Statistics permeates nearly every aspect of our lives. From opinion polls, to clinical trials in medicine, self-driving cars, drones, and biometric security, statistics influences and shapes the world around us. Essentials of Statistics forges the relationship between statistics and our world through extensive use of a wide variety of real applications that bring life to theory and methods.

Goals of This Sixth Edition
- Foster personal growth of students through critical thinking, use of technology, collaborative work, and development of communication skills.
- Incorporate the latest and best methods used by professional statisticians.
- Include features that address all of the recommendations included in the Guidelines for Assessment and Instruction in Statistics Education (GAISE) as recommended by the American Statistical Association.
- Provide an abundance of new and interesting data sets, examples, and exercises, such as those involving biometric security, cybersecurity, drones, and smartphone data speeds.
- Enhance teaching and learning with the most extensive and best set of supplements and digital resources.

Audience / Prerequisites
Essentials of Statistics is written for students majoring in any subject. Algebra is used minimally. It is recommended that students have completed at least an elementary algebra course or that students learn the relevant algebra components through an integrated or co-requisite course available through MyLab™ Statistics. In many cases, underlying theory is included, but this book does not require the mathematical rigor more appropriate for mathematics majors.

Hallmark Features
Great care has been taken to ensure that each chapter of Essentials of Statistics will help students understand the concepts presented. The following features are designed to help meet that objective of conceptual understanding.

Real Data
Hundreds of hours have been devoted to finding data that are real, meaningful, and interesting to students. 97% of the examples are based on real data, and 93% of the exercises are based on real data. Some exercises refer to the 32 data sets listed in Appendix B, and 12 of those data sets are new to this edition. Exercises requiring use of the Appendix B data sets are located toward the end of each exercise set and are marked with a special data set icon.

Real data sets are included throughout the book to provide relevant and interesting real-world statistical applications including biometric security, self-driving cars, smartphone data speeds, and use of drones for delivery. Appendix B includes descriptions of the 32 data sets that can be downloaded from the companion website www.pearsonhighered.com/triola or www.TriolaStats.com.
The companion website and TriolaStats.com include downloadable data sets in formats for technologies including Excel, Minitab, JMP, SPSS, and TI-83/84 Plus calculators. The data sets are also included in the free Statdisk software, which is also available on the website.

Readability
Great care, enthusiasm, and passion have been devoted to creating a book that is readable, understandable, interesting, and relevant. Students pursuing any major are sure to find applications related to their future work.

Website
This textbook is supported by www.pearsonhighered.com/triola and the author’s website www.TriolaStats.com which are continually updated to provide the latest digital resources for the Triola Statistics Series, including:

- Statdisk: A free robust statistical software package designed for this book.
- Downloadable Appendix B data sets in a variety of technology formats.
- Downloadable textbook supplements including Section 4-5 Probabilities Through Simulations, Glossary of Statistical Terms, and Formulas and Tables.
- Online instructional videos created specifically for the 6th edition that provide step-by-step technology instructions.
- Triola Blog which highlights current applications of statistics, statistics in the news, and online resources.
- Contact link providing one-click access for instructors and students to contact the author, Marty Triola, with questions and comments.

Chapter Features

Chapter Opening Features

- Chapters begin with a Chapter Problem that uses real data and motivates the chapter material.
- Chapter Objectives provide a summary of key learning goals for each section in the chapter.

Exercises
Many exercises require the interpretation of results. Great care has been taken to ensure their usefulness, relevance, and accuracy. Exercises are arranged in order of increasing difficulty and exercises are also divided into two groups: (1) Basic Skills and Concepts and (2) Beyond the Basics. Beyond the Basics exercises address more difficult concepts or require a stronger mathematical background. In a few cases, these exercises introduce a new concept.

End-of-Chapter Features

- Chapter Quick Quiz provides 10 review questions that require brief answers.
- Review Exercises offer practice on the chapter concepts and procedures.
- Cumulative Review Exercises reinforce earlier material.
- Technology Project provides an activity that can be used with a variety of technologies.
- From Data to Decision is a capstone problem that requires critical thinking and writing.
- Cooperative Group Activities encourage active learning in groups.
Other Features

Margin Essays There are 92 margin essays designed to highlight real-world topics and foster student interest. There are also many Go Figure items that briefly describe interesting numbers or statistics.

Flowcharts The text includes flowcharts that simplify and clarify more complex concepts and procedures. Animated versions of the text’s flowcharts are available within MyLab Statistics and MathXL®.

Detachable Formula and Table Card This insert, organized by chapter, gives students a quick reference for studying or for use when taking tests (if allowed by the instructor). It also includes the most commonly used tables. This is also available for download at www.TriolaStats.com.

Technology Integration

As in the preceding edition, there are many displays of screens from technology throughout the book, and some exercises are based on displayed results from technology. Where appropriate, sections end with a new Tech Center subsection that includes new technology-specific videos and detailed instructions for Statdisk, Minitab®, Excel®, StatCrunch, or a TI-83/84 Plus® calculator. (Throughout this text, “TI-83/84 Plus” is used to identify a TI-83 Plus or TI-84 Plus calculator). The end-of-chapter features include a Technology Project.

The Statdisk statistical software package is designed specifically for this textbook and contains all Appendix B data sets. Statdisk is free to users of this book and it can be downloaded at www.Statdisk.org.

Changes in This Edition

New Features

Chapter Objectives provide a summary of key learning goals for each section in the chapter.

Your Turn: Many examples include a new “your turn” feature that directs students to a relevant exercise so that they can immediately apply what they just learned from the example.


Larger Data Sets: Some of the data sets in Appendix B are much larger than in previous editions. It is no longer practical to print all of the Appendix B data sets in this book, so the data sets are described in Appendix B, and they can be downloaded at www.TriolaStats.com.

New Content: New examples, exercises and chapter problems provide relevant and interesting real-world statistical applications including biometric security, self-driving cars, smartphone data speeds, and use of drones for delivery.

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>New to This Edition</th>
<th>Use Real Data</th>
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<tbody>
<tr>
<td>Exercises</td>
<td>1495</td>
<td>82% (1230)</td>
<td>93% (1392)</td>
</tr>
<tr>
<td>Examples</td>
<td>183</td>
<td>73% (133)</td>
<td>97% (177)</td>
</tr>
<tr>
<td>Chapter Problems</td>
<td>11</td>
<td>100% (11)</td>
<td>100% (11)</td>
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Organization Changes

**New Chapter Objectives:** All chapters now begin with a list of key learning goals for that chapter. *Chapter Objectives* replaces the former *Review and Preview* numbered section. The first numbered section of each chapter now covers a major topic.

**New Subsection 1-3, Part 2:** Big Data and Missing Data: Too Much and Not Enough

**New Section 2-4:** Scatterplots, Correlation, and Regression

The previous edition included scatterplots in Chapter 2, but this new section includes scatterplots in Part 1, the linear correlation coefficient $r$ in Part 2, and linear regression in Part 3. These additions are intended to greatly facilitate coverage for those professors who prefer some early coverage of correlation and regression concepts. Chapter 10 continues to include these topics discussed with much greater detail.

**New Subsection 4-3, Part 3:** Bayes’ Theorem

**New Section 7-4:** Bootstrapping: Using Technology for Estimates

**Combined Sections:**
- 4-2: Addition Rule and Multiplication Rule
  Combines 5th edition Section 4-3 (*Addition Rule*) and Section 4-4 (*Multiplication Rule: Basics*).
- 5-2: Binomial Probability Distributions
  Combines 5th edition Section 5-3 (*Binomial Probability Distributions*) and Section 5-4 (*Parameters for Binomial Distributions*)

**Changed Terminology**

*Significant:* References in the previous edition to “unusual” outcomes are now described in terms of “significantly low” or “significantly high,” so that the link to hypothesis testing is further reinforced.

*Multiplication Counting Rule:* References in Section 4-4 (*Counting*) to the “fundamental counting rule” now use “multiplication counting rule” so that the name of the rule better suggests how it is applied.

**Flexible Syllabus**

This book’s organization reflects the preferences of most statistics instructors, but there are two common variations:

- **Early Coverage of Correlation and Regression:** Some instructors prefer to cover the basics of correlation and regression early in the course. Section 2-4 now includes basic concepts of scatterplots, correlation, and regression without the use of formulas and greater depth found in Sections 10-1 (*Correlation*) and 10-2 (*Regression*).

- **Minimum Probability:** Some instructors prefer extensive coverage of probability, while others prefer to include only basic concepts. Instructors preferring minimum coverage can include Section 4-1 while skipping the remaining sections of Chapter 4, as they are not essential for the chapters that follow. Many instructors prefer to cover the fundamentals of probability along with the basics of the addition rule and multiplication rule (Section 4-2).

**GAISE** This book reflects recommendations from the American Statistical Association and its *Guidelines for Assessment and Instruction in Statistics Education* (GAISE). Those guidelines suggest the following objectives and strategies.
1. **Emphasize statistical literacy and develop statistical thinking:** Each section exercise set begins with *Statistical Literacy and Critical Thinking* exercises. Many of the book’s exercises are designed to encourage statistical thinking rather than the blind use of mechanical procedures.

2. **Use real data:** 97% of the examples and 93% of the exercises use real data.

3. **Stress conceptual understanding rather than mere knowledge of procedures:** Instead of seeking simple numerical answers, most exercises and examples involve conceptual understanding through questions that encourage practical interpretations of results. Also, each chapter includes a *From Data to Decision* project.

4. **Foster active learning in the classroom:** Each chapter ends with several *Cooperative Group Activities*.

5. **Use technology for developing conceptual understanding and analyzing data:** Computer software displays are included throughout the book. Special *Tech Center* subsections include instruction for using the software. Each chapter includes a *Technology Project*. When there are discrepancies between answers based on tables and answers based on technology, Appendix D provides both answers. The website www.TriolaStats.com includes free, text-specific software (Statdisk), data sets formatted for several different technologies, and instructional videos for technologies.

6. **Use assessments to improve and evaluate student learning:** Assessment tools include an abundance of section exercises, *Chapter Quick Quizzes*, *Chapter Review Exercises*, *Cumulative Review Exercises*, *Technology Projects*, *From Data to Decision* projects, and *Cooperative Group Activities*.

**Acknowledgments**

I would like to thank the thousands of statistics professors and students who have contributed to the success of this book. I thank the reviewers for their suggestions for this sixth edition: Eric Gorenstein, Bunker Hill Community College; Rhonda Hatcher, Texas Christian University; Ladorian Latin, Franklin University; Joseph Pick, Palm Beach State College; and Lisa Whitaker, Keiser University. Special thanks to Laura Iossi of Broward College for her comprehensive work in reviewing and contributing to this 6th edition.

Other recent reviewers have included Raid W. Amin, University of West Florida; Robert Black, United States Air Force Academy; James Bryan, Merced College; Donald Burd, Monroe College; Keith Carroll, Benedictine University; Monte Cheney, Central Oregon Community College; Christopher Donnelly, Macomb Community College; Billy Edwards, University of Tennessee—Chattanooga; Marcos Enriquez, Moorpark College; Angela Everett, Chattanooga State Technical Community College; Joe Franko, Mount San Antonio College; Rob Fusco, Broward College; Sanford Geraci, Broward College; Laura Heath, Palm Beach State College; Richard Herbst, Montgomery County Community College; Richard Hertz; Diane Hollister, Reading Area Community College; Michael Huber, Muhlenberg College; George Jahn, Palm Beach State College; Gary King, Ozarks Technical Community College; Kate Kozak, Coconino Community College; Dan Kumpf, Ventura College; Mickey Levendusky, Pima County Community College; Mitch Levy, Broward College; Tristan Londre, Blue River Community College; Alma Lopez, South Plains College; Kim McHale, Heartland Community College; Carla Monticelli, Camden County Community College; Ken Mulzet, Florida State College at Jacksonville; Julia Norton, California State University Hayward; Michael Oriolo,
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This sixth edition of Essentials of Statistics is truly a team effort, and I consider myself fortunate to work with the dedication and commitment of the Pearson team. I thank Suzy Bainbridge, Deirdre Lynch, Peggy McMahon, Vicki Dreyfus, Christine O’Brien, Joe Vetere, and Rose Kernan of Cenveo Publisher Services.

I extend special thanks to Marc Triola, M.D., New York University School of Medicine, for his outstanding work on creating the new 13th edition of the Statdisk software. I thank Scott Triola for his very extensive help throughout the entire production process for this 6th edition.

I thank the following for their help in checking the accuracy of text and answers in this edition: James Lapp, Paul Lorczak, and Dirk Tempelaar.

M.F.T.

Madison, Connecticut

September 2017
Resources for Success

MyLab Statistics Online Course for Essentials of Statistics, 6e by Mario F. Triola (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.

Expanded objective-based MathXL coverage
MathXL® is newly mapped to improve student learning outcomes. Homework reinforces and supports students’ understanding of key statistics topics.

Enhanced video program to meet Introductory Statistics needs:
- New! Tech-Specific Video Tutorials - These short, topical videos address how to use various technologies to complete exercises.
- Updated! Chapter Review Exercise Videos - Watch the Chapter Review Exercises come to life with new review videos that help students understand key chapter concepts.
- Updated! Section Lecture Videos - Watch author, Marty Triola, work through examples and elaborate on key objectives of the chapter.

Real-world data examples
Examples and exercises throughout the textbook and MyLab Statistics use current, real-world data to help students understand how statistics applies to everyday life.

pearson.com/mylab/statistics

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Resources for Success

Student Resources


The following technology manuals contain detailed tutorial instructions and worked-out examples and exercises for many technologies. They correspond with the Triola Statistics Series and can be downloaded by students and instructors from www.pearsonhighered.com/Triola or from within MyLab Statistics.

Excel Student Laboratory Manual and Workbook (download only), by Laurel Chiappetta (University of Pittsburgh).

Minitab® Student Laboratory Manual and Workbook (download only), by Mario F. Triola.

Graphing Calculator Manual for the TI-83 Plus, TI-84 Plus, TI-84 Plus C and TI-84 Plus CE (download only), by Kathleen McLaughlin (University of Connecticut) and Dorothy Wakefield (University of Connecticut Health Center).

Statdisk Student Laboratory Manual and Workbook (download only), by Mario F. Triola.

SPSS Student Laboratory Manual and Workbook (download only), by James J. Ball (Indiana State University).

Instructor Resources


Instructor's Solutions Manual (download only), by James Lapp (Colorado Mesa University), contains solutions to all the exercises. These files are available to qualified instructors through Pearson's online catalog at www.pearson.com/us/higher-education or within MyLab Statistics.

Insider's Guide to Teaching with the Triola Statistics Series (download only), by Mario F. Triola, contains sample syllabi and tips for incorporating projects, as well as lesson overviews, extra examples, minimum outcome objectives, and recommended assignments for each chapter. This file is available to qualified instructors through Pearson's online catalog at www.pearson.com/us/higher-education or within MyLab Statistics.

TestGen® Computerized Test Bank (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 test-bank are available for download from Pearson's online catalog at www.pearson.com/us/higher-education. Test Forms (download only) are also available from the online catalog.

PowerPoint Lecture Slides: Free to qualified adopters, this classroom lecture presentation software is geared specifically to the sequence and philosophy of Essentials of Statistics. Key graphics from the book are included to help bring the statistical concepts alive in the classroom. These files are available to qualified instructors through Pearson's online catalog at www.pearson.com/us/higher-education or within MyLab Statistics.

Learning Catalytics™ is a web-based engagement and assessment tool. As a “bring-your-own-device” direct response system, Learning Catalytics offers a diverse library of dynamic question types that allow students to interact with and think critically about statistical concepts. As a real-time resource, instructors can take advantage of critical teaching moments both in the classroom or through assignable and gradeable homework.

Pearson.com/mylab/statistics
Technology Resources
The following resources can be found at www.pearsonhighered.com/triola, the author-maintained Triola Statistics Series Web site (http://www.triolastats.com), and MyLab Statistics

- Appendix B data sets formatted for Minitab, SPSS, SAS, Excel, JMP, and as text files. Additionally, these data sets are available as data lists for the TI-83/84 Plus calculators; supplemental programs for the TI-83/84 Plus calculator are also available.
- Statdisk statistical software instructions for download. New features include the ability to directly use lists of data instead of requiring the use of their summary statistics.
- Extra data sets, Probabilities Through Simulations, Bayes’ Theorem, an index of applications, and a symbols table.

Video Resources has been expanded and updated and now supplements most sections in the book, with many topics presented by the author. The videos aim to support both instructors and students through lecture, reinforcement of statistical basics through technology, and application of concepts:

- Section Lecture Videos
- Chapter Review Exercise Videos walk students through the exercises and help them understand key chapter concepts.
- New! Technology Video Tutorials These short, topical videos address how to use Excel, StatDisk, and the TI graphing calculator to complete exercises.
- StatTalk Videos: 24 Conceptual Videos to Help You Actually Understand Statistics. Fun-loving statistician Andrew Vickers takes to the streets of Brooklyn, NY, to demonstrate important statistical concepts through interesting stories and real-life events. These fun and engaging videos will help students actually understand statistical concepts. Available with an instructors user guide and assessment questions.

Videos also contain optional English and Spanish captioning. All videos are available through the MyLab Statistics online course.

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. Each course is developed to accompany Pearson’s best-selling content, authored by thought leaders across the statistics curriculum, and can be easily customized to fit any course format.

- MyLab Statistics 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. You can determine which points of data you want to export, and then analyze the results to determine success.

MyLab Statistics delivers assessment, tutorials, and multimedia resources that provide engaging and personalized experiences for each student, so learning can happen in any environment. In addition to the resources below, each course includes a full interactive online version of the accompanying textbook.

- Tutorial Exercises with Multimedia Learning Aids: The homework and practice exercises in MyLab Statistics 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.
- Getting Ready for Statistics: A library of questions now appears within each MyLab Statistics course to offer the developmental math topics students need for the course. These can be assigned as a prerequisite to other assignments, if desired.
- Conceptual Question Library: In addition to algorithmically regenerated questions that are aligned with your textbook, there is a library of 1,000 Conceptual Questions available in the assessment manager that require students to apply their statistical understanding.
- StatCrunch: MyLab Statistics integrates the 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, MyLab Statistics 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.
- Statistical Software Support: Knowing that students often use external statistical software, we make it easy to copy our data sets, from the ebook and the
MyLab Statistics questions, into software such as StatCrunch, Minitab, Excel, and more. Students have access to a variety of support tools—Technology Tutorial Videos, Technology Study Cards, and Technology Manuals for select titles—to learn how to effectively use statistical software.

MathXL for Statistics Online Course (access code required)
MathXL is the homework and assessment engine that runs MyLab Statistics. (MyLab Statistics 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.
- Access supplemental animations and video clips directly from selected exercises.
- Can easily copy our data sets, both from the ebook and the MyLab Statistics 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. A vibrant online community offers 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 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.

Full access to StatCrunch is available with a MyLab Statistics kit, and StatCrunch is available by itself to qualified adopters. StatCrunch Mobile is also now available when you visit www.StatCrunch.com from the browser on your smartphone or tablet. For more information, visit www.StatCrunch.com or contact your Pearson representative.

Minitab and Minitab Express™ make learning statistics easy and provide students with a skill set that’s 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 the latest version of Minitab ensures that students can use the software for the duration of their course.

ISBN 10: 0-13-445640-8 (Access Card only; not sold as stand alone.)

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.


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