation Army, 12
  - Salvation army loss, 539
  - Total World War II veterans, 18
  - U.S. Paper money, 33
  - U.S. Patent recipients, 107
  - Voter registration, 97
  - War deaths, 664
  - World War II Veterans, 18
- H**
- Healthcare
- Alcohol level, 107
  - Blood cells, 153
  - Calories from fat, 98
  - Cholesterol levels, 98
  - Cone zone deaths, 114
  - Criminology lab, 212
  - Dental office furniture, 603
  - Diabetes, 91
  - Dispensing eye drops, 67
  - Flu pandemic of 1918, 98
  - Gambling with health, 71
  - Health food, 333
  - Health in a machine, 106
  - Medicine dose, 33
  - Motor Vehicle Accidents, 11
  - Overweight, 92
  - Oxygen supply, 632
  - Physically impaired, 18
  - Sick pet, 99
  - Side-impact collisions, 107
  - Smoking and cancer, 71
  - Smoking or nonsmoking, 97
  - Social Security and Medicare, 225–226
  - Weight-training equipment, 577
- I**
- Insurance
- 20-pay life policy, 555
  - Adult auto insurance, 546–547
  - Bodily injury insurance, 547
  - Coinsured fire loss, 539
  - Fire insurance premium, 538
  - Fire loss, 539
  - Industrial building insurance, 538
  - Insurance company payment, 547–548
  - Key employee insurance, 555
  - Life insurance, 555
  - Major fire loss, 539
  - Medical expenses and property damage, 547
  - Multiple carriers, 539
  - Premium factors, 555
  - Property insurance, 98
  - Underinsured, 540
  - Universal life insurance, 555
  - Whole life insurance, 555
  - Youthful-operator auto insurance, 547
  - Youthful operator—no driver's training, 547
- R**
- Real estate
- Fourplex, 516
  - Home ownership, 96
  - Home prices, 105
  - Office building, 603
  - Pharmacy, 516
  - Radio station building, 516
  - Real estate commissions, 93
  - Real estate development, 153
  - Real estate fees, 33
  - Residential rental property, 602
- S**
- Sales/Marketing
- Auto sales, 113
  - Auto sales in China, 92
  - Boat purchase, 349
  - Cell phone, E-12
  - Computer sales, E-13
  - Condominium purchase, 496
  - Consumer internet sales, 93
  - Crayon sales, 12
  - Deli sales, 112
  - Department sales, 10
  - Furniture sales, 237
  - Hardware purchase, 255
  - Home purchase, 496
  - Hot tub purchase, 464
  - Inside sales, 212
  - iPad sales, 12
  - Jell-O sales, 12
  - Jetson aircraft sales, 626
  - Kitchen appliances, 271
  - Monthly sales, E-11
  - National home sales, 113
  - Nissan sales, 138
  - Nursing-care purchases, 254
  - Purchase of T-bills, 351, 359
  - Purchasing power, 392
  - Refrigerator, 473
  - Restaurant sales, 186–187
  - River-raft sales, 295
  - Sales of health food, 154
  - Selling a restaurant, 423
  - Selling bananas, 295
  - Smart phone discount, 104
  - Soda sales, 137
  - Subway sales, 26
  - Ticket sales, 153
  - Total sales, 106
  - Tractor purchase, 358, 473, 487
  - Travel-agency sales, 238
  - Tripod purchase, 255
  - Van purchase, 423
  - Vegetable sales, 138
  - Wholesale auto parts, 255
- Science/Technology
- Apple, Inc., E-11
  - Canning machine, 473
  - Carpet-cleaning equipment, 578
  - Ceiling fans, 296
  - Cell phones, E-12
  - Chip fabrication, 473
  - Communication equipment, 579
  - Computer chips, 145
  - Computer replacement, 422
  - Computer system, 473
  - Construction power tools, 579
  - Conveyor system, 578
  - Copy machines, 587
  - Device assembly, 53
  - Digital camera, 92
  - Digital thermometers, 296
  - Electric guitar, 472
  - Electronic analyzer, 578
  - Facebook users, 113
  - Flash drive, 297
  - Global Positioning Systems (GPS), 272, 302
  - Graphic arts, 255
  - Laptops, 341, 603
  - Lawn mowing, 341, E-13
  - Measuring brass trim, 59
  - Metal lathe, 472
  - Notebook, 18
  - Outdoor lighting, 287
  - Printing, 481
  - Refrigerators, 144
  - Smart phones, E-14
  - Sound system, 137, 577
  - Surveillance cameras, 480
  - Video equipment, 589
  - Web design, 144, 333, 349, 481
  - Wind energy, 103
  - Wind turbine, 585
- Stocks/Investments
- Bond fund, 448
  - Bond purchase, 448
  - CDs or global stocks, 441
  - Fixed rate or stocks, 442
  - Investing, 382
  - Investing in bonds, 340
  - Investment, 381
  - Investment decision, 381
  - Mutual fund investing, 415
  - Stock price, E-12
  - Stock purchase, 441

T-bill and stock investing, 415  
Trade discount, 256  
Which investment?, 382

**T**

## Taxes

Comparing property tax rates, 517  
Federal withholding tax, 235–236

Gasoline taxes, 91  
Income tax payment, 349  
Married—income tax, 530, 531  
Penalty on unpaid income tax, 334  
Penalty on unpaid property tax, 333  
Real estate taxes, 516  
Sales tax, 91, 112  
Sales-tax computation, 92

Single—income tax, 530  
Social Security tax, 225  
State withholding tax, 236  
Taxes on home, 517  
Top tax rates, 665



# Whole Numbers and Decimals

1

## CHAPTER CONTENTS

- 1.1 Whole Numbers
- 1.2 Application Problems
- 1.3 Decimal Numbers
- 1.4 Addition and Subtraction of Decimals
- 1.5 Multiplication and Division of Decimals



## CASE IN POINT

**JESSICA FERNANDEZ** worked part time for Subway when taking classes at a local community college, but she is now a manager who oversees 18 employees. She looks for employees who have a

good work ethic, are honest and friendly, and can work with numbers. She uses numbers daily to schedule employees, compute sales, figure sales taxes, complete the payroll, and order inventory.

This book will improve your ability to work with numbers and make you a better reader. It will teach you important concepts related to your personal life such as debt, savings, investments, home mortgages, insurance, and taxes. It will also teach you many concepts related to business, such as those just mentioned in addition to markup, markdown, bank services, payroll, and interest. You will use the concepts covered in this book throughout your life.

## 1.1 Whole Numbers

### OBJECTIVES

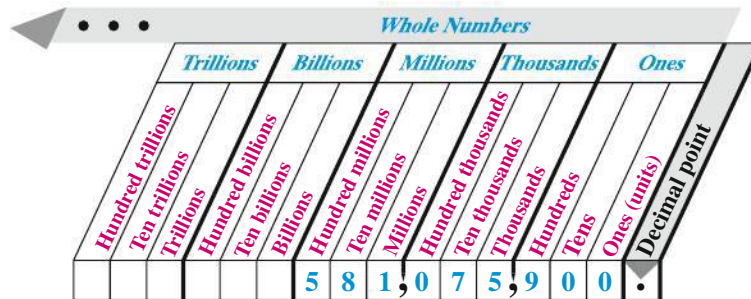
- 1 Define whole numbers.
- 2 Round whole numbers.
- 3 Add whole numbers.
- 4 Round numbers to estimate an answer.
- 5 Subtract whole numbers.
- 6 Multiply whole numbers.
- 7 Multiply by omitting zeros.
- 8 Divide whole numbers.



**CASE IN POINT** // To improve efficiency, Jessica Fernandez cross-trains each employee to 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 had to 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 the fourth quarter of 2018. 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 2017, the national debt of the United States was \$20,750,361,119,450. Write the number in words.

**OBJECTIVE 2 Round whole numbers.** Large numbers usually have more detail (digits) than needed, as is the case for the national debt in Quick Check 1 above. So, these numbers are often rounded. For example, money amounts related to a large firm are often rounded to the nearest thousand or million dollars. Use these steps to **round whole numbers**.



**Quick TIP //**

These steps are used to round numbers throughout this book.

**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 the nearest ten  
 (b) 34,127 to the nearest thousand  
 (c) 475,871 to the nearest ten thousand  
 (d) 79,625 to the nearest thousand

**SOLUTION //**

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

$$\begin{array}{r} 579 \\ \hline \end{array}$$
 ↑ ——— 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.**

- (b) **Step 1** Locate the thousands place and underline.  $34,127$

**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.  $475,871$

**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.  $79,625$

**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 TIP //**

When rounding a number, look **ONLY** at the first digit to the right of the digit being rounded.

**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**.

$$\begin{array}{r} 8 \text{ addend} \\ + 9 \text{ addend} \\ \hline 17 \text{ sum (answer)} \end{array}$$

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 total sales over the weekend at her Subway store, manager Jessica Fernandez needed to add the following amounts.

**Quick TIP** // To minimize errors, check your work. You do not want to make a mistake and hand it to your boss.

**CASE IN POINT** //

|                                |  |                              |
|--------------------------------|--|------------------------------|
| First, add down<br>the columns | $  \begin{array}{r}  \$4028 \\  \$738 \\  63 \\  125 \\  2617 \\  + 485 \\  \hline  \$4028  \end{array}  $ | Then, check by<br>adding up. |
|--------------------------------|--|------------------------------|

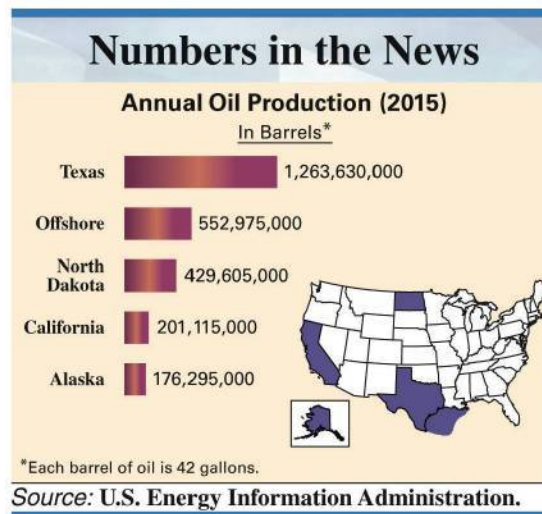
Adding from the top down results in an answer of \$4028. Check for accuracy by adding again—this time from the bottom up. If the answers are the same, the sum is probably correct. If the answers are different, there is an error in either adding down or adding up, and the problem should be reworked. Both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



**SOLUTION** //

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

|              | Actual                                       |   | Front-End Rounded |
|--------------|--|---|-------------------|
| Texas        | 1,263,630,000                                | → | 1,000,000,000     |
| Offshore     | 552,975,000                                  | → | 600,000,000       |
| North Dakota | 429,605,000                                  | → | 400,000,000       |
| California   | 201,115,000                                  | → | 200,000,000       |
| Alaska       | 176,295,000                                  | → | 200,000,000       |
|              | Estimated Total 2,400,000,000 barrels of oil |   |                   |

This rough estimate shows that total U.S. oil production was about 2.4 billion barrels in 2015. It is a rough estimate because some states that produce oil are not included in the list and we have used front-end rounding. For a more precise number, you need to get the data from all oil-producing areas and add.

**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**.

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

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.



**CASE IN POINT**

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

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.

$$\begin{array}{r} \color{blue}{2} \ \color{blue}{16} \ \color{blue}{17} \ \color{blue}{13} \\ \cancel{3} \ \cancel{7} \ \cancel{8} \ \cancel{3} \\ - 2 \ \ 8 \ \ 9 \ \ 4 \\ \hline 8 \ \ 8 \ \ 9 \ \ \text{drink cups} \end{array}$$

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  $(5 - 9)$ .

|                              |  |  |  |   |
|------------------------------|--|--|--|---|
|                              | <b>Problem</b>   |  | <b>Check</b>   |   |
| Problem<br>(subtract down) ↓ | $\begin{array}{r} 5383 \text{ minuend} \\ - 1635 \text{ subtrahend} \\ \hline 3748 \text{ difference} \end{array}$ |  | $\begin{array}{r} 5383 \\ + 1635 \\ \hline 3748 \end{array}$ | ↑ This result should equal the minuend.<br>Check (add up) |

**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,  $3 \times 4$  means to add three fours:  $4 + 4 + 4 = 12$ . However, it is not practical to use addition for large numbers such as  $103 \times 92$ , which would require you to add 92 to itself 103 times. Instead, find this result with multiplication. The multiplication of 103 by 92 can be written in any of the following ways:

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

It is okay to change the order when adding two numbers, e.g.,  $3 + 5 = 5 + 3$ . It is also okay to change the order when multiplying two numbers, so  $103 \times 92 = 92 \times 103$ .

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

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

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  $25 \times 34$  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   |   |
|--|--|--|--|---|
| $\begin{array}{r} 25 \\ \times 34 \\ \hline \end{array}$ | $\begin{array}{r} 25 \\ \times 34 \\ \hline 100 \end{array}$ | $\begin{array}{r} 25 \\ \times 34 \\ \hline 100 \\ 75 \end{array}$ | $\begin{array}{r} 25 \\ \times 34 \\ \hline 100 \\ + 75 \\ \hline 850 \end{array}$ | multiplicand<br>multiplier<br>partial product ( $25 \times 4$ )<br>partial product ( $25 \times 3$ )<br>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 tens 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.

$$\begin{array}{r} 240 \\ \times 13 \\ \hline 72 \\ 24 \phantom{0} \\ \hline 3120 \end{array}$$

Omit the zero in the calculation.

Replace the omitted zero at the right of 312 for a final answer (product) of 3120.

### 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) | $\begin{array}{r} 150 \\ \times 70 \\ \hline \end{array}$ | $\begin{array}{r} 15 \\ \times 7 \\ \hline 105 \end{array}$ | ← omit zeros | (b) | $\begin{array}{r} 300 \\ \times 90 \\ \hline \end{array}$ | $\begin{array}{r} 3 \\ \times 9 \\ \hline 27 \end{array}$ | ← omit zeros |
|     |   | ← attach 2 zeros  |              |     |   | ← attach 3 zeros  |              |
|     |   | ← answer  |              |     |   | ← answer  |              |

#### 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,

$$\begin{array}{l} 33 \times 10 = 33 \text{ and } 1 \text{ zero} = 330 \\ 56 \times 100 = 56 \text{ and } 2 \text{ zeros} = 5600 \\ 732 \times 1000 = 732 \text{ and } 3 \text{ zeros} = 732,000 \end{array}$$





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.

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

Drop 2 zeros.  $\leftarrow$   $\leftarrow$  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.

$$\begin{array}{r} 120 \\ 9 \overline{)1080} \\ \underline{9} \phantom{00} \\ 18 \phantom{0} \\ \underline{18} \\ 00 \\ \underline{00} \end{array}$$

Check Answer

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

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)  $37 \text{ R}3$

$$\begin{array}{r} 716 \overline{)26,495} \\ \underline{21} \phantom{48} \\ 5015 \\ \underline{5012} \\ 3 \text{ remainder} \end{array}$$

(b)  $85 \text{ R}6$

$$\begin{array}{r} 418 \overline{)35,536} \\ \underline{33} \phantom{44} \\ 2096 \\ \underline{2090} \\ 6 \text{ remainder} \end{array}$$

**SOLUTION** //

(a)

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

(b)

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

**Quick TIP** //

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

**QUICK CHECK 12** //

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

## 1.1 Exercises // MyLab Math

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.)

|             | <i>Nearest Ten</i> | <i>Nearest Hundred</i> | <i>Nearest Thousand</i> |
|-------------|--------------------|------------------------|-------------------------|
| 7. 2065     | <u>2070</u>        | <u>2100</u>            | <u>2000</u>             |
| 8. 8385     | <u>8390</u>        | <u>8400</u>            | <u>8000</u>             |
| 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.)

Add each of the following. Check your answers. (See Example 3.)

|   |  |   |   |
|---|--|---|---|
| 15. $\begin{array}{r} 75 \\ 63 \\ 45 \\ + 27 \\ \hline 210 \end{array}$   | 16. $\begin{array}{r} 57 \\ 26 \\ 43 \\ + 18 \\ \hline \end{array}$        | 17. $\begin{array}{r} 875 \\ 364 \\ 171 \\ + 776 \\ \hline \end{array}$     | 18. $\begin{array}{r} 135 \\ 594 \\ 415 \\ + 276 \\ \hline \end{array}$     |
| 19. $\begin{array}{r} 750 \\ 91 \\ 8 \\ 540 \\ + 7 \\ \hline \end{array}$ | 20. $\begin{array}{r} 371 \\ 45 \\ 839 \\ 3 \\ + 47 \\ \hline \end{array}$ | 21. $\begin{array}{r} 311,479 \\ 77,631 \\ + 594,383 \\ \hline \end{array}$ | 22. $\begin{array}{r} 803,526 \\ 759,991 \\ + 36,024 \\ \hline \end{array}$ |

Subtract each of the following. Check your answers. (See Examples 5 and 6.)

|   |  |   |   |
|---|--|---|---|
| 23. $\begin{array}{r} 896 \\ - 228 \\ \hline \end{array}$       | 24. $\begin{array}{r} 757 \\ - 286 \\ \hline \end{array}$        | 25. $\begin{array}{r} 3715 \\ - 838 \\ \hline \end{array}$          | 26. $\begin{array}{r} 6215 \\ - 767 \\ \hline \end{array}$          |
| 27. $\begin{array}{r} 65,198 \\ - 43,652 \\ \hline \end{array}$ | 28. $\begin{array}{r} 445,193 \\ - 62,785 \\ \hline \end{array}$ | 29. $\begin{array}{r} 7,025,389 \\ - 936,490 \\ \hline \end{array}$ | 30. $\begin{array}{r} 9,807,943 \\ - 959,489 \\ \hline \end{array}$ |