

# *elementary* **STATISTICS**

**PICTURING THE WORLD**

6e



*7th*  
**LARSON**  
*7th*  
**FARBER**



# Elementary Statistics

PICTURING THE WORLD

6th  
EDITION

**Ron Larson**

The Pennsylvania State University  
The Behrend College

**Betsy Farber**

Bucks County Community College

**PEARSON**

Boston Columbus Indianapolis New York San Francisco Upper Saddle River  
Amsterdam Cape Town Dubai London Madrid Milan Munich Paris Montréal Toronto  
Delhi Mexico City São Paulo Sydney Hong Kong Seoul Singapore Taipei Tokyo

Editor in Chief: *Deirdre Lynch*  
Acquisitions Editor: *Marianne Stepanian*  
Senior Content Editor: *Chere Bemelmans*  
Assistant Editor: *Sonia Ashraf*  
Senior Managing Editor: *Karen Wernholm*  
Associate Managing Editor: *Tamela Ambush*  
Digital Assets Manager: *Marianne Groth*  
Media Producer: *Audra Walsh*  
QA Manager, Assessment Content: *Marty Wright*  
Senior Content Developer: *John Flanagan*  
Project Supervisor, MyStatLab: *Bob Carroll*  
Senior Marketing Manager: *Erin Lane*  
Marketing Manager, AP and Electives: *Jackie Flynn*  
Marketing Assistant: *Kathleen DeChavez*  
Liaison Manager, Text Permissions Group: *Joseph Croscup*  
Image Manager: *Rachel Youdelman*  
Procurement Specialist: *Debbie Rossi*  
Associate Director of Design, USHE North and West: *Andrea Nix*  
Program Design Lead: *Beth Paquin*  
Production Coordination, Composition, and Illustrations: *Larson Texts, Inc.*

Text and Cover Design: *Infiniti*  
Cover Images: *Shutterstock*

For permission to use copyrighted material, grateful acknowledgment is made to the copyright holders on page P1, which is hereby made part of this copyright page.

Many of the designations used by manufacturers and sellers to distinguish their products are claimed as trademarks. Where those designations appear in this book, and Pearson Education was aware of a trademark claim, the designations have been printed in initial caps or all caps.

#### **Library of Congress Cataloging-in-Publication Data**

Larson, Ron, 1941-

Elementary statistics : picturing the world/Ron Larson, Betsy Farber.—6th ed.  
p. cm.

ISBN 978-0-321-91121-6

1. Statistics—Textbooks. I. Farber, Elizabeth. II. Title.

QA276.12.L373 2012

519.5—dc22

Copyright © 2015, 2012, 2009 Pearson Education, Inc.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher. Printed in the United States of America. For information on obtaining permission for use of material in this work, please submit a written request to Pearson Education, Inc., Rights and Contracts Department, 501 Boylston Street, Suite 900, Boston, MA 02116, fax your request to 617-671-3447, or e-mail at <http://www.pearsoned.com/legal/permissions.htm>.

1 2 3 4 5 6 7 8 9 10—DOW—17 16 15 14 13

**PEARSON**

[www.pearsonhighered.com](http://www.pearsonhighered.com)

ISBN 10: 0-321-91121-0  
ISBN 13: 978-0-321-91121-6

## About the Authors



### Ron Larson

The Pennsylvania State University  
The Behrend College

**RON LARSON** received his Ph.D. in mathematics from the University of Colorado in 1970. At that time he accepted a position with Penn State University, and he currently holds the rank of professor of mathematics at the university. Larson is the lead author of more than two dozen mathematics textbooks that range from sixth grade through calculus levels. Many of his texts, such as the tenth edition of his calculus text, are leaders in their markets. Larson is also one of the pioneers in the use of multimedia and the Internet to enhance the learning of mathematics. He has authored multimedia programs, extending from the elementary school through calculus levels. Larson is a member of several professional groups and is a frequent speaker at national and regional mathematics meetings.



### Betsy Farber

Bucks County Community College

**BETSY FARBER** received her Bachelor's degree in mathematics from Penn State University and her Master's degree in mathematics from the College of New Jersey. Beginning in 1976, she taught all levels of mathematics at Bucks County Community College in Newtown, Pennsylvania, where she held the rank of professor. She was particularly interested in developing new ways to make statistics relevant and interesting to her students and taught statistics in many different modes—with the TI-83 Plus, with Minitab, and by distance learning as well as in the traditional classroom. A member of the American Mathematical Association of Two-Year Colleges (AMATYC), she authored *The Student Edition of MINITAB* and *A Guide to MINITAB*. She served as consulting editor for *Statistics, A First Course* and wrote computer tutorials for the CD-ROM correlating to the texts in the Streeter Series in mathematics. Sadly, Betsy passed away during the production of this book after battling an extended illness.

# Contents

Preface	x	Acknowledgments	xiv	Index of Applications	xvi
Supplements	xii	How to Study Statistics	xv		

## PART 1 DESCRIPTIVE STATISTICS

### 1



## Introduction to Statistics

◀ Where You've Been	▶ Where You're Going	1
<b>1.1 An Overview of Statistics</b>		2
<b>1.2 Data Classification</b>		9
Case Study: <i>Rating Television Shows in the United States</i>		16
<b>1.3 Data Collection and Experimental Design</b>		17
Activity: <i>Random Numbers</i>		27
Uses and Abuses: <i>Statistics in the Real World</i>		28
<b>Chapter Summary</b>		29
<b>Review Exercises</b>		30
<b>Chapter Quiz</b>		32
<b>Chapter Test</b>		33
Real Statistics—Real Decisions: <i>Putting it all together</i>		34
History of Statistics— <i>Timeline</i>		35
Technology: <i>Using Technology in Statistics</i>		36

### 2



## Descriptive Statistics

38

◀ Where You've Been	▶ Where You're Going	39
<b>2.1 Frequency Distributions and Their Graphs</b>		40
<b>2.2 More Graphs and Displays</b>		55
<b>2.3 Measures of Central Tendency</b>		67
Activity: <i>Mean Versus Median</i>		81
<b>2.4 Measures of Variation</b>		82
Activity: <i>Standard Deviation</i>		100
Case Study: <i>Business Size</i>		101
<b>2.5 Measures of Position</b>		102
Uses and Abuses: <i>Statistics in the Real World</i>		114
<b>Chapter Summary</b>		115
<b>Review Exercises</b>		116
<b>Chapter Quiz</b>		120
<b>Chapter Test</b>		121
Real Statistics—Real Decisions: <i>Putting it all together</i>		122
Technology: <i>Parking Tickets</i>		123
Using Technology to Determine Descriptive Statistics		124
<b>Cumulative Review: Chapters 1 and 2</b>		126

## PART 2 PROBABILITY AND PROBABILITY DISTRIBUTIONS

### 3

## Probability

128



◀ Where You've Been ▶ Where You're Going

<b>3.1</b>	<b>Basic Concepts of Probability and Counting</b>	129
	Activity: <i>Simulating the Stock Market</i>	130
		146
<b>3.2</b>	<b>Conditional Probability and the Multiplication Rule</b>	147
<b>3.3</b>	<b>The Addition Rule</b>	157
	Activity: <i>Simulating the Probability of Rolling a 3 or 4</i>	166
	Case Study: <i>United States Congress</i>	167
<b>3.4</b>	<b>Additional Topics in Probability and Counting</b>	168
	Uses and Abuses: <i>Statistics in the Real World</i>	178
	<b>Chapter Summary</b>	179
	<b>Review Exercises</b>	180
	<b>Chapter Quiz</b>	184
	<b>Chapter Test</b>	185
	Real Statistics—Real Decisions: <i>Putting it all together</i>	186
	Technology: <i>Simulation: Composing Mozart Variations with Dice</i>	187

### 4

## Discrete Probability Distributions

188



◀ Where You've Been ▶ Where You're Going

<b>4.1</b>	<b>Probability Distributions</b>	189
<b>4.2</b>	<b>Binomial Distributions</b>	190
	Activity: <i>Binomial Distribution</i>	201
	Case Study: <i>Distribution of Number of Hits in Baseball Games</i>	214
		215
<b>4.3</b>	<b>More Discrete Probability Distributions</b>	216
	Uses and Abuses: <i>Statistics in the Real World</i>	223
	<b>Chapter Summary</b>	224
	<b>Review Exercises</b>	225
	<b>Chapter Quiz</b>	228
	<b>Chapter Test</b>	229
	Real Statistics—Real Decisions: <i>Putting it all together</i>	230
	Technology: <i>Using Poisson Distributions as Queuing Models</i>	231

## 5

## Normal Probability Distributions

232



	◀ Where You've Been	▶ Where You're Going	233
<b>5.1</b>	<b>Introduction to Normal Distributions and the Standard Normal Distribution</b>		234
<b>5.2</b>	<b>Normal Distributions: Finding Probabilities</b>		246
<b>5.3</b>	<b>Normal Distributions: Finding Values</b>		252
	Case Study: <i>Birth Weights in America</i>		260
<b>5.4</b>	<b>Sampling Distributions and the Central Limit Theorem</b>		261
	Activity: <i>Sampling Distributions</i>		274
<b>5.5</b>	<b>Normal Approximations to Binomial Distributions</b>		275
	Uses and Abuses: <i>Statistics in the Real World</i>		284
	<b>Chapter Summary</b>		285
	<b>Review Exercises</b>		286
	<b>Chapter Quiz</b>		290
	<b>Chapter Test</b>		291
	Real Statistics—Real Decisions: <i>Putting it all together</i>		292
	Technology: <i>Age Distribution in the United States</i>		293
	<b>Cumulative Review: Chapters 3–5</b>		294

## PART 3 STATISTICAL INFERENCE

## 6

## Confidence Intervals

296



	◀ Where You've Been	▶ Where You're Going	297
<b>6.1</b>	<b>Confidence Intervals for the Mean (<math>\sigma</math> Known)</b>		298
<b>6.2</b>	<b>Confidence Intervals for the Mean (<math>\sigma</math> Unknown)</b>		310
	Activity: <i>Confidence Intervals for a Mean</i>		318
	Case Study: <i>Marathon Training</i>		319
<b>6.3</b>	<b>Confidence Intervals for Population Proportions</b>		320
	Activity: <i>Confidence Intervals for a Proportion</i>		329
<b>6.4</b>	<b>Confidence Intervals for Variance and Standard Deviation</b>		330
	Uses and Abuses: <i>Statistics in the Real World</i>		336
	<b>Chapter Summary</b>		337
	<b>Review Exercises</b>		338
	<b>Chapter Quiz</b>		340
	<b>Chapter Test</b>		341
	Real Statistics—Real Decisions: <i>Putting it all together</i>		342
	Technology: <i>Most Admired Polls</i>		343
	Using Technology to Construct Confidence Intervals		344

## 7

## Hypothesis Testing with One Sample

346



◀ Where You've Been ▶ Where You're Going

<b>7.1</b>	<b>Introduction to Hypothesis Testing</b>	347
<b>7.2</b>	<b>Hypothesis Testing for the Mean (<math>\sigma</math> Known)</b>	348
<b>7.3</b>	<b>Hypothesis Testing for the Mean (<math>\sigma</math> Unknown)</b>	363
	Activity: <i>Hypothesis Tests for a Mean</i>	377
	Case Study: <i>Human Body Temperature: What's Normal?</i>	386
<b>7.4</b>	<b>Hypothesis Testing for Proportions</b>	387
	Activity: <i>Hypothesis Tests for a Proportion</i>	388
<b>7.5</b>	<b>Hypothesis Testing for Variance and Standard Deviation</b>	393
	A Summary of Hypothesis Testing	394
	Uses and Abuses: <i>Statistics in the Real World</i>	402
	<b>Chapter Summary</b>	404
	<b>Review Exercises</b>	405
	<b>Chapter Quiz</b>	406
	<b>Chapter Test</b>	410
	Real Statistics—Real Decisions: <i>Putting it all together</i>	411
	Technology: <i>The Case of the Vanishing Women</i>	412
	Using Technology to Perform Hypothesis Tests	413
		414

## 8

## Hypothesis Testing with Two Samples

416



◀ Where You've Been ▶ Where You're Going

<b>8.1</b>	<b>Testing the Difference Between Means (Independent Samples, <math>\sigma_1</math> and <math>\sigma_2</math> Known)</b>	417
<b>8.2</b>	<b>Testing the Difference Between Means (Independent Samples, <math>\sigma_1</math> and <math>\sigma_2</math> Unknown)</b>	418
	Case Study: <i>How Protein Affects Weight Gain in Overeaters</i>	428
<b>8.3</b>	<b>Testing the Difference Between Means (Dependent Samples)</b>	436
<b>8.4</b>	<b>Testing the Difference Between Proportions</b>	437
	Uses and Abuses: <i>Statistics in the Real World</i>	447
	<b>Chapter Summary</b>	454
	<b>Review Exercises</b>	455
	<b>Chapter Quiz</b>	456
	<b>Chapter Test</b>	460
	Real Statistics—Real Decisions: <i>Putting it all together</i>	461
	Technology: <i>Tails over Heads</i>	462
	Using Technology to Perform Two-Sample Hypothesis Tests	463
	<b>Cumulative Review: Chapters 6–8</b>	464
		466



## PART 4 MORE STATISTICAL INFERENCE

### 9

## Correlation and Regression

468



◀ Where You've Been    ▶ Where You're Going

<b>9.1</b>	<b>Correlation</b>	469
	Activity: <i>Correlation by Eye</i>	470
		485
<b>9.2</b>	<b>Linear Regression</b>	486
	Activity: <i>Regression by Eye</i>	496
	Case Study: <i>Correlation of Body Measurements</i>	497
<b>9.3</b>	<b>Measures of Regression and Prediction Intervals</b>	498
<b>9.4</b>	<b>Multiple Regression</b>	509
	Uses and Abuses: <i>Statistics in the Real World</i>	514
	<b>Chapter Summary</b>	515
	<b>Review Exercises</b>	516
	<b>Chapter Quiz</b>	520
	<b>Chapter Test</b>	521
	Real Statistics—Real Decisions: <i>Putting it all together</i>	522
	Technology: <i>Nutrients in Breakfast Cereals</i>	523

### 10

## Chi-Square Tests and the *F*-Distribution

524



◀ Where You've Been    ▶ Where You're Going

<b>10.1</b>	<b>Goodness-of-Fit Test</b>	525
<b>10.2</b>	<b>Independence</b>	526
	Case Study: <i>Food Safety Survey</i>	536
		548
<b>10.3</b>	<b>Comparing Two Variances</b>	549
<b>10.4</b>	<b>Analysis of Variance</b>	558
	Uses and Abuses: <i>Statistics in the Real World</i>	570
	<b>Chapter Summary</b>	571
	<b>Review Exercises</b>	572
	<b>Chapter Quiz</b>	576
	<b>Chapter Test</b>	577
	Real Statistics—Real Decisions: <i>Putting it all together</i>	578
	Technology: <i>Teacher Salaries</i>	579
	<b>Cumulative Review: Chapters 9 and 10</b>	580

# 11

## Nonparametric Tests (Web Only)\*

◀ Where You've Been    ▶ Where You're Going



### 11.1 The Sign Test

### 11.2 The Wilcoxon Tests

Case Study: *College Ranks*

### 11.3 The Kruskal-Wallis Test

### 11.4 Rank Correlation

### 11.5 The Runs Test

Uses and Abuses: *Statistics in the Real World*

#### Chapter Summary

#### Review Exercises

#### Chapter Quiz

#### Chapter Test

Real Statistics—Real Decisions: *Putting it all together*

Technology: *U.S. Income and Economic Research*

\* Available at [www.pearsonhighered.com/mathstatsresources](http://www.pearsonhighered.com/mathstatsresources) and in MyStatLab.

## Appendices

### APPENDIX A    Alternative Presentation of the Standard Normal Distribution    A1

Standard Normal Distribution Table (0-to-z)    A1

Alternative Presentation of the Standard Normal Distribution    A2

### APPENDIX B    Tables    A7

Table 1    *Random Numbers*    A7

Table 2    *Binomial Distribution*    A8

Table 3    *Poisson Distribution*    A11

Table 4    *Standard Normal Distribution*    A16

Table 5    *t-Distribution*    A18

Table 6    *Chi-Square Distribution*    A19

Table 7    *F-Distribution*    A20

Table 8    *Critical Values for the Sign Test*    A25

Table 9    *Critical Values for the Wilcoxon Signed-Rank Test*    A25

Table 10    *Critical Values for the Spearman Rank Correlation Coefficient*    A26

Table 11    *Critical Values for the Pearson Correlation Coefficient*    A26

Table 12    *Critical Values for the Number of Runs*    A27

### APPENDIX C    Normal Probability Plots    A28

Answers to the Try It Yourself Exercises    A31

Answers to the Odd-Numbered Exercises    A48

Index    I1

Photo Credits    P1



# Preface

Welcome to *Elementary Statistics: Picturing the World*, Sixth Edition. You will find that this textbook is written with a balance of rigor and simplicity. It combines step-by-step instruction, real-life examples and exercises, carefully developed features, and technology that makes statistics accessible to all.

We are grateful for the overwhelming acceptance of the first five editions. It is gratifying to know that our vision of combining theory, pedagogy, and design to exemplify how statistics is used to picture and describe the world has helped students learn about statistics and make informed decisions.

## WHAT'S NEW IN THIS EDITION

The goal of the Sixth Edition was a thorough update of the key features, examples, and exercises:

**Examples** This edition includes more than 210 examples, approximately 40% of which are new or revised.

**Exercises** Approximately 45% of the more than 2300 exercises are new or revised.

**Chapter Tests** New to this edition are comprehensive tests that appear at the end of each chapter. These tests allow students to assess their understanding of the concepts of the chapter. The questions are given in random order.

**Extensive Feature Updates** Approximately 65% of the following key features are new or revised, making this edition fresh and relevant to today's students:

- Chapter Openers
- Case Studies
- Real Statistics–Real Decisions: Putting it all together

**Revised Content** The following sections have been changed:

- **Section 1.3, Data Collection and Experimental Design**, now includes an example distinguishing between an observational study and an experiment.
- **Section 2.4, Measures of Variation**, now defines coefficient of variation and contains an example.
- **Section 2.5, Measures of Position**, now includes guidelines and an example on using the interquartile range to identify outliers. The section defines and includes an example on how to find a percentile that corresponds to a specific data entry as well as an example on comparing  $z$ -scores from different data sets.
- **Section 5.5, Normal Approximations to Binomial Distributions**, now includes a discussion of when to add or subtract when using a continuity correction.
- **Sections 6.1, 6.2, 7.2, 7.3, 8.1, and 8.2** have changed to the more modern approach of using the standard normal distribution when the population standard deviation is known and using the  $t$ -distribution when the population standard deviation is unknown.
- Chapter 11 can now be found online in MyStatLab and at [www.pearsonhighered.com/mathstatsresources](http://www.pearsonhighered.com/mathstatsresources).

## FEATURES OF THE SIXTH EDITION

### Guiding Student Learning

**Where You've Been and Where You're Going** Each chapter begins with a two-page visual description of a real-life problem. *Where You've Been* connects the chapter to topics learned in earlier chapters. *Where You're Going* gives students an overview of the chapter.

**What You Should Learn** Each section is organized by learning objectives, presented in everyday language in *What You Should Learn*. The same objectives are then used as subsection titles throughout the section.

**Definitions and Formulas** are clearly presented in easy-to-locate boxes. They are often followed by **Guidelines**, which explain *In Words* and *In Symbols* how to apply the formula or understand the definition.

**Margin Features** help reinforce understanding:

- **Study Tips** show how to read a table, use technology, or interpret a result or a graph. **Round-off Rules** guide the student during calculations.
- **Insights** help drive home an important interpretation or connect different concepts.
- **Picturing the World** sections illustrate important concepts in the section through mini case studies. Each feature concludes with a question and can be used for general class discussion or group work. The answers to these questions are included in the *Annotated Instructor's Edition*.

### Examples and Exercises

**Examples** Every concept in the text is clearly illustrated with one or more step-by-step examples. Most examples have an interpretation step that shows the student how the solution may be interpreted within the real-life context of the example and promotes critical thinking and writing skills. Each example, which is numbered and titled for easy reference, is followed by a similar exercise called **Try It Yourself** so students can immediately practice the skill learned. The answers to these exercises are in the back of the book, and the worked-out solutions are in the *Student's Solutions Manual*. The Videos in MyStatLab show clips of an instructor working out each *Try It Yourself* exercise.

**Technology Examples** Many sections contain a worked example that shows how technology can be used to calculate formulas, perform tests, or display data. Screen displays from Minitab® version 16, Excel® 2013, and the TI-84 Plus graphing calculator (operating system version 2.55) are given. Additional screen displays are presented at the ends of selected chapters, and detailed instructions are given in separate technology manuals available with the book.

**Exercises** The Sixth Edition includes more than 2300 exercises, giving students practice in performing calculations, making decisions, providing explanations, and applying results to a real-life setting. Approximately 45% of these exercises are new or revised. The exercises at the end of each section are divided into three parts:

- **Building Basic Skills and Vocabulary** are short answer, true or false, and vocabulary exercises carefully written to nurture student understanding.
- **Using and Interpreting Concepts** are skill or word problems that move from basic skill development to more challenging and interpretive problems.
- **Extending Concepts** go beyond the material presented in the section. They tend to be more challenging and are not required as prerequisites for subsequent sections.

**Technology Answers** Answers in the back of the book are found using calculations by hand and by tables. Answers found using technology (usually the TI-84 Plus) are also included when there are discrepancies due to rounding.

## Review and Assessment

**Chapter Summary** Each chapter concludes with a Chapter Summary that answers the question *What did you learn?* The objectives listed are correlated to Examples in the section as well as to the Review Exercises.

**Chapter Review Exercises** A set of Review Exercises follows each Chapter Summary. The order of the exercises follows the chapter organization. Answers to all odd-numbered exercises are given in the back of the book.

**Chapter Quizzes** Each chapter has a Chapter Quiz. The answers to all quiz questions are provided in the back of the book. For additional help, see the step-by-step video solutions on the companion DVD-ROM.

**Chapter Tests** Each chapter has a Chapter Test. The questions are in random order. The answers to all test questions are provided in the *Annotated Instructor's Edition*.

**Cumulative Review** A Cumulative Review at the end of Chapters 2, 5, 8, and 10 concludes each part of the text. Exercises in the Cumulative Review are in random order and may incorporate multiple ideas. Answers to all odd-numbered exercises are given in the back of the book.

## Statistics in the Real World

**Uses and Abuses: Statistics in the Real World** Each chapter discusses how statistical techniques should be used, while cautioning students about common abuses. The discussion includes ethics, where appropriate. Exercises help students apply their knowledge.

**Applet Activities** Selected sections contain activities that encourage interactive investigation of concepts in the lesson with exercises that ask students to draw conclusions. The accompanying applets are contained on the DVD that accompanies new copies of the text and at [www.pearsonhighered.com/mathstatsresources](http://www.pearsonhighered.com/mathstatsresources).

**Chapter Case Study** Each chapter has a full-page Case Study featuring actual data from a real-world context and questions that illustrate the important concepts of the chapter.

**Real Statistics–Real Decisions: Putting it all together** This feature encourages students to think critically and make informed decisions about real-world data. Exercises guide students from interpretation to drawing of conclusions.

**Chapter Technology Project** Each chapter has a Technology project using Minitab, Excel, and the TI-84 Plus that gives students insight into how technology is used to handle large data sets or real-life questions.


## CONTINUED STRONG PEDAGOGY FROM THE FIFTH EDITION

**Versatile Course Coverage** The table of contents was developed to give instructors many options. For instance, the *Extending Concepts* exercises, applet activities, Real Statistics–Real Decisions, and Uses and Abuses provide sufficient content for the text to be used in a two-semester course. More commonly, we expect the text to be used in a three-credit semester course or a four-credit semester course that includes a lab component. In such cases, instructors will have to pare down the text's 41 sections.

**Graphical Approach** As with most introductory statistics texts, we begin the descriptive statistics chapter (Chapter 2) with a discussion of different ways to display data graphically. A difference between this text and many others is that **we continue to incorporate the graphical display of data throughout the text**. For example, see the use of stem-and-leaf plots to display data on page 387. This emphasis on graphical displays is beneficial to all students, especially those utilizing visual learning strategies.

**Balanced Approach** The text strikes a **balance among computation, decision making, and conceptual understanding**. We have provided many Examples, Exercises, and Try It Yourself exercises that go beyond mere computation.

**Variety of Real-Life Applications** We have chosen real-life applications that are representative of the majors of students taking introductory statistics courses. We want statistics to come alive and appear relevant to students so they understand the importance of and rationale for studying statistics. We wanted the applications to be **authentic**—but they also need to be **accessible**. See the Index of Applications on page xvi.

**Data Sets and Source Lines** The data sets in the book were chosen for interest, variety, and their ability to illustrate concepts. Most of the **240-plus data sets** contain real data with source lines. The remaining data sets contain simulated data that are representative of real-life situations. All data sets containing 20 or more entries are available in a variety of formats on the DVD that accompanies new copies of the text, within MyStatLab, or at [www.pearsonhighered.com/mathstatsresources](http://www.pearsonhighered.com/mathstatsresources). In the exercise sets, the data sets that are available electronically are indicated by the icon .

**Flexible Technology** Although most formulas in the book are illustrated with “hand” calculations, we assume that most students have access to some form of technology, such as Minitab, Excel, or the TI-84 Plus. Because technology varies widely, the text is flexible. **It can be used in courses with no more technology than a scientific calculator—or it can be used in courses that require sophisticated technology tools**. Whatever your use of technology, we are sure you agree with us that the goal of the course is not computation. Rather, it is to help students gain an understanding of the basic concepts and uses of statistics.

**Prerequisites** Algebraic manipulations are kept to a minimum—often we display informal versions of formulas using words in place of or in addition to variables.

**Choice of Tables** Our experience has shown that students find a **cumulative distribution function (CDF)** table easier to use than a “0-to-z” table. Using the CDF table to find the area under the standard normal curve is a topic of Section 5.1 on pages 237–241. Because we realize that some teachers prefer to use the “0-to-z” table, we have provided an alternative presentation of this topic in Appendix A.

**Page Layout** Statistics instruction is more accessible when it is carefully formatted on each page with a consistent open layout. This text is the first college-level statistics book to be written so that, when possible, its features are not split from one page to the next. Although this process requires extra planning, the result is a presentation that is clean and clear.

## MEETING THE STANDARDS

**MAA, AMATYC, NCTM Standards** This text answers the call for a **student-friendly text that emphasizes the uses of statistics**. Our job as introductory instructors is not to produce statisticians but to produce informed consumers of statistical reports. For this reason, we have included exercises that require students to interpret results, provide written explanations, find patterns, and make decisions.

**GAISE Recommendations** Funded by the American Statistical Association, the Guidelines for Assessment and Instruction in Statistics Education (GAISE) Project developed six recommendations for teaching introductory statistics in a college course. These recommendations are:

- Emphasize statistical literacy and develop statistical thinking.
- Use real data.
- Stress conceptual understanding rather than mere knowledge of procedures.
- Foster active learning in the classroom.
- Use technology for developing conceptual understanding and analyzing data.
- Use assessments to improve and evaluate student learning.

The examples, exercises, and features in this text embrace all of these recommendations.

# Supplements

## STUDENT RESOURCES

**Student Solutions Manual** Includes complete worked-out solutions to all of the *Try It Yourself* exercises, the odd-numbered exercises, and all of the *Chapter Quiz* exercises. (ISBN-13: 978-0-321-91125-4; ISBN-10: 0-321-91125-3)

**Videos** A comprehensive set of videos tied to the textbook, containing short video clips of an instructor working every *Try It Yourself* exercise. New to this edition are section lecture videos. These videos are available in MyStatLab.

A **Companion DVD-ROM** is bound in new copies of *Elementary Statistics: Picturing the World*. The DVD holds a number of supporting materials, including:

- **Chapter Quiz Prep:** video solutions to Chapter Quiz questions in the text, with English and Spanish captions
- **Data Sets:** selected data sets from the text, available in Excel, Minitab (v.14), TI-84 Plus, and txt (tab delimited)
- **Applets** by Webster West

**Graphing Calculator Manual** Tutorial instruction and worked-out examples for the TI-84 Plus graphing calculator. (Available for download from [www.pearsonhighered.com/mathstatsresources](http://www.pearsonhighered.com/mathstatsresources).)

**Excel Manual** Tutorial instruction and worked-out examples for Excel. (Available for download from [www.pearsonhighered.com/mathstatsresources](http://www.pearsonhighered.com/mathstatsresources).)

**Minitab Manual** Tutorial instruction and worked-out examples for Minitab. (Available for download from [www.pearsonhighered.com/mathstatsresources](http://www.pearsonhighered.com/mathstatsresources).)

**Study Cards** for the following statistical software products are available: Minitab, Excel, SPSS, JMP, R, StatCrunch, and the TI-84 Plus graphing calculator.

## INSTRUCTOR RESOURCES

**Annotated Instructor's Edition** Includes suggested activities, additional ways to present material, common pitfalls, alternative formats or approaches, and other helpful teaching tips. All answers to the section and review exercises are provided with short answers appearing in the margin next to the exercise. (ISBN-13: 978-0-321-90110-1; ISBN-10: 0-321-90110-X)

**Instructor Solutions Manual** (download only) Includes complete solutions to all of the exercises, *Try It Yourself* exercises, Case Studies, Technology pages, Uses and Abuses exercises, and Real Statistics–Real Decisions exercises. The **Instructor's Solutions Manual** is available within MyStatLab or at [www.pearsonhighered.com/irc](http://www.pearsonhighered.com/irc).

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

**PowerPoint Lecture Slides** Fully editable and printable slides that follow the textbook. Use during lecture or post to a website in an online course. Most slides include notes offering suggestions for how the material may effectively be presented in class. These slides are available within MyStatLab or at [www.pearsonhighered.com/irc](http://www.pearsonhighered.com/irc).

**Active Learning Questions** Prepared in PowerPoint®, these questions are intended for use with classroom response systems. Several multiple-choice questions are available for each chapter of the book, allowing instructors to quickly assess mastery of material in class. The Active Learning Questions are available to download from within MyStatLab or at [www.pearsonhighered.com/irc](http://www.pearsonhighered.com/irc).

## TECHNOLOGY SUPPLEMENTS

### MyStatLab™ Online Course (access code required)

MyStatLab is a course management system that delivers **proven results** in helping individual students succeed.

- MyStatLab can be successfully implemented in any environment—lab-based, hybrid, fully online, traditional—and demonstrates the quantifiable difference that integrated usage has on student retention, subsequent success, and overall achievement.
- MyStatLab's comprehensive online gradebook automatically tracks students' results on tests, quizzes, homework, and in the study plan. Instructors can use the gradebook to provide positive feedback or intervene if students have trouble. Gradebook data can be easily exported to a variety of spreadsheet programs, such as Microsoft Excel.

MyStatLab provides **engaging experiences** that personalize, stimulate, and measure learning for each student.

- **Tutorial Exercises with Multimedia Learning Aids:** The homework and practice exercises in MyStatLab align with the exercises in the textbook, and they regenerate algorithmically to give students unlimited opportunity for practice and mastery. Exercises offer immediate helpful feedback, guided solutions, sample problems, animations, videos, and eText clips for extra help at point-of-use.
- **Adaptive Study Plan:** Pearson now offers an optional focus on adaptive learning in the study plan to allow students to work on just what they need to learn when it makes the most sense to learn it. The adaptive study plan maximizes students' potential for understanding and success.
- **Additional Statistics Question Libraries:** In addition to algorithmically regenerated questions that are aligned with your textbook, MyStatLab courses come with two additional question libraries. **450 Getting Ready for Statistics** questions offer the developmental math topics students need for the course. These can be assigned as a prerequisite to other assignments, if desired. The **1000 Conceptual Question Library** require students to apply their statistical understanding.
- **StatCrunch™:** MyStatLab includes a web-based statistical software, StatCrunch, within the online assessment platform so that students can easily analyze data sets from exercises and the text. In addition, MyStatLab includes access to **www.StatCrunch.com**, a website where users can access tens of thousands of shared data sets, conduct online surveys, perform complex analyses using the powerful statistical software, and generate compelling reports.
- **Integration of Statistical Software:** Knowing that students often use external statistical software, we make it easy to copy our data sets, both from the ebook and the MyStatLab questions, into software such as StatCrunch, Minitab, Excel, and more. Students have access to a variety of support tools—Technology Instruction Videos, Technology Study Cards, and Manuals for select titles—to learn how to effectively use statistical software.
- **StatTalk Videos:** Fun-loving statistician Andrew Vickers takes to the streets of Brooklyn, NY to demonstrate important statistical concepts through interesting stories and real-life events. This series of 24 videos will actually help you understand statistics. Accompanying assessment questions and instructor's guide available.
- **Expert Tutoring:** Although many students describe the whole of MyStatLab as “like having your own personal tutor,” students also have access to live tutoring from Pearson. Qualified statistics instructors provide tutoring sessions for students via MyStatLab.

And, MyStatLab comes from a **trusted partner** with educational expertise and an eye on the future.

- Knowing that you are using a Pearson product means knowing that you are using quality content. That means that our eTexts are accurate, that our assessment tools work, and that our questions are error-free. And whether you are just getting started with MyStatLab, or have a question along the way, we're here to help you learn about our technologies and how to incorporate them into your course.

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

## MyStatLab™ Ready to Go Course (access code required)

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

## MathXL® for Statistics Online Course (access code required)

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

With MathXL for Statistics, instructors can:

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

With MathXL for Statistics, students can:

- Take chapter tests in MathXL and receive personalized study plans and/or personalized homework assignments based on their test results.
- Use the study plan and/or the homework to link directly to tutorial exercises for the objectives they need to study.
- Students can also access supplemental animations and video clips directly from selected exercises.
- Knowing that students often use external statistical software, we make it easy to copy our data sets, both from the ebook and the MyStatLab questions, into software like StatCrunch™, Minitab, Excel, and more.

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

## StatCrunch™

StatCrunch is powerful web-based statistical software that allows users to perform complex analyses, share data sets, and generate compelling reports of their data. The vibrant online community offers more than tens of thousands of data sets for students to analyze.

- **Collect.** Users can upload their own data to StatCrunch or search a large library of publicly shared data sets, spanning almost any topic of interest. Also, an online survey tool allows users to quickly collect data via web-based surveys.
- **Crunch.** A full range of numerical and graphical methods allows users to analyze and gain insights from any data set. Interactive graphics help users understand statistical concepts, and are available for export to enrich reports with visual representations of data.
- **Communicate.** Reporting options help users create a wide variety of visually-appealing representations of their data.

Full access to StatCrunch is available with a MyStatLab kit, and StatCrunch is available by itself to qualified adopters. For more information, visit our website at **www.StatCrunch.com**, or contact your Pearson representative.

# Acknowledgments

We owe a debt of gratitude to the many reviewers who helped us shape and refine *Elementary Statistics: Picturing the World*, Sixth Edition.

## REVIEWERS OF THE CURRENT EDITION

Dawn Dabney, Northeast State Community College  
 Patricia Foard, South Plains College  
 Larry Green, Lake Tahoe Community College  
 Austin Lovenstein, Pulaski Technical College  
 Abdallah Shuaibi, Harry S. Truman College  
 Jennifer Strehler, Oakton Community College  
 Millicent Thomas, Northwest University  
 Cathy Zucco-Teveloff, Rider University

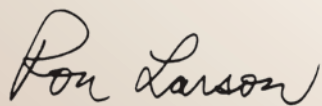
## REVIEWERS OF THE PREVIOUS EDITIONS

Rosalie Abraham, Florida Community College at Jacksonville  
 Ahmed Adala, Metropolitan Community College  
 Olcay Akman, College of Charleston  
 Polly Amstutz, University of Nebraska, Kearney  
 John J. Avioli, Christopher Newport University  
 David P. Benzel, Montgomery College  
 John Bernard, University of Texas—Pan American  
 G. Andy Chang, Youngstown State University  
 Keith J. Craswell, Western Washington University  
 Carol Curtis, Fresno City College  
 Dawn Dabney, Northeast State Community College  
 Cara DeLong, Fayetteville Technical Community College  
 Ginger Dewey, York Technical College  
 David DiMarco, Neumann College  
 Gary Egan, Monroe Community College  
 Charles Ehler, Anne Arundel Community College  
 Harold W. Ellingsen, Jr., SUNY—Potsdam  
 Michael Eurgubian, Santa Rosa Jr. College  
 Jill Fanter, Walters State Community College  
 Douglas Frank, Indiana University of Pennsylvania  
 Frieda Ganter, California State University  
 David Gilbert, Santa Barbara City College  
 Donna Gorton, Butler Community College  
 Dr. Larry Green, Lake Tahoe Community College  
 Sonja Hensler, St. Petersburg Jr. College  
 Sandeep Holay, Southeast Community College, Lincoln Campus  
 Lloyd Jaisingh, Morehead State  
 Nancy Johnson, Manatee Community College

Martin Jones, College of Charleston  
 David Kay, Moorpark College  
 Mohammad Kazemi, University of North Carolina—Charlotte  
 Jane Keller, Metropolitan Community College  
 Susan Kellicut, Seminole Community College  
 Hyune-Ju Kim, Syracuse University  
 Rita Kolb, Cantonsville Community College  
 Rowan Lindley, Westchester Community College  
 Jeffrey Linek, St. Petersburg Jr. College  
 Benny Lo, DeVry University, Fremont  
 Diane Long, College of DuPage  
 Austin Lovenstein, Pulaski Technical College  
 Rhonda Magel, North Dakota State University  
 Mike McGann, Ventura Community College  
 Vicki McMillian, Ocean County College  
 Lynn Meslinsky, Erie Community College  
 Lyn A. Noble, Florida Community College at Jacksonville—  
 South Campus  
 Julie Norton, California State University—Hayward  
 Lynn Onken, San Juan College  
 Lindsay Packer, College of Charleston  
 Nishant Patel, Northwest Florida State  
 Jack Plaggemeyer, Little Big Horn College  
 Eric Preibisius, Cuyamaca Community College  
 Melonie Rasmussen, Pierce College  
 Neal Rogness, Grand Valley State University  
 Elisabeth Schuster, Benedictine University  
 Jean Sells, Sacred Heart University  
 John Seppala, Valdosta State University  
 Carole Shapero, Oakton Community College  
 Abdullah Shuaibi, Truman College  
 Aileen Solomon, Trident Technical College  
 Sandra L. Spain, Thomas Nelson Community College  
 Michelle Strager-McCarney, Penn State—Erie, The Behrend College  
 Deborah Swiderski, Macomb Community College  
 William J. Thistleton, SUNY—Institute of Technology, Utica  
 Agnes Tuska, California State University—Fresno  
 Clark Vangilder, DeVry University  
 Ting-Xiu Wang, Oakton Community  
 Dex Whittinghall, Rowan University  
 Cathleen Zucco-Teveloff, Rowan University

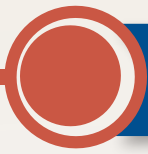
We also give special thanks to the people at Pearson Education who worked with us in the development of *Elementary Statistics: Picturing the World*, Sixth Edition: Marianne Stepanian, Sonia Ashraf, Chere Bemelmans, Erin Lane, Jackie Flynn, Kathleen DeChavez, Audra Walsh, Tamela Ambush, Joyce Kneuer, and Rich Williams. We also thank Allison Campbell, Integra—Chicago, and the staff of Larson Texts, Inc., who assisted with the development and production of the book. On a personal level, we are grateful to our spouses, Deanna Gilbert Larson and Richard Farber, for their love, patience, and support. Also, a special thanks goes to R. Scott O’Neil.

We have worked hard to make *Elementary Statistics: Picturing the World*, Sixth Edition, a clean, clear, and enjoyable text from which to teach and learn statistics. Despite our best efforts to ensure accuracy and ease of use, many users will undoubtedly have suggestions for improvement. We welcome your suggestions.



Ron Larson, [odx@psu.edu](mailto:odx@psu.edu)





# How to Study Statistics



## STUDY STRATEGIES

Congratulations! You are about to begin your study of statistics. As you progress through the course, you should discover how to use statistics in your everyday life and in your career. The prerequisites for this course are two years of algebra, an open mind, and a willingness to study. When you are studying statistics, the material you learn each day builds on material you learned previously. There are no shortcuts—you must keep up with your studies every day. Before you begin, read through the following hints that will help you succeed.

**Make a Plan** Make your own course plan right now! A good rule of thumb is to study at least two hours for every hour in class. After your first major exam, you will know if your efforts were sufficient. If you did not get the grade you wanted, then you should increase your study time, improve your study efficiency, or both.

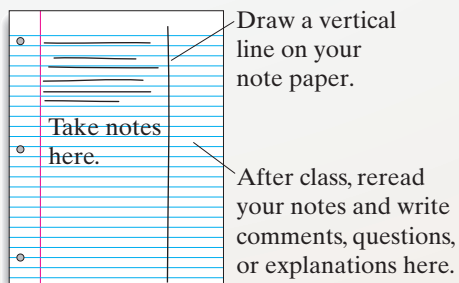
**Prepare for Class** Before every class, review your notes from the previous class and read the portion of the text that is to be covered. Pay special attention to the definitions and rules that are highlighted. Read the examples and work through the Try It Yourself exercises that accompany each example. These steps take self-discipline, but they will pay off because you will benefit much more from your instructor's presentation.

**Attend Class** Attend every class. Arrive on time with your text, materials for taking notes, and calculator. If you must miss a class, get the notes from another student, go to a tutor or your instructor for help, or view the appropriate video in MyStatLab. Try to learn the material that was covered in the class you missed before attending the next class.

**Participate in Class** When reading the text before class, reviewing your notes from a previous class, or working on your homework, write down any questions you have about the material. Ask your instructor these questions during class. Doing so will help you (and others in your class) understand the material better.

### Take Notes

During class, be sure to take notes on definitions, examples, concepts, and rules. Focus on the instructor's cues to identify important material. Then, as soon after class as possible, review your notes and add any explanations that will help to make your notes more understandable to you.



**Do the Homework** Learning statistics is like learning to play the piano or to play basketball. You cannot develop skills just by watching someone do it; you must do it yourself. The best time to do your homework is right after class, when the concepts are still fresh in your mind.

Doing homework at this time increases your chances of retaining the information in long-term memory.

**Find a Study Partner** When you get stuck on a problem, you may find that it helps to work with a partner. Even if you feel you are giving more help than you are getting, you will find that teaching others is an excellent way to learn.

**Keep Up with the Work** Don't let yourself fall behind in this course. If you are having trouble, seek help immediately—from your instructor, a statistics tutor, your study partner, or additional study aids such as the Chapter Quiz Prep videos on the companion DVD-ROM and the Try It Yourself video clips in MyStatLab. Remember: If you have trouble with one section of your statistics text, there's a good chance that you will have trouble with later sections unless you take steps to improve your understanding.

**If You Get Stuck** Every statistics student has had this experience: You work a problem and cannot solve it, or the answer you get does not agree with the one given in the text. When this happens, consider asking for help or taking a break to clear your thoughts. You might even want to sleep on it, or rework the problem, or reread the section in the text. Avoid getting frustrated or spending too much time on a single problem.

**Prepare for Tests** Cramming for a statistics test seldom works. If you keep up with the work and follow the suggestions given here, you should be almost ready for the test. To prepare for the chapter test, review the Chapter Summary and work the Review Exercises and the Cumulative Review Exercises. Then set aside some time to take the sample Chapter Quiz and Chapter Test. Analyze your results to locate and correct test-taking errors.

**Take a Test** Most instructors do not recommend studying right up to the minute the test begins. Doing so tends to make people anxious. The best cure for test-taking anxiety is to prepare well in advance. Once the test begins, read the directions carefully and work at a reasonable pace. (You might want to read the entire test first, and then work the problems in the order in which you feel most comfortable.) Don't rush! People who hurry tend to make careless errors. If you finish early, take a few moments to clear your thoughts and then go over your work.

**Learn from Mistakes** After your test is returned to you, go over any errors you might have made. Doing so will help you avoid repeating some systematic or conceptual errors. Don't dismiss any error as just a "dumb mistake." Take advantage of any mistakes by hunting for ways to improve your test-taking skills.



# Index of Applications

## Biology and Life Sciences

Air quality, 116  
 Alligators, 127  
 Animal species, 480  
 Bacteria, 495  
 Black cherry tree, 512  
 Blue crabs, 433  
 Bumblebee bats, 287, 288  
 Calves, 191  
 Cats, 254, 392  
 Clinical mastitis in dairy herds, 233  
 Cloning, 390  
 Dogs, 144, 199, 254, 392, 467  
 Eastern box turtle, 232, 233  
 Elephants, 435, 512  
 Elk, 18  
 Endangered and threatened species, 573  
 Environmentally friendly products, 212  
 Fish, 511  
 Fisher's Iris data set, 60  
 Florida panther, 332  
 Fox squirrels, 341  
 Fruit flies, 112  
 Genetics, 144, 213  
 Gorillas, 50  
 Harbor seals, 385, 461, 492  
 Houseflies, 64  
 Iguanas, 121  
 Mariana fruit bats, 53  
 North Atlantic right whale, 385  
 Ostrich, 467  
 Pets, 63, 96, 182  
 Pink seaperch, 433  
 Predator-prey relationships, 24  
 Rabbits, 218  
 Salmon, 137, 149  
 Sandhill cranes, 287, 288  
 Snapdragon flowers, 144  
 Soil, 6, 554  
 Soybeans, 26  
 Swans, 361  
 Trees, 13, 505, 507  
 Trout, 218  
 Waste, 384  
 Water  
   conductivity, 381  
   contaminants, 342  
   pH level, 381  
   quality, 335  
 White oak trees, 265

## Business

Advertising, 225, 390, 568, 573  
 and sales, 501  
 Advisory committee, 171  
 Bankruptcies, 222  
 Beverage company, 145  
 Board of directors, 169  
 Company departments, 31

Defective parts, 163, 177, 184, 220, 222, 295  
 Executives, 111, 183  
 Facebook presence, 3  
 Fortune 500 companies, 30, 191  
 Free samples, 392  
 Glass manufacturer, 221  
 Inventory shrinkage, 59  
 Manufacturer claims, 243  
 Manufacturing businesses, 101  
 Product ratings, 199, 445  
 Profit, 2  
 Quality control, 32, 36, 37, 126, 131, 180  
 Sales, 52, 66, 118, 159, 192, 193, 194, 195, 220, 505, 507, 513, 521, 562  
 Salesperson, 15  
 Shipping errors, 360  
 Sizes of firms, 180  
 Small business websites, 207  
 Telemarketing, 190  
 Wal-Mart shareholder's equity, 513  
 Website costs, 335

## Combinatorics

Letters, 175  
 License plates, 133, 180  
 Password, 174  
 Security code, 174, 183, 184, 185

## Computers

Bill pay, online, 325  
 Computer(s), 8, 175, 228, 325  
   repairs, 315, 316, 360  
   software engineer earnings, 335  
 Disk drive, 569  
 Facebook, 76, 164, 291  
 Internet, 32, 72, 182, 361, 545  
 Laptop, 141, 360  
 Monitors, 268  
 Search engines, 320, 322  
 Security, 290  
 Shopping online, 69  
 Social networking sites, 63, 136, 138, 197  
 Spam, 282  
 Tablets, 341  
 Videos, online, 340

## Demographics

Age, 6, 30, 39, 42, 43, 45–48, 56, 57, 62, 72, 78, 89, 94, 98, 99, 102, 104–106, 119, 121, 142, 162, 163, 180, 293, 411, 482, 483, 490, 493, 495, 508, 530, 566  
 Best years for U.S., 30  
 Birth weights in America, 260  
 Births, 220, 535  
 Bride's age, 93

Cars per household, 97  
 Children per household, 90  
 Employee selection, 177  
 Eye color, 13, 153  
 Generations, 211  
 Grandchildren, 163  
 Height, 482, 492, 495  
   of men, 79, 88, 108, 111, 249, 258, 272  
   and metacarpal bone length, 581  
   of women, 50, 88, 108, 249, 258, 272, 391

Household, 294  
 Marriage, 5  
 Most admired polls, 343  
 New car, 132  
 New home prices, 120  
 Physician information, 33  
 Population  
   United States, 229  
   cities, 1, 9  
   West Ridge County, 21–23  
 Religious preference, 182, 183  
 Retirement age, 26, 53  
 Shoe size, 51, 492, 495  
 Supporting kids after college, 5  
 U.S. unemployment rate, 117  
 Weight of newborns, 235, 466  
 Zip codes, 30

## Earth Science

Acid rain, 522  
 Air pollution, 32  
 Clear days, May, San Francisco, CA, 209  
 Cloudy days, June, Pittsburgh, PA, 209  
 Conserving water or electricity, 273  
 Earth Day, 406  
 Earthquakes, 255  
 Environmental impact, 325  
 Global warming, 14, 294, 321  
 Hurricanes, 199, 221  
 Ice thickness, 63  
 Landfill, 379  
 Lightning strikes, 228  
 Nitrogen dioxide, 376  
 Old Faithful, Yellowstone  
   National Park, 46, 96, 273, 472, 475, 477, 480, 488, 489, 499  
 Precipitation  
   Orlando, FL, 12  
   San Francisco, CA, 335  
   Savannah, GA, 220  
 Protecting environment, 461  
 Seawater, 306  
 Snowfall  
   New York county, 270  
   Nome, AK, 198

Soil contamination, 175  
 Solar power, 340  
 Sunny and rainy days, 189, 193  
   Seattle, WA, 143  
 Temperature  
   Cleveland, OH, 49  
   Denver, CO, 12  
   Sacramento, CA, 30  
 Tornadoes, 127, 197  
 Water pollution, 175  
 Weather forecasts, 130, 140  
 Wildland fires, 516

## Economics and Finance

Account balance, 77  
 Allowance, 572  
 ATM machine, 54  
 Audit, 135, 229, 328  
 Bank bailouts, 409  
 Book spending, 51  
 Children's savings accounts, 289  
 Commission, 114  
 Credit card, 113, 193, 268, 339, 360, 384, 422, 581  
 Credit score, 460  
 Dividends and earnings, 483  
 Dow Jones Industrial Average, 6  
 Economic power, 8  
 Emergency savings, 152  
 Financial shape, 176  
 Forecasting earnings, 5  
 Gross domestic product, 471, 474, 479, 480, 487, 489, 499, 500, 501, 503, 508  
 Home owner income, 7  
 Household income, 97, 127, 433, 458, 575  
 Improving economy, 202, 339  
 Income, 482  
 Investments, 64  
 IRAs, 506, 507  
 IRS tax filing wait times, 384  
 Largest charities, 10  
 Manufacturing, 65  
 Money managing, 534  
 Mortgages, 317  
 Paycheck errors, 222  
 Profit and loss analysis, 199  
 Raising a child, cost, 372, 407  
 Repeat buyers, 360  
 Retirement income, 211  
 Salaries, 4, 6, 7, 31, 33, 50, 66, 74, 82–84, 94, 95, 98, 99, 118, 120, 126, 200, 271, 289, 371, 375, 384, 401, 427, 456, 508, 509–511, 520, 521, 556, 567  
 Saving more money, 339  
 Spending before traveling, 91  
 Stock, 114, 142, 145, 180, 307, 504, 507, 554  
   McDonald's, 520  
 Stock market, 146

- Tax preparation methods, 526, 527, 529
- Taxes, 391
- U.S. exports, 79
- Utility bills, 96, 108, 249
- Education**
- Achievement and school location, 543
- ACT scores, 8, 244, 249, 286, 426
- Affordability of higher education, 126, 221
- Ages of students, 70, 131, 284, 303, 307, 308
- Alumni, annual contributions by, 471, 475, 477, 488
- Biology major, 162
- Books, 197, 306
- Borrowing and education, 545
- Business schools, 13
- Chairs in a classroom, 310
- Class level, 76
- Class size, 385
- Classes, 180, 225
- College costs, 7, 534
- College credits, 75
- College graduates, 282
- College president, 32
- College students, 21
- Community college, 466
- Continuing education, 544
- Degrees, 58, 390  
and gender, 184
- Diploma, 291
- Dormitory room prices, 118
- Ebooks, 155
- Education, study plans, 453
- Educational attainment and age, 576  
and employment, 547  
and work location, 538
- Enrollment, 451, 452
- Essays, 270
- Expenditure per student, 408
- Extracurricular activities, 199, 350, 355, 356
- Faculty hours, 385
- Final grade, 77
- Foreign language, 282
- Freshman orientation, 229
- GPA, 33, 62, 76, 119, 316, 471, 480, 563, 569
- Group activity, 175
- Health-related fields, study plans, 453
- Highest level, 143
- History presentations, 185
- Homework, 316
- LSAT scores, 75
- Mathematics assessment test, 430
- MCAT scores, 51, 375
- Medical school, 151
- Musical training, 429
- New York State Tests  
Grade 8 English Language Arts, 236  
Grade 8 Mathematics, 236
- Nursing major, 152, 157, 164
- Performance, 2
- Physics minors, 30
- Plans after high school, 33
- Political correctness, 212
- Public charter schools, 182
- Public school teachers, 421
- Public schools, 164
- Quiz, 141, 202
- Reading activities, 457
- Reading test scores, 581
- SAT scores, 4, 33, 54, 98, 106, 200, 244, 250, 271, 316, 341, 410, 442, 467, 514, 574
- Scholarship, 181
- School assessment testing, 460
- School safety, 543
- School standards, 212
- Science assessment test, 401, 460, 556
- Statistics course, 21
- Student  
advisory board, 172  
drinking habits, 25  
ID numbers, 13, 139  
loans, 482, A29  
sleep habits, 225, 318  
survey results, 66  
time spent online, 419
- Student-athletes, 227
- Student-to-faculty ratio, 116, 117
- Study habits, 31
- Study hours, 97, 491
- Teacher salaries, 65, 579
- Teaching experience, 295, 573
- Teaching methods, 33, 434
- Test grades/scores, 63, 71, 74, 78, 96, 109, 111, 117, 119, 127, 137, 140, 259, 270, 276, 278, 418, 491, 510, 511, 535  
cheating, 221
- Tuition, 75, 103, 107, 361, 385
- U.S. history assessment tests, 401, 556
- Vocabulary, 482, 483
- Engineering**
- Bolts, 334, 335, 409
- Building heights  
Atlanta, GA, 491  
Houston, TX, 117
- Cooling capacity, 490
- Engine part, 251
- Flow rate, 360
- Gears, 251
- Insert diameters, 575
- Liquid dispenser, 251
- Lumber cutter, 272
- Machine settings, 292
- Nails, 251
- Rocket, speed of, 191
- Roller coaster heights, 50, A30
- Tensile strength, 433, 434
- Washers, 334
- Wind turbine, 6
- Entertainment**
- Academy Awards, 112, 135
- Amusement park, 360
- Best-selling books, 14, 135
- Broadway tickets, 15
- Celebrities, 282
- Concert attendance, 197
- DJ playlist, 175
- DVDs, 270
- DVRs, 140, 307
- E-reader, 208
- Game of chance, 199
- Game show, 140
- Home theater systems, 350
- Jukebox, 176
- Lottery, 142, 175, 176, 178, 211, 222, 226
- Magazine, 117, 183
- Media, 7
- Mega Millions lottery, 173
- Mobile device, 276, 279
- Monopoly game, 148
- Motion Picture Association, ratings, 12
- Movie(s), 10, 26, 32, 109, 121, 153, 229, 532, 543  
ratings, 162, 581
- MP3 player, 270
- Music albums, 15  
The Beatles, 121
- New Year's Eve, 30, 116
- News, 211, 226, 283
- Nielsen Company ratings, 16, 26
- Offensive songs, 212
- Political blog, 51
- Radio stations, 119
- Raffle ticket, 137, 183, 196, 200
- Reading, 30
- Rock concert, fan age, 68
- Roulette, 200
- Satellite television, 118
- Singing competition, 175
- Social media, 204
- Song lengths, 14, 113
- Television, 6, 12, 13, 110, 119, 198, 426, 517, 518  
LCD TV, 335  
*The Price Is Right*, 128, 129
- Video games, 32, 174, 206, 210, 346, 347, 360
- Food and Nutrition**
- Apples, 63, 259
- Bananas, 259
- Caffeine, 97, 376
- Calories, 361
- Canned fruit, 271
- Canned vegetables, 271
- Carrots, 259
- Cauliflower yield, 512
- Cereal, 341, 492, 523
- Cheese, 307, 375
- Coffee, 79, 312, 313, 406, 411, 532
- Corn, toxin, 173
- Dark chocolate, 404
- Delivery, 533
- Dried fruit, 406
- Energy bar, 406
- Fast food, 227, 376  
amount spent, 433
- Fat, 490
- Food away from home, money spent on, 408
- Food expenses, 291
- Food safety, 548
- Food waste, 2
- Fruit consumption, 288
- Genetically modified food, 289, 326
- Green tea, 349
- Healthier foods, 26
- High fructose corn syrup, 375
- Hot dogs, 492
- Ice cream, 259, 272, 326, 536, 537, 539, 540
- Jelly beans, 181
- Junk food tax, 164, 211
- M&M's, 226, 530, 531
- Meat consumption, 288
- Menu, 141, 175
- Milk  
consumption, 244  
containers, 272  
processing, 397  
production, 517, 518
- Nutrition bar, 411
- Nutritional information, 154
- Oatmeal, 114
- Peanuts, 406
- Pepper pungencies, 52
- Pizza, 176
- Protein, 490
- Restaurant, 154, 542  
serving time, 409, 553
- Salmonella, 352
- Sodium, 456
- Sorghum yield, 512
- Soup, 406
- Roulette, 200
- Spinach, 519
- Sports drink, 397
- Storing fish, 4
- Sugar, 516
- Supermarket, 247
- Taste test, 52, 412
- Tea, 145, 411
- Tomatoes, 411
- Vending machine, 259
- Water, 482
- Whole-grain foods, 26
- Government**
- Better Business Bureau, 59
- Declaration of Independence, 53
- Department of Energy, gas prices, 3
- Federal income tax, 404
- Governor, Republicans, 8
- Legal system in U.S., 352
- Registered voters, 6, 8, 37, 182
- Securities and Exchange Commission, 37
- Senate committee, 176
- U.S. Census undercount, 4
- Wages, 505, 507, 566, 569
- Health and Medicine**
- Allergy medicine, 24, 333
- Anterior cruciate ligament surgery, 150
- Appetite suppressant, 438
- Arthritis, 25, 280, 454
- Assisted reproductive technology, 155, 230

- Asthma, 391  
 Blood  
   donations, 6, 157, 160  
   pressure, 32, 64, 126, 418, 482, 483, 490  
   test, 197  
   type, 141, 154, 155, 289  
 BMI, 32, 77, 317  
 Body fat percentage, 444, 446  
 Body measurements, 497  
 Body temperature, 11, 358, 387, 441, 482  
 Brain size, 516  
 BRCA gene, 153  
 Breast cancer, 28  
 Calcium supplements, 458  
 Cancer and cell phones, 153  
 Cancer drugs, 435, 451  
 Cancer survivors, 208  
 Carbohydrate contents, 557  
 Cardiovascular disease, 24  
 Cavities, 516  
 Cholesterol, 6, 75, 250, 256, 445, 450, 557  
 Chronic medications, 467  
 Cough syrup, 334, 335  
 Dengue virus, 153  
 Dentist, 24, 325, 341  
 Diabetes, 448  
 Diabetic, 17  
 Diet, 26, 32, 425  
 Doctor, tell truth, 339  
 Drug testing, 283, 446  
 Drug treatment, 542  
 Exercise, 25, 26, 120, 541  
 Female physicians, 18  
 Femur lengths, 51, A30  
 Flu, 185  
 Grip strength, 444  
 Headaches, 443, 561, 562  
 Health care rating, 294  
 Health care reform, 126  
 Health care visits, 361, 527  
 Health club, 249, 408  
 Heart medication, 361  
 Heart rate, 11, 77, 314, 491  
 Heart rhythm abnormality, 7  
 Herbal medicine, 446  
 HIV test, 324, 409  
 Hospital beds, 78  
 Hospital length of stay, 79, 317, 462, 567  
 Hospital waiting times, 317, 401  
 Hospitals, 54  
 Hypothyroidism, 31  
 Influenza vaccine, 7, 20  
 Intravenous solution, 553  
 Length of visit, physician's office, 572  
 Lung cancer, 360  
 Managed health care, 30  
 Medicare, 282  
 Medication errors, 64  
 Mental illness, 229  
 Migraines, 459  
 Mouthing behavior, 17  
 Musculoskeletal injury, 544  
 Nursing, 63  
 Obesity, 8, 211  
 Pain relievers, 564  
 Physician's intake form, 15  
 Plantar heel pain, 451  
 Pneumonia, 442  
 Post-lunch nap, 443  
 Pregnancy durations, 94, 99  
 Pregnancy study, 31  
 Prescription drugs, 25, 126  
 Protein, 436  
 Pulse rate, 54  
 Putting off medical care, 7  
 QT interval, 491  
 Recovery, 136  
 Registered nurse salaries, 493  
 Reliability of testing, 156  
 Respiratory therapy technician wages, 577  
 Rotator cuff surgery, 150, 203  
 Saturated fat intake, 53  
 Seeing a health care provider, 30  
 Serum copper concentration, 461  
 Sleep, 258, 426, 493, 495, 508, 517, 518  
   deprivation, 7, 8, 25, 33  
 Sleep apnea and high blood pressure, 153  
 Smoking, 2, 20, 32, 145, 148, 227, 375, 391, 544  
 Stem cell research, 23  
 Stress, 80, 153  
 Stroke prevention device, 126  
 Surgery  
   bariatric, 367  
   corneal transplant, 228  
   heart transplant, 221, 258, 556  
   kidney transplant, 258, 435  
   procedure, 202, 275  
   survival, 155  
   treatment, 358  
 Triglyceride levels, 53, 248, A30  
 Vaccine, 28  
 Vitamins, 18, 32, 328  
 Weight, 13, 67–69, 74, 418, 456, 508  
 Weight loss, 19, 226, 399, 410, 458, 482  
 Yoga, 66, 408, 416, 417, 449, 450
- Housing and Construction**  
 Construction, 273, 314  
 House size, 350, 355, 357, 535  
 Monthly apartment rents, 122  
 Prices of condominiums, 69  
 Prices of homes, 70, 267, 426, 491, 553, 568  
 Realty, 141, 178  
 Room and board, 267  
 Security system, 143, 360  
 Square footage, 491, 505, 513  
 Subdivision, 170  
 Tacoma Narrows Bridge, 218
- Law**  
 Ban on skateboarding, 33, 142  
 Blood alcohol content, 31  
 California Bar Examination, 181  
 California Peace Officer Standards and Training test, 255  
 Child support, 265  
 Fraud, 135, 578  
 Geneva Conventions, 282  
 Going to court, 281  
 Gun ownership, 226  
 Hourly billing rate, 7  
 Identity theft, 135, 295  
 Immigration, 117  
 Jury selection, 151, 173, 175, 413  
 Justice system, 228  
 Police officers, 213, 360  
 Regulation of oil companies, 341  
 Speeding, 384
- Miscellaneous**  
 Aggressive behavior, children, 454  
 Air conditioning, 205  
 Appliances, 555  
 Archaeology, 93, 175  
 Badge numbers, police officers, 32  
 Ball, numbered, 153  
 Bank, 186, 326, 335, 542  
 Battery life of an MP3 player, 384  
 Birthday, 156, 162, 185, 212  
 Bracelets, 175  
 Breaking up, 221  
 Calculators, defects, 183  
 Camcorder, 65  
 Camping chairs, 199  
 Car wash, 174  
 Carbon dioxide emissions, 471, 474, 479, 480, 487, 489, 499, 500, 501, 503, 508  
 Cards, 134, 140, 141, 145, 147–149, 153, 158, 159, 163, 173, 177, 180, 182, 183, 201, 203, 211  
 Casino, 155  
 Cell phones, 7, 61, 225, 246, 264, 281, 289, 389, 391  
 Charity, 165, 325  
 Checking email, 14, 340  
 Chess, 360  
 Chlorine levels in a pool, 397  
 Cigarettes, 519  
 Clocks, 360  
 Clothes shopping, 211  
 Coffee shop, remodeling, 19  
 Coin toss, 37, 130, 136, 139, 140, 141, 148, 149, 153, 178, 180, 181, 226, 351, 463  
 Conference, 162  
 Crawling infants, 499  
 Customer service, 33  
 Daylight Savings Time, 227  
 Die roll, 37, 74, 79, 130, 131, 134, 138, 140, 141, 142, 145, 148, 149, 153, 157–159, 163, 166, 180, 182, 228  
 Digital cameras, 335, 339  
 Digital photo frames, 68  
 Disaster area, 25  
 Electricity consumption, 376  
 Energy cost, 575  
 Energy efficiency, 490  
 Eye survey, contacts, glasses, 76, 165  
 Farm values, 289, 489  
 Favorite day of the week, 65  
 Favorite season, 65  
 Favorite store, 26  
 Fishing line, 399  
 Floral arrangement, 295  
 Fluorescent lamps, 376  
 Furnaces, 350, 355  
 Gas grill, 518  
 Gas station, 225  
 Gasoline, volume of, 191  
 Gender of children, 180  
 Ghost sighting, 325  
 Global positioning system (GPS) navigators, 41, 43–48  
 Grocery store waiting times, 13  
 Hat size, 410  
 Hidden purchases, 205, 278  
 Hindenburg, 7  
 Hot air balloons, 13  
 Hotel rooms, 7, 76, 116, 401, 411, 574  
 House cleaning, 159  
 Journal article lengths, 75  
 Lawn mowers, 361  
 Life on other planets, 212  
 Light bulbs, 317, 376  
 Liquid volume of cans, 116, 117  
 Living on your own survey, 76  
 Living with parents, 453  
 Marbles, 202  
 Meals and lodging costs, 410, 423  
 Memory, 8  
 Microwave, 315, 316, 410  
 Middle initial, 140  
 Months of the year, 180  
 Mozart, 187  
 Natural gas, 580  
 Necklaces, 175  
 Nuclear energy, 221  
 Nuclear power plants, 102, 104, 105, 452  
 Obstacle course, 445  
 Oil, 66, 506, 507  
 Opinion poll, 13  
 Paint  
   cans, 272, 308  
   damage, 358  
   drying time, 360  
 Parachute assembly, 352  
 Pet food, 432  
 Pin numbers, 32  
 Power failure, 75  
 Preparedness for disaster, 141  
 Queuing models, 231  
 Random number selection, 25, 140, 141, 142, 262  
 Recycling, 135, 384  
 Refrigerator, 306, 307, 361  
 Rolling the tongue, 180  
 Safety recall, 211  
 St. Patrick's Day, 229  
 Smartphones, 33, 34, 300, 320, 322, 389  
 Socks, 181  
 Space exploration, 411

- Space shuttle flights, 118  
 Speed of sound, 483  
 Spinner, 139, 142  
 Spring break, 7, 31  
 Sprinkler system, 375  
 State park beaches, 171  
 Sudoku, 168  
 Surveillance cameras, 392  
 Survey of shoppers, 7  
 Sweet potato yield, 580  
 Telephone calls, 398  
 Telephone numbers, 10, 181  
 Text messages, 55–57  
 Tip, 341  
 Toothpaste, 181, 223, 565, 569  
 Typographical errors, 220, 228  
 UFO  
   belief in, 326  
   sighting, 135  
 Vacation, 14, 325  
 Vacuum cleaners, 565, 569  
 Valentine's Day gifts, 59  
 Washing machines, 142, 425  
 Water dispensing machine, 308  
 Weigh station, 225  
 Well-being index, 567, 569  
 Wheat production, 574  
 Wind energy, 425  
 Winning a prize, 145, 221
- Mortality**  
 Alcohol-related accidents, 545  
 Emergency response time, 51, 398  
 Heart disease, women, 127  
 Homicides, 533, 534  
 Motor vehicle casualties, 197, 546, 574  
 Shark attacks, 227  
 Tornado deaths, 227
- Motor Vehicles and Transportation**  
 Acceleration times, 339  
 Air travel, 31, 326, 327  
 Airplanes, 110, 119  
   baggage delays, 126  
   fuel usage, 228  
 ATV, 360  
 Automobile battery, 295, 334, 350, 355, 565  
 Bicycle  
   helmet, 279  
   tires, 295  
 Braking distance, 255, 271, 288, 425, 484  
 Car accidents, 148, 217, 218, 482  
 Car dealership, 25, 182, 313, 568  
 Car ownership, 480, 543  
 Carpooling, 207, 577  
 Carrying capacities, 13  
 Carry-on luggage, 76  
 Crash test, 524, 525  
 Dangerous drivers, 323  
 Department of Motor Vehicles  
   wait times, 382  
 Drivers, 63  
 Driver's license exam, 181  
 Driving habits, 24  
 Driving time, 266, 267  
 Engine displacements, 517, 518  
 Fatalities, 14  
 Flights, 156  
 Fuel consumption, 556  
 Fuel economy/efficiency, 30, 73, 78, 79, 80, 109, 338, 456, 517, 518, 519  
 Garage security system, 142  
 Gas prices, 272, 273, 306, 326  
 Horsepower, 32  
 Hybrid vehicle, 541  
 Mileage, 118, 317, 348, 361, 371, 385, 401, 466  
 Motorcycles, 65, 119, 335  
 New highway, 171  
 Oil change, 350, 355, 356, 385  
 Oil tankers, 221  
 Parking infractions, 123  
 Parking ticket, 153  
 Pickup trucks, 153  
 Pilot test, 221  
 Pit stop, 366  
 Powerboats, 424  
 Price of a car, 9, 518  
 Public transportation, 283  
 Safety driving classes, 482  
 Seat belt use, 452  
 Speed of vehicles, 62, 96, 108, 246, 366, 407  
 Taxicab, 361  
 Text messaging while driving, 26  
 Theft, 63  
 Tires, 112, 259, 401  
 Towing capacities, 119  
 Traffic congestion, 327, 328  
 Traffic signal, 269  
 Traffic tickets, 225  
 Transmission, 306  
 Travel concerns, 537, 540  
 Uninsured drivers, 227  
 Used car  
   cost, 380, 383  
   insurance, 380  
 Vehicle  
   costs, 431, 566  
   crashes, 545  
   manufacturers, 158  
   occupants, 449  
   old, 507  
   owned, 178, 573  
   sales, 506, 507  
   security system, 133  
   size classes, 30
- Political Science**  
 Ages of members of House of Representatives, 75  
 Congress, 162, 167, 282  
 First Lady of the United States, 126  
 General election, Virginia, 143  
 Legislator performance ratings, 440, 441  
 Officers, 176, 184, 294  
 112th Congress, 14, 15  
 Political parties, 69, 162  
 Presidential candidates, 162  
 President's approval ratings, 18, 23  
 Rezoning, 336  
 Senate, 162  
 Supreme Court justice  
   ages, 118  
   names, 213  
 U.S. Presidents  
   best, 154  
   children, 53  
   political party, 6  
   weights, 94  
   worst, 154  
 Voters, 137, 142, 143, 211, 214, 324, 506, 507
- Psychology**  
 Eating disorders, 75  
 Experiment, 31  
 Experimental group, 175  
 IQ, 109, 147, 290, 297, 424, 516  
 Obsessive-compulsive disorder, 546  
 Passive-aggressive traits, 192, 194, 195  
 Psychological tests, 169, 418  
 Reaction times, 52, 470, A30  
 Wechsler Intelligence Scales, 296
- Sports**  
 Baseball, 197, 361, 491  
   batting averages, 98, 248, 443  
   home run totals, 11  
   Jeter, Derek, 225  
   Major League, 30, 98, 120, 126, 127, 215, 468, 469, 472, 475, 479, 480, 488  
   World Series, 11, 199  
 Basketball, 10, 183  
   heights, 65, 67, 92, A29  
   Howard, Dwight, 228  
   James, LeBron, 216, 217  
   Paul, Chris, 294  
   points per game, 445, 446  
   vertical jumps, 117, 119  
   Wade, Dwyane, 121  
   weights, 92  
 Bicycle race, 183  
 Boston marathon, 32  
 Cross-country race, 185  
 Daytona 500, 169  
 Favorite sport, 282, 283  
 Favorite team, 131  
 Finishing times for a race, 52  
 Football, 142, 516  
   bench press weights, 424  
   Brady, Tom, 220  
   college, 15, 144, 316  
   concussions, 85, 86  
   kick, 314  
   National Football League, 75, 98, 161, 280, 291  
   Super Bowl, 64, 105  
   weight, 119  
   wins, 93  
   yards per carry, 317  
 Footrace, 175  
 Golf, 6, 30, 80, 184, 222, 360, 435, 556, 572  
 Hockey, 127, 168, 227, 467  
 Horse race, 176, 226  
 Lacrosse, 174  
 Marathon training, 319  
 Maximal strength  
   jump height and, 483, 484  
   sprint performance and, 483, 484  
 New York City marathon, 64  
 Olympics  
   800-meter freestyle swimming, 96  
   medal count, 64  
   men's diving, 15  
   100-meter times, 580  
 Popular sports teams, 33  
 Practice times, 197  
 Skiing, 174  
 Soccer, 14, 288, 308  
 Softball, 174  
 Sporting goods sales, 120  
 Stretching, 542  
 Tennis, 317  
 Tour de France, 112  
 Training heart rates, 265  
 Training shoes, 439, 440  
 Volleyball, 77
- Work**  
 Accidents, 470  
 Annual wages, 422, 576  
 Career goals, 544  
 CEO, 213  
   ages, 64  
 Committees, 174, 177, 223  
 Commute/travel time, 49, 62, 76, 197, 306, 315, 424  
 Driving distance, 315, 316, 338  
 Earnings, 226, 316, 340, 410, 430, 467, 505, 507, 563  
 hourly, 64, 76, 110, 361  
 Employment, 22, 33, 60  
   applications, 15, 183  
   equal opportunities, 178  
 Going to work sick, 281  
 Hours worked per week, 298, 300–302, 304  
 Interview, 77  
 Job opening, 32  
 Leaving job, 533  
 Messy desk, 212  
 Night shift, 339  
 Office rentals, 86, 92  
 Overtime hours, 198, 288  
 Sick days, 76, 226  
 Strike, 136  
 Telecommuting, 282  
 Time wasted, 562  
 Vacation days, 110  
 Waking times, 338  
 Warehouse, 177  
 Work day, 371  
 Work performance, 212  
 Work time and leisure time, 490  
 Workers by industry, 144  
 Working during retirement, 31  
 Years of service, 52, 256

# Introduction to Statistics



1.1

## An Overview of Statistics

1.2

## Data Classification

- Case Study

1.3

## Data Collection and Experimental Design

- Activity
- Uses and Abuses
- Real Statistics—  
Real Decisions
- History of Statistics—  
Timeline
- Technology



The number three through fifteen U.S. cities (population over 50,000) with the greatest percent increases in population in 2011 were in Texas.

## Where You've Been

You are already familiar with many of the practices of statistics, such as taking surveys, collecting data, and describing populations. What you may not know is that collecting accurate statistical data is often difficult and costly. Consider, for instance, the monumental task of counting and describing the entire population

of the United States. If you were in charge of such a census, how would you do it? How would you ensure that your results are accurate? These and many more concerns are the responsibility of the United States Census Bureau, which conducts the census every decade.

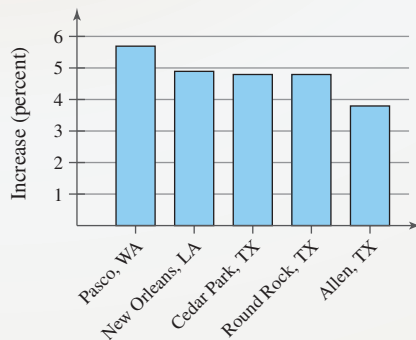
## Where You're Going

In Chapter 1, you will be introduced to the basic concepts and goals of statistics. For instance, statistics were used to construct the figures below, which show the fastest-growing U.S. cities (population over 50,000) in 2011 by percent increase in population, U.S. cities with the greatest numerical increases in population, and the regions where these cities are located.

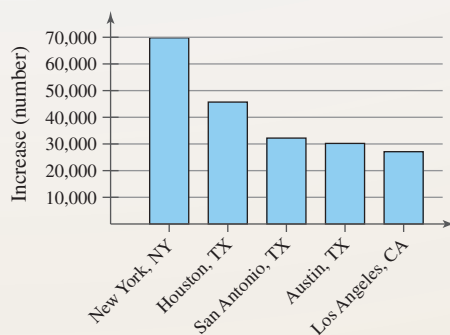
For the 2010 Census, the Census Bureau sent short forms to every household. Short forms ask all members of every household such things as their

gender, age, race, and ethnicity. Previously, a long form, which covered additional topics, was sent to about 17% of the population. But for the first time since 1940, the long form is being replaced by the American Community Survey, which will survey about 3 million households a year throughout the decade. These 3 million households will form a sample. In this course, you will learn how the data collected from a sample are used to infer characteristics about the entire population.

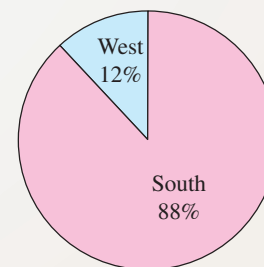
**Fastest-Growing U.S. Cities  
(Population over 50,000)**



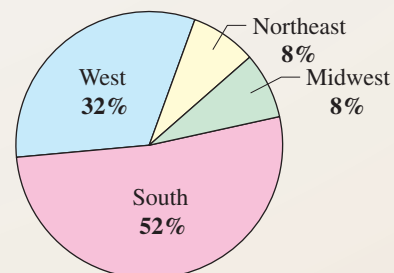
**U.S. Cities with Greatest  
Numerical Increases  
(Population over 50,000)**



**Location of the 25  
Fastest-Growing U.S. Cities  
(Population over 50,000)**



**Location of the 25 U.S. Cities with  
Greatest Numerical Increases  
(Population over 50,000)**



# An Overview of Statistics

## WHAT YOU SHOULD LEARN

- The definition of statistics
- How to distinguish between a population and a sample and between a parameter and a statistic
- How to distinguish between descriptive statistics and inferential statistics

## A Definition of Statistics • Data Sets • Branches of Statistics

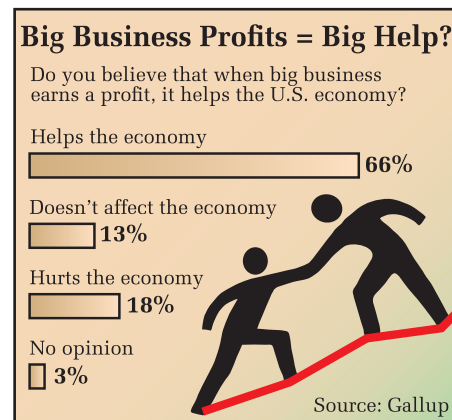
### A DEFINITION OF STATISTICS

Almost every day you are exposed to statistics. For instance, consider the next three statements.

- “(Women) who smoked one to 14 cigarettes daily had nearly two times the risk of sudden cardiac death as their nonsmoking counterparts.” (*Source: American Heart Association*)
- “Food waste (in the United States) has progressively increased from about 30% of the available food supply in 1974 to almost 40% in recent years.” (*Source: National Institute of Diabetes and Digestive and Kidney Diseases*)
- “The percentage of students in Detroit who performed at or above the *Proficient* level (for reading) was 7 percent (in a recent year).” (*Source: U.S. Department of Education*)

By learning the concepts in this text, you will gain the tools to become an informed consumer, understand statistical studies, conduct statistical research, and sharpen your critical thinking skills.

Many statistics are presented graphically. For instance, consider the figure shown below.



The information in the figure is based on the collection of **data**.

### DEFINITION

**Data** consist of information coming from observations, counts, measurements, or responses.

The use of statistics dates back to census taking in ancient Babylonia, Egypt, and later in the Roman Empire, when data were collected about matters concerning the state, such as births and deaths. In fact, the word *statistics* is derived from the Latin word *status*, meaning “state.” The modern practice of statistics involves more than counting births and deaths, as you can see in the next definition.

### DEFINITION

**Statistics** is the science of collecting, organizing, analyzing, and interpreting data in order to make decisions.

## DATA SETS

There are two types of data sets you will use when studying statistics. These data sets are called **populations** and **samples**.

### Insight

A census consists of data from an entire population. But, unless a population is small, it is usually impractical to obtain all the population data. In most studies, information must be obtained from a random sample. (You will learn more about random sampling and data collection in Section 1.3.)



### DEFINITION

A **population** is the collection of *all* outcomes, responses, measurements, or counts that are of interest.

A **sample** is a subset, or part, of a population.

A sample should be representative of a population so that sample data can be used to draw conclusions about that population. Sample data must be collected using an appropriate method, such as *random sampling*. When sample data are collected using an *inappropriate* method, the data cannot be used to draw conclusions about the population.

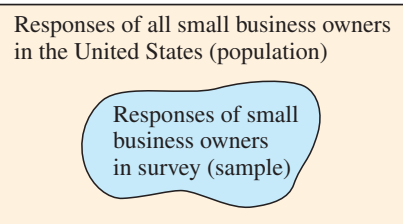
### EXAMPLE 1

#### Identifying Data Sets

In a recent survey, 614 small business owners in the United States were asked whether they thought their company's Facebook presence was valuable. Two hundred fifty-eight of the 614 respondents said yes. Identify the population and the sample. Describe the sample data set. (*Adapted from Manta*)

#### Solution

The population consists of the responses of all small business owners in the United States, and the sample consists of the responses of the 614 small business owners in the survey. Notice that the sample is a subset of the responses of all small business owners in the United States. The sample data set consists of 258 owners who said yes and 356 owners who said no.



#### Try It Yourself 1

The U.S. Department of Energy conducts weekly surveys of approximately 800 gasoline stations to determine the average price per gallon of regular gasoline. On December 10, 2012, the average price was \$3.35 per gallon. Identify the population and the sample. Describe the sample data set. (*Source: Energy Information Administration*)

- Identify the population and the sample.
- What does the sample data set consist of?

*Answer: Page A31*

Whether a data set is a population or a sample usually depends on the context of the real-life situation. For instance, in Example 1, the population is the set of responses of all small business owners in the United States. Depending on the purpose of the survey, the population could have been the set of responses of all small business owners who live in California or who have networked online.



**Study Tip**

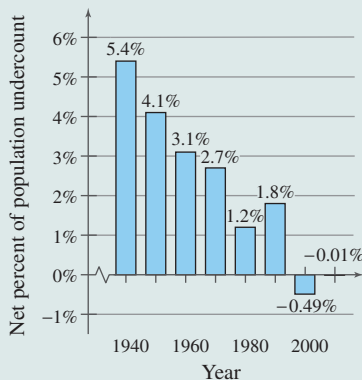
To remember the terms parameter and statistic, try using the mnemonic device of matching the first letters in *population parameter* and the first letters in *sample statistic*.



**Picturing the World**

How accurate is the count of the U.S. population taken each decade by the Census Bureau? According to estimates, the net undercount of the U.S. population by the 1940 census was 5.4%. The accuracy of the census has improved greatly since then. The net undercount in the 2010 census was  $-0.01\%$ . (This means that the 2010 census *overcounted* the U.S. population by 0.01%, which is about 36,000 people.)

**U.S. Census  
Net Undercount**



Source: U.S. Census Bureau

**What are some difficulties in collecting population data?**

Two important terms that are used throughout this course are **parameter** and **statistic**.

**DEFINITION**

A **parameter** is a numerical description of a *population* characteristic.

A **statistic** is a numerical description of a *sample* characteristic.

It is important to note that a sample statistic can differ from sample to sample whereas a population parameter is constant for a population.

**EXAMPLE 2****Distinguishing Between a Parameter and a Statistic**

Determine whether the numerical value describes a population parameter or a sample statistic. Explain your reasoning.

1. A recent survey of approximately 400,000 employers reported that the average starting salary for marketing majors is \$53,400. (*Source: National Association of Colleges and Employers*)
2. The freshman class at a university has an average SAT math score of 514.
3. In a random check of 400 retail stores, the Food and Drug Administration found that 34% of the stores were not storing fish at the proper temperature.

**Solution**

1. Because the average of \$53,400 is based on a subset of the population, it is a sample statistic.
2. Because the average SAT math score of 514 is based on the entire freshman class, it is a population parameter.
3. Because the percent, 34%, is based on a subset of the population, it is a sample statistic.

**Try It Yourself 2**

Last year, a company with 65 employees spent a total of \$5,150,694 on employees' salaries. Does the amount spent describe a population parameter or a sample statistic?

- a. Determine whether the amount spent is from a population or a sample.
- b. Specify whether the amount spent is a parameter or a statistic.

*Answer: Page A31*

In this course, you will see how the use of statistics can help you make informed decisions that affect your life. Consider the census that the U.S. government takes every decade. When taking the census, the Census Bureau attempts to contact everyone living in the United States. Although it is impossible to count everyone, it is important that the census be as accurate as it can be, because public officials make many decisions based on the census information. Data collected in the census will determine how to assign congressional seats and how to distribute public funds.

## BRANCHES OF STATISTICS

The study of statistics has two major branches: **descriptive statistics** and **inferential statistics**.

### DEFINITION

**Descriptive statistics** is the branch of statistics that involves the organization, summarization, and display of data.

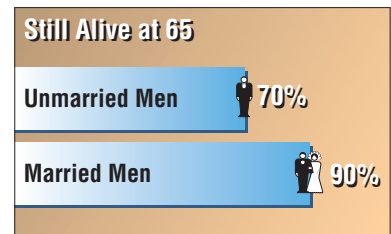
**Inferential statistics** is the branch of statistics that involves using a sample to draw conclusions about a population. A basic tool in the study of inferential statistics is probability. (You will learn more about probability in Chapter 3.)

### EXAMPLE 3

#### Descriptive and Inferential Statistics

Determine which part of the study represents the descriptive branch of statistics. What conclusions might be drawn from the study using inferential statistics?

1. A large sample of men, aged 48, was studied for 18 years. For unmarried men, approximately 70% were alive at age 65. For married men, 90% were alive at age 65. (Source: *The Journal of Family Issues*)



2. In a sample of Wall Street analysts, the percentage who incorrectly forecasted high-tech earnings in a recent year was 44%. (Source: *Bloomberg News*)

#### Solution

1. Descriptive statistics involves statements such as “For unmarried men, approximately 70% were alive at age 65” and “For married men, 90% were alive at age 65.” Also, the figure represents the descriptive branch of statistics. A possible inference drawn from the study is that being married is associated with a longer life for men.
2. The part of this study that represents the descriptive branch of statistics involves the statement “the percentage [of Wall Street analysts] who incorrectly forecasted high-tech earnings in a recent year was 44%.” A possible inference drawn from the study is that the stock market is difficult to forecast, even for professionals.

#### Try It Yourself 3

A survey of 750 parents found that 31% support their kids financially until they graduate college, and 6% provide financial support until they start college. (Source: *Yahoo Finance*)

- a. Determine which part of the survey represents the descriptive branch of statistics.
- b. What conclusions might be drawn from the survey using inferential statistics?

Answer: Page A31

Throughout this course you will see applications of both branches. A major theme in this course will be how to use sample statistics to make inferences about unknown population parameters.

## 1.1

## Exercises



## BUILDING BASIC SKILLS AND VOCABULARY

1. How is a sample related to a population?
2. Why is a sample used more often than a population?
3. What is the difference between a parameter and a statistic?
4. What are the two main branches of statistics?

**True or False?** In Exercises 5–10, determine whether the statement is true or false. If it is false, rewrite it as a true statement.

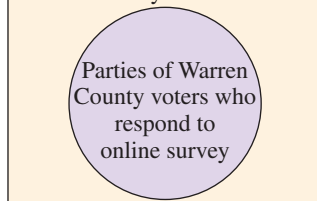
5. A statistic is a numerical value that describes a population characteristic.
6. A sample is a subset of a population.
7. It is impossible for the Census Bureau to obtain all the census data about the population of the United States.
8. Inferential statistics involves using a population to draw a conclusion about a corresponding sample.
9. A population is the collection of some outcomes, responses, measurements, or counts that are of interest.
10. A sample statistic will not change from sample to sample.

**Classifying a Data Set** In Exercises 11–20, determine whether the data set is a population or a sample. Explain your reasoning.

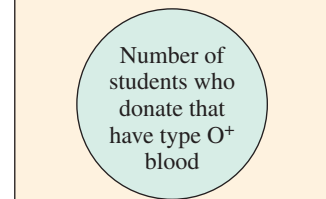
11. The revenue of each of the 30 companies in the Dow Jones Industrial Average
12. The amount of energy collected from every wind turbine on a wind farm
13. A survey of 500 spectators from a stadium with 42,000 spectators
14. The annual salary of each pharmacist at a pharmacy
15. The cholesterol levels of 20 patients in a hospital with 100 patients
16. The number of televisions in each U.S. household
17. The final score of each golfer in a tournament
18. The age of every third person entering a clothing store
19. The political party of every U.S. president
20. The soil contamination levels at 10 locations near a landfill

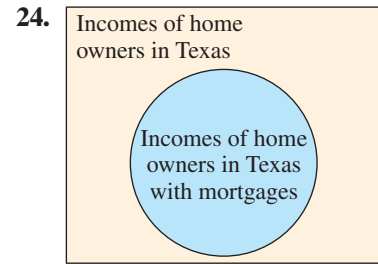
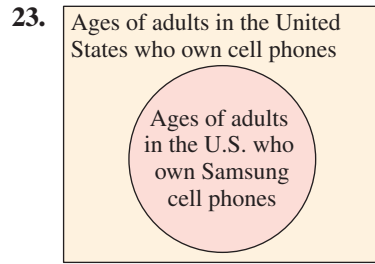
**Graphical Analysis** In Exercises 21–24, use the Venn diagram to identify the population and the sample.

21. Parties of registered voters in Warren County



22. Number of students who donate at a blood drive





## USING AND INTERPRETING CONCEPTS

**Identifying Populations and Samples** In Exercises 25–34, identify the population and the sample.

25. A survey of 1015 U.S. adults found that 32% have had to put off medical care for themselves or their family in the past year due to the cost. (Source: Gallup)
26. A study of 33,043 infants in Italy was conducted to find a link between a heart rhythm abnormality and sudden infant death syndrome. (Source: New England Journal of Medicine)
27. A survey of 12,082 U.S. adults found that 45.5% received an influenza vaccine for a recent flu season. (Source: U.S. Centers for Disease Control and Prevention)
28. A survey of 1012 U.S. adults found that 5% consider pet-friendliness an important factor for choosing a hotel.
29. A survey of 55 U.S. law firms found that the average hourly billing rate was \$425. (Source: The National Law Journal)
30. A survey of 496 students at a college found that 10% planned on traveling out of the country during spring break.
31. A survey of 202 pilots found that 20% admit that they have made a serious error due to sleepiness. (Source: National Sleep Foundation)
32. A survey of 961 major-appliance shoppers found that 23% bought extended warranties.
33. To gather information about starting salaries at companies listed in the Standard & Poor's 500, a researcher contacts 65 of the 500 companies.
34. A survey of 2002 third- to twelfth-grade students found that they devoted an average of 7 hours and 38 minutes per day to using entertainment media. (Source: Kaiser Family Foundation)

**Distinguishing Between a Parameter and a Statistic** In Exercises 35–42, determine whether the numerical value is a parameter or a statistic. Explain your reasoning.

35. The average annual salary for 35 of a company's 1200 accountants is \$68,000.
36. A survey of 2514 college board members found that 38% think that higher education costs what it should relative to its value. (Source: Association of Governing Boards of Universities and Colleges)
37. Sixty-two of the 97 passengers aboard the Hindenburg airship survived its explosion.

38. In January 2013, 60% of the governors of the 50 states in the United States were Republicans. (*Source: National Governors Association*)
39. In a survey of 300 computer users, 8% said their computers had malfunctions that needed to be repaired by service technicians.
40. Voter registration records show that 78% of all voters in a county are registered as Democrats.
41. A survey of 1004 U.S. adults found that 52% think that China's emergence as a world power is a major threat to the well-being of the United States. (*Source: Pew Research Center*)
42. In a recent year, the average math score on the ACT for all graduates was 21.1. (*Source: ACT, Inc.*)
43. Which part of the survey described in Exercise 31 represents the descriptive branch of statistics? Make an inference based on the results of the survey.
44. Which part of the survey described in Exercise 32 represents the descriptive branch of statistics? Make an inference based on the results of the survey.

## EXTENDING CONCEPTS

45. **Identifying Data Sets in Articles** Find an article that describes a survey.
  - (a) Identify the sample used in the survey.
  - (b) What is the sample's population?
  - (c) Make an inference based on the results of the survey.
46. **Sleep Deprivation** In a recent study, volunteers who had 8 hours of sleep were three times more likely to answer questions correctly on a math test than were sleep-deprived participants. (*Source: CBS News*)
  - (a) Identify the sample used in the study.
  - (b) What is the sample's population?
  - (c) Which part of the study represents the descriptive branch of statistics?
  - (d) Make an inference based on the results of the study.
47. **Living in Florida** A study shows that senior citizens who live in Florida have better memories than senior citizens who do not live in Florida.
  - (a) Make an inference based on the results of this study.
  - (b) What is wrong with this type of reasoning?
48. **Increase in Obesity Rates** A study shows that the obesity rate among boys ages 2 to 19 has increased over the past several years. (*Source: Washington Post*)
  - (a) Make an inference based on the results of this study.
  - (b) What is wrong with this type of reasoning?
49. **Writing** Write an essay about the importance of statistics for one of the following.
  - A study on the effectiveness of a new drug
  - An analysis of a manufacturing process
  - Making conclusions about voter opinions using surveys

## 1.2

## Data Classification

## WHAT YOU SHOULD LEARN

- How to distinguish between qualitative data and quantitative data
- How to classify data with respect to the four levels of measurement: nominal, ordinal, interval, and ratio

## Types of Data • Levels of Measurement

## TYPES OF DATA

When doing a study, it is important to know the kind of data involved. The nature of the data you are working with will determine which statistical procedures can be used. In this section, you will learn how to classify data by type and by level of measurement. Data sets can consist of two types of data: **qualitative data** and **quantitative data**.

## DEFINITION

**Qualitative data** consist of attributes, labels, or nonnumerical entries.

**Quantitative data** consist of numerical measurements or counts.

## EXAMPLE 1

## Classifying Data by Type

The suggested retail prices of several Honda vehicles are shown in the table. Which data are qualitative data and which are quantitative data? Explain your reasoning. (Source: American Honda Motor Company, Inc.)

Model	Suggested retail price
Accord Sedan	\$21,680
Civic Hybrid	\$24,200
Civic Sedan	\$18,165
Crosstour	\$27,230
CR-V	\$22,795
Fit	\$15,425
Odyssey	\$28,675
Pilot	\$29,520
Ridgeline	\$29,450

## Solution

The information shown in the table can be separated into two data sets. One data set contains the names of vehicle models, and the other contains the suggested retail prices of vehicle models. The names are nonnumerical entries, so these are qualitative data. The suggested retail prices are numerical entries, so these are quantitative data.

## Try It Yourself 1

The populations of several U.S. cities are shown in the table. Which data are qualitative data and which are quantitative data? (Source: U.S. Census Bureau)

City	Population
Baltimore, MD	619,493
Chicago, IL	2,707,120
Glendale, AZ	230,482
Miami, FL	408,750
Portland, OR	593,820
San Francisco, CA	812,826

- Identify the two data sets.
  - Decide whether each data set consists of numerical or nonnumerical entries.
- c. Specify the qualitative data and the quantitative data. *Answer: Page A31*