Statistical Techniques in
Business & Economics
Fifteenth Edition

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Dedication

To Jane, my wife and best friend, and our sons, their wives, and our grandchildren: Mike and Sue (Steve and Courtney), Steve and Kathryn (Kennedy and Jake), and Mark and Sarah (Jared, Drew, and Nate).

Douglas A. Lind

To John Eric Mouser, his siblings, parents, and Granny.

William G. Marchal

To my wonderful family: Isaac, Hannah, and Barb.

Samuel A. Wathen
Over the years, we have received many compliments on this text and understand that it's a favorite among students. We accept that as the highest compliment and continue to work very hard to maintain that status.

The objective of *Statistical Techniques in Business and Economics* is to provide students majoring in management, marketing, finance, accounting, economics, and other fields of business administration with an introductory survey of the many applications of descriptive and inferential statistics. We focus on business applications, but we also use many exercises and examples that relate to the current world of the college student. A previous course in statistics is not necessary, and the mathematical requirement is first-year algebra.

In this text, we show beginning students every step needed to be successful in a basic statistics course. This step-by-step approach enhances performance, accelerates preparedness, and significantly improves motivation. Understanding the concepts, seeing and doing plenty of examples and exercises, and comprehending the application of statistical methods in business and economics are the focus of this book.

The first edition of this text was published in 1967. At that time, locating relevant business data was difficult. That has changed! Today, locating data is not a problem. The number of items you purchase at the grocery store is automatically recorded at the checkout counter. Phone companies track the time of our calls, the length of calls, and the identity of the person called. Credit card companies maintain information on the number, time and date, and amount of our purchases. Medical devices automatically monitor our heart rate, blood pressure, and temperature from remote locations. A large amount of business information is recorded and reported almost instantly. CNN, USA Today, and MSNBC, for example, all have websites that track stock prices with a delay of less than 20 minutes.

Today, skills are needed to deal with a large volume of numerical information. First, we need to be critical consumers of information presented by others. Second, we need to be able to reduce large amounts of information into a concise and meaningful form to enable us to make effective interpretations, judgments, and decisions. All students have calculators and most have either personal computers or access to personal computers in a campus lab. Statistical software, such as Microsoft Excel and Minitab, is available on these computers. The commands necessary to achieve the software results are available in a special section at the end of each chapter. We use screen captures within the chapters, so the student becomes familiar with the nature of the software output.

Because of the availability of computers and software, it is no longer necessary to dwell on calculations. We have replaced many of the calculation examples with interpretative ones, to assist the student in understanding and interpreting the statistical results. In addition, we now place more emphasis on the conceptual nature of the statistical topics. While making these changes, we still continue to present, as best we can, the key concepts, along with supporting interesting and relevant examples.
What’s New in This Fifteenth Edition?

We have made changes to this edition that we think you and your students will find useful and timely.

- We have revised the learning objectives so they are more specific, added new ones, identified them in the margin, and keyed them directly to sections within the chapter.
- We have replaced the key example in Chapters 1 to 4. The new example includes more variables and more observations. It presents a realistic business situation. It is also used later in the text in Chapter 13.
- We have added or revised several new sections in various chapters:
  - Chapter 7 now includes a discussion of the exponential distribution.
  - Chapter 9 has been reorganized to make it more teachable and improve the flow of the topics.
  - Chapter 13 has been reorganized and includes a test of hypothesis for the slope of the regression coefficient.
  - Chapter 17 now includes a graphic test for normality and the chi-square test for normality.
- New exercises and examples use Excel 2007 screenshots and the latest version of Minitab. We have also increased the size and clarity of these screenshots.
- There are new Excel 2007 software commands and updated Minitab commands at the ends of chapters.
- We have carefully reviewed the exercises within the chapters, those at the ends of chapters, and in the Review Section. We have added many new or revised exercises throughout. You can still find and assign your favorites that have worked well, or you can introduce fresh examples.
- Section numbers have been added to more clearly identify topics and more easily reference them.
- The exercises that contain data files are identified by an icon for easy identification.
- The Data Exercises at the end of each chapter have been revised. The baseball data has been updated to the most current completed season, 2009. A new business application has been added that refers to the use and maintenance of the school bus fleet of the Buena School District.
- There are many new photos throughout, with updated exercises in the chapter openers.
How Are Chapters Organized to

Chapter Learning Objectives

Each chapter begins with a set of learning objectives designed to provide focus for the chapter and motivate student learning. These objectives, located in the margins next to the topic, indicate what the student should be able to do after completing the chapter.

Chapter Opening Exercise

A representative exercise opens the chapter and shows how the chapter content can be applied to a real-world situation.

Introduction to the Topic

Each chapter starts with a review of the important concepts of the previous chapter and provides a link to the material in the current chapter. This step-by-step approach increases comprehension by providing continuity across the concepts.

Example/Solution

After important concepts are introduced, a solved example is given to provide a how-to illustration for students and to show a relevant business or economics-based application that helps answer the question, “What will I use this for?” All examples provide a realistic scenario or application and make the math size and scale reasonable for introductory students.

Self-Reviews

Self-Reviews are interspersed throughout each chapter and closely patterned after the preceding Examples. They help students monitor their progress and provide immediate reinforcement for that particular technique.
Engage Students and Promote Learning?

Statistics in Action

Statistics in Action articles are scattered throughout the text, usually about two per chapter. They provide unique and interesting applications and historical insights in the field of statistics.

Margin Notes

There are more than 300 concise notes in the margin. Each is aimed at reemphasizing the key concepts presented immediately adjacent to it.

Definitions

Definitions of new terms or terms unique to the study of statistics are set apart from the text and highlighted for easy reference and review.

Formulas

Formulas that are used for the first time are boxed and numbered for reference. In addition, a formula card is bound into the back of the text, which lists all the key formulas.

Exercises

Exercises are included after sections within the chapter and at the end of the chapter. Section exercises cover the material studied in the section.

Computer Output

The text includes many software examples, using Excel, MegaStat®️, and Minitab.
**How Does This Text**

**BY CHAPTER**

**Chapter Summary**

Each chapter contains a brief summary of the chapter material, including the vocabulary and the critical formulas.

**Pronunciation Key**

This tool lists the mathematical symbol, its meaning, and how to pronounce it. We believe this will help the student retain the meaning of the symbol and generally enhance course communications.

**Chapter Exercises**

Generally, the end-of-chapter exercises are the most challenging and integrate the chapter concepts. The answers and worked-out solutions for all odd-numbered exercises appear at the end of the text. For exercises with more than 20 observations, the data can be found on the text’s website. These files are in Excel and Minitab formats.

**Data Set Exercises**

The last several exercises at the end of each chapter are based on three large data sets. These data sets are printed in Appendix A in the text and are also on the text’s website. These data sets present the students with real-world and more complex applications.

**Software Commands**

Software examples using Excel, MegaStat®, and Minitab are included throughout the text, but the explanations of the computer input commands for each program are placed at the end of the chapter. This allows students to focus on the statistical techniques rather than on how to input data.
Reinforce Student Learning?

Answers to Self-Review

The worked-out solutions to the Self-Reviews are provided at the end of each chapter.

BY SECTION

Section Reviews

After selected groups of chapters (1–4, 5–7, 8 and 9, 10–12, 13 and 14, 15 and 16, and 17 and 18), a Section Review is included. Much like a review before an exam, these include a brief overview of the chapters, a glossary of key terms, and problems for review.

Cases

The review also includes continuing cases and several small cases that let students make decisions using tools and techniques from a variety of chapters.

Practice Test

The Practice Test is intended to give students an idea of content that might appear on a test and how the test might be structured. The Practice Test includes both objective questions and problems covering the material studied in the section.
McGraw-Hill Connect™ Business Statistics

**Less Managing, More Teaching, Greater Learning.** McGraw-Hill Connect Business Statistics is an online assignment and assessment solution that connects students with the tools and resources they’ll need to achieve success.

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**Simple Assignment Management.** With *Connect Business Statistics*, creating assignments is easier than ever, so you can spend more time teaching and less time managing. The assignment management function enables you to:

- Create and deliver assignments easily with selectable end-of-chapter questions and test bank items.
- Streamline lesson planning, student progress reporting, and assignment grading to make classroom management more efficient than ever.
- Go paperless with the eBook and online submission and grading of student assignments.

**Integration of Excel Data Sets.** A convenient feature is the inclusion of an Excel data file link in many problems using data files in their calculation. This allows students to easily launch into Excel, work the problem, and return to *Connect* to key in the answer.
Students to Business Statistics?

Smart Grading. When it comes to studying, time is precious. Connect Business Statistics helps students learn more efficiently by providing feedback and practice material when they need it, where they need it. When it comes to teaching, your time also is precious. The grading function enables you to:

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- eBook
- PowerPoint presentations
- Test Bank
- Solutions Manual
- Digital Image Library

Student Study Center. The Connect Business Statistics Student Study Center is the place for students to access additional resources. The Student Study Center:

- Offers students quick access to lectures, practice materials, eBooks, and more.
- Provides instant practice material and study questions and is easily accessible on-the-go.

Guided Examples. These narrated video walkthroughs provide students with step-by-step guidelines for solving problems similar to those contained in the text. The student is given personalized instruction on how to solve a problem by applying the concepts presented in the chapter.

Student Progress Tracking. Connect Business Statistics keeps instructors informed about how each student, section, and class is performing, allowing for more productive use of lecture and office hours. The progress-tracking function enables you to:

- View scored work immediately and track individual or group performance with assignment and grade reports.
- Access an instant view of student or class performance relative to learning objectives.
- Collect data and generate reports required by many accreditation organizations, such as AACSB.
What Technology Connects

McGraw-Hill CONNECT™ PLUS BUSINESS STATISTICS


- An integrated eBook, allowing for anytime, anywhere access to the textbook.
- Dynamic links between the problems or questions you assign to your students and the location in the eBook where that problem or question is covered.
- A powerful search function to pinpoint and connect key concepts in a snap.

In short, Connect Business Statistics offers you and your students powerful tools and features that optimize your time and energies, enabling you to focus on course content, teaching, and student learning. Connect Business Statistics also offers a wealth of content resources for both instructors and students. This state-of-the-art, thoroughly tested system supports you in preparing students for the world that awaits. For more information about Connect, go to www.mcgrawhillconnect.com or contact your local McGraw-Hill sales representative.

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Tegrity Campus is a service that makes class time available 24/7 by automatically capturing every lecture in a searchable format for students to review when they study and complete assignments. With a simple one-click start-and-stop process, you capture all computer screens and corresponding audio. Students can replay any part of any class with easy-to-use browser-based viewing on a PC or Mac.

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To learn more about Tegrity, watch a two-minute Flash demo at http://tegritycampus.mhhe.com.
Assurance-of-Learning Ready

Many educational institutions today are focused on the notion of assurance of learning an important element of some accreditation standards. *Statistical Techniques in Business & Economics* is designed specifically to support your assurance-of-learning initiatives with a simple, yet powerful solution.

Each test bank question for *Statistical Techniques in Business & Economics* maps to a specific chapter learning outcome/objective listed in the text. You can use our test bank software, EZ Test and EZ Test Online, or Connect Business Statistics to easily query for learning outcomes/objectives that directly relate to the learning objectives for your course. You can then use the reporting features of EZ Test to aggregate student results in similar fashion, making the collection and presentation of assurance of learning data simple and easy.

AACSB Statement

The McGraw-Hill Companies is a proud corporate member of AACSB International. Understanding the importance and value of AACSB accreditation, *Statistical Techniques in Business & Economics* recognizes the curricula guidelines detailed in the AACSB standards for business accreditation by connecting selected questions in the text and the test bank to the six general knowledge and skill guidelines in the AACSB standards.

The statements contained in *Statistical Techniques in Business & Economics* are provided only as a guide for the users of this textbook. The AACSB leaves content coverage and assessment within the purview of individual schools, the mission of the school, and the faculty. While *Statistical Techniques in Business & Economics* and the teaching package make no claim of any specific AACSB qualification or evaluation, we have labeled selected questions within *Statistical Techniques in Business & Economics* according to the six general knowledge and skills areas.

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What Software Is Available with This Text?

MegaStat® for Microsoft Excel®

MegaStat® by J. B. Orris of Butler University is a full-featured Excel add-in that is available on CD and on the MegaStat website at www.mhhe.com/megastat. It works with Excel 2003, 2007, and 2010. On the website, students have 20 days to successfully download and install MegaStat on their local computer. Once installed, MegaStat will remain active in Excel with no expiration date or time limitations. The software performs statistical analyses within an Excel workbook. It does basic functions, such as descriptive statistics, frequency distributions, and probability calculations as well as hypothesis testing, ANOVA, and regression. MegaStat output is carefully formatted and ease-of-use features include Auto Expand for quick data selection and Auto Label detect. Since MegaStat is easy to use, students can focus on learning statistics without being distracted by the software. MegaStat is always available from Excel’s main menu. Selecting a menu item pops up a dialog box. MegaStat works with all recent versions of Excel, including Excel 2007 and Excel 2010. Screencam tutorials are included that provide a walkthrough of major business statistics topics. Help files are built in, and an introductory user’s manual is also included.

Minitab®/SPSS®/JMP®

Minitab® Student Version 14, SPSS® Student Version 18.0, and JMP® Student Edition Version 8 are software tools that are available to help students solve the business statistics exercises in the text. Each can be packaged with any McGraw-Hill business statistics text.
What Resources Are Available for Instructors?

Instructor’s Resources CD-ROM
(ISBN: 0077327055)
This resource allows instructors to conveniently access the Instructor’s Solutions Manual, Test Bank in Word and EZ Test formats, Instructor PowerPoint slides, data files, and data sets.

Online Learning Center:
www.mhhe.com/lind15e
The Online Learning Center (OLC) provides the instructor with a complete Instructor’s Manual in Word format, the complete Test Bank in both Word files and computerized EZ Test format, Instructor PowerPoint slides, text art files, an introduction to ALEKS®, an introduction to McGraw-Hill Connect Business Statistics™, access to Visual Statistics, and more.

All test bank questions are available in an EZ Test electronic format. Included are a number of multiple-choice, true/false, and short-answer questions and problems. The answers to all questions are given, along with a rating of the level of difficulty, chapter goal the question tests, Bloom’s taxonomy question type, and AACSB knowledge category.

WebCT/Blackboard/eCollege
All of the material in the Online Learning Center is also available in portable WebCT, Blackboard, or eCollege content “cartridges” provided free to adopters of this text.
What Resources Are Available for Students?

CourseSmart

CourseSmart is a convenient way to find and buy eTextbooks. CourseSmart has the largest selection of eTextbooks available anywhere, offering thousands of the most commonly adopted textbooks from a wide variety of higher-education publishers. Course Smart eTextbooks are available in one standard online reader with full text search, notes and highlighting, and e-mail tools for sharing notes between classmates. Visit www.CourseSmart.com for more information on ordering.

ALEKS

ALEKS is an assessment and learning program that provides individualized instruction in Business Statistics, Business Math, and Accounting. Available online in partnership with McGraw-Hill/Irwin, ALEKS interacts with students much like a skilled human tutor, with the ability to assess precisely a student’s knowledge and provide instruction on the exact topics the student is most ready to learn. By providing topics to meet individual students’ needs, allowing students to move between explanation and practice, correcting and analyzing errors, and defining terms, ALEKS helps students to master course content quickly and easily.

ALEKS also includes a new instructor module with powerful, assignment-driven features and extensive content flexibility. ALEKS simplifies course management and allows instructors to spend less time with administrative tasks and more time directing student learning. To learn more about ALEKS, visit www.aleks.com.

Online Learning Center: www.mhhe.com/lind15e

The Online Learning Center (OLC) provides students with the following content:

- Quizzes
- PowerPoint
- *Narrated PowerPoint
- *Screencam tutorials
- *Guided Examples
- *Visual Statistics
- Data sets/files
- Appendixes
- Chapter 20
- Appendixes

*Premium Content


This supplement helps students master the course content. It highlights the important ideas in the text and provides opportunities for students to review the worked-out solutions, review terms and concepts, and practice.


This workbook introduces students to Excel and shows how to apply it to introductory statistics. It presumes no prior familiarity with Excel or statistics and provides step-by-step directions in a how-to style using Excel 2007 with text examples and problems.

Business Statistics Center (BSC): www.mhhe.com/bstat/

The BSC contains links to statistical publications and resources, software downloads, learning aids, statistical websites and databases, and McGraw-Hill/Irwin product websites and online courses.
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Changes Made in All Chapters and Major Changes to Individual Chapters:

- Changed Goals to Learning Objectives and identified the location in the chapter where the learning objective is discussed.
- Added section numbering to each main heading.
- Identified exercises where the data file is included on the text website.
- Revised the Major League Baseball data set to reflect the latest complete season, 2009.
- Revised the Real Estate data to ensure the outcomes are more realistic to the current economy.
- Added a new data set regarding school buses in a public school system.
- Revised the core example in Chapters 1–4 to reflect the current economic conditions as it relates to automobile dealers. This example is also discussed in Chapter 13 and 17.
- Added a new section in Chapter 7 describing the exponential distribution.
- Added a new section in Chapter 13 describing a test to determine whether the slope of the regression line differs from zero.
- Added updates and clarifications throughout.

Chapter 1  What Is Statistics?

- New photo and chapter opening exercise on the “Nook” sold by Barnes and Nobel.
- New chapter exercises 17 (data on 2010 vehicle sales) and 19 (ExxonMobil sales prior to Gulf oil spill).

Chapter 2  Describing Data: Frequency Tables, Frequency Distributions, and Graphic Presentation

- New data on Ohio State Lottery expenses for 2009 with new Excel 2007 screenshot.
- New exercises 45 (brides picking their wedding site) and 45 (revenue in the state of Georgia).

Chapter 3  Describing Data: Numerical Measures

- New data on averages in the introduction: average number of TV sets per home, average spending on a wedding, and the average price of a theater ticket.
- A new description of the calculation and interpretation of the population mean using the distance between exits on I-75 through Kentucky.
- A new description of the median using the time managing Facebook accounts.
- Updated example/solution on the population in Las Vegas.
- Update “Statistics in Action” on the highest batting average in Major League Baseball for 2009. It was Joe Mauer of the Minnesota Twins, with an average of .365.
- New chapter exercises 22 (real estate commissions), 67 (laundry habits), 77 (public universities in Ohio), 72 (blood sugar numbers), and 82 (Kentucky Derby payoffs). Exercises 30 to 34 were revised to include the most recent data.

Chapter 4  Describing Data: Displaying and Exploring Data

- New chapter exercise 36 (American Society of Peri-Anesthesia nurses component membership).

Chapter 5  A Survey of Probability Concepts

- New exercise 58 (number of hits in a Major League Baseball game), 59 (winning a tournament), and 60 (winning Jeopardy).

Chapter 6  Discrete Probability Distributions

- No changes.

Chapter 7  Continuous Probability Distributions

- New Self-Review 7–4 and 7–5 involving coffee temperature.
- New exercise 26 (SAT Reasoning Test).
- New exercise 29 (Hurdle Rate for economic investment).
- New section and corresponding problems on the exponential probability distribution.
- Several glossary updates and clarifications.

Chapter 8  Sampling Methods and the Central Limit Theorem

- No changes.

Chapter 9  Estimation and Confidence Intervals

- New separate section on point estimates.
- Integration and application of the central limit theorem.
• A revised discussion of determining the confidence interval for the population mean.
• Expanded section on calculating sample size.
• New exercise 12 (milk consumption), 33 (cost of apartments in Milwaukee), 47 (drug testing in the fashion industry), and 48 (survey of small-business owners regarding healthcare).
• The discussion of the finite correction factor has been relocated in the chapter.

Chapter 10 One-Sample Tests of Hypothesis
• New exercises 17 (daily water consumption), 19 (number of text messages by teenagers), 35 (household size in the United States), 49 (Super Bowl coin flip results), 54 (failure of gaming industry slot machines), 57 (study of the percentage of Americans that do not eat breakfast), and 69 (daily water usage).

Chapter 11 Two-Sample Tests of Hypothesis
• New exercises 15 (2010 New York Yankee salaries), 37 (Consumer Confidence Survey), and 39 (pets as listeners).

Chapter 12 Analysis of Variance
• Revised the names of airlines in the one-way ANOVA example.
• New exercise 30 (flight times between Los Angeles and San Francisco).

Chapter 13 Correlation and Linear Regression
• Rewrote the introduction section to the chapter.
• Added a new section using the Applewood Auto Group data from chapters 1 to 4.
• Added a section on testing the slope of a regression line.
• Added discussion of the regression ANOVA table with Excel examples.
• Rewrote and relocated the section on the coefficient of determination.
• Updated exercise 60 (movie box office amounts).

Chapter 14 Multiple Regression Analysis
• Rewrote the section on evaluating the multiple regression equation.
• More emphasis on the regression ANOVA table.
• Enhanced the discussion of the p-value in decision making.
• Added a separate section on qualitative variables in regression analysis.
• Moved the “Stepwise Regression” section to improve the sequence of topics.
• Added a summary problem at the end of the chapter to review the major concepts.

Chapter 15 Index Numbers
• Updated census and economic data.

Chapter 16 Time Series and Forecasting
• Updated economic data.

Chapter 17 Nonparametric Methods: Goodness-of-Fit Tests
• Reworked the Example/Solution on the chi-square goodness-of-fit test with equal cell frequencies (favorite meals of adults).
• Added a section and corresponding examples describing the goodness-of-fit test for testing whether sample data are from a normal population.
• Added a section and corresponding examples using graphical methods for testing whether sample data are from a normal population.

Chapter 18 Nonparametric Methods: Analysis of Ranked Data
• Revised the Example/Solution for the Kruskal-Wallis test (waiting times in the emergency room).
• Revised the Example/Solution for the Spearman coefficient of rank correlation (comparison of recruiter and plant scores for trainees).

Chapter 19 Statistical Process Control and Quality Management
• Updated the section on the Malcolm Baldrige National Quality Award.
• Reworked and updated the section on Six Sigma.
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