

Sample Preface. Not for Distribution.

INSTRUCTOR'S EDITION

Elementary Algebra

Graphs & Authentic Applications

Third Edition

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College of San Mateo



Pearson

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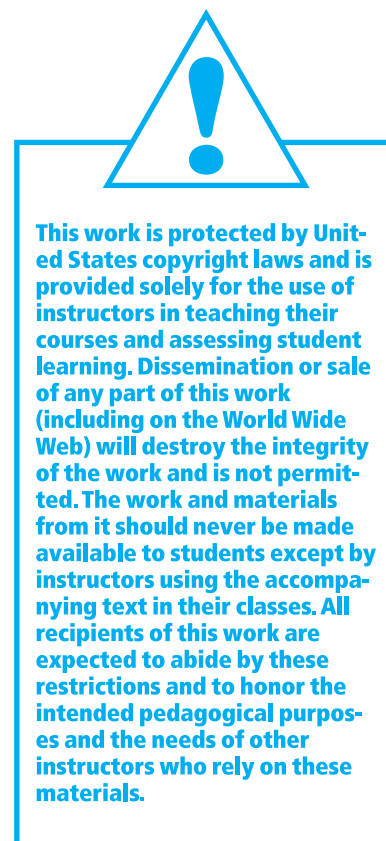
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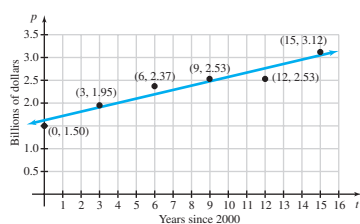


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Contents

PREFACE ix
 ACKNOWLEDGMENTS xviii
 INDEX OF APPLICATIONS xix

1 Total Profit for Top-100-Grossing Concert Tours (p. 37)



2 Presidential Election Voter Turnout (p. 89)

Year	Percent of Eligible Voters Who Voted
1980	59.2
1984	59.9
1988	57.4
1992	61.9
1996	54.2
2000	54.7
2004	63.8
2008	63.6
2012	57.5
2016	60.0

3 Percentages of Adult Internet Users Who Use Social Networking Sites (p. 170)

Year	Percent
2010	60
2011	65
2012	67
2013	73
2014	74
2015	76

INTRODUCTION TO MODELING 1

1.1 Variables and Constants 1
 1.2 Scatterplots 13
 1.3 Exact Linear Relationships 26
 1.4 Approximate Linear Relationships 37
 Taking It to the Lab: Climate Change Lab • Volume Lab • Linear Graphing Lab: Topic of Your Choice 48
 CHAPTER SUMMARY 50
 Key Points of Chapter 1 50
 Chapter 1 Review Exercises 51
 Chapter 1 Test 53

OPERATIONS AND EXPRESSIONS 55

2.1 Expressions 55
 2.2 Operations with Fractions 63
 2.3 Absolute Value and Adding Real Numbers 74
 2.4 Change in a Quantity and Subtracting Real Numbers 82
 2.5 Ratios, Percents, and Multiplying and Dividing Real Numbers 91
 2.6 Exponents and Order of Operations 103
 Taking It to the Lab: Climate Change Lab (continued from Chapter 1) • Stocks Lab 111
 CHAPTER SUMMARY 114
 Key Points of Chapter 2 114
 Chapter 2 Review Exercises 116
 Chapter 2 Test 117
 Cumulative Review of Chapters 1 and 2 118

USING SLOPE TO GRAPH LINEAR EQUATIONS 120

3.1 Graphing Equations of the Forms $y = mx + b$ and $x = a$ 120
 3.2 Graphing Linear Models; Unit Analysis 130
 3.3 Slope of a Line 138
 3.4 Using Slope to Graph Linear Equations 148
 3.5 Rate of Change 160
 Taking It to the Lab: Climate Change Lab (continued from Chapter 2) • Workout Lab • Balloon Lab 174
 CHAPTER SUMMARY 177

Key Points of Chapter 3 177

Chapter 3 Review Exercises 179

Chapter 3 Test 181

Revenues from Social Network Gaming and Mobile Games (pp. 241–242)

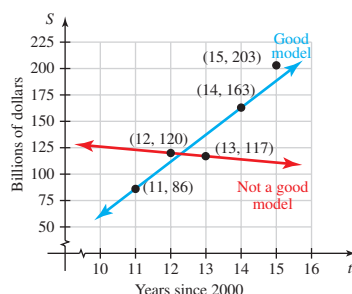
Year	Revenue (billions of dollars)
2009	5.4
2010	7.0
2011	7.5
2012	6.7
2013	9.0
2014	9.9
2015	11.2

4

SIMPLIFYING EXPRESSIONS AND SOLVING EQUATIONS 183

- 4.1 Simplifying Expressions 183
- 4.2 Simplifying More Expressions 194
- 4.3 Solving Linear Equations in One Variable 199
- 4.4 Solving More Linear Equations in One Variable 210
- 4.5 Comparing Expressions and Equations 225
- 4.6 Formulas 232
- CHAPTER SUMMARY 243
- Key Points of Chapter 4 243
- Chapter 4 Review Exercises 245
- Chapter 4 Test 246
- Cumulative Review of Chapters 1–4 247

Total College Student Discretionary Spending (pp. 266–267)

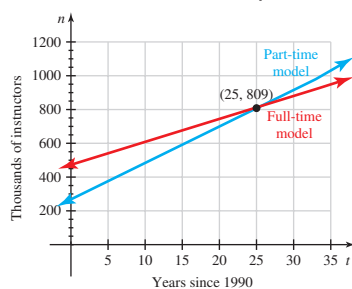


5

LINEAR EQUATIONS IN TWO VARIABLES AND LINEAR INEQUALITIES IN ONE VARIABLE 249

- 5.1 Graphing Linear Equations in Two Variables 249
- 5.2 Finding Equations of Lines 256
- 5.3 Finding Equations of Linear Models 265
- 5.4 Using Equations of Linear Models to Make Estimates and Predictions 274
- 5.5 Solving Linear Inequalities in One Variable 283
- Taking It to the Lab: Climate Change Lab (continued from Chapter 3) • Rope Lab • Shadow Lab • Linear Lab: Topic of Your Choice 294
- CHAPTER SUMMARY 298
- Key Points of Chapter 5 298
- Chapter 5 Review Exercises 299
- Chapter 5 Test 301

Numbers of Part-Time and Full-Time Instructors (p. 307)



6

SYSTEMS OF LINEAR EQUATIONS AND SYSTEMS OF LINEAR INEQUALITIES 303

- 6.1 Using Graphs and Tables to Solve Systems 303
- 6.2 Using Substitution to Solve Systems 314
- 6.3 Using Elimination to Solve Systems 320
- 6.4 Using Systems to Model Data 327
- 6.5 Perimeter, Value, Interest, and Mixture Problems 335
- 6.6 Linear Inequalities in Two Variables; Systems of Linear Inequalities in Two Variables 346
- Taking It to the Lab: Climate Change Lab (continued from Chapter 5) 356
- CHAPTER SUMMARY 357

Key Points of Chapter 6	357
Chapter 6 Review Exercises	358
Chapter 6 Test	360
Cumulative Review of Chapters 1–6	362

Percentages of 10th Graders Who Have Used Marijuana in the Past 30 Days (p. 377)

Year	Percent
2008	13.8
2009	15.9
2010	16.7
2011	17.6
2012	17.0
2013	18.0
2014	16.6
2015	14.8

7

POLYNOMIALS AND PROPERTIES OF EXPONENTS 365

7.1	Graphing Quadratic Equations	365
7.2	Quadratic Models	371
7.3	Adding and Subtracting Polynomials	381
7.4	Multiplying Polynomials	389
7.5	Powers of Polynomials; Product of Binomial Conjugates	396
7.6	Properties of Exponents	402
7.7	Negative-Integer Exponents	409
7.8	Dividing Polynomials	419
	Taking It to the Lab: Climate Change Lab (continued from Chapter 6) • Projectile Lab	426
	CHAPTER SUMMARY	428
	Key Points of Chapter 7	428
	Chapter 7 Review Exercises	430
	Chapter 7 Test	432

Worldwide iPhone Sales (p. 474)

Year	Sales (millions)
2007	1.4
2009	20.7
2011	72.3
2013	150.3
2015	231.2

8

FACTORING POLYNOMIALS AND SOLVING POLYNOMIAL EQUATIONS 434

8.1	Factoring Trinomials of the Form $x^2 + bx + c$ and Differences of Two Squares	434
8.2	Factoring Out the GCF; Factoring by Grouping	441
8.3	Factoring Trinomials of the Form $ax^2 + bx + c$	448
8.4	Sums and Differences of Cubes; A Factoring Strategy	454
8.5	Using Factoring to Solve Polynomial Equations	459
8.6	Using Factoring to Make Predictions with Quadratic Models	468
	CHAPTER SUMMARY	477
	Key Points of Chapter 8	477
	Chapter 8 Review Exercises	478
	Chapter 8 Test	479
	Cumulative Review of Chapters 1–8	480

Percentages of Lawyers Who Are Women (pp. 521–522)

Year	Percent
1970	5
1980	14
1990	24
2000	30
2010	33
2017	35

9

SOLVING QUADRATIC EQUATIONS 483

9.1	Simplifying Radical Expressions	483
9.2	Simplifying More Radical Expressions	489
9.3	Solving Quadratic Equations by the Square Root Property; The Pythagorean Theorem	495
9.4	Solving Quadratic Equations by Completing the Square	502
9.5	Solving Quadratic Equations by the Quadratic Formula	507
9.6	More Quadratic Models	516
	Taking It to the Lab: Climate Change Lab (continued from Chapter 7) • Projectile Lab (continued from Chapter 7)	526
	CHAPTER SUMMARY	527

Key Points of Chapter 9 527
 Chapter 9 Review Exercises 529
 Chapter 9 Test 531

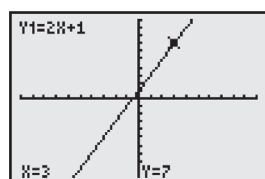
Numbers of Households Burglarized (p. 541)

Year	Number of Households Burglarized (millions)	Total Number of Households (millions)
2011	1.63	118.7
2012	1.56	121.1
2013	1.43	122.5
2014	1.27	123.2
2015	1.13	124.6

Numbers of 3D Movie Screens (p. 623)

Year	Number of Screens (thousands)
2010	14.7
2011	25.6
2012	33.1
2013	36.8
2014	38.4

Tracing a Curve (p. A-2)



10

RATIONAL EXPRESSIONS AND EQUATIONS 533

- 10.1 Simplifying Rational Expressions 533
 - 10.2 Multiplying and Dividing Rational Expressions; Converting Units 542
 - 10.3 Adding Rational Expressions 550
 - 10.4 Subtracting Rational Expressions 558
 - 10.5 Solving Rational Equations 563
 - 10.6 Proportions; Similar Triangles 571
 - 10.7 Variation 577
 - 10.8 Simplifying Complex Rational Expressions 589
- Taking It to the Lab: Climate Change Lab (continued from Chapter 9) • Estimating π Lab 596
- CHAPTER SUMMARY 598
- Key Points of Chapter 10 598
- Chapter 10 Review Exercises 600
- Chapter 10 Test 602

11

MORE RADICAL EXPRESSIONS AND EQUATIONS 604

- 11.1 Adding and Subtracting Radical Expressions 604
 - 11.2 Multiplying Radical Expressions 608
 - 11.3 Solving Square Root Equations 614
- CHAPTER SUMMARY 625
- Key Points of Chapter 11 625
- Chapter 11 Review Exercises 626
- Chapter 11 Test 626
- Cumulative Review of Chapters 1–11 627

A

USING A TI-83 OR TI-84 GRAPHING CALCULATOR 630

- A.1 Turning a Graphing Calculator On or Off 630
- A.2 Making the Screen Lighter or Darker 630
- A.3 Entering an Equation 631
- A.4 Graphing an Equation 631
- A.5 Tracing a Curve without a Scatterplot 631
- A.6 Zooming 631
- A.7 Setting the Window Format 632
- A.8 Drawing a Scatterplot 633
- A.9 Tracing a Scatterplot 633
- A.10 Graphing Equations with a Scatterplot 634
- A.11 Tracing a Curve with a Scatterplot 634
- A.12 Turning a Plotter On or Off 634

- A.13 Constructing a Table 634
- A.14 Constructing a Table for Two Equations 635
- A.15 Using “Ask” in a Table 635
- A.16 Drawing Two Scatterplots 635
- A.17 Finding the Intersection Point(s) of Two Curves 636
- A.18 Finding the Minimum Point(s) or Maximum Point(s) of a Curve 636
- A.19 Finding Any x -Intercepts of a Curve 637
- A.20 Turning an Equation On or Off 637
- A.21 Finding Coordinates of Points 637
- A.22 Entering an Equation by Using Y_n References 638
- A.23 Responding to Error Messages 638

B

USING STATCRUNCH 641

- B.1 Entering Data 641
- B.2 Constructing Scatterplots 641

ANSWERS TO ODD-NUMBERED EXERCISES 643

INDEX I-1

Preface

“The question of common sense is always, ‘What is it good for?’—a question which would abolish the rose and be answered triumphantly by the cabbage.”

—James Russell Lowell

These words seem to suggest that poet and editor James Russell Lowell (1819–1891) took Elementary Algebra. How many times have your students asked, “What is it good for?” After years of responding “You’ll find out in the next course,” I began an ongoing quest to develop a more satisfying and substantial response to my students’ query.

This ongoing quest has led me to author three algebra texts and, most recently, a new stat prep text, *A Pathway to Introductory Statistics*. I have a passion for using authentic data, centered around a curve-fitting approach to help students learn in context.

Curve-Fitting Approach Although there are many ways to center an Elementary Algebra course around authentic applications, I chose a curve-fitting approach for several reasons. A curve-fitting approach

- allows great flexibility in choosing interesting, authentic, current situations to model.
- emphasizes key concepts and skills in a natural, substantial way.
- deepens students’ understanding of equations in two variables because it requires students to describe these equations graphically, numerically, symbolically, and verbally.
- unifies the many diverse topics of a typical Elementary Algebra course.

There is yet one more reason I chose a curve-fitting approach. An Elementary Algebra course is meant to prepare some students for a Calculus STEM track and others for Statistics, Liberal Arts Math, and so on (non-STEM tracks). This is a great challenge because Calculus, Statistics, and so on are vastly different courses not only in content but also in the type of problem solving they require. Teaching algebra with curve fitting empowers instructors to prepare students for all types of content and problem solving.

To fit a curve to data, students learn the following four-step modeling process:

1. Examine the data set to determine which type of model, if any, to use.
2. Find an equation of the model.
3. Verify that the model fits the data.
4. Use the model to make estimates and predictions.

This four-step process weaves together topics that are crucial to the course. Students must notice numerical patterns from data displayed in tables, recognize graphical patterns in scatterplots, find equations of models, graph models, and solve equations.



Not only does curve fitting foster cohesiveness within chapters, but it also creates a parallel theme for each set of chapters that introduces and discusses a new type of model. This structure enhances students’ abilities to observe similarities and differences among fundamental models such as linear models, quadratic models, rational models, and radical models.

Curve fitting serves as a portal for students to see the usefulness of mathematics so they become fully engaged in the class. Once involved, students are more receptive to all aspects of the course.

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NEW TO THE THIRD EDITION

Students will benefit from the following changes to the third edition of *Elementary Algebra: Graphs and Authentic Applications*:

- In previous editions, all authentic data sets in the print text were represented by similar, yet generic (inauthentic), data sets in MyLab Math to provide algorithmically-generated similar exercises for students completing homework in MyLab Math. However, in the new edition, where possible, MyLab Math exercises maintain the authenticity of the data. This has been accomplished by sampling from a large data set to generate six authentic data sets that inherit the same trend.
- **MyLab Math Exercises:** The number of skill, modeling, and conceptual exercises in MyLab Math has been increased to fully capture the spirit of the print textbook. In fact, for the first time ever, Related Review exercises (described later in the preface) will be assignable in MyLab Math.
- **Large Data Sets:** Many students who use this textbook will not perform regression analysis in their careers, but some *will* work with large data sets. Such work will also help prepare students to take Statistics. With this in mind, new exercises that involve large data sets have been sprinkled throughout the textbook. They directly follow the heading “Large Data Sets.” The data sets consist of as many as thousands of rows and tens of columns of data.
- ** Downloadable Data Sets:** To support the appropriate use of technology when completing exercises and labs, data sets that consist of 16 or more data values can now be downloaded as Excel files at MyLab Math and at the Pearson Downloadable Student Resources for Math and Statistics website: <http://www.pearsonhighered.com/mathstatsresources>. These data sets in MyLab Math can also be opened in StatCrunch. Exercises that involve such data sets are flagged in the print textbook by the icon .
- **Augmented Data Sets:** To make the data sets as current and relevant as possible, 162 data sets in examples and exercises have been augmented to include values for recent years.
- **New Data Sets:** 212 data sets in examples and exercises have been replaced with more compelling and contemporary topics such as immigration, national health care, and trust in the mass media.
- **Climate Change Labs:** All eight Climate Change labs have been updated to address the latest data and political events concerning this incredibly important global issue.
- **Graphing Calculator Instructions:** Appendix A, which consists of TI-83/TI-84 graphing calculator instructions, was available only online in the previous edition. To make the appendix more accessible to students, it is now included in the textbook.
- **StatCrunch Instructions:** Some departments that require StatCrunch for their Statistics courses introduce StatCrunch in their Elementary Algebra courses. To support such departments, Appendix B, which contains StatCrunch instructions, has been added to the textbook.
- **Section Opener Explorations:** Explorations that can be used at the start of a section have been moved from the preceding section to the current section. The new placement will visually remind instructors to assign such explorations and make it easier for students to access them.
- **Statistics Terminology:** To better support students who will take Statistics, the terminology has been improved: The words *scattergram*, *independent variable*, and *dependent variable* have been replaced with *scatterplot*, *explanatory variable*, and *response variable*.

- **Graphing Linear Equations and Linear Models:** The technique of graphing equations of the forms $x = a$ and $y = b$ has been moved from Section 3.2 to Section 3.1. This way, all equations of the forms $y = mx + b$ and $x = a$ are now contained within one section (3.1), and Section 3.2 is now devoted to unit analysis and graphing linear models.
- **Color:** More color has been used to enhance connections between equations, graphs, tables, and coordinates of ordered pairs.

CONTINUED FROM THE SECOND EDITION

Unique Organization Many college students who take Elementary Algebra had significant difficulties with the equivalent courses in high school. These students face a greater challenge in the college courses because they must complete the course in one semester, rather than two. Instead of presenting the material in the “same old way,” this textbook provides a unique organization that will better aid students in succeeding. Three key aspects of the organization—providing the “big picture,” early graphing, and spiraling of concepts—are described in the following paragraphs.

Providing the Big Picture The text uses modeling to provide the “big picture” before going into details. For example, Chapter 1 gives an overview of linear modeling, which is the main theme of Chapters 1–6, and Section 7.2 provides an overview of quadratic modeling, which is a major focus of Chapters 7–9. Using modeling to provide the big picture not only is good pedagogy, but also sets the tone that this course will be different, interesting, alive, and relevant, inviting students’ creativity into the classroom.

Early Graphing In Chapter 3, students learn to graph linear equations only in the forms $y = mx + b$ and $x = a$. This way, they can focus on the fundamental concepts of slope and y -intercept. As many professors have reported, students do exceedingly well in Chapter 3. This early-graphing organization postpones simplifying expressions and solving equations, buying students a bit more time to find their “sea legs” before moving on to the more challenging symbolic manipulation work in Chapter 4. By the time that students reach Section 5.1, they are ready to graph equations that are not in slope-intercept form, but can be put into it.

The early-graphing approach also enables students to solve equations graphically as well as symbolically. Most of Chapters 4–11 include exercises that reinforce the connection between graphing and solving equations or systems of equations.

Spiraling of Concepts If a concept is never revisited, students may not retain it. Fortunately, curve fitting naturally revisits concepts as students’ tool bag of models grows. In each modeling section, exercises require students to compare the implications of using the various types of equations to model authentic situations. In addition, students’ retention of key concepts can be enhanced in Chapters 5–11 by completing two special types of exercises, **Related Review** and **Expressions, Equations, and Graphs**. These types of exercises are described in greater detail later in the preface.

Modeling Exercises To give this third edition a current and lively feel, the vast majority of the hundreds of modeling exercises in the text have been updated or replaced. Most of the application exercises contain tables of data, but some describe data in paragraph form to give students practice in picking out relevant information and defining variables. Both types of applications are excellent preparation for subsequent courses (especially Statistics).

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Group Explorations All sections of this text contain one or two explorations that support student investigation of a concept. Instructors can use explorations as collaborative activities during class time or as part of homework assignments. The “Section Opener” explorations are meant to have students discover the section’s concepts at the start of class. The other explorations are designed to have students apply concepts they have learned in the section in new ways. Both types of explorations can empower students to become active explorers of mathematics and open the door to the wonder and beauty of the subject.

Taking It to the Lab Sections Laboratory assignments have been included at the end of most chapters to deepen students’ understanding of concepts and the scientific method. These labs reinforce the idea that mathematics is useful. They are also an excellent avenue for more in-depth writing assignments.

Some of the labs are about climate change and have been written at a higher reading level than the rest of the text in order to give students a sense of what it is like to perform research. Students will find that by carefully reading (and possibly rereading) the background information, they can comprehend the information and apply concepts they have learned in the course to make estimates and predictions about this compelling, current, and authentic situation.

Balanced Extensive Homework Sections Most exercise sets contain a large number of modeling, skill, and conceptual exercises to allow professors maximum flexibility in setting assignments.

Related Review These exercises (in every section of Chapters 5–11) relate current concepts to previously learned concepts. Such exercises assist students in seeing the “big picture” of the course. This exercise type is now also assignable in MyLab Math.

Expressions, Equations, and Graphs These exercises (in every section of Chapters 5–11) help students gain a solid understanding of these three core concepts, including how to distinguish among them.

Technology The text assumes students have access to technology such as the TI-83 or TI-84 graphing calculator, Excel, or StatCrunch. Technology of this sort allows students to construct scatterplots and check the fit of a model quickly and accurately. It also empowers students to verify their results from Homework exercises and efficiently explore mathematical concepts in the Group Explorations.

The text supports instructors in holding students accountable for all aspects of the course without the aid of technology, including finding equations of linear models. (Linear regression equations are included in the Answers section because it can be difficult or impossible to anticipate which points a student will choose in trying to find a reasonable equation.)

Appendix A: Using a TI-83 or TI-84 Graphing Calculator Appendix A contains step-by-step instructions for using the TI-83 and TI-84 graphing calculators. A subset of this appendix can serve as a tutorial early in the course. In addition, when the text requires a new calculator skill, students are referred to the appropriate section in Appendix A.

Appendix B: Using StatCrunch Appendix B contains step-by-step instructions for using StatCrunch. The appendix describes how to enter data and construct scatterplots.

Exposition If students can’t make sense of the prose, it doesn’t matter how precise it is. One of my top goals is to write descriptions that are straightforward, accessible, clear, and rigorous.

Tips for Success Many sections close with tips that are intended to help students succeed in the course. A complete listing of these tips is included in the Index.

Warnings These are discussions (flagged by the margin entry “WARNING”) that address students’ common misunderstandings about key concepts and help students avoid such misunderstandings.

Chapter Opener Each chapter begins with a description of an authentic situation that can be modeled by the concepts discussed in the chapter.

GETTING IN TOUCH

I would love to hear from you and would greatly appreciate receiving your comments regarding this text. If you have any questions, please ask them, and I will respond.

Thank you for your interest in preserving the rose.

Jay Lehmann
MathNerdJay@aol.com

Resources for Success


Get the Most Out of MyLab Math

for *Elementary Algebra*, Third Edition, by Jay Lehmann


When it comes to developmental math, one size does not fit all. Jay Lehmann's *Elementary Algebra* offers market-leading content written by an author-educator, tightly integrated with the #1 choice in digital learning—MyLab Math. MyLab Math courses can be tailored to the needs of instructors and students, while weaving the author's voice and unique approach into all elements of the course. Learning mathematical concepts through authentic data comes through from the text to the MyLab course seamlessly.

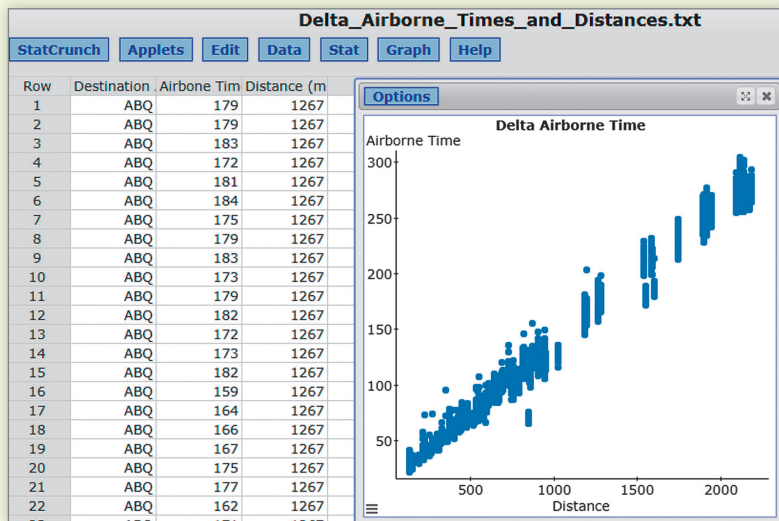
Take advantage of the following resources to get the most out of your MyLab Math course.

Conceptual Understanding and Motivation

New! Large Data Sets in exercises and explorations get students accustomed to working with as many as thousands of rows of data. Data sets that involve 16 or more values are available for download to support the appropriate use of technology. Noted with a  icon, these exercises are ideal for using technology, like StatCrunch or Excel, to analyze the data and synthesize concepts. In today's age of "big data," it's important for students to see how technology can efficiently and accurately help when working with large data sets.

Large Data Sets

47.  Access the data about airborne times and distances of Delta Airlines flights, which are available at MyLab Math and at the Pearson Downloadable Student Resources for Math & Stats website. Let T be the airborne time (in minutes) and D be the distance (in miles) for a flight.
- Construct a scatterplot of the data.
 - Give a possible reason why the scatterplot consists of vertically aligned clumps of data points.
 - On the basis of just the scatterplot, guess whether Delta offers more *routes* that are less than 1000 miles or greater than 1000 miles. On the basis of just the scatterplot, why is it not possible to be sure?



New! StatCrunch is a web-based statistical software available from within the MyLab Math course that students can use to easily analyze data sets from exercises and the text. Through StatCrunch users can access tens of thousands of shared data sets, create and conduct online surveys, perform complex analyses using the powerful statistical software, and generate compelling reports.

New! Select exercises with authentic data have been carefully revised to retain authentic data values, even when regenerating algorithmically. Oftentimes students sacrifice working with real-world data when they regenerate exercises with new values in MyLab Math. In this revision, the author has taken special care to ensure that many exercises' algorithmic versions of the question still ask the student to work with actual data pulled from real-world situations.

Homework: Section 1.4 Homework

Score: 0 of 1 pt 4 of 10 (1 complete)

1.4.8

The temperature at which water boils (the boiling point) depends on elevation: The higher the elevation, the lower is the boiling point. At sea level, water boils at 212°F ; at an elevation of 10,000 meters, water boils at about 153°F . Boiling points are listed in the table below for various elevations. Complete parts a. through d. to the right.

Elevation (in thousands of meters)	Boiling Point ($^{\circ}\text{F}$)
0	212
1	204
2	201
5	184
10	153
15	125

a. Let B be the boiling point in degrees Fahrenheit that comes

Determine the domain and range of the function.

The domain is $-2 \leq x \leq 3$.

00:23 01:09

Updated! The video program provides students with extra help for each objective of the textbook. The videos highlight key examples, and a modern interface allows easy navigation. Videos have been updated to reflect all changes in the current edition.

Personalized Learning and Preparedness

New! Skill Builder exercises offer just-in-time additional adaptive practice. The adaptive engine tracks student performance and delivers questions to each individual that adapt to his or her level of understanding. This new feature allows instructors to assign fewer questions for homework, allowing students to complete as many or as few questions needed.

Homework: Skill Builder Assignment

Score: 0 of 1 pt 10 of 10 (0 complete) HW Score: 0%, 0 of 10 pts

7.2.85

Use rational exponents to write as a single radical expression. Assume that all variables represent positive real numbers.

$$\sqrt[3]{y} \cdot \sqrt[4]{y^7}$$

$$\sqrt[3]{y} \cdot \sqrt[4]{y^7} = \square$$

Enter your answer in the answer box.

All parts showing

Homework: Skill Builder Assignment

Prerequisite: Understand the meaning of a^m/n .

Let's review a concept needed to answer your homework question.

Use radical notation to write the expression. Simplify if possible.

$$16^{\frac{3}{4}}$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

A. $\frac{3}{16^4}$

(Simplify your answer. Type an exact answer, using radicals as needed.)

B. The answer is not a real number.

Click to select and enter your answer(s) and then click Check Answer.

All parts showing Clear All Check Answer

Enhanced Sample Assignments make course set-up easier by giving instructors a starting point for each section and chapter. Homework assignments have been carefully curated for this specific text and include a thoughtful mix of question types. Find these sample assignments in the Assignment Manager, under Copy and Assign Sample Assignments.

Resources for Success

Instructor Resources

The following instructor resources are available to download from the Instructor Resource Center at www.pearson.com, or in your MyLab Math course.

Instructor's Resource Manual

This manual, written by the author, 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.

Power Points

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 manual includes complete solutions to the even-numbered exercises in 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 download from Pearson's online catalogue.

Student Resources

New! Concepts and Explorations Notebook: Working with Authentic Data

This new compelling resource for students correlates to the text and provides students with opportunities to dig into data and solve problems using pencil and paper. The workbook includes:

- Explorations that offer collaborative activities to support discovery of key concepts.
- Modeling exercises with authentic data that give students more practice on this multifaceted concept, that can be sometimes hard to fully accomplish through MyLab Math.
- Projects that can be either open-ended or more guided, and ask students to dig deeper into a data set and think critically.
- Graphing exercises that ask students to practice graphing on their own, beyond what they do in MyLab Math.
- Mini-Essay questions that prompt students to think conceptually, also beyond what they do in MyLab Math!

Student's Solutions Manual

This manual contains the complete solutions to the odd-numbered exercises in the Homework sections of the text.

To the Student

You are about to embark on an exciting journey. In this course, you will learn not only more about algebra but also how to apply algebra to describe and make predictions about authentic situations. “Authentic situations” might make you think twice, but this just means situations that are *really* happening in the world. This text contains data that describe hundreds of these situations. Most of the data have been collected from recent publications, so the information is current and of interest to the general public. There is data about profit from concerts, success in school, climate change, sports, and so on. I hope it interests you too.

Working with authentic data will make mathematics more meaningful. While working with data about authentic situations, you will learn mathematical concepts more easily because they will be connected to familiar contexts. And you will see that almost any situation can be viewed mathematically. That vision will help you understand the situation and make estimates and/or predictions.

Many of the problems you will explore in this course involve data collected in a scientific experiment, survey, or census. The practical way to deal with such data sets is to use technology. So, a graphing calculator or computer system is probably required.

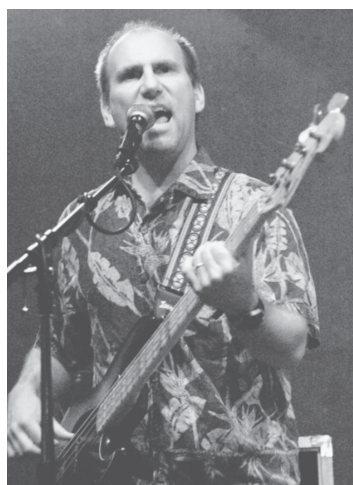
Analyzing authentic situations is a lifelong skill. We are living in the “age of data.” In addition to working with data sets in this text, your instructor may assign some of the labs. Here you will collect data through experiment or research. This will give you a more complete picture of how you can use the approaches presented in this text in everyday life, and likely in your lifelong careers. Being able to work with and understand data can lead to higher-paying jobs and success.

Hands-on explorations are rewarding and fun. This text contains explorations with step-by-step instructions that will lead you to *discover* concepts, rather than hear or read about them. Because discovering a concept is exciting, it is more likely to leave a lasting impression on you. Also, as you progress through the explorations, your ability to make intuitive leaps will improve, as will your confidence in doing mathematics. Over the years, students have remarked to me time and time again that they never dreamed that learning math could be so much fun.

This text contains special features to help you succeed. Many sections contain a Tips for Success feature. These tips are meant to inspire you to try new strategies to help you succeed in this course and future courses. If you browse through all the tips early in the course, you can take advantage of as many of them as you wish. Then, as you progress through the text, you’ll be reminded of your favorite strategies. A complete listing of Tips for Success is included in the Subject Index.

Other special features that can support you include Warnings, which can help you avoid common misunderstandings; Key Points summaries, which can help you review and retain concepts and skills addressed in the chapter you have just read; Related Review exercises, which can help you understand current concepts in the context of previously learned concepts; and Expressions, Equations, and Graphs exercises, which can help you understand and distinguish among these three core concepts.

Feel free to contact me. It is my pleasure to read and respond to e-mails from students who are using my text. If you have any questions or comments about the text, feel free to contact me.



Jay has a wide variety of interests. He is pictured here playing with his rock band, The Procrastinistas. (Photo courtesy of Rick Gilbert)

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Index of Applications

A

acoustics

loudness of foghorn, 15
sound levels

electric guitar, 418
examples of, 46

aeronautics and astronomy

distance to Proxima Centauri, 415
period of a planet, 607
space debris, numbers of, 54
U.S. employees who manufacture
aerospace products and
parts, number of, 274
weight of person on the moon, 575

age

of American adults who say they
are interested in soccer,
628–629

of Americans going to movies, 45
of Americans who regularly
attend church, 629

approval of single men raising
children on their own by,
24–25

automobile accidents by, 24
of automobile and its value, 35
cigarette smoking in 18–24 age
group, 526

of college and enrollment, 264
of computer owners, 22

dog years compared to human
years, 271, 279, 354

drivers stopped by police, 40–42
height and, 21

high cholesterol, percentages of
Americans with, 523

home address considered as
personal information and,
268, 274–276

home ownership and, 17–18, 51
ideal age chosen by age groups,
281

joblessness, percentages of
Americans concerned
about, 523

life expectancy, 19
of dogs, 172
spending and, 624

of light vehicles, 44
of marathon finishers, 332–333

memory impairment, 530–531
online trading sites, percentage
of American visiting by
age, 484

percentage of Americans who are
obese by, 53

percentage of Americans working
by, 480

percentages of Americans
ordering takeout food
by, 24

percentages of Americans
without health insurance
and, 54

percentage that would choose
television viewing over
Internet access, 332

prime-time television viewing by,
516–518

of speeding male drivers in fatal
crashes, 629

talk radio listening and, 376
times spent driving each day by,
365, 371–372

workers at age 65 or older, 522

agriculture

acreage for grape/raisin
production, 281

cheese consumption, average
per-person annual, 223

Columbia's cocaine cultivations
and production potentials,
521

fair-trade coffee, 136

farm injuries, 157

farmland, acres of, 272

farms owning or leasing
computers, 525

genetically modified crops, 622

oat production levels, 273

orange production in United
States, 242

air travel

airborne times and distances of
Delta airlines flights, 173
airline seats filled, percentage of,
270, 278

altitude of airplane
during descent, 31–32, 35, 136,
628

rate of change, 160, 169, 179
altitude of hot-air balloon, 26–28,
30, 35–36

Americans flying to Europe,
number of, 117

bird species involved in airline
bird strikes, number of, 171

distance from airplane to horizon
at given altitude, 494

firearm discoveries at U.S.
airports, numbers of, 23

flights delayed, percentages of, 36
flights on time, percentages of, 12

incline of climbing airplane, 146
passenger complaints against
TSA, 364

price per barrel of crude oil and
total fuel cost for airline
industry, average, 23

times and distances traveled,
171–173

voluntary bumping rates of U.S.
airlines, 44

animals and pets

average weight of a turkey, 222

bachelor's degrees in biology, 333

bird species involved in airline
bird strikes, number of, 171

cricket chirp rate and temperature,
362

deer population, 90

dog years compared to human
years, 271, 279, 354

Florida's manatee populations, 474
flounder, East Coast's summer,
282

herbicide use and number of bee
colonies, 172–173

threatened species, number of, 44
weight of dogs and their average
life expectancy, 172

wolf population, 89

art and architecture

classroom size in school building
design, 232–233

dimensions of frame for
photograph, 239

astronomy. *See* aeronautics and
astronomy

automobiles. *See also* motor
vehicles

accidents

by age group, 24
crash deaths, 156–157, 629

Acura[®] RLX sedan, 334

ages and values of, 35

battery packs for electric cars, 272

braking distance, 488–489, 587

depreciation, 223, 334

driving speed, 15, 62, 63, 135–136

electric cars, 53, 518–520

force of impact, 576

gas mileage of car, 47, 52, 63, 134

gas mileage of Porsche[®] 911
Turbo[®] Coupe, 549

gasoline consumption and time
traveled, 136, 274

Honda[®] Accord, 334

Hyundai Sonata, 387

Jeep[®] Patriot, 334

Kia[®] sales, 242

Kia[®] Soul, 334

length of driving trip, 500

Lexus RX 400h, 387

market shares of automakers,
334–335, 335

miles traveled and gallons of
gasoline, 35

Nissan Altima[®] average sales
price, 171

Porsche 911 Carrera Turbo fuel
tank capacity, 10

sales of, 12

seat belt use, 280

speeding drivers, 629

speed of, 2

temperature within, 576

times and distances traveled,
34, 171

time to fill gasoline tank, 587

Toyota Camry Hybrid XLE[®] gas
consumption, 134

Toyota Prius[®] gas consumption,
170

Toyota Prius[®] sales, 89

Toyota Prius Two Eco[®] gas
consumption, 603

traveling speed and stopping
distance, 15

value comparison, 335

value decline, 181

volume of gasoline in tank after
road trip, 170, 172, 274

aviation. *See* air travel

B

banking. *See* finance and banking

biology

bachelor's degrees in, 333

cricket chirp rate and temperature,
362

evolution belief by Americans,
281

head sizes and brain weights, 334
number of threatened species, 44
rate of change in ti plant height,
169

business

advertising

ads blocked by Google, 22
price for 30-second ad during
Academy Awards, 301

annual revenue of U.S. electronics
and appliance stores
compared to rare earth
mining, 36

bike rental, 136, 577

CEOs that are women, percentage
of, 42, 151–152

changes in number of clients for
financial planner, 87–88

craft beer breweries, numbers
of, 12

department stores, 364

dollar stores, households that
shop at, 293

drive-in movie sites, number of,
169

independent CD and record
stores, 137

Kmart stores, number of, 110

losses for various years, 12

market share

automakers, 334–335

GM's U.S., 376–377

large-screen and very-large-
screen televisions, 387

Sparkling Ice and Diet Pepsi,
329–330

McDonald's restaurants, numbers
of, 604

number of years until invention
reaches mass use, 24

patent applications per year,
number of U.S., 247

percentages of consumers
who try products if it is
sponsoring an event for
an artist they like, 525

rate of change in PC shipments,
161

satisfaction with size and influence
of major corporations, 22

7-eleven stores, number of
worldwide, 156

shopping malls, numbers of, 624

Subway[®] restaurants, number
of, 15

Uber, 12

C

chemistry

acid solutions, 342–343, 345, 364,
575

alcohol solutions, 341–342, 345

antifreeze solutions, 341, 345

butterfat in 2% milk, 345

lemon juice solution, 575

lime juice, 340–341

oil solutions, 345

communication

average daily number of texts, 117

cost of phone service, 575

FM radio stations, 384–385

communication (*continued*)

households with wireless telephones and no land-line, 281
 iPad® sales, 10
 iPhone sales, 434, 474
 mothers who use Twitter, 473
 Samsung smartphone average selling price, 223
 smartphone, number of Americans with, 10
 smartphone prices, average, 377–378
 smartphone subscriptions, worldwide, 241
 social networking sites
 percentage of adults who use, 242
 percentage of Internet users who use, 22, 120, 170
 T-Mobile charges, 240
 U.S. Postal Service first-class mail volume, 118

computers and Internet
 age of ownership, 22
 Apple's revenue, 12
 from iPad, 526
 digital ad revenue, 110
 downloaded songs, 12
 farms owning or leasing computers, 525
 Google's worldwide revenues, 168
 households that stream Netflix, 541, 570
 Internet access, 522, 570
 percentage that would choose television viewing over, 332
 using desktop and mobile devices, 332
 malware, 526
 mothers who use Twitter, 473
 new scripted TV shows aired online, 476
 online banking, 533, 567–568
 online crime, number of complaints about, 247
 online trading sites, percentage of American visiting by age, 484
 PC shipments, rate of change in, 161
 rate of change in PC shipments, 161
 social network gaming and mobile games, revenue from, 241–242
 social networking sites
 percentage of adults who use, 242
 percentage of Internet users who use, 22, 120, 170
 percentage of mothers who use several times per day, 607
 percentages of women and men who use, 388
 tax returns filed online, 476
 Twitter, 62
 YouTube visitors, average number of unique monthly, 247

consumer behavior
 cost of groceries, 575
 cost of notebook, 575
 cost of phone service, 575

cost of pillows, 589
 cost of Thanksgiving dinner for ten people, 430
 debit card purchases, 223
 dollar stores, households that shop at, 293
 paying for cable TV, 575
 percentages of consumers
 who try products if it is sponsoring an event for an artist they like, 525
 shopping malls, numbers of, 624
 single-cup coffee brewing system ownership, 302
 spending on Father's Day, 169, 180
 spending on Halloween, 278

crime

assaults in New York City, 524
 complaints about online crime, number of, 247
 households burglarized, 541, 569
 inmates younger than 18 in state prisons, number of, 269
 percentages of Americans who favor ban on handgun possession, 44
 prisoners and releases from prison, 602
 released convicts that have been arrested for a new crime, 623
 sexual-harassment charges filed, number of, 270
 violent-crime rates, 301

D**demographics and population**

billionaires, 51, 101
 birth order and sex ratio at birth, 476
 children younger than 18 living with two married parents, percentage of, 269
 China population, 526
 Cuban-Americans in Miami-Dade, 282
 deer, 90
 female members of Congress, 269
 Florida's manatee, 474
 flounder, East Coast's summer, 282
 foreign born, percentage of, 379
 Gary, Indiana, 110
 gray hair in men, 22
 happiness, 624
 height and weight of basketball teams in 2014 draft, 173–174
 home ownership, 17–18, 51
 household sizes, 522–523
 household structure, 359–360, 431
 House of Representatives, men and women in, 333
 immigrants, 282
 lawyers who are women, percentages of, 521–522
 life expectancy, 19
 lower-income, middle-income, or upper income households, 332
 marijuana use, 117
 marriage
 married-couple households, 292, 431
 married persons "very happy" with their marriages, percentages of, 249, 280

percentage of Americans who are married, 334, 359–360
 percentage of married people reaching major anniversaries, 377
 medical degrees earned by women, 531
 men and women living alone, 333
 number of Americans affected by plastic-bag bans, 110
 number of nuns in United States, 180
 number of parents, 364
 number of people living in two-bedroom house, 2
 number of women and men living alone, 432–433
 numbers of teenage women, 395
 obesity, 53
 osteopathic doctors who are women, percentages of, 292
 percentages of CEOs that are women, 42, 151–152
 populations and land areas for various states, 102
 teenage birthrate, 293, 395
 U.S. population, 426, 526, 597–598
 wolf, 89
 world population, 426, 597–598

distance
 across a lake, 501
 braking, 488–489, 587
 of falling object, 587
 of falling sky diver, 408
 gasoline consumption and distance traveled, 134
 to horizon at given altitude, 494
 intensity of television signal at a distance, 408, 414
 Jackson to Memphis, 501
 from kite to ground, 498–499
 ladder reach, 500, 530
 length of driving trip, 500
 light amount at, 418
 on maps, 575
 number line use, 73
 to Proxima Centauri, 415
 race, 549
 rise in elevator over time, 63
 speed and, 63, 135–136, 242, 418
 steepness and vertical to horizontal distance
 comparing guy wires from ground to telephone pole, 138
 grade of road, 139, 146, 247
 incline of climbing airplane, 146, 179
 ski run decline, 146, 181, 628
 time traveled and, 34, 57, 162–163, 171, 173, 182, 242, 579–580

E**economics**

lower-income, middle-income, or upper income households, 332
 trade with Chile, 334

education
 after-school activity participation by elementary school students, 45
 calculating total course points, 72
 charter schools, 8

college

acceptance, 95
 Americans ages 25 and older with degree, 270–271, 278–279
 bachelor's degrees, number earned, 208
 bachelor's degrees earned by men and women, 311, 331, 386–387
 bachelor's degrees in biology, 333
 bachelor's degrees in parks, recreation, leisure, and fitness studies, 333–334
 core GPAs/SAT scores needed to qualify to play sports, 171
 credit/hours/units, 10, 12, 541
 discretionary spending by students, 136, 266–267
 full-time equivalent faculty, 101–102
 grade point average and acceptance, 21
 law school applicants, 476
 outstanding student debt, 472
 part-time and full-time instructors, number of, 307, 327–328
 part-time work by students, 34
 percentage of Boise State freshman whose high school GPA was at least 3.5, 183, 222
 percentage of full-time students, 51
 residence halls, 575
 room and board cost, 476
 student-to-faculty ratio, 270, 576
 textbook rental, 136
 undergraduates living on campus, 100

college enrollment
 age of college and, 34, 264
 changes in, 83–84, 86, 90
 DeVry University, 119
 in elementary algebra course, 271, 279
 female undergraduates, 100
 full-time equivalent, 101–102
 in Intermediate Algebra course, 469–470
 male at Boston University, 575
 public community colleges, 392–393
 rate of change in, 164
 of recent high school graduates, 539

college tuition
 average annual at public four-year vs. public two-year colleges, 92
 credits (hours) and, 22, 62, 134, 136, 169, 587, 603
 fees and, 136, 170
 public community colleges, 392–393
 total costs and, 61, 62, 134
 enrollment at Thomas Edison High School, 474
 floor area of a classroom, 22, 232–233
 FM radio stations, 384–385
 high school students dropping out, 280

- importance of degree or professional certificate beyond high school, 22
- international students, 379
- karate class cost, 161
- median annual income and, 524
- medical degrees earned by women, 531
- number of students in algebra class, 11
- nursing degrees awarded, 107–108
- salaries
 - average starting salary for employees with bachelor's degree, 25
 - of public school teachers, 45, 246, 394
 - years of education and, 51
- spending on back-to-schools shopping, 44
- student loans, 292
- textbook weight, 587–588
- time student prepares for exam, 11
- tutoring costs, 73, 173
- electricity**
 - battery packs for electric cars, 272
 - conduction in DNA strand, 587
 - electric cars, 53, 518–520
 - from nuclear power, 52
- electronics**
 - annual revenue of U.S. electronics and appliance stores compared to rare earth mining, 36
 - iPad® sales, 10
 - Xbox One S console, time needed to purchase, 223
- elevation**
 - boiling points of water, 165
 - change from Dead Sea to Mt. Everest, 89
 - change from Death Valley to Denali, 89
 - height of Golden Gate Bridge towers, 86
- employment**
 - college part-time and full-time instructors, number of, 307, 327–328
 - commute time to work, average U.S., 269
 - employee contribution required to cover family in employer-sponsored health plan, 156
 - hours worked, 9–10
 - money earned and, 60, 63, 193, 575, 577, 586, 589
 - in week, 11
 - illness and injury rate in, 525
 - joblessness, percentages of Americans concerned about, 523
 - lawyers who are women, percentages of, 521–522
 - number of employees, 61, 136
 - number of nuns in United States, 180
 - number of U.S. employees who manufacture aerospace products and parts, 274
 - office space per worker, 223
 - percentage of Americans who are confident they will retire ahead of their schedule, 180
 - percentage of Americans working by age, 480
 - salary
 - annual, 11
 - author earnings from book agent, 208
 - average for NHL hockey player, 222
 - average starting salary for employees with bachelor's degree, 25
 - average U.S. hourly pay, 23–24
 - bonuses, 55–56, 57–58
 - Congressional pay, 109–110
 - hours worked and money earned, 60, 63
 - of Joe Mauer, 54
 - minimum wage workers, 169
 - number of years worked and, 21, 34, 54, 131–132, 134–135
 - part-time work by students, 34
 - payroll of Baltimore Orioles and Seattle Mariners, 334
 - public school teachers, 246
 - of public school teachers, 45
 - savings deposit and, 205
 - yearly raises, 223
 - years of education and, 51
 - traditional benefit plans offered by companies, 110
 - unemployment rate, 119, 282
 - union workers, 10, 223
 - volunteer firefighter deaths while on duty, 170
 - waiter's tips, 208
 - workers at age 65 or older, 522
 - workers saving for retirement, percentages of, 480
 - working from home, 2
 - youth, 360
- energy**
 - average price per barrel of crude oil and total fuel cost for airline industry, 23
 - battery packs for electric cars, 272
 - consumption by propane-gas barbecue grill, 170
 - electric cars, 53
 - electricity generated by nuclear power, 52
 - gas mileage of car, 47, 52, 63, 134
 - gasoline consumed after filling tank, 79
 - gasoline consumption and time traveled, 136
 - onshore and offshore oil production, 629
 - wind energy capacities in the United States, 273
- entertainment, leisure, and recreation**
 - Academy Awards, 271, 279, 301
 - amusement park ride-related injuries, 46–47
 - arts-and-crafts fair, 135
 - auditorium/theater seating and revenue, 338, 344–345, 360, 362
 - author earnings from book agent, 208
 - author's royalties, 601
 - bachelor's degrees in parks, recreation, leisure, and fitness studies, 333–334
 - bicycles
 - rental, 136, 577
 - riders, number of, 110
 - sales, 108
 - tire pressure, 136
 - book sales, 344
 - box office gross from movie theaters, 51
 - Broadway-based movie musicals, revenue of, 20
 - drive-in movie sites, number of, 169
 - e-books in public libraries, 281
 - FM radio stations, 384–385
 - Harry Potter series, number of pages in books of, 22–23
 - households that stream Netflix, 541, 570
 - karate class cost, 161
 - legal capacity of a club, 10
 - lottery winnings, 60
 - magazine subscriptions, 22
 - marijuana use, 117
 - movie attendance, 45, 476
 - movie ticket price, average, 83
 - new scripted TV shows aired online, 476
 - Nintendo handheld games, 135
 - novels owned, number of, 136
 - party, per-person cost of, 541
 - percentage of adults who exercise and percentage of adults who are obese, 224
 - percentage of children ages 5–18 participating in organized physical activity, 10
 - Sea World attendance, 246
 - skier/snowboarder visits to U.S. slopes, number of, 169
 - ski trip, 63, 538
 - social network gaming and mobile games, revenue from, 241–242
 - subscribers of pay-TV and Netflix, 388
 - talk radio, 376
 - ticket sales, 246, 482
 - walking/running speed, 175–176
 - wooden roller coasters, 282
 - Xbox One S console, time needed to purchase, 223
- environment**
 - clarity of Lake Tahoe, 525
 - fires, number of, 222
 - herbicide use and number of bee colonies, 172–173
 - number of Americans affected by plastic-bag bans, 110
 - numbers of space debris, 54
 - reused or recycled tires, 623–624
 - worldwide cost of natural disasters, 208
- F**
- farming.** *See* agriculture
- finance and banking**
 - annual expenditures, average, 430
 - ATM fees, 238
 - average life span of denominations of bills, 23
 - bike rental, 136, 577
 - changes in number of clients for financial planner, 87–88
 - checking account balance, 3, 9, 33, 63, 78–79, 80–81, 119, 179–180
 - cost of buying pens, 22
 - cost of notebook, 575
 - cost of Thanksgiving dinner for ten people, 430
 - credit card balance, 76, 81, 97, 98–99, 102, 116–117, 119
 - currency exchange, 575
 - debit card purchases, 223
 - debt lowering, 76
 - demand for refinancing home loans, 587
 - exchange of money, 76
 - household debt, 570
 - income
 - education *versus* median annual, 524
 - household collected by middle class, 300
 - median household, 92–93, 482
 - median sales prices of existing homes and, 92–93
 - percentages of adults who watch cable television by, 620
 - percentages of incomes unreported to IRS, 607
 - personal, average, 380
 - remaining after mortgage and food expense, 72
 - interest from bank account, 241
 - online banking, 533, 567–568
 - overdraft fees, 165–166
 - owners who owe more money than worth of their vehicle, 375
 - PACE loans, 272
 - person's saving at various years, 264
 - savings account balance, 170, 247–248
 - savings deposits and weekly pay, 205
 - spending on Father's Day, 169, 180
 - value of unused gift cards, 137
- food and nutrition**
 - baking time for brownie mix, 135
 - bread loaves, price of, 63
 - caffeine in Jolt® soft drink, 549
 - cereal, U.S. revenue from, 182
 - cheese consumption, average per-person annual, 223
 - chicken cacciatore, tomato in recipe for, 601
 - cooking times of a turkey, 182
 - cooling of a potato, 22
 - cost of groceries, 575
 - cost of Thanksgiving dinner for ten people, 430
 - craft beer breweries, numbers of, 12
 - fair-trade coffee, 136
 - fat in Chef Boyardee Mini Ravioli®, 575
 - fish and shellfish consumption, 549
 - Five Guys hamburgers, 117
 - herbal dietary supplements, revenue from, 283
 - hot dog and soft drink prices at National League baseball stadiums, 281
 - hot dogs, 56, 57–58
 - McDonald's restaurants, numbers of, 604
 - meat consumption, 546–547
 - orange production in United States, 242

food and nutrition (*continued*)

pizza
 carbohydrates and calories for, 43
 cost per person for, 73
 dividing into slices, 63–64, 65, 68, 69, 71
 weight of, 587
 prices of hot dogs and soft drinks at MLB stadiums, 43
 recipe
 beef stroganoff, 101
 roasted red-pepper pasta, 101
 revenue from gluten-free products, 135
 revenue from organic and non-genetically-modified food, 335
 salt in Snyder's® pretzels, 549
 single-cup coffee brewing system ownership, 302
 snacking, percentage of people who say they try to avoid, 242
 soda market share, 329–330
 Sparkling Ice and Diet Pepsi, market shares of, 329–330
 sports drink consumption, 12
 Starbucks stores, number of, 246
 sugar in bread pudding recipe, 628
 sugar in Coca-Cola®, 549
 sugar in Post Grape-Nuts Flakes®, 575
 Supplemental Nutrition Assistance Program, number of people in, 110
 takeout food, percentages of Americans ordering more by age, 24
 vendor charges for hamburgers and hot dogs, 337–338
 waiter's tips, 208
 weight before and after diet, 81
 Weight Watcher subscribers, 110

G**garden**

area of, 62, 240
 dimensions, 247, 343, 471–472, 475
 fencing around, 240, 247

geometry

floor area of a classroom, 22, 232
 height of water in a cylinder, 49
 knot number and rope length relationship, 296–297
 polygon perimeter, 233, 239, 246
 rectangle, 11, 51, 53
 area, 2, 11, 62, 72, 239–240
 diagonal length, 501–502
 diagonal length of a painting, 501
 diagonal length of football field, 501
 diagonal length of soccer field, 501
 diagonal length of television screen, 489, 501
 dimensions, 247, 343, 360, 471–472, 475, 479, 482
 golden, 336, 343
 length, 247, 343–344, 360, 531
 perimeter, 11, 72, 116, 118, 233, 236–237, 239–240, 242, 247, 336, 343–344
 vertices, 25

rise and run, 147
 telescope length and diameter of vision, 584–585
 trapezoid, area of, 240
 triangle side length, 577, 601, 603, 628
 vertices, 25
 volume
 of cylinder, 408–409, 597
 gasoline, 549
 gasoline tank, 587
 of rectangular box, 240, 409

global warming

average surface temperature of Earth, 48, 112, 174–175, 294, 296
 carbon emissions
 burning fossil fuels, 112, 294
 China, 526–527
 developed and developing countries, 356
 per-person, 295–296, 356, 426–427, 526–527
 United States, 294–296, 526, 597
 Global Climate Change Initiative, 112–113
 Kyoto Protocol, 112, 294–295
 population and, 322–324, 426–427, 597–598

government. See politics and government

H**health**

cancer cases, number of new, 208
 cigarette smoking in 18–24 age group, 526
 deaths
 from adverse reactions to drugs, 248
 from AIDS, 55, 87
 firearm suicides, 273
 from heart disease, 45, 394
 Iraq war death rates, 271, 279
 from malaria, 479
 from motor vehicle crash, 156–157, 629
 from opioid overdose, 169
 overdose, 169, 475
 patient mortality and nurse staffing, 273, 281
 pedestrian fatalities, 363
 of police, 46
 of volunteer firefighters, 170
 exercise, 224
 farm injuries, 157
 head sizes and brain weights, 334
 health insurance
 employee contribution required to cover family in employer-sponsored health plan, 156
 maximum income level to qualify for NY Child Health Plus program, 169
 percentages of Americans without, 54
 high cholesterol, 523
 illness and injury rate in the workplace, 525
 kidney transplants, 301
 life expectancy, 19
 spending and, 624
 marijuana use, 117, 377
 medical degrees earned by women, 531

memory impairment, 530–531
 nurse staffing and patient mortality, 273, 281
 nursing degrees awarded, 107–108
 obesity
 percentage of Americans who are, 53
 percentage of obese adults and percentage of adults who exercise, 224
 percentages of women and men who are, 432
 osteopathic doctors who are women, percentages of, 292
 percentage of Americans saying they would like to lose, 265
 percentage of Americans saying they would like to lose weight, 169
 picture warnings on cigarette packages, 110
 prescription sleep medication, 520–521
 smoking
 Americans who support making illegal, 300–301
 by mothers during pregnancy, 281–282
 smoking by high school students, 335
 spending
 on prescription drugs, 223
 steroid use by professional baseball players, 573
 target heart-rate zone, 350–351
 traumatic brain injuries, 376
 Weight Watcher subscribers, 110

height

age and, 21
 apparent height of a painting, 601
 of baseball hit upward, 22, 470–471, 475
 of basketball hoop, 546–547
 of basketball teams in 2014 draft, 173–174
 of cliff, 587
 of Golden Gate Bridge towers, 86
 grass heights on golf putting surfaces, 73
 growth of a child, 60
 of objects and their shadow length, 297
 of person in inches, 11
 rate of change in ti plant height, 169
 ratio of One World Trade Center to John Hancock Tower, 101
 of stacked cups, 169
 of tennis net, 549
 of thrown ball, 475
 of water in a cylinder, 49

I**insurance, health**

employee contribution required to cover family in employer-sponsored health plan, 156
 maximum income level to qualify for NY Child Health Plus program, 169
 percentages of Americans without, 54

Internet. See computers and Internet investment

interest, 339–340
 annual, 339–340, 344–345, 362, 408, 418, 628
 total, 339–340, 344–345, 362, 408, 628
 stock values, 82
 after bad publicity, 136
 change over time, 34, 35, 133, 222, 274
 collecting data, 113
 current values and changes in values, 90
 daily change in Microsoft, 118
 of Martha Stewart Living Omnimedia, 222
 number of shares and total value, 62
 percent change in, 114, 119

L

law and law enforcement. See also crime; military
 Americans who support making smoking illegal, 300–301
 cost of War on Terror, US annual, 475
 drivers stopped by police, 40–42
 gun seizures by New York Police Department, 245
 inmates younger than 18 in state prisons, number of, 269
 marijuana legalization, 277
 police fatalities, 46
 prisoners and releases from prison, 602
 released convicts that have been arrested for a new crime, 623
 sexual-harassment charges filed, number of, 270
 wiretap authorizations, 378
leisure. See entertainment, leisure, and recreation

length

basketball court, 549
 of electric 1974 Fender® Jazz Bass, 546–547
 guitar string frequency and, 588
 of telescopes and diameter of vision, 584–585
 of triangle side, 577, 601, 603, 628

light

amount from bulb at given distance, 418
 illumination/ brightness, 557, 587

M**mathematics**

translating from English into mathematics, 59, 60, 78, 107
 translating from mathematics into English, 59

media and news

average number of magazine subscriptions sold, 22
 average time American adult spends daily with digital media, 269
 newspaper
 morning and evening daily, 311, 331, 387
 numbers and revenues of print, 601
 trust in mass media, 293

- medicine.** *See also* health
 deaths from adverse reactions to drugs, 248
 overdose deaths from opioids, 169
 prescription sleep medication, 520–521
 radiation treatment, 584
 revenue from ADHD drugs, 51
 spending on prescription drugs, 223
- military**
 annual defense spending, 22
 Iraq war death rates, 271, 279
 nuclear bomb tests, 101
- miscellaneous**
 average release times for balloon inflated with a single breath, 176–177
 fires, number of, 222
 relationship of emotions and knowledge, 587
 terrorist attacks in United States, 110
- motor vehicles**
 accidents
 by age group, 24
 crash deaths, 156–157, 629
 age of light vehicles, 44
 average annual lost time due to traffic congestion, 12
 drivers stopped by police, 40–42
 gasoline consumed after filling tank, 79
 GM's U.S. market share, 376–377
 owners who owe more money than worth of their vehicle, 375
 pedestrian fatalities, 363
 reused or recycled tires, 623–624
 running red lights, percentage of drivers admitting to, 483, 522
 sales of light vehicles, 269–274
 seat belt use, 280
 speeding drivers, 629
 super-premium vehicle sales, 473
 times spent driving each day, 365, 371–372
 truck rental, 274
- music**
 album purchases, 61
 album sales, 136, 223
 downloaded, 524
 Kendrick Lamar, 344
 Radiohead, 344
 change in quantity of CDs, 82
 concert
 CD sales at, 31
 drink cost and total cost, 134
 number of fans at Kendrick Lamar, 10
 profit of top grossing concert tours, 1, 37–40
 ticket prices, 53
 cost of recording time, 575
 downloaded songs, 12
 FM radio stations, 384–385
 guitar purchase, 95
 guitar string vibration, 588
 length of electric 1974 Fender® Jazz Bass, 546–547
 number of independent CD and record stores, 137
 revenue from digital, 208
 songs learned by garage band, 169
 sound level
 of electric guitar, 418, 587
 of music played by a stereo, 46
 subscription and streaming services, revenues from, 290
- N**
news. *See* media and news
- P**
physics
 altitude of hot-air balloon, 26–28, 30, 35–36
 average release times for balloon inflated with a single breath, 176–177
 bike tire pressure, 136
 boiling points of water and elevation, 165
 force
 of car impact, 576
 to lift object, 241
 on string, 587
 tension of string, 583
 on wrench, 418, 587
 guitar string vibration, 588
 height of water in a cylinder, 49
 intensity of longwave radiation emission, 587
 intensity of television signal, 408, 414, 587
 light
 amount at given distance, 418
 illumination/brightness, 557, 587
 loudness of foghorn, 15
 power of windmill, 408
 projectile motion
 height of baseball hit upward, 22, 470–471, 475
 vertical throwing speed, 427
 sound levels
 electric guitar, 418, 587
 examples of, 46
 traveling speed and stopping distance, 15
 volume of gasoline in tank after road trip, 170, 172
 volume of water in bathtub after plug is pulled, 118
 volume of water in swimming pool, rate of increase in, 169
 volume of water pumped out of flooded basement, 33, 117
 volumes and pressures in a syringe, 588
- politics and government**
 background checks for gun purchases, 118
 Congressional pay, 109–110
 contributions in presidential elections, 116–117
 cost of War on Terror, US annual, 475
 countries requiring picture warnings on cigarette packages, 110
 female members of Congress, 269
 government's share of outstanding student debt, 472
 House of Representatives
 men and women in, 333
 seats by region, 361
 IRS budget, 180
 Patriot Groups, 89–90
 presidential election voter turnout, 89
- population.** *See* demographics and population
- profits.** *See* revenue and profits
- R**
real estate
 average selling price of home in San Bruno, California, 222
 demand for refinancing home loans, 587
 home address as personal information, 268, 274–276
 home ownership
 age and, 17–18, 51
 percentage of adults owning homes, 17–18
 rate among people age 35 and under, change in, 248
 home security systems, revenue from, 281
 median asking rents, 532
 median home price in San Francisco, 169
 median sales prices of homes, 248
 new home value, 11
 number of people living in two-bedroom house, 2
 PACE loans, 272
 sales price of home, 282
- recreation.** *See* entertainment, leisure, and recreation; sports
- revenue and profits**
 from ADHD drugs, 51
 annual company, 2, 34, 35, 51–53, 169, 475, 480, 482
 Apple, 12
 from iPad, 526
 auditorium/theater seating and, 338, 344–345, 360, 362
 author's royalties, 601
 average Super Bowl ticket prices, 16–17
 Bank of America, 223
 from book sales, 344
 BP's annual profit, 11
 Broadway-based movie musicals, 20
 from cereal, 182
 from computer sales, 63
 from concert tours, 1
 from department stores, 364
 from digital ads, 110
 from digital music, 208
 from Dr. Grip® pen sales, 629
 ExxonMobile, 118
 from gluten-free products, 135
 Google's worldwide, 168
 herbal dietary supplements, 283
 from home security systems, 281
 iRobot® Corporation, 283
 from Ivory bar soap, 135
 LinkedIn, 474
 Nike
 clothing, 373–374
 from North American, 110
 percentages from footwear, 302
 from organic and non-genetically-modified food, 335
 of print newspapers, 601
 of social network gaming and mobile games, 241–242
 for stocks, 113–114
 Tiffany's, 521
 U.S. *versus* worldwide, 172
 of U.S. electronics and appliance stores compared to rare earth mining, 36
 Viacom, 223
 Whole Food's, 380
- S**
sales
 of albums, 136, 223
 of automobiles, 12
 background checks for gun purchases, 118
 bicycle, 108
 book, 344
 box office gross from movie theaters, 51
 of bread loaves, 63
 of CDs at concerts, 31
 digital ad revenue, 110
 of digital cameras, 170, 215
 electric cars, 518–520
 of fair-trade coffee, 136
 gasoline sales price, 173
 of gluten-free products, 135
 guitar, 95, 240
 Hyundai Sonata and Lexus RX 400h, 387
 iPad®, 10
 iPhone, 434, 474
 Kia® automobiles, 242
 of light vehicles, 269–274
 of magazine subscriptions by telemarketer, 22
 median prices for existing homes, 92–93
 of Nintendo handheld games, 135
 Nissan Altima® average sales price, 171
 refrigerator, 100
 retail and sale prices of televisions, 73
 retail price and net price of shaver, 134
 Samsung smartphone average selling price, 223
 of socks, 62
 super-premium vehicles, 473
 taxes, 95, 100, 208
 ticket sales, 246, 482
 TI-84 Plus® graphing calculator retail price, 180
 total gasoline, 240
 Toyota Prius®, 89
 video game price, 11
- society**
 approval of single men raising children on their own by age, 24–25
 children younger than 18 living with two married parents, percentage of, 269
 church attendance, 629
 cost of Thanksgiving dinner for ten people, 430
 evolution belief by Americans, 281
 foreign born, percentages of U.S. population, 379
 guns in circulation, numbers of, 361–362
 happiness, 624
 home address considered as personal information, 268, 274–276

society (*continued*)

marijuana legalization, percentage of Americans favoring, 277
 marijuana use, 117, 377
 marriage
 married-couple households, 292, 431
 married persons “very happy” with their marriages, percentages of, 249, 280
 percentage of Americans who are married, 334, 359–360
 percentage of married people reaching major anniversaries, 377
 number of Americans who live alone, 282
 number of women and men living alone, 432–433
 percentage of Americans who are confident they will retire ahead of their schedule, 180
 percentage of Americans who believe gay/lesbian relations are morally acceptable, 214
 percentages of Americans who favor ban on handgun possession, 44
 religion, importance of, 281
 teenage birthrate, 293
sound. *See* acoustics
space. *See* aeronautics and astronomy
speed
 braking distance and, 488–489, 587
 driving, 549
 land speed records, 272
 limit on motorways in France, 602
 men’s 200-meter run record times, 303, 311–312, 331
 500-meter speed-skating times, 312, 331
 runner’s pulse rate and, 15
 running, 175–176
 speed limit in miles per hour, 62
 stopping distance and, 15
 time, speed, and distance traveled, 34, 57, 135–136, 162–163, 171, 182, 242, 418, 579–580, 601
 walking, 175–176, 546–547
 women’s 200-meter run record times, 303, 311–312, 331
sports
 baseball
 height baseball hit upward, 22, 470–471, 475
 height thrown ball, 475
 home runs hit by Chris Davis in a season, 10
 hot dog and soft drink prices at National League baseball stadiums, 281
 most career grand slams, 25
 number of bats broken in MLB games, 118
 payroll of Baltimore Orioles and Seattle Mariners, 334
 prices of hot dogs and soft drinks at MLB stadiums, 43
 salary of Joe Mauer, 54

steroid use by professional players, 573
 stolen bases by Willie Mays, 30
 ticket cost at Wrigley Field, 234
 ticket cost at Yankee Stadium, 240
 time to hit ground of dropped baseball, 494
 basketball
 court length, 549
 height and weight of basketball teams in 2014 draft, 173–174
 height of hoop, 546–547
 percentages of Americans who have ever played organized, 523
 college
 core GPAs/SAT scores needed to qualify to play, 171
 football
 ages and level of experience of NFL players, 224
 average attendance at college bowl games, 274
 average Super Bowl ticket prices, 16–17
 diagonal length of field, 501
 little-league field dimensions, 343
 season ticket costs at University of Illinois, 240
 golf
 grass heights on putting surfaces, 73
 Tiger Wood’s tournament earnings and number of wins, 23
 hockey
 average salary for player, 222
 Olympics
 restriction to amateur athletes, 576
 winning times for men’s 100-meter freestyle, 269
 running, 182
 marathon finishers by age, 332–333
 men’s 200-meter run record times, 303, 311–312, 331
 pulse rate and speed, 15
 women’s 200-meter run record times, 303, 311–312, 331
 women who have run in the NYC marathon, 523
 shot puts, 524–525
 skating
 500-meter speed-skating times, 312, 331
 skiing
 number of skier/snowboarder visits to U.S. slopes, 169
 ski run decline, 146, 181, 628
 ski trip costs, 63, 538
 soccer
 American adults who say they are interested in, 628–629
 diagonal length of field, 501
 percentages of Americans who have ever played organized, 378–379
 softball
 cost to join league, 117

swimming
 winning times for men’s Olympic 100-meter freestyle, 269
 table tennis dimensions, 343
 tennis
 court dimensions, 343
 height of tennis net, 549
 weightlifting, 524–525

T**taxes**

chances of audit by IRS, 118
 grocery, 100
 IRS budget, 180
 number of pages in IRS 1040 instruction booklet, 379–380
 opinion on taxing the rich, 576
 percentages of incomes unreported to IRS, 607
 returns filed online, 476
 sales, 95, 100
 in Chicago, 208

television

average daily viewing time, 334
 average weekly viewing time, 215
 cable TV
 paying for, 575
 percentages of adults who watch, 620
 diagonal length of screen, 489, 501
 intensity of television signal at a distance, 408, 414, 587
 market share of large-screen and very-large-screen televisions, 387
 new scripted shows aired online, 476
 number of shows, 182
 number of viewers for *Today* vs. *CBS This Morning*, 101
 percentage of people who binge watch, 22
 percentages of viewers who watch their programs within a specific number of days, 627
 percentage that would choose television viewing over Internet access, 332
 prime-time viewing by age group, 516–518
 retail and sale prices, 73
 subscribers of pay-TV and Netflix, 388
temperature. 12. *See also* global warming
 average surface temperature of Earth, 48, 112, 174–175
 boiling points of water and elevation, 165
 in closed car, 576
 cooling of a potato, 22
 cricket chirp rate, 362
 decrease, 81, 89, 116–117, 480, 628
 Fahrenheit *versus* Celsius, 170, 234–235, 237
 increase, 78–79, 81, 84–85, 86, 89, 91
 low, 11
 in Chicago, 11, 119
 in Indianapolis, 53
 in New York, 362
 open doors and, 587

oven, 11
 rate of change, 160, 169, 172, 180
 relative humidity, 587
tests and testing
 AP exams, 395
 average response time, 60
 scores
 adding points to, 57, 60
 average, 13, 61, 241
 average SAT, 63
 calculus Test 2 *versus* Test 3, 21
 change between tests, 247
 LSD concentration and, 46
 quiz scores, 7, 13–14, 21
 on second exam and changes in scores, 90
 time student prepares for exam, 11
time
 commute time to work, average U.S., 269
 cost of recording time, 575
 distance of falling object, 587
 distance traveled and, 34, 57, 162–163, 171, 182, 242, 572–573
 driving Torrance, CA to Sun Lakes, AZ, 557
 to fill gasoline tank, 587
 gasoline consumption and time traveled, 136
 to hit ground of dropped baseball, 494
 men’s 200-meter run record times, 303, 311–312, 331
 500-meter speed-skating times, 312, 331
 period of a pendulum, 607
 period of a planet, 607
 spent driving each day, 365, 371–372
 time, speed, and distance traveled, 34, 57, 135–136, 162–163, 171, 182, 242, 418, 579–580, 601
 winning times for men’s Olympic 100-meter freestyle, 269
 women’s 200-meter run record times, 303, 311–312, 331
 years since specific date, 2, 11, 18, 51
transportation and travel
 airline passenger complaints against TSA, 364
 cities where Uber operates, 12
 commute time to work, average U.S., 269
 cruise ship size and crew, 47
 driving speed, 62, 63, 135–136, 242
 gasoline consumption
 distance traveled and, 35, 134
 time traveled and, 136
 volume of gasoline in tank after road trip, 170, 172
 hotels, average daily price at, 61
 length of driving trip, 500
 number of U.S. passports issued, 36
 parking costs, 135
 public transportation, number of trips by Americans on, 223
 running red lights, percentage of drivers admitting to, 483, 522
 ski trip, 63, 538

taxi charges, 180, 223
 time, speed, and distance
 traveled, 34, 57, 162–163,
 171, 182, 242, 418
 times and distances traveled, 34,
 57, 135–136, 171, 173, 242
 times spent driving each day, 365,
 371–372
 traffic congestion, average annual
 lost time due to, 12
 volume of gasoline in tank after
 road trip, 170, 172
travel. *See* transportation and travel

W
weather
 relative humidity, 587
weight
 before and after diet, 81, 132–133
 baby at birth, 2
 basketball teams in 2014 draft,
 173–174
 brain, 334
 cooking times of a turkey and,
 182
 of dogs and their average life
 expectancy, 172

flounder, East Coast's summer,
 282
 ideal of men with medium frame,
 354
 ideal of women with medium
 frame, 360
 of math professor, 280
 obesity
 percentage of Americans who
 are, 53
 percentage of obese adults and
 percentage of adults who
 exercise, 224

percentage of Americans saying
 they would like to lose,
 169, 265
 percentage of obese adults and
 percentage of adults who
 exercise, 224
 of person on the moon, 575
 of pizza, 587
 pizza crust, 408
 textbook, 587–588