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工商管理经典教材·核心课系列

Administration Classics

商务统计学

BUSINESS

(第4版)

STATISTICS (Fourth Edition)

戴维·M·莱文 (David M. Levine)
蒂莫西·C·克雷比尔 (Timothy C. Krehbiel) 著
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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

中国人民大学商学院

2005年1月

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, Decision Sciences Institute, and American Statistical Association conferences as well as the reality of serving a diverse group of students at large universities has shaped our vision for teaching these courses. Over the years, our vision has come to include these key principles:

1. Students need to be shown 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, 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.
 - 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. Students need to be familiar with the software used in the business world.
 - Integrating spreadsheet or statistical 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 in business, spreadsheet software is typically available on a decision-maker's desktop (and sometimes statistical software is as well).
3. Students need to be given sufficient guidance on using software.
 - Textbooks should provide enough instructions so that students can effectively use the software integrated with the study of statistics, without having the software instruction dominate the course.
4. Students need ample practice in order to understand how statistics is used in 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

This new fourth edition of *Business Statistics, A First Course* has been improved in a number of important areas.

Improved accessibility for students

- Every chapter in the text has undergone major rewriting and the text now uses a more active, conversational writing style that students will appreciate. Sentences have been shortened and simplified.
- The text now focuses more on those topics typically covered in a first course. Coverage of multiple regression has been reduced and time series forecasting has been deleted.
- The text now includes many more examples from everyday life. Such examples include those on online shopping (Chapter 2), time to get ready in the morning (Chapter 3), and waiting time at a fast-food restaurant (Chapter 9).

* 原书第 11 章和第 14 章,附录 A~G,偶数号习题的答案在影印删节版中已被删去。原书光盘中内容放在 www.rdjg.com.cn 上,敬请读者留意。

- Many problems have been simplified so that they contain no more than four parts.
- Key formulas are now included at the end of each chapter.
- Worked-out solutions to Self-Test Questions are provided in the back of the text.
- A roadmap for selecting the proper statistical method is included at the front of the text to help students select the proper technique and to make connections between topics.
- Many new applied examples and exercises with data from *The Wall Street Journal*, *USA Today*, *Consumer Reports*, and other sources have been added to the text.
- 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.)

Enhanced software instruction

- End-of-chapter Microsoft Excel appendices now discuss how to use standard Excel worksheets to perform most statistical analyses. Instructors and students who wish to avoid using add-ins will find these new instructions immediately useful. (Those who choose to use the PHStat2 Excel add-in will find that all explanations of PHStat2 commands have been placed together in a new Appendix G for easy reference.)

	A	B	
1	Estimate for the Mean Sales Invoice Amount		
2			
3	Data		
4	Sample Standard Deviation	28.95	
5	Sample Mean	110.27	
6	Sample Size	100	
7	Confidence Level	95%	
8			
9	Intermediate Calculations		
10	Standard Error of the Mean	2.8950	=B4/SQRT(B6)
11	Degrees of Freedom	99	=B6 - 1
12	t Value	1.9842	=TINV(1-B7,B11)
13	Interval Half Width	5.7443	=B12 * B10
14			
15	Confidence Interval		
16	Interval Lower Limit	104.53	=B5 - B13
17	Interval Upper Limit	116.01	=B5 + B13

- Many of the standard Excel worksheets discussed in the Excel appendices are included as in-chapter illustrations. Each illustration (see example above) include a listing of all cell formulas contained in the worksheet. (PHStat2 users will also find these illustrations informative as they are consistent with the worksheets that PHStat2 produces for you.)
- Updated version of PHStat2—PHStat2 version 2.5, the newest version of Prentice Hall’s add-in for Microsoft Excel is bundled free with this text. This updated version includes enhancements such as multiple regression with independent variables in noncontiguous columns, improved stem-and-leaf displays and box-and-whisker plots, the Z test for the difference in two means, Levene’s test for the homogeneity of variance, and the Marascuilo multiple comparisons procedure for proportions. (Support for PHStat2, including free updates when available, can be found at www.prenhall.com/phstat.)
- Use of Minitab Version 14, the latest version of the Minitab statistical software—All Minitab output in the text and all Minitab appendices are from Minitab Version 14, the latest version of the Minitab statistical software.

Reorganization of the hypothesis-testing chapters

- All tests involving the normal and t distribution are covered in Chapters 9 and 10 *prior to* coverage of the F test.
- The Analysis of Variance is covered in Chapter 10.
- All chi-square tests are covered in Chapter 11.

Chapter-by-Chapter Changes in the Fourth Edition

Each chapter has a new opening page that shows the sections and subsections for the chapter.

- *Chapter 1* has rewritten sections 1.1, 1.2, and 1.3. The sections on survey sampling have been moved to Chapter 7.
- *Chapter 2* has a new data set concerning mutual fund returns for 1999–2003. Graphs for categorical variables are discussed prior to graphs for numerical variables. All graphs for one variable are discussed before any graphs for two variables. The examples within the chapter refer to online shopping and the cost of restaurant meals in addition to mutual fund returns.
- *Chapter 3* has a new data set concerning mutual fund returns for 1999–2003. The examples within the chapter refer to the time to get ready in the morning as well as mutual fund returns. Z scores for detecting outliers are now included. The sample covariance is now included along with the coefficient of correlation.
- *Chapter 4* now includes Bayes' theorem and counting rules.
- *Chapter 5* now covers the Poisson distribution. The normal distribution has been moved to Chapter 6.
- *Chapter 6* is entirely devoted to the normal distribution and includes a simplified section on the normal probability plot.
- *Chapter 7* includes sampling distributions and Types of Survey Sampling Methods and Survey Worthiness.
- *Chapter 8* includes confidence interval estimation and sample size determination.
- *Chapter 9* uses a simpler, six-step method to perform hypothesis tests using the critical value approach and a straightforward five-step method to perform hypothesis tests using the p -value approach.
- *Chapter 10* is reorganized so that two-sample tests for means and proportions precede the F test for the difference between the variances. The chapter includes the One-Way ANOVA.
- *Chapter 11* includes only the χ^2 tests.
- *Chapter 12* now includes computations for the regression coefficients and sum of squares in chapter examples.
- *Chapter 13* now covers R^2 , adjusted R^2 , and the overall F test prior to residual analysis. The chapter also includes quadratic regression.
- *Chapter 14* has coverage of Six Sigma Management.

Hallmark Features

We have continued many of the traditions of past editions. We've 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, management, or marketing. Each scenario is used throughout the chapter to provide an applied context for the concepts.

USING STATISTICS



Comparing the Performance of Mutual Funds

Among the many investment choices available today, mutual funds, a market basket of a portfolio of securities, are a common choice for those thinking about their retirement. If you decided to purchase mutual funds for your retirement account, how would you go about making a reasonable choice among the many funds available today?

You first would want to know the strategies of the professionals who manage the funds. Do they invest in high-risk securities or do they make more conservative choices? Does the fund specialize in a certain sized company, one whose outstanding stock totals a large amount (large cap) or one that is quite small (small cap)? Does the fund charge management fees that reduce the percentage return earned by an investor? And, of course, you would want to know how well the fund performed in the past.

All of this is a lot of data to review if you consider several dozen or more mutual funds. How could you “get your hands around” such data and explore it in a comprehensible manner?

- **Emphasis on data analysis and interpretation of computer output**—We believe that the use of computer software is an integral part of learning statistics. Our focus emphasizes analyzing data by interpreting the output from Microsoft Excel and Minitab, while reducing emphasis on doing computations. Therefore, we have included more 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 11, extensive computer output has been included so that focus can be placed on the p -value approach. In our coverage of simple linear regression in Chapter 12, we assume that Microsoft Excel or Minitab will be used. Thus, the focus is on the interpretation of the output, not on hand calculations.
- **Pedagogical aides** such as 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, and key terms are included.
- **End-of-chapter appendices** using standard Microsoft Excel and Minitab Version 14, with illustrations, provide easy-to-follow instructions. PHStat2 instructions are included in Appendix G. SPSS appendices are included on the CD-ROM that accompanies this text.
- **Answers** to most of the even-numbered exercises are provided at the end of the book.
- **PHStat2**, a supplemental add-in program for Microsoft Excel, that enhances the statistical capabilities of Microsoft Excel and executes for you the low-level menu selection and worksheet entry tasks associated with implementing statistical analysis in Excel is included on the student CD-ROMs. When combined with Microsoft Excel’s own Data Analysis ToolPak add-in, virtually all statistical methods taught in an introductory statistics course can be illustrated using Microsoft Excel.
- **Case Studies and Team Projects**—Detailed case studies are included at the end of numerous chapters. The *Springville Herald* case is included at the end of virtually all chapters as an integrating theme. A Team Project relating to mutual funds is included at the end of many chapters as an integrating theme.
- **Visual Explorations**—a Microsoft Excel workbook bundled free with this text—allows 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 mean, median, quartiles, and standard deviation. In sampling distributions, students use simulation to explore the effect of sample size on a sampling distribution. With the normal distribution, students get to 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. (Visual Explorations requires a Microsoft Excel security setting of Medium.)

Supplement Package

The supplement package that accompanies this text includes the following:

- **Instructor's Solution Manual**—This manual includes teaching tips for each chapter, 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**—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 testing software**—The printed test bank is 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 banks; edit existing graphics and create new graphics; analyze test results; and organize a database of tests and student results. This software allows for greater flexibility and ease of use. It provides many options for organizing and displaying tests, along with a search and sort feature. The program is available both on the Instructor's CD-ROM and on the Prentice Hall online catalog for download.
- **Instructor's Resource Center**—The Instructor's Resource Center contains the electronic files for the complete Instructor's Solutions Manual (MS Word), the Test Item File (MS Word), the computerized Test Item File (MS Word), TestGen, and PowerPoint presentations.
- **Course and Homework Management Tools**
 - **Prentice Hall's OneKey** offers the best teaching and learning resources all in one place. OneKey for *Business Statistics, A First Course, 4e*, is all you need to plan and administer your course, and is all your students need for anytime, anywhere access to your course materials. Conveniently organized by textbook chapter, the compiled resources include: links to quizzes, PowerPoint presentations, data files, links to Web cases, PHStat2 download, Visual Explorations download, Student Solutions Manual, as well as additional instructor resources.
 - **WebCT and Blackboard**—With a local installation of either course management system, Prentice Hall provides content designed especially for this textbook to create a complete course suite, tightly integrated with the system's course management tools.
 - **PH GradeAssist**—This online homework and assessment system allows the instructor to assign problems for student practice, homework, or quizzes. The problems, taken directly from the text, are algorithmically generated, so each student gets a slightly different problem with a different answer. This feature allows students multiple attempts for more practice and improved competency. PH GradeAssist grades the results and can export them to Microsoft Excel worksheets.
- **Companion Web site**—This site contains
 - An online study guide with true/false, multiple choice, and essay questions designed to test student's comprehension of chapter topics.
 - PowerPoint presentation files with chapter outlines and key formulas.
 - Student data files for text problems in Excel, Minitab, and SPSS.
- **Student version of Minitab**—For a reasonable additional cost, a student version of Minitab Version 14 can be packaged with this text. Please contact your Prentice Hall Sales Representative for ordering information.
- **Student version of SPSS**—For a reasonable additional cost, a student version of SPSS 12 can be packaged with the text. Please contact your Prentice Hall Sales Representative for ordering information.
- **Text Web site**—The text has a home page on the World Wide Web at www.prenhall.com/levine. This site provides many resources for both faculty members and students.
 - PHStat2 has a home page on the World Wide Web at www.prenhall.com/phstat.
 - An index page for the supporting material for all the Web cases included in the text can be found at www.prenhall.com/Springville/Springvillecc.htm.

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We would like to thank our statistical readers and accuracy checkers Annie Puciloski, Stonehill College, and James Zimmer, Chattanooga State University, for their diligence in checking our work; Robie Grant for her proofreading; Julie Kennedy for her copyediting; and Sandra Krausman of GGS Book Services, Atlantic Highlands, for her work in the production of this text.

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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. Include the phrase BSFC—version 4 in the subject line of your e-mail. For more information about using PHStat2, see Appendixes F and G, and the PHStat2 readme file on the CD-ROM packaged with this book.

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CHAPTER 1

Introduction and Data Collection

USING STATISTICS: Good Tunes

1.1 BASIC CONCEPTS OF STATISTICS

1.2 THE GROWTH OF STATISTICS AND INFORMATION TECHNOLOGY

1.3 COLLECTING DATA

Identifying Sources of Data

1.4 TYPES OF DATA

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