

PREFACE

Welcome to *Elementary Statistics: Picturing the World*, Seventh 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.

I am grateful for the overwhelming acceptance of the first six editions. It is gratifying to know that my 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 Seventh Edition was a thorough update of the key features, examples, and exercises:

Examples This edition has 213 examples, over 60% of which are new or revised. Also, several of the examples now show an alternate solution or a check using technology.

Technology Examples In addition to showing screen displays from Minitab®, Excel®, and the TI-84 Plus, this edition also shows screen displays from StatCrunch®.

Try It Yourself Over 40% of the 213 Try It Yourself exercises are new or revised.

Picturing the World Over 50% of these are new or revised.

Tech Tips New to this edition are technology tips that appear in most sections. These tips show how to use Minitab, Excel, the TI-84 Plus, or StatCrunch to solve a problem.

Exercises Over 40% of the more than 2300 exercises are new or revised.

Extensive Chapter Feature Updates Over 60% of the following key features are new or revised, making this edition fresh and relevant to today's students:

- Where You've Been and Where You're Going
- Uses and Abuses: Statistics in the Real World
- Real Statistics–Real Decisions: Putting it all together
- Chapter Technology Project

Revised Content Here is a summary of the content changes.

- **Section 1.1** now has more discussion about populations and samples, how to identify them, and their relationships to parameters and statistics. Also, the Venn Diagrams have been redrawn to use clearer labeling to help students distinguish between a population and a sample.
- **In Section 1.3**, the figure depicting systemic sampling has been redrawn to more clearly depict the sampling process.
- **Section 2.1** now has more discussion of class widths and open-ended classes. Also, a figure showing a histogram and its corresponding frequency polygon was added after Example 4.
- **In Section 2.4**, Example 9 was rewritten to explain the use of an open-ended class.
- **Section 2.5** now has a Study Tip discussing outliers and modified box-and-whisker plots. On pages 124 and 125,

students are shown how to create modified box-and-whisker plots using technology.

- **In Section 3.1**, the solutions to the examples were rewritten to explain why a formula was chosen to find a probability.
- **In Chapter 5**, in addition to using a table, examples were revised and Tech Tips were added to show how to find areas or probabilities using technology.
- **In Chapter 6**, in addition to using a table, examples were revised and Tech Tips were added to show how to find critical values using technology. Also, the exercises in this chapter were revised to ask more conceptual questions.
- **Section 6.2** now has more explanation about why the t -distribution is needed when σ is unknown. Also, the flowchart on page 314 was revised to illustrate when it is not possible to use the normal distribution or the t -distribution to construct a confidence interval.
- **In Chapters 7–9**, in addition to using a table, examples were revised and Tech Tips were added to show how to find P -values and critical values using technology.
- **Section 8.2** now shows the formula for the number of degrees of freedom for the t -test often used by technology.
- **In Section 9.1**, the requirements to use a correlation coefficient r to make an inference about a population have been revised.

Features of the Seventh 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, interpret a result, help drive home an important interpretation, or connect different concepts.
- **Tech Tips** show how to use Minitab, Excel, the TI-84 Plus, or StatCrunch to solve a problem.
- **Picturing the World** is a “mini case study” in each section that illustrates the important concept or concepts of the section. Each Picturing the World 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*.

Technology Examples Many sections contain an example that shows how technology can be used to calculate formulas, perform tests, or display data. Screen displays from Minitab, Excel, the TI-84 Plus, and StatCrunch are shown. 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 exercises give students practice in performing calculations, making decisions, providing explanations, and applying results to a real-life setting. The section exercises 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 available in MyLab Statistics.

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 There is a Cumulative Review after Chapters 2, 5, 8, and 10. 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 applets are available in MyLab Statistics and at www.pearson.com/math-stats-resources.

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 Sixth 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, I 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 46 sections.

Graphical Approach As with most introductory statistics texts, this text begins 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 **it continues 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**. I have provided many Examples, Exercises, and Try It Yourself exercises that go beyond mere computation.

Variety of Real-Life Applications I have chosen real-life applications that are representative of the majors of students taking introductory statistics courses. I want statistics to come alive and appear relevant to students so they understand the importance of and rationale for studying statistics. I 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 **250-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 in MyLab™ Statistics or at www.pearson.com/math-stats-resources. 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, I assume that most students have access to some form of technology, such as Minitab, Excel, StatCrunch, 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, I am sure you agree with me 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 I display informal versions of formulas using words in place of or in addition to variables.

Choice of Tables My 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 some teachers prefer to use the “0-to-z” table, an alternative presentation of this topic is provided 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.** My goal is not to produce statisticians but to produce informed consumers of statistical reports. For this reason, I 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.

Technology Resources

MyLab Statistics Online Course (access code required)

Used by nearly one million students a year, MyLab Statistics is the world’s leading online program for teaching and learning statistics. MyLab Statistics delivers assessment, tutorials, and multimedia resources that provide engaging and personalized experiences for each student, so learning can happen in any environment.

Personalized Learning Not every student learns the same way or at the same rate. Personalized learning in the MyLab gives instructors the flexibility to incorporate the approach that best suits the needs of their course and students.

- Based on their performance on a quiz or test, **personalized homework** allows students to focus on just the topics they have not yet mastered.
- With **Companion Study Plan Assignments** you can assign the Study Plan as a prerequisite to a test or quiz, guiding students through the concepts they need to master.

Preparedness Preparedness is one of the biggest challenges in statistics courses. Pearson offers a variety of content and course options to support students with just-in-time remediation and key-concept review as needed.

- **Redesign-Ready Course Options** Many new course models have emerged in recent years, as institutions “redesign” to help improve retention and results. At Pearson, we’re focused on tailoring solutions to support your plans and programs.
- **Getting Ready for Statistics Questions** This question library contains more than 450 exercises that cover the relevant developmental math topics for a given section. These can be made available to students for extra practice or assigned as a prerequisite to other assignments.

Conceptual Understanding Successful students have the ability to apply their statistical ideas and knowledge to new concepts and real-world situations. Providing frequent opportunities for data analysis and interpretation helps students develop the 21st century skills that they need in order to be successful in the classroom and workplace.

- **Conceptual Question Library** There are 1,000 questions in the Assignment Manager that require students to apply their statistical understanding.
- **Modern statistics is practiced with technology**, and MyLab Statistics makes learning and using software programs seamless and intuitive. Instructors can copy data sets from the text and MyLab Statistics exercises directly into software such as StatCrunch or Excel®. Students can also access instructional support tools including tutorial videos, Study Cards, and manuals for a variety of statistical software programs including StatCrunch, Excel, Minitab®, JMP®, R, SPSS, and TI 83/84 calculators.

Motivation Students are motivated to succeed when they are engaged in the learning experience and understand the relevance and power of statistics.

- **Exercises with Immediate Feedback** Homework and practice exercises in MyLab Statistics regenerate algorithmically to give students unlimited opportunity for

practice and mastery. Instructors can choose from the many exercises available for the author's approach—or even choose additional exercises from other MyLab Statistics courses. Most exercises include learning aids, such as guided solutions, sample problems, extra help at point-of-use, and immediate feedback when students enter incorrect answers.

- Instructors can create, import, and manage online homework assignments, quizzes, and tests—or start with sample assignments—all of which are automatically graded, allowing instructors to spend less time grading, and more time teaching.

Data & Analytics MyLab Statistics provides resources to help instructors assess and improve student results. A comprehensive gradebook with enhanced reporting functionality makes it easier for instructors to manage courses efficiently.

- **Reporting Dashboard** Instructors can view, analyze, and report learning outcomes, gaining the information they need to keep our students on track. Available via the Gradebook and fully mobile-ready, the Reporting Dashboard presents student performance data at the class, section, and program levels in an accessible, visual manner. Its finegrain reports allow instructors and administrators to compare performance across different courses, across individual sections and within each course.
- **Item Analysis** Instructors can track class-wide understanding of particular exercises in order to refine your class lectures or adjust the course/department syllabus. Just-in-time teaching has never been easier.

Accessibility Pearson works continuously to ensure our products are as accessible as possible to all students. We are working toward achieving WCAG 2.0 Level AA and Section 508 standards, as expressed in the Pearson Guidelines for Accessible Educational Web Media, www.pearson.com/mylab/statistics/accessibility.

StatCrunch

Integrated directly into MyLab Statistics, StatCrunch® is powerful web-based statistical software that allows users to perform complex analyses, share data sets, and generate compelling reports of their data.

- **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. A Featured Data page houses the best data sets, making it easy for instructors to use current data in their course. Data sets from the text and from online homework exercises can also be accessed and analyzed in StatCrunch. An online survey tool allows users to quickly collect data via web-based surveys.
- **Crunch** A full range of numerical and graphical methods allow 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.

StatCrunch is integrated into MyLab Statistics, but it is also available by itself to qualified adopters. StatCrunch is also now available on your smartphone or tablet when you visit

www.statcrunch.com from the device's browser. For more information, visit our website at www.statcrunch.com, or contact your Pearson representative.

MathXL Online Course (access code required)

Part of the world's leading collection of online homework, tutorial, and assessment products, MathXL® delivers assessment and tutorial resources that provide engaging and personalized experiences for each student. Each course is developed to accompany Pearson's best-selling content, authored by thought leaders across the math curriculum, and can be easily customized to fit any course format.

With MathXL, instructors can:

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

With MathXL, students can:

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

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

Minitab and Minitab Express

Minitab and Minitab Express™ make learning statistics easy and provide students with a skill-set that is in demand in today's data driven workforce. Bundling Minitab software with educational materials ensures students have access to the software they need in the classroom, around campus, and at home. And having 12-month access to Minitab and Minitab Express ensures students can use the software for the duration of their course. ISBN 13: 978-0-13-445640-9 ISBN 10: 0-13-445640-8 (access card only; not sold as stand alone)

JMP Student Edition

JMP® Student Edition is an easy-to-use, streamlined version of JMP desktop statistical discovery software from SAS Institute, Inc. and is available for bundling with the text. ISBN-13: 978-0-13-467979-2 ISBN-10: 0-13-467979-2

XLSTAT

XLSTAT™ is an Excel add-in that enhances the analytical capabilities of Excel. XLSTAT is used by leading businesses and universities around the world. It is available to bundle with this text. For more information, go to www.pearsonhighered.com/xlstat. ISBN-13: 978-0-321-75932-0; ISBN-10: 0-321-75932-X

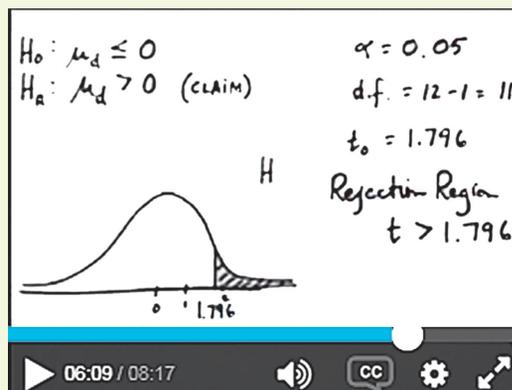
Resources for Success

MyLab Statistics Online Course for *Elementary Statistics: Picturing the World, 7e* (access code required)

MyLab™ Statistics is available to accompany Pearson’s market-leading text offerings. To give students a consistent tone, voice, and teaching method, each text’s flavor and approach is tightly integrated throughout the accompanying MyLab Statistics course, making learning the material as seamless as possible. MyLab Statistics for *Elementary Statistics* includes the following new features, in addition to the resources listed on the previous page.

UPDATED! Video Program

Chapter Review Exercises come to life with new review videos that help students understand key chapter concepts. Section Lecture Videos work through examples and elaborate on key objectives.



A prestigious research university has just been awarded a grant by a private, anonymous donor to explore the potential relationship between an individual's natural intelligence quotient (IQ) and a more important factor in a person's life: this project as the first of many research university's upcoming discussion with the random sample of 500 volunteers and IQ information. The Volunteer Number, Gender, and Geographic Region are listed in the StatCrunch Data Set.

The research team leadership is interested in analyzing the distribution of the miles from interstate to the nearest gas station. The distribution is approximately normal. Describe the shape of the distribution.

A. The distribution is right-skewed.
 B. The distribution is approximately normal.
 C. The distribution is left-skewed.

Question is complete. Tap on the red icon to show completed problem. Work problem

| Row | Geographic | Annual Revenue | Average Cost of Gasoline | Miles from Interstate |
|-----|-------------|----------------|--------------------------|-----------------------|
| 1 | Southeast | 12000000 | 3.42 | 0.35 |
| 2 | Midwest | 12378991 | 3.26 | 0.58 |
| 3 | Northeast | 12149171 | 3.29 | 0.7 |
| 4 | Midatlantic | 14412876 | 2.68 | 0.92 |
| 5 | West | 15244993 | 2.69 | 0.48 |
| 6 | South | 15157320 | 2.62 | 0.1 |
| 7 | Southeast | 13242108 | 2.86 | 0.5 |
| 8 | Midwest | 18226327 | 2.1 | 0.82 |
| 9 | Northeast | 12763602 | 3.11 | 0.34 |
| 10 | Midatlantic | 13905469 | 2.73 | 0.31 |
| 11 | West | 19508494 | 2.08 | 0.41 |
| 12 | South | 13841958 | 2.85 | 0.73 |
| 13 | Southeast | 18352320 | 2.04 | 0.12 |
| 14 | West | 18898740 | 2.2 | 0.29 |

NEW! StatCrunch Question Library

This library of questions provides opportunities for students to analyze and interpret data sets in StatCrunch. Instructors can assign individual questions from the library by topic or they can assign questions from the same data set as a longer assignment that spans multiple learning objectives.

NEW! Integrated Review Course

Designed for just-in-time prerequisite review or for co-requisite courses, the Integrated Review version of the MyLab Statistics course provides pre-made, assignable skill-review quizzes and personalized homework assignments that are integrated throughout the regular statistics course content.

Integrated Review Manage View

Skills Check
Start by taking the Chapter 5 Skills Check. If you master the Skills Check, move on to the next section. If not, proceed to the Skills Review Homework below.

Skills Review
Complete your personalized Chapter 5 Skills Review Homework. For additional help, review the Learning Objectives listed below.

Learning Objectives
For any objectives you may still need to master, use the Integrated Review videos and worksheets below for extra help and practice. You can also check your answers for the Integrated Review Worksheets.

| Objective | Video | Worksheet |
|----------------------------------------------------------|-------|-----------------------------|
| S.R. 1: Evaluate formulas for probability distributions. | Video | Integrated Review Worksheet |
| S.R. 2: Evaluate the binomial probability formula. | Video | Integrated Review Worksheet |
| S.R. 3: Evaluate expressions with e. | Video | Integrated Review Worksheet |
| S.R. 4: Evaluate the Poisson formula. | Video | Integrated Review Worksheet |

Resources for Success

Instructor Resources

Annotated Instructor's Edition

Includes suggested activities, additional ways to present material, common pitfalls, and other helpful teaching tips. All answers to the section and review exercises are provided in the margins next to the exercise. (ISBN-13: 978-0-13-468358-4; ISBN-10: 0-13-468358-7)

Instructor's Solutions Manual (downloadable)

Includes complete solutions to all of the exercises (including exercises in *Try It Yourself*, *Case Study*, *Technology*, *Uses and Abuses*, and *Real Statistics—Real Decisions* sections). It can be downloaded from within MyLab Statistics or from Pearson's online catalog, www.pearson.com/us/higher-education.

PowerPoint Lecture Slides (downloadable)

Classroom presentation slides feature key concepts, examples, and definitions from this text, along with notes with suggestions for presenting the material in class. They can be downloaded from within MyLab Statistics or from Pearson's online catalog, www.pearson.com/us/higher-education.

TestGen

TestGen® (www.pearson.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 test bank are available for download from Pearson's online catalog, www.pearson.com/us/higher-education. The questions are also assignable in MyLab Statistics.

Learning Catalytics

Now included in all MyLab Statistics courses, this student response tool uses students' smartphones, tablets, or laptops to engage them in more interactive tasks and thinking during lecture. Learning Catalytics™ fosters student engagement and peer-to-peer learning with real-time analytics. Access pre-built exercises created specifically for statistics.

Student Resources

Video Resources

A comprehensive set of videos tied to the textbook contain short video clips with solutions to *Try It Yourself* exercises, Chapter Quiz Prep Videos, and Section Lecture Videos. Also, StatTalk Videos, hosted by fun-loving statistician Andrew Vickers, demonstrate important statistical concepts through interesting stories and real-life events. StatTalk Videos include assessment questions and an instructor's guide.

Student's Solutions Manual

(softcover and downloadable)

This 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. This manual is available in print and can be downloaded from MyLab Statistics. (ISBN-13: 978-0-13-468361-4; ISBN-10: 0-13-468361-7)

Technology Manuals for Elementary Statistics (downloadable)

Technology-specific manuals for Graphing Calculator, Excel®, and Minitab® include tutorial instruction and worked-out examples from the book. Each manual can be downloaded from within MyLab Statistics.

pearson.com/mylab/statistics

ACKNOWLEDGMENTS

I owe a debt of gratitude to the many reviewers who helped me shape and refine *Elementary Statistics: Picturing the World*, Seventh Edition.

Reviewers of the Current Edition

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 Clark Vangilder, DeVry University
 Ting-Xiu Wang, Oakton Community
 Dex Whittinghall, Rowan University
 Cathleen Zucco-Teveloff, Rider University

Many thanks to Betsy Farber for her significant contributions to previous editions of the text. Sadly, Betsy passed away in 2013.

I would also like to thank the staff of Larson Texts, Inc., who assisted with the production of the book. On a personal level, I am grateful to my spouse, Deanna Gilbert Larson, for her love, patience, and support. Also, a special thanks goes to R. Scott O'Neil.

I have worked hard to make this text a clean, clear, and enjoyable one from which to teach and learn statistics. Despite my best efforts to ensure accuracy and ease of use, many users will undoubtedly have suggestions for improvement. I welcome your suggestions.



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