BASIC

Eighth Edition

BUSINESS STATISTICS

CONCEPTS AND APPLICATIONS

BERENSON LEVINE KREHBIEL

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Software
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Basic Business Statistics

CONCEPTS AND APPLICATIONS

EIGHTH EDITION

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PREFACE

Educational Philosophy

In our many years of teaching introductory statistics courses, we have continually searched for ways to improve the teaching of these courses. Our vision for teaching these introductory business statistics courses has been shaped by active participation in a series of Making Statistics More Effective in Schools of Business, Decision Sciences Institute, and American Statistical Association conferences as well as the reality of serving a diverse group of students at large universities. Over the years, our vision has come to include these principles:

1. Students need a frame of reference when learning statistics, especially since statistics is not their major. That frame of reference for business students should be the functional areas of business—that is, accounting, economics and finance, information systems, management, and marketing. Each statistical topic needs to be presented in an applied context related to at least one of these functional areas.
2. Virtually all the students taking introductory business statistics courses are majoring in areas other than statistics. Introductory courses should focus on underlying principles that non-statistics majors will find useful.
3. The use of spreadsheet and/or statistical software should be integrated into all aspects of an introductory statistics course. In the workplace, spreadsheet software (and sometimes statistical software) is usually available on a decision maker's desktop. Our teaching approach needs to recognize this reality, and we need to make our courses more consistent with the workplace environment.
4. Textbooks that use software must provide enough instructions that students can effectively use the software, without the software (and instruction) dominating the course.
5. The focus in teaching each topic should be on the application of the topic to a functional area of business, the interpretation of results, the presentation of assumptions, the evaluation of the assumptions, and the discussion of what should be done if the assumptions are violated. These points are particularly important in regression and forecasting and in hypothesis testing. Although the illustration of some computations is inevitable, the focus on computations should be minimized.
6. Both classroom examples and homework exercises should relate to actual or realistic data as much as possible. Students should work with data sets, both small and large, and be encouraged to look beyond the statistical analysis of data to the interpretation of results in a managerial context.
7. Introductory courses should avoid an overconcentration on one topic area (such as hypothesis testing) and instead provide breadth of coverage of a variety of statistical topics. This will help students avoid the "I can't see the forest from the trees" syndrome.

New to This Edition

This new eighth edition of *Basic Business Statistics: Concepts and Applications* has been vastly improved in a number of important areas.

Applications

Updated and improved *Using Statistics* business scenarios—Each chapter begins with a *Using Statistics* example that shows how statistics can be used in one of the

functional areas of business—accounting, finance, information systems, management, or marketing. This scenario is used throughout the chapter to provide an applied context for the concepts. The following are the *Using Statistics* scenarios presented throughout the book:

CHAPTER TITLE	*"USING STATISTICS"* SCENARIO	FUNCTIONAL AREA
1. Introduction and Data Collection	*Good Tunes*, an e-commerce web site	E-marketing
2. Presenting Data in Tables and Charts	Comparing the performance of mutual funds	Finance
3. Numerical Descriptive Measures	Comparing the performance of mutual funds	Finance
4. Basic Probability	Consumer electronics company	Marketing
5. Some Important Discrete Probability Distributions	Accounting information systems	Accounting
6. The Normal Distribution and Other Continuous Distributions	Downloading time for a web site	Information Systems
7. Sampling Distributions	Cereal-fill packaging process	Operations Management
8. Confidence Interval Estimation	Auditing sales invoices	Accounting
9. Fundamentals of Hypothesis Testing: One-Sample Tests	Cereal-fill packaging process	Operations Management
10. Two-Sample Tests with Numerical Data	Comparing end-aisle and normal displays in a supermarket	Marketing
11. Analysis of Variance	Evaluating strength of parachutes	Operations Management
12. Tests for Two or More Samples with Categorical Data	Guest satisfaction at hotel properties	Quality Management
13. Simple Linear Regression	Forecasting sales at a women's clothing store franchise	Management
14. Introduction to Multiple Regression	Predicting sales of test market data	Marketing
15. Multiple Regression Model Building	Predicting standby hours of workers	Management
16. Time-Series Analysis	Forecasting revenues of companies	Finance
17. Decision Making	Making investment decisions	Finance
18. Statistical Applications in Quality and Productivity Management	Service quality at a hotel	Quality Management

- **Hundreds of new applied examples and exercises, with data from the *Wall Street Journal, USA Today,*** and other sources have been added to the text.
- ***Visual Explorations***—Provided on the book's accompanying CD-ROM are visual explorations that allow students to interactively explore important statistical concepts in descriptive statistics, probability, the normal distribution, and regression analysis. For example, in descriptive statistics, students observe the effect of changes in the data on the average, median, quartiles, and standard deviation. In sampling distributions, students use simulation to explore the effect of sample size on a probability distribution. With the normal distribution, students see the effect of changes in the mean and standard deviation on the areas under the normal curve. In regression analysis, students have the opportunity of *fitting a line* and observing how changes in the slope and intercept affect the goodness of fit of the fitted line.

- ***Using Microsoft Office*** is a new feature. Located at the ends of chapters 2 and 3, this feature enables the student to prepare reports by using Microsoft Office tools. This section shows step-by-step how to paste Microsoft Excel tables and charts into a Microsoft Word document and how to prepare PowerPoint presentations.

Exercises

- **Answers to most even-numbered exercises** are provided at the end of the book.
- **Report Writing Exercises** allow students to place the results of an analysis in a business context by incorporating Microsoft Office techniques such as pasting Microsoft Excel tables and charts into a Microsoft Word document and PowerPoint presentation.
- **Internet Exercises**, located on the book's web site (www.prenhall.com/berenson), allow students to explore data sources that are available on the World Wide Web.
- **Case Studies and Team Projects**—Detailed case studies are included at the ends of many chapters. The *Springville Herald* case is included at the end of most chapters as an integrating theme. A team project relating to mutual funds is also included at the end of most chapters as an integrating theme.

Software

- **Emphasis on data analysis and interpretation of computer output**—We take the position that the use of computer software (Microsoft Excel or a statistical software package such as Minitab) is an integral part of learning statistics. Our focus emphasizes analyzing data, interpreting the output from Microsoft Excel and Minitab, and explaining how to use this software while reducing emphasis on doing computations. Therefore, we have added a great deal of computer output and integrated this output into the fabric of the text. For example, in the coverage of tables and charts in Chapter 2, the focus is on the interpretation of various charts, not on their construction by hand. In our coverage of hypothesis testing in Chapters 9 through 12, extensive computer output has been included so that the p-value approach can be used. In our coverage of simple linear regression in Chapter 13, it is assumed that Microsoft Excel or Minitab will be used, and thus the focus is on the interpretation of the output and not on hand calculations (which have been placed in a separate section of the chapter).
- **PHStat2** is Prentice Hall's Excel add-in, which provides a custom menu of topics that supplement the Data Analysis Tool of Microsoft Excel. Using Excel and PHStat2, the user is able to perform statistical analysis for virtually all the topics that would be covered in a two-term business statistics course at the introductory level. PHStat2, an updated version of PHStat, includes new features such as tables, charts, and a help system.
- **End-of-chapter appendices** on Microsoft Excel and Minitab, with screen shots, provide easy-to-follow instructions.

Content Changes in the Eighth Edition

- Chapters 1 and 2 have been combined into a single chapter ("Introduction and Data Collection"). This updated chapter provides explanation of how to obtain data from the World Wide Web, contains additional chapter review problems on accessing the World Wide Web, and contains a new *Using Statistics* example involving an e-commerce company.

- Chapter 2 ("Presenting Data in Tables and Charts") contains an updated *Using Statistics* example, new graphical excellence examples, a section on the scatter diagram, and a section on placing Microsoft Excel worksheet data and charts into Microsoft Word documents.
- Chapter 3 ("Descriptive Statistics") contains an updated *Using Statistics* example, additional integration of Excel and Minitab output, coverage of the correlation coefficient, coverage of the geometric mean (which finance students especially need), a Visual Explorations module for descriptive statistics, and placing Microsoft Excel worksheet data and charts in PowerPoint presentations.
- Chapter 4 ("Basic Probability") includes an appendix on PHStat2.
- Chapter 5 ("Some Important Discrete Probability Distributions") changes the *Using Statistics* binomial example to an accounting information system, moves covariance so that it follows expected value, and uses an example with a negative covariance.
- Chapter 6 ("The Normal Distribution") changes the *Using Statistics* example to an Internet example, uses only the cumulative normal table, integrates Excel and Minitab output into the normal distribution section, and contains a Visual Exploration module for the normal distribution.
- Chapter 7 ("Sampling Distributions") streamlines the introductory section, contains a visual exploration module for sampling distributions, contains a Visual Explorations module for sampling distributions, and puts the section on the finite population correction factor on the CD-ROM.
- Chapter 8 ("Confidence Interval Estimation") adds one-sided confidence intervals to the section on auditing and moves the finite population correction factor to the CD-ROM.
- Chapter 9 ("Fundamentals of Hypothesis Testing: One-Sample Tests") adds computer output to all sections and combines sections 9.2 and 9.3 so that *p*-value is not a separate section.
- Chapter 10 ("Two-Sample Tests with Numerical Data") changes the *Using Statistics* example to one related to marketing, provides additional emphasis on *p*-values, and adds the confidence interval estimate for the difference between two means.
- Chapter 11 ("Analysis of Variance") changes the *Using Statistics* example, adds computer output, provides additional emphasis on *p*-values and substitutes the modified Levene test for the Hartley test.
- Chapter 12 ("Tests for Two or More Samples with Categorical Data") adds the confidence interval estimate for the difference between two proportions.
- Chapter 13 ("Simple Linear Regression") adds additional coverage of PHStat2 and contains a Visual Explorations module on regression.
- Chapter 14 ("Introduction to Multiple Regression") changes the *Using Statistics* example to a marketing problem.
- Chapter 15 ("Multiple Regression and Model Building") includes additional discussion of interaction terms in multiple regression and adds new PHStat2 features to the section on stepwise regression and confidence intervals for the mean response.
- Chapter 16 ("Time-Series Analysis") changes the *Using Statistics* example and adds a section on index numbers that is on the CD-ROM.

- Chapter 17 ("Decision Making") has been moved after regression and time series forecasting and adds a section on PHStat2.
- Chapter 18 ("Statistical Applications in Quality and Productivity Management") has been moved after the regression and time series chapters and adds a section on process capability.

Supplement Package

The supplement package that accompanies this text includes the following:

- **Instructor's Solution Manual**—This manual includes extra detail in the problem solutions and many Excel and Minitab solutions.
- **Student Solutions Manual**—This manual provides detailed solutions to virtually all the even-numbered exercises.
- **Test Item File**—This supplement includes extra Excel-based test questions.
- **Instructor's CD/ROM**—The instructor's CD-ROM contains PowerPoint slides, the Instructor's Solutions Manual and Test Item File, and Prentice Hall's Custom Test Manager.
- **PHStat2**—This is a statistical add-in for Microsoft Excel. The data files for the examples and exercises are contained on the CD-ROM that accompanies the text.
- **MyPHLIP Web site**—This site contains additional problems, teaching tips, tips for students, current events exercises, practice exams, and links to other sites that contain statistical data.
- **Student version of Minitab**—For a reasonable additional cost, a student version of Minitab can be packaged with this text. To order this package, use ISBN 0–13–072040–2.

About the World Wide Web

The text has a home page on the World Wide Web at **www.prenhall.com/berenson**.

This site incorporates the features of MyPHLIP (Prentice Hall's Learning on the Internet Partnership), a robust Web site that provides many resources for both faculty members and students. A partial list of the features includes:

- Teaching tips
- Links to other sites that provide data appropriate for statistics courses
- Student tips
- Sample exams
- Current event exercises
- Internet exercises

Acknowledgments

We are extremely grateful to the many organizations and companies that allowed us to use their data in developing problems and examples throughout the text. We would like to thank *The New York Times*, Consumers Union (publishers of *Consumer Reports*), Moody's Investor Service (publishers of *Moody's Handbook of Common Stocks*), CEEPress, and Gale Research.

In addition, we would like to thank the Biometrika Trustees, American Cyanimid Company, the Rand Corporation, the American Society for Testing and Materials (for their kind permission to publish various tables in Appendix E), and the American Statistical Association (for its permission to publish diagrams from the *American Statistician*). Finally, we are grateful to Professors George A. Johnson and Joanne Tokle of Idaho State University and Ed Conn, Mountain States Potato Company, for their kind permission to

incorporate parts of their work as our Mountain States Potato Company case in Chapter 15.

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Concluding Remarks

We have gone to great lengths to make this text both pedagogically sound and error free. If you have any suggestions or require clarification about any of the material, or if you find any errors, please contact us at David_Levine@BARUCH.CUNY.EDU or KREHBITC@MUOHIO.EDU. For questions and more information about PHStat2, see Appendix F and the PHStat web site located at www.prenhall.com/phstat.

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David M. Levine
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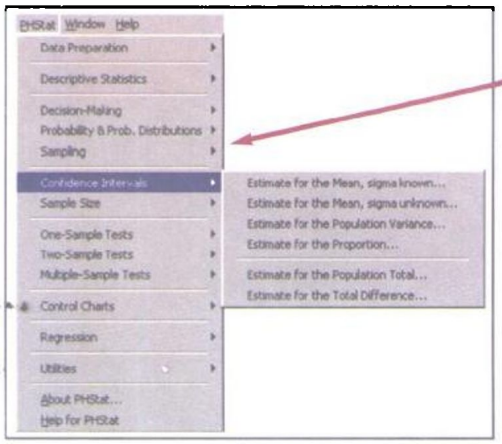
STATISTICAL SOFTWARE...PHStat2

PHStat2 is a statistical add-in for Microsoft Excel® provided free with Berenson/Levine/Krehbiel, ***Basic Business Statistics*, Eighth Edition**. This powerful add-in is included free on the Student CD-ROM.



PHStat2 provides a custom menu of topics which supplement the Data Analysis Add-in Tools already included in Microsoft Excel®. Between these two, the user is able to perform statistical analysis for most of the topics that would be covered in a two-term business statistics course at the introductory level.

Easy-to-use Dialog boxes allow the user to make entries and select the options they want, expanding the capabilities of Excel to a wide range of statistical topics.

BELOW IS A FULL LISTING OF THE MENU CHOICES FOR PHStat2:

Data Preparation
- Stack Data
- Unstack Data

Descriptive Statistics
- Box-and-Whisker Plot ***(enhanced)***
- Dot Scale Diagram ***(new)***
- Frequency Distribution ***(new)***
- Histogram & Polygons ***(new)***
- Stem-and-Leaf Display
- One-Way Tables & Charts ***(enhanced)***
- Two-Way Tables & Charts

Decision-Making
- Covariance and Portfolio Analysis
- Expected Monetary Value
- Expected Opportunity Loss
- Opportunity Loss

Probability & Probability Distributions
- Simple & Joint Probabilities
- Normal
- Normal Probability Plot
- Binomial
- Exponential
- Hypergeometric
- Poisson

Sampling
- Random Sample Generation
- Sampling Distributions Simulation

Confidence Intervals
- Estimate for the Mean, Sigma Known
- Estimate for the Mean, Sigma Unknown
- Estimate for the Population Variance ***(new)***
- Estimate for the Proportion
- Estimate for the Population Total
- Estimate for the Total Difference

Sample Size
- Determination for the Mean
- Determination for the Proportion

One-Sample Tests
- *Z* Test for the Mean, sigma known
- *t* Test for the Mean, sigma unknown
- Chi-Square Test for the Variance ***(new)***
- *Z* Test for the Proportion

Two-Sample Tests
- *t* Test for the Differences in Two Means
- *F* Test for the Differences in Two Variances
- Wilcoxon Rank Sum Test
- Chi-Square Test for Differences in Two Proportions
- *Z* Test for Differences in Two Proportions

Multiple-Sample Tests
- Chi-Square Test
- Kruskal-Wallis Rank Test
- Tukey-Kramer Procedure ***(enhanced)***

Control Charts
- *p* Chart
- *R* & *X*Bar Charts

Regression
- Simple Linear Regression
- Multiple Regression
- Best Subsets
- Stepwise Regression ***(new)***

Utilities
- Fix Up Chart ***(new)***
- Remove Worksheet Cell Tints ***(new)***

About PHStat

Help for PHStat (new)

"USING STATISTICS" APPLICATIONS
(APPLYING STATISTICS TO THE FUNCTIONAL AREAS OF BUSINESS)

CHAPTER TITLE	*"USING STATISTICS"* SCENARIO	FUNCTIONAL AREA
1. Introduction and Data Collection	*Good Tunes,* an e-commerce Web site	E-Marketing
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3. Numerical Descriptive Measures	Comparing the performance of Mutual Funds	Finance
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5. Some Important Probability Distributions	Accounting Information Systems	Accounting
6. The Normal Distribution and Other Continuous Distributions	Downloading time for a Web site	Information Systems
7. Sampling Distributions Management	Cereal-fill packaging process	Operations
8. Confidence Interval Estimation	Auditing sales invoices	Accounting
9. Fundamentals of Hypothesis Management Testing: One-Sample Tests	Cereal-fill packaging process	Operations
10. Two Sample Tests with Numerical Data	Comparing end-aisle and normal displays in a supermarket	Marketing
11. Analysis of Variance	Evaluating strength of parachutes	Operations Management
12. Tests for Two or More Samples with Categorical Data	Guest satisfaction at hotel properties	Quality Management
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18. Statistical Applications in Quality and Productivity Management	Service quality at a hotel	Quality Management

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BRIEF CONTENTS

CD-ROM TOPICS

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