教育部高校工商管理类教学指导委员会 双语教学推荐教材

PEARSON

BUSINESS ADMINISTRATION CLASSICS

Business Administration Classics

工商管理经典教材·核心课系列

商务统计学

Business Statistics (Fifth Edition)

（英文版·第5版）

戴维·M·莱文（David M. Levine）
[美] 蒂莫西·C·克雷比尔（Timothy C. Krehbiel） 著
马克·L·贝伦森（Mark L. Berenson）

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总　序

随着我国加入WTO，越来越多的国内企业参与到国际竞争中来，用国际上通用的语言思考、工作、交流的能力也越来越受到重视。这样一种能力也成为我国各类人才参与竞争的一种有效工具。国家教育机构、各类院校以及一些主要的教材出版单位一直在思考，如何顺应这一发展潮流，推动各层次人员通过学习来获取这种能力。双语教学就是这种背景下的一种尝试。

双语教学在我国主要指汉语和国际通用的英语教学。事实上，双语教学在我国教育界已经不是一个陌生的词汇了，以双语教学为主的科研课题也已列入国家“十五”规划的重点课题。但从另一方面来看，双语教学从其诞生的那天起就被包围在人们的赞成与反对声中。如今，依然是有人赞成有人反对，但不论是赞成居多还是反对占上，双语教学的规模和影响都在原有的基础上不断扩大，且呈大发展之势。一些率先进行双语教学的院校在实践中积累了经验，不断加以改进；一些待进入者也在模仿中学习，并静待时机成熟时加入这一行列。由于我国长期缺乏讲第二语言（包括英语）的环境，开展双语教学面临特殊的困难，因此，选用合适的教材就成为双语教学成功与否的一个重要问题。我们认为，双语教学从一开始就应该使用原版的各类学科的教材，而不是由本土教师自编的教材，从而可以避免中国式英语问题，保证语言的原汁原味。各院校除应执行国家颁布的教学大纲和课程标准外，还应根据双语教学的特点和需要，适当调整教学课时的设置，合理选择优秀的、合适的双语教材。

顺应这样一种大的教育发展趋势，中国人民大学出版社同众多国际知名的大出版公司，如麦格劳-希尔出版公司、培生教育出版公司等合作，面向大学本科生层次，遴选了一批国外最优秀的管理类原版教材，涉及专业基础课，人力资源管理、市场营销及国际化管理等专业方向课，并广泛听取有着丰富的双语一线教学经验的教师的建议和意见，对原版教材进行了适当的改编，删减了一些不适合我国国情和不适合教学的内容；另一方面，根据教育部对双语教学教材篇幅合理、定价低的要求，我们更是努力区别于目前市场上形形色色的各类英文版、英文影印版的大部头，将目标受众锁定在大学本科生层次。本套教材尤其突出了以下一些特点：

● 保持英文原版教材的特色。本套双语教材根据国内教学实际需要，对原书进行了一定的改编，主要是删减了一些不适合教学以及不符合我国国情的内容，但在体系结构和内容特色方面都保持了原版教材的风貌。专家们的认真改编和审定，使本套教材既保持了学术上的完整性，又贴近中国实际；既方便教师教学，又方便学生理解和掌握。

● 突出管理类专业教材的实用性。本套教材既强调学术的基础性，又兼顾应用的广泛性；既侧重让学生掌握基本的理论知识、专业术语和专业表达方式，又考虑到教材和管理实践的紧密结合，有助于学生形成专业的思维能力，培养实际的管理技能。

● 体系经过精心组织。本套教材在体系架构上充分考虑到当前我国在本科教育阶段推广双语教学的进度安排，首先针对那些课程内容国际化程度较高的学科进行双语教材开发，在其专业模块内精心选择各专业教材。这种安排既有利于我国教师摸索双语教学的经验，使得双语教学贴近现实教学的需要；也有利于我们收集关于双语教学教材的建议，更好地推出后续的双语教材及教辅材料。

● 篇幅合理，价格相对较低。为适应国内双语教学内容和课时上的实际需要，本套教材进行了一定的删减和改编，使总体篇幅更为合理；而采取低定价，则充分考虑到了学生实际的购买能力，从而使本套教材得以真正走近广大读者。

● 提供强大的教学支持。依托国际大出版公司的力量，本套教材为教师提供了配套的教辅材料，如教师手册、PowerPoint 讲义、试题库等，并配有内容极为丰富的网络资源，从而使教学更为便利。

本套教材是在双语教学教材出版方面的一种尝试。我们在选书、改编及出版的过程中得到了国内许多高校的专家、教师的支持和指导，在此深表谢意。同时，为使我们后续推出的教材更适于教学，我们也真诚地期待广大读者提出宝贵的意见和建议。需要说明的是，尽管我们在改编的过程中已加以注意，但由于各教材的作者所处的政治、经济和文化背景不同，书中内容仍可能有不妥之处，望读者在阅读时注意比较和甄别。

徐二明
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Preface*

Educational Philosophy

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

1. **Show students the relevance of statistics.** Students need a frame of reference when learning statistics, especially when statistics is not their major. That frame of reference for business students should be the functional areas of business—that is, accounting, 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. The focus in teaching each topic should be on its application in 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.
2. **Familiarize students with software used in the business world.** Integrating business software into all aspects of an introductory statistics course allows the course to focus on interpretation of results instead of computations. Introductory business statistics courses should recognize that spreadsheet programs and statistical packages are commonly found on a business decision maker's desktop computer, therefore making the *interpretation* of results more important than the tedious hand calculations required to produce them.
3. **Provide guidance to students for using software.** Books should contain clear instructions to help students effectively use the programs that are integrated with the study of statistics, without having those instructions dominating the book or the courses in which they are used.
4. **Give students ample practice in understanding how to apply statistics to business.** Both classroom examples and homework exercises should involve 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.

New to This Edition: Enhanced Statistics Coverage

This fifth edition of *Business Statistics: A First Course* enhances the statistical coverage of previous editions in a number of ways:

- *Think About This* essays in selected chapters provide greater insight to what has just been learned as well as raise important issues about the application of statistical knowledge.
- Revised simplified notation for test statistics in hypothesis testing.
- Many new applied examples and exercises with data from *The Wall Street Journal, USA Today*, and other sources have been added to the book.
- Student surveys are included as an integrating theme for exercises across many chapters.
- Even more illustrations of Microsoft Excel and Minitab results are included, all with cross-references to the appropriate software appendix sections.
- Each chapter ends with a Using Statistics Revisited section which reinforces the applications and lessons learned in the chapter.

* 为节省篇幅，原著附录及第 14 章在本书中删去。删减的内容及原著所附光盘的内容，读者可登录中国人民大学出版社工商管理分社网站 www.rdjg.com.cn 下载或阅读。

New to This Edition: Expanded Hands-on Software Appendices

This fifth edition of *Business Statistics: A First Course* now contains separate and expanded appendices for using Microsoft Excel, Minitab, and PHStat2, the Excel add-in that is included on the Student CD-ROM:

- Totally rewritten Excel appendices contain instructions for using all versions of Excel, including Excel 2007. (Some sections contain two sets of instructions, one for using Excel 97 through Excel 2003, the other for using Excel 2007, when appropriate.)
- Minitab appendices feature the use of Minitab 15, the latest Minitab version, but are also fully compatible with Minitab 14.
- PHStat2 appendices at the end of each chapter identify the PHStat2 procedures that can be used for the chapter's statistical methods.
- New PHStat2 version (2.8) that is Excel 2007 compatible and contains new and enhanced procedures including the separate-variance *t* test, and one-way ANOVA.

Chapter-by-Chapter Changes in the Fifth Edition

Each chapter includes a new opening page that displays the chapter sections and subsections. The following changes have been made to this fifth edition:

Chapter 1 has completely new Sections 1.1, 1.2, 1.6, 1.7, and 1.8.

Chapter 2 has new examples throughout the chapter and uses a new mutual fund data set.

Chapter 3 has moved quartiles to the section with boxplots (name changed from box-and-whisker), and has new examples throughout the chapter using a new mutual fund data set.

Chapter 4 has a revised example throughout the chapter, and a *Think About This* essay about Bayes' theorem.

Chapter 5 has changed notation in the binomial and Poisson distributions with p changed to π, and successes changed to items of interest.

Chapter 6 has a revised normal distribution table with additional header lines and a *Think About This* essay about the normal distribution.

Chapter 7 has survey sampling and survey worthiness preceding sampling distributions and a *Think About This* essay on the pros and cons of web-based surveys.

Chapter 8 has a greatly reduced focus on the confidence interval estimate for the mean with sigma known, revised notation that uses a subscript for distributions that indicates the α level (such as $Z_{\alpha/2}$ or $t_{\alpha/2}$), a subsection on sigma known, and revised normal distribution and t distribution tables with additional header lines.

Chapter 9 has combined previous Sections 9.1 and 9.2 to reduce the emphasis on testing the population mean with sigma known, has moved the t test for the mean ahead of the one-tail test, changed notation to use a subscript for distributions to indicate the α level (such as $Z_{\alpha/2}$ or $t_{\alpha/2}$), revised notation that uses subscript *STAT* with the test statistic (such as Z_{STAT} and t_{STAT}), and revised normal distribution and t distribution tables with additional header lines.

Chapter 10 has revised notation that uses a subscript for distributions to indicate the α level (such as $Z_{\alpha/2}$, $t_{\alpha/2}$, or F_{α}), revised notation that uses subscript *STAT* with the test statistic (such as Z_{STAT}, t_{STAT}, and F_{STAT}), revised normal, t, and F distribution tables with additional header lines, revised F test for the difference between variances that consists of the larger variance divided by the smaller variance, and a *Think About This* essay that presents a business application of the differences between two means.

Chapter 11 has revised notation that uses a subscript for distributions to indicate the α level (such as χ^2_{α}), revised notation that uses subscript *STAT* with the test statistic (such as χ^2_{STAT}), and revised χ^2 distribution tables with additional header lines.

Chapter 12 has revised notation that uses the subscript *STAT* with the test statistic such as t_{STAT}, and a *Think About This* essay on using regression in the business world.

Chapter 13 has revised notation that uses the subscript *STAT* with the test statistic such as t_{STAT}.

Hallmark Features

We have continued many of the traditions of past editions and have highlighted some of those features below:

Using Statistics business scenarios—Each chapter begins with a Using Statistics example that shows how statistics is used in accounting, finance, information systems, management, or marketing. Each scenario is used throughout the chapter to provide an applied context for the concepts.

Emphasis on data analysis and interpretation of software results—We believe that the use of computer software is an integral part of learning statistics. Our focus emphasizes analyzing data by interpreting the results from Microsoft Excel or Minitab while reducing emphasis on doing computations. 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 11, extensive computer results have been included so that the *p*-value approach can be emphasized.

Pedagogical aides—An active writing style, boxed numbered equations, set-off examples to provide reinforcement for learning concepts, problems divided into "Learning the Basics" and "Applying the Concepts," key equations, and key terms are included.

Answers—Most answers to the even-numbered exercises are provided at the end of the book.

PHStat2—This add-in, included on the Student CD-ROM, extends the statistical capabilities of Microsoft Excel and executes the low-level menu selection and worksheet entry tasks associated with implementing statistical analysis in Excel. When combined with the Analysis ToolPak add-in, virtually all statistical methods taught in an introductory statistics course can be demonstrated using Microsoft Excel.

Web Cases—A chapter-ending Web Case is included for most of the chapters. By visiting Web sites related to the companies and researching the issues raised in the Using Statistics scenarios that start each chapter, students learn to identify misuses of statistical information. The Web Cases require students to sift through claims and assorted information in order to discover the data most relevant to the case. Students then determine whether the conclusions and claims are supported by the data. (Instructional tips for using the Web Cases and solutions to the Web Cases are included in the Instructor's Solutions Manual.)

Case studies and team projects—Detailed case studies are included in numerous chapters. A Managing the *Springville Herald* case is included at the end of most chapters as an integrating theme. A team project relating to mutual funds is included in many chapters as an integrating theme.

Visual Explorations—A Microsoft Excel add-in workbook allows students to interactively explore important statistical concepts in descriptive statistics, the normal distribution, sampling distributions, and regression analysis. For example, in descriptive statistics, students observe the effect of changes in the data on the mean, median, quartiles, and standard deviation. With the normal distribution, students see the effect of changes in the mean and standard deviation on the areas under the normal curve. In sampling distributions, students use simulation to explore the effect of sample size on a sampling distribution. 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.

Supplement Package

The supplement package that accompanies this text includes the following:

Instructor's Solutions Manual—This manual includes solutions for end-of-section and end-of-chapter problems, answers to case questions, where applicable, and teaching tips for each chapter. Electronic solutions are provided in PDF and Word formats.

Student Solutions Manual—This manual provides detailed solutions to virtually all the even-numbered exercises and worked-out solutions to the self-test problems.

Test Item File—The Test Item File contains true/false, multiple-choice, fill-in, and problem-solving questions based on the definitions, concepts, and ideas developed in each chapter of the text.

TestGen software—A test bank has been designed for use with the TestGen test-generating software. This computerized package allows instructors to custom design, save, and generate classroom tests. The test program permits instructors to edit, add, or delete questions from the test bank; edit existing graphics and create new graphics; analyze test results; and organize a database of tests and student results. This software allows for flexibility and ease of use. It provides many options for organizing and displaying tests, along with a search-and-sort feature. The program can be found online at the Instructor's Resource Center.

Instructor's Resource Center—The Instructor's Resource Center contains the electronic files for the complete Instructor's Solutions Manual, the Test Item File, and Lecture PowerPoint presentations (**www.pearsonhighered.com**).

Course and Homework Management Tools

MyStatLab—Provides a rich and flexible set of course materials, featuring free-response exercises that are algorithmically generated for unlimited practice and mastery. Students can also use a variety of online tools to independently improve their understanding and performance in the course. Instructors can use MyStatLab's homework and test manager to select and assign their own online exercises and import TestGen tests for added flexibility.

Acknowledgments

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Finally, we would like to thank our parents, wives, and children for their patience, understanding, love, and assistance in making this book a reality. It is to them that we dedicate this book.

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 **davidlevine@davidlevinestatistics.com** or **Krehbitc@muohio.edu**. Include the phrase "BSAFC edition 5" in the subject line of your e-mail. For more information or questions about using PHStat2, review Appendix F and the PHStat2 readme file on the Student CD-ROM. For support issues, visit the PHStat2 Web site, **www.prenhall.com/phstat** and the Pearson Customer Technical Support website, **247.pearsoned.com**.

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1 Introduction and Data Collection

Learning Objectives

In this chapter, you learn:

- How statistics is used in business
- The sources of data used in business
- The types of data used in business
- The basics of Microsoft Excel
- The basics of Minitab

USING STATISTICS

@ Good Tunes

Good Tunes, a growing four-store home entertainment systems retailer, seeks to double their number of stores within the next three years. The managers have decided to approach local area banks for the funding needed to underwrite this expansion. They need to prepare an electronic slide show and a formal prospectus that will argue that Good Tunes is a thriving business and a good candidate for expansion.

You have been asked to assist in the process of preparing the slide show and prospectus. How would you do this job? Learning more about statistics would be a good start.

1.1 Why Learn Statistics

People use numbers every day to describe or analyze the world we live in. For example, consider these recent headlines:

- "Stocks May Fall, But Execs' Pay Doesn't" (G. Farrell and B. Hansen, **usatoday.com**, April 10, 2008)—In 2007, the median compensation for the CEOs of the 50 largest corporations in the S&P 500 was $15.7 million.
- "Americans Gulping More Bottled Water" (*USA Today*, February 28, 2007, p. 1D)—The annual per capita consumption of bottled water has increased from 18.8 gallons in 2001 to 28.3 gallons in 2006.
- "Paying More with Plastic" (*USA Today*, March 6, 2007, p. 1D)—Consumer payment with credit cards increased from 18% in 1995 to 25% in 2005, while payment in cash decreased to 14% from 21%.
- "The Real Most Valuable Players" (R. Adams, *The Wall Street Journal*, April 14, 2007, pp. P1, P4)—Economists have developed models to predict the real value of baseball player performance and have related it to player salary.

You will make better sense of the numbers in the stories behind these headlines if you understand statistics. **Statistics** is the branch of mathematics that transforms numbers into useful information for decision makers. Statistics provides a way of understanding and then reducing—but not eliminating—the variation that is part of any decision-making process, and also can tell you the known risks associated with making a decision.

Statistics does this by providing a set of methods for analyzing the numbers. These methods help you to find patterns in "the numbers" and enable you to determine whether differences in "the numbers" are just due to chance. As you learn these methods, you will also learn the appropriate conditions for using those methods. And because so many statistical methods must be computerized in order to be of practical benefit, as you learn statistics you also need to learn about the programs that help apply statistics in the business world.

1.2 Statistics in the Business World

In the business world, statistics has four important applications:

- To summarize business data
- To draw conclusions from that data
- To make reliable forecasts about business activities
- To improve business processes

The field of statistics consists of two branches, descriptive statistics and inferential statistics.

Descriptive statistics focuses on collecting, summarizing, presenting, and analyzing a set of data. You are probably familiar with presentations such as tables and charts, and statistics such as the mean and median from your previous school experience.

Inferential statistics uses data that have been collected from a small group to draw conclusions about a larger group. These methods are used to make decisions about which investment might lead to a higher return and what marketing strategy might lead to increased sales.

Looking at the first bulleted point above, descriptive statistics allows you to create different tables and charts to summarize your data. It also provides statistical measures such as the mean, median, and standard deviation to describe different characteristics of your data.

Drawing conclusions from your data is the heart of inferential statistics. Using these methods enables you to make decisions based on data rather than just on intuition.

Making reliable forecasts involves developing statistical models for prediction. These models enable you to develop more accurate predictions of future activities.

Improving business processes involves using managerial approaches that focus on quality improvement such as Six Sigma. These approaches are data-driven and use statistical methods as an integral part of the quality improvement approach.

To help you develop the skills for making better decisions, every chapter of *Business Statistics: A First Course* has a Using Statistics scenario. The scenarios describe realistic situations in which you will be asked to make decisions to transform data into statistical information. For example, in one chapter you will be asked to decide the location in a supermarket that best enhances sales of a cola drink; and in another chapter, you will be asked to forecast sales for a clothing store.

In the scenario, you must ask the following questions. What data should you include that will convince bankers to extend the credit that Good Tunes needs? How should you present that data?

However, presenting the bankers with the thousands of transactions would overwhelm them and not be very useful. You need to transform the transactions data into information by summarizing the details of each transaction in some useful way that would allow the bankers to (perhaps) uncover a favorable pattern about the sales over time.

One piece of information that the bankers would presumably want to see is the yearly dollar sales totals. Tallying and totaling sales is a common process of transforming data into information. When you tally sales—or any other relevant data about Good Tunes you choose to use—you follow normal business practice and tally by a business period such as by month, quarter, or year. When you do so, you end up with multiple values: sales for this year, sales for last year, sales for the year before that, and so on. How to determine the best way to refer to these multiple values requires learning the basic vocabulary of statistics.

1.3 Basic Vocabulary of Statistics

Variables are characteristics of items or individuals and are what you analyze when you use a statistical method. For the Good Tunes scenario, sales, expenses by year, and net profit by year are variables that the bankers would want to analyze.

VARIABLE

A **variable** is a characteristic of an item or individual.

When used in everyday speech, *variable* suggests that something changes or varies, and you would expect the sales, expenses, and net profit to have different values from year to year. These different values are the **data** associated with a variable, and more simply, the "data" to be analyzed.

Variables can differ for reasons other than time. For example, if you conducted an analysis of the composition of a large lecture class, you would probably want to include the variables class standing, gender, and major field of study. These variables would vary, too, because each student in the class is different. One student might be a sophomore, male, accounting major, while another may be a junior, female, finance major.

You also need to remember that values are meaningless unless their variables have **operational definitions**. These definitions are universally accepted meanings that are clear to all associated with an analysis. Even though the operational definition for sales per year might seem clear, miscommunication could occur if one person was referring to sales per year for the entire chain of stores and another to sales per year per store. Even individual values for variables sometimes need definition—for the class standing variable, for example, what *exactly* is meant by the words *sophomore* and *junior*? (Perhaps the most famous example of vague definitions was the definition of a valid vote in the state of Florida during the 2000 U.S. presidential election. Vagueness about the operational definitions there ultimately required a U.S. Supreme Court ruling.)

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