

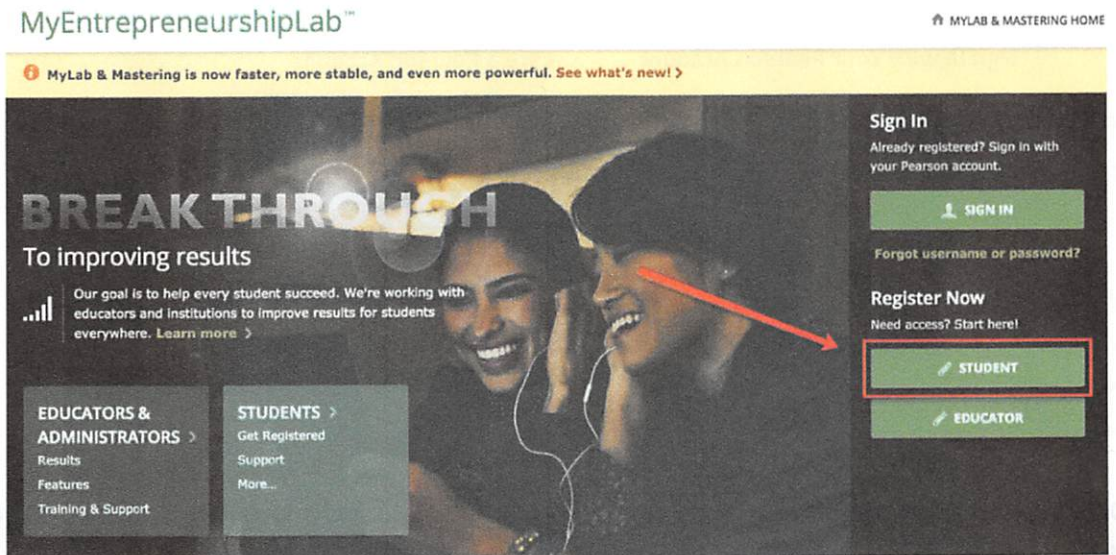
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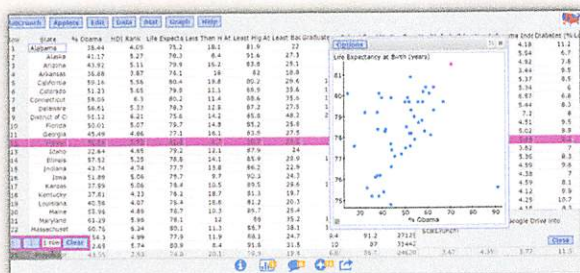
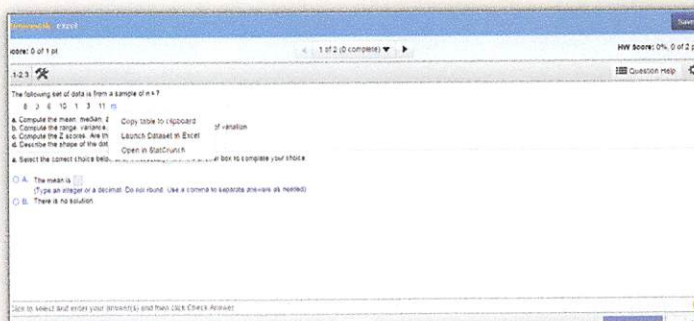
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Business Statistics

A First Course

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Norean R. Sharpe • Richard D. De Veaux • Paul F. Velleman

Business Statistics

A First Course

Custom Edition for MiraCosta College

Taken from:

Business Statistics: A First Course, Third Edition

by Norean R. Sharpe, Richard D. De Veaux, and Paul F. Velleman

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by Norean R. Sharpe, Richard D. De Veaux, and Paul F. Velleman
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To my husband, Peter, for his patience and support

—*Noreen*

To my family

—*Dick*

To my father, who taught me about ethical business practice by
his constant example as a small businessman and parent

—*Paul*

Meet the Authors



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Richard De Veaux and Paul Velleman have authored successful books in the introductory college and AP High School market with David Boeck, including *Intro Stats*, Fourth Edition (Pearson, 2014); *Stats: Modeling the World*, Fourth Edition (Pearson, 2015); and *Stats: Data and Models*, Fourth Edition (Pearson, 2016).

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Preface

The question that should motivate a business student's study of Statistics should be "How can I make better decisions?"¹ As entrepreneurs and consultants, we know that in today's data-rich environment, knowledge of Statistics is essential to survive and thrive in the business world. But, as educators, we've seen a disconnect between the way business statistics is traditionally taught and the way it should be used in making business decisions. In *Business Statistics: A First Course*, we try to narrow the gap between theory and practice by presenting relevant statistical methods that will empower business students to make effective, data-informed decisions.

Of course, students should come away from their statistics course knowing how to think statistically and how to apply statistics methods with modern technology. But they must also be able to communicate their analyses effectively to others. When asked about statistics education, a group of CEOs from *Fortune* 500 companies recently said that although they were satisfied with the technical competence of students who had studied statistics, they found the students' ability to communicate their findings to be woefully inadequate.

Our Plan, Do, Report rubric provides a structure for solving business problems that mimics the correct application of statistics to solving real business problems. We emphasize the often neglected thinking (Plan) and communication (Report) steps in problem solving in addition to the methodology (Do). This approach requires up-to-date, real-world examples and data. So we constantly strive to illustrate our lessons with current business issues and examples.

What's New in This Edition?

We've been delighted with the reaction to previous editions of *Business Statistics: A First Course*. We've streamlined the third edition further to help students focus on the central material. And, of course, we continue to update examples and exercises so that the story we tell is always tied to the ways Statistics informs modern business practice.

- **Recent data.** We teach with real data whenever possible, so we've updated data throughout the book. New examples reflect current stories in the news and recent economic and business events. The Brief Cases have been updated with new data and new contexts.
- **Improved organization.** We have retained our "data first" presentation of topics because we find that it provides students with both motivation and a foundation in real business decisions on which to build an understanding.
 - Chapters 1–4 have been streamlined to cover collecting, displaying, summarizing, and understanding data in four chapters. We find that this provides students with a solid foundation to launch their study of probability and statistics.
 - Chapters 5–9 introduce students to randomness and probability models. They then apply these new concepts to sampling. This provides a gateway to the core material on statistical inference. We've moved the discussion of probability trees and Bayes' rule into these chapters.
 - Chapters 10–13 cover inference for both proportions and means. We introduce inference by discussing proportions because most students are better acquainted with proportions reported in surveys and news stories. However, this edition ties in the discussion of means immediately so students can appreciate that the reasoning of inference is the same in a variety of contexts.
 - Chapters 14 and 15 cover regression-based models for decision making.
 - Chapter 16 introduces Data Mining and points the way forward for further study.
- **Streamlined design.** Our goal has always been an accessible text. This edition sports a new design that clarifies the purpose of each text element. The major theme of each

¹Unfortunately, not the question most students are asking themselves on the first day of the course.

chapter is more linear and easier to follow without distraction. Supporting material is clearly boxed and shaded, so students know where to focus their study efforts.

- **Enhanced Technology Help with expanded Excel 2013 coverage.** We've updated Technology Help with instructions for R and XLStat and added detailed instructions for Excel 2013 to almost every chapter.
- **Updated Ethics in Action features.** We've updated more than half of our Ethics in Action features. Ethically and statistically sound alternative approaches to the questions raised in these features and a link to the American Statistical Association's Ethical Guidelines are now presented in the Instructor's Solutions Manual, making the Ethics features suitable for assignment or class discussion.
- **Updated examples to reflect the changing world.** The time since our last revision has seen marked changes in the U.S. and world economies. Our examples and exercises have been updated to keep pace.
- **Increased focus on core material.** Statistics in practice means making smart decisions based on data. Students need to know the methods, how to apply them, and the assumptions and conditions that make them work. We've tightened our discussions to get students there as quickly as possible, focusing increasingly on the central ideas and core material.
- **Used MyStatLab performance data to improve exercises.** The authors analyzed aggregated student usage and performance data from MyStatLab for the previous edition of this text. The results of this analysis helped improve the quality and quantity of exercises that matter the most to instructors and students.

Our Approach

Statistical Thinking

For all of our improvements, examples, and updates in this edition of *Business Statistics: A First Course* we haven't lost sight of our original mission—writing a modern business statistics text that addresses the importance of *statistical thinking* in making business decisions and that acknowledges how Statistics is actually used in business.

Statistics is practiced with technology, and this insight informs everything from our choice of forms for equations (favoring intuitive forms over calculation forms) to our extensive use of real data. But most important, understanding the value of technology allows us to focus on teaching statistical thinking rather than calculation. The questions that motivate each of our hundreds of examples are not “How do you find the answer?” but “How do you think about the answer?”, “How does it help you make a better decision?”, and “How can you best communicate your decision?”

Our focus on statistical thinking ties the chapters of the book together. An introductory Business Statistics course covers an overwhelming number of new terms, concepts, and methods, and it is vital that students see their central core: how we can understand more about the world and make better decisions by understanding what the data tell us. From this perspective, it is easy to see that the patterns we look for in graphs are the same as those we think about when we prepare to make inferences. We can see that the many ways to draw inferences from data are several applications of the same core concepts. And it follows naturally that when we extend these basic ideas into more complex (and even more realistic) situations, the same basic reasoning is still at the core of our analyses.

Our Goal: Read This Book!

The best textbook in the world is of little value if it isn't read. Here are some of the ways we made *Business Statistics: A First Course* more approachable:

- **Readability.** We strive for a conversational, approachable style, and we introduce anecdotes to maintain interest. Instructors report (to their amazement) that their students read ahead of their assignments voluntarily. Students tell us (to *their* amazement) that they actually enjoy the book. In this edition, we've tightened our discussions to be more focused on the central ideas we want to convey.

- **Focus on assumptions and conditions.** More than any other textbook, *Business Statistics: A First Course* emphasizes the need to verify assumptions when using statistical procedures. We reiterate this focus throughout the examples and exercises. We make every effort to provide templates that reinforce the practice of checking these assumptions and conditions, rather than rushing through the computations. Business decisions have consequences. Blind calculations open the door to errors that could easily be avoided by taking the time to graph the data, check assumptions and conditions, and then check again that the results and residuals make sense.
- **Emphasis on graphing and exploring data.** We consistently emphasize the importance of displaying data. Examples often illustrate the value of examining data graphically, and the Exercises reinforce this. Good graphics reveal structures, patterns, and occasional anomalies that could otherwise go unnoticed. These patterns often raise new questions and inform both the path of a resulting statistical analysis and the business decisions. Hundreds of new graphics found throughout the book demonstrate that the simple structures that underlie even the most sophisticated statistical inferences are the same ones we look for in the simplest examples. This helps tie the concepts of the book together to tell a coherent story.
- **Consistency.** We work hard to avoid the “do what we say, not what we do” trap. Having taught the importance of plotting data and checking assumptions and conditions, we are careful to model that behavior throughout the book. (Check the Exercises in the chapter on multiple regression and you’ll find us still requiring and demonstrating the plots and checks that were introduced in the early chapters.) This consistency helps reinforce these fundamental principles and provides a familiar foundation for the more sophisticated topics.
- **The need to read.** In this book, important concepts, definitions, and sample solutions are not always set aside in boxes. The book needs to be read, so we’ve tried to make the reading experience enjoyable. The common approach of skimming for definitions or starting with the exercises and looking up examples just won’t work here. (It never did work as a way to learn about and understand Statistics.)

Coverage

The topics covered in a Business Statistics course are generally mandated by our students’ needs in their studies and in their future professions. But the *order* of these topics and the relative emphasis given to each is not well established. *Business Statistics: A First Course* presents some topics sooner or later than other texts. Although many chapters can be taught in a different order, we urge you to consider the order we have chosen.

We’ve been guided in the order of topics by the fundamental goal of designing a coherent course in which concepts and methods fit together to provide a new understanding of how reasoning with data can uncover new and important truths. Each new topic should fit into the growing structure of understanding that students develop throughout the course. For example, we teach inference concepts with proportions first and then with means. Most people have a wider experience with proportions, seeing them in polls and advertising. And by starting with proportions, we can teach inference with the Normal model and then introduce inference for means with the Student’s t distribution.

We introduce the concepts of association, correlation, and regression early. Our experience in the classroom shows that introducing these fundamental ideas early makes Statistics useful and relevant even at the beginning of the course. By Chapter 4, students can discuss relationships among variables in a meaningful way. Later in the semester, when we discuss inference, it is natural and relatively easy to build on the fundamental concepts learned earlier and enhance them with inferential methods.

GAISE Report

We've been guided in our choice of what to emphasize by the GAISE (Guidelines for Assessment and Instruction in Statistics Education) Report, which emerged from extensive studies of how students best learn Statistics (http://www.amstat.org/education/gaise/GaiseCollege_full.pdf). Those recommendations, now officially adopted and recommended by the American Statistical Association, urge (among other detailed suggestions) that Statistics education should:

1. Emphasize statistical literacy and develop statistical thinking.
2. Use real data.
3. Stress conceptual understanding rather than mere knowledge of procedures.
4. Foster active learning.
5. Use technology for developing conceptual understanding and analyzing data.
6. Make assessment a part of the learning process.

In this sense, this book is thoroughly modern.

Continuing Features

A textbook isn't just words on a page. A textbook is many elements that come together to form a big picture. The features in *Business Statistics: A First Course* provide a real-world context for concepts, help students apply these concepts, promote problem solving, and integrate technology—all of which help students understand and see the big picture of Business Statistics.

Providing Real-World Context

Motivating Vignettes. Each chapter opens with a motivating vignette, often taken from the authors' consulting experiences. Companies featured include Amazon.com, Zillow.com, and Keen Inc. We analyze data from or about the companies in the motivating vignettes throughout the chapter.

Brief Cases. Each chapter includes one or more Brief Cases that use real data and ask students to investigate a question or make a decision. Students define the objective, plan the process, complete the analysis, and report a conclusion. Data for the Brief Cases are available online, formatted for various technologies.

Case Studies. Each of the parts of the book ends with a Case Study. Students are given realistically large data sets (online) and challenged to respond to open-ended business questions using the data. Students can bring together methods they have learned throughout the book to address the issues raised. Students will have to use a computer to work with the large data sets that accompany these Case Studies.

What Can Go Wrong? In each chapter, What Can Go Wrong? highlights the most common statistical errors and the misconceptions about Statistics. The most common mistakes for the new user of Statistics often involve misusing a method—not miscalculating a statistic. One of our goals is to arm students with the tools to detect statistical errors and to offer practice in debunking misuses of Statistics, whether intentional or not.

Applying Concepts

For Examples. Almost every section of every chapter includes a focused example that illustrates and applies the concepts or methods of that section to a real-world business context.

Step-by-Step Guided Examples. The answer to a statistical question is almost never just a number. Statistics is about understanding the world and making better decisions with data. Guided Examples model a thorough solution in the right column with commentary in the left column. The overall analysis follows our innovative **Plan, Do, Report** template. Each analysis begins with a clear question about a business decision and an examination of the data (**Plan**), moves to calculating the selected statistics (**Do**), and finally concludes with a **Report** that specifically addresses the question. To emphasize that our goal is to address the motivating question, we present the **Report** step as a business memo that summarizes the results in the context of the example and states a recommendation if the data are able to support one. To preserve the realism of the example, whenever it is appropriate, we include limitations of the analysis or models in the concluding memo, as one should in making such a report.

By Hand. Even though we encourage the use of technology to calculate statistical quantities, we recognize the pedagogical benefits of occasionally doing a calculation by hand. The By Hand boxes break apart the calculation of some of the simpler formulas and help the student through the calculation of a worked example.

Reality Check. We regularly offer reminders that Statistics is about understanding the world and making decisions with data. Results that make no sense are probably wrong, no matter how carefully we think we did the calculations. Mistakes are often easy to spot with a little thought, so we ask students to stop for a reality check before interpreting results.

Notation Alert. Throughout this book, we emphasize the importance of clear communication. Proper notation is part of the vocabulary of Statistics, but it can be daunting. We've found that it helps students when we are clear about the letters and symbols statisticians use to mean very specific things, so we've included Notation Alerts whenever we introduce a special notation that students will see again.

Math Boxes. In many chapters, we present the mathematical underpinnings of the statistical methods and concepts. We set proofs, derivations, and justifications apart from the narrative, so the underlying mathematics is there for those who want greater depth, but the text itself presents the logical development of the topic at hand without distractions.

What Have We Learned? Each chapter ends with a What Have We Learned? summary that includes learning objectives and definitions of terms introduced in the chapter. Students can think of these as study guides.

Promoting Problem Solving

Just Checking. Throughout each chapter we pose short questions to help students check their understanding. The answers are at the end of the exercise sets in each chapter to make them easy to check. The questions can also be used to motivate class discussion.

Ethics in Action. Statistics is not just plugging numbers into formulas; most statistical analyses require a fair amount of judgment. Ethics in Action vignettes—updated for this edition—in each chapter provide a context for some of the judgments needed in statistical analyses. Possible errors, a link to the American Statistical Association's Ethical Guidelines, and ethically and statistically sound alternative approaches are presented in the Instructor's Solutions Manual.

Section Exercises. The exercises for each chapter begin with straightforward exercises targeted at the topics in each section. These are designed to check understanding of specific topics. Because they are labeled by section, it is easy to turn back to the chapter to clarify a concept or review a method.

Chapter Exercises. These exercises are designed to be more realistic than Section Exercises and to lead to conclusions about the real world. They may combine concepts and methods from different sections, and they contain relevant, modern, and real-world questions. Many come from news stories; some come from recent research articles. The exercises marked with a **T** indicate that the data are provided online (at the book's companion website, www.pearsonhighered.com/sharpe) in a variety of formats. We pair the exercises so that each odd-numbered exercise (with answer in the back of the book) is followed by an even-numbered exercise on the same Statistics topic. Exercises are roughly ordered within each chapter by both topic and by level of difficulty.

Integrating Technology

Data and Sources. Most of the data used in examples and exercises are from real-world sources and whenever we can, we include URLs for Internet data sources. The data we use are on the companion website, www.pearsonhighered.com/sharpe.

Videos with Optional Captioning. Videos, featuring the *Business Statistics: A First Course* authors, review the high points of each chapter. The presentations feature the same student-friendly style and emphasis on critical thinking as the textbook. In addition, 10 *Business Insight Videos* feature Deckers, Southwest Airlines, Starwood, and other companies and focus on statistical concepts as they pertain to the real world. Videos are available with captioning and can be viewed from within the online MyStatLab course.

Technology Help. In business, Statistics is practiced with computers using a variety of statistics packages. In Business-school Statistics classes, however, Excel is the software most often used. In Technology Help at the end of each chapter, we summarize what students can find in the most common software, often with annotated output. Updated for this edition, we offer extended guidance for Excel 2013, and start-up pointers for Minitab, SPSS, XLStat, R, and JMP, formatted in easy-to-read bulleted lists. This advice is not intended to replace the documentation for any of the software, but rather to point the way and provide start-up assistance.

Resources for Success

MyStatLab® Online Course *Business Statistics:*

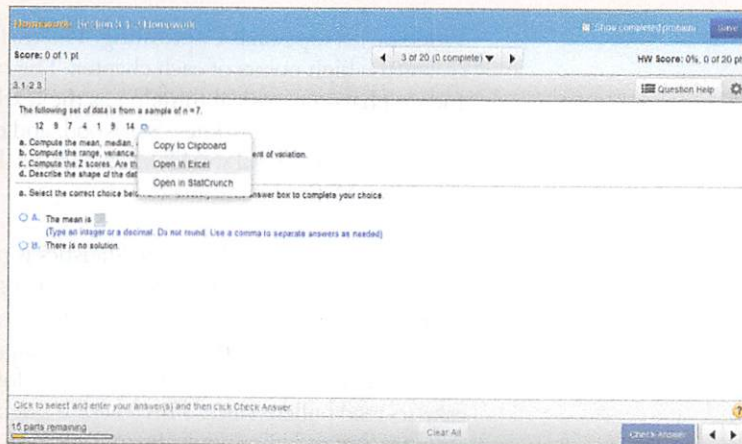
A First Course, 3rd edition, Sharpe/De Veaux/Velleman

(access code required)

MyStatLab 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 MyStatLab course, making learning the material as seamless as possible.

New! Launch Exercise Data in Excel

Students are now able to quickly and seamlessly launch data sets from exercises within MyStatLab into a Microsoft Excel spreadsheet for easy analysis. As always, students may also copy and paste exercise data sets into most other software programs.

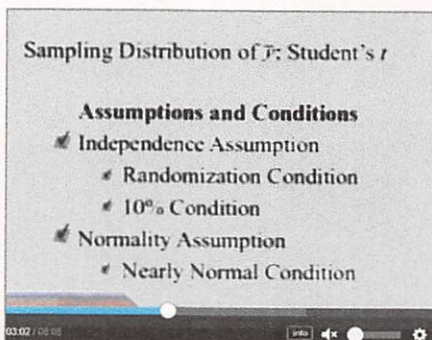


Business Insight Videos

Ten engaging videos showing managers at top companies using statistics in their everyday work. Assignable questions built in to your MyStatLab course encourage discussion.

Chapter Overview Videos

Featuring each of the book's authors, 5-10 minute chapter overview videos walk students through key concepts covered in each chapter. These videos are accessible through the multimedia library and are assignable.



Resources for Success

Instructor Resources

Additional resources can be downloaded from **www.pearsonhighered.com** or MyStatLab; hardcopy resources can be ordered from your sales representative.

Instructor's Edition

Instructor's Edition contains answers to all exercises.

Instructor's Resource Guide

Instructor's Resource Guide (download only), written by the authors, contains chapter-by-chapter comments on the major concepts, tips on presenting topics (and what to avoid), teaching examples, suggested assignments, basic exercises, and web links and lists of other resources.

Online Test Bank

Online Test Bank (download only), includes chapter quizzes and part level tests.

Instructor's Solutions Manual

Instructor's Solutions Manual (download only) contains detailed solutions to all of the exercises.

TestGen®

TestGen® (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, so instructors can 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.

PowerPoint® Lecture Slides

PowerPoint Lecture Slides provide an outline to use in a lecture setting, presenting definitions, key concepts, and figures from the text.

Learning Catalytics

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 gradable homework.

XLStat for Pearson

XLStat for Pearson is an Excel® add-in that offers a wide variety of functions to enhance the analytical capabilities of Microsoft Excel, making it the ideal tool for your everyday data analysis and statistics requirements. Developed in 1993, XLStat is used by leading businesses and universities around the world. XLStat is compatible with all Excel versions from version 97 to version 2013 (except Mac 2008) including PowerPC and Intel-based Mac systems.

Student Resources

Additional resources for student success.

Student's Solutions Manual

Student's Solutions Manual provides detailed, worked-out solutions to odd-numbered exercises.

Study Cards for Business Statistics Software

This series of study cards, available for Excel® 2013 with XLSTAT, Excel 2013 with Data Analysis Toolpak, Minitab, JMP, SPSS, and StatCrunch provide students with easy step-by-step guides to the most common business statistics software.

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