高等学校经济类双语教学推荐教材

CENGAGE Learning

ECONOMICS CLASSICS

经济学经典教材·核心课系列

Economics Classics

统计学：在经济和管理中的应用

（第八版）

Statistics for Economics and Management

(8th Edition)

杰拉德·凯勒（Gerald Keller） 著

中国人民大学出版社

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出版说明

入世十年，我国已完全融入到经济全球化的浪潮中。党的十六大确立了“引进来，走出去”的发展战略，使得“国际化”复合型人才的需求不断增加。这就对我国一般本科院校多年来所采取的单一语言（母语）教学提出了严峻挑战，经济类专业双语教学改革迫在眉睫。

为配合高校经济类专业双语教学改革，中国人民大学出版社携手培生、麦格劳－希尔、圣智等众多国际知名出版公司，倾情打造了该套“经济类双语系列教材”。本套教材包括：经济管理类专业开设的核心课程、经济学专业开设的主干课程以及财政金融专业和国际贸易专业的主要课程。所选教材均为国外最优秀的本科层次经济类教材。

我们在组织、引进和出版该系列教材的过程中，严把质量关。聘请国内著名经济学家、学者以及一线授课教师审核国外原版教材，广泛听取意见，努力做到把国外真正高水平的适合国内实际教学需求的优秀教材引进来，供国内广大师生参考、研究和学习。

本系列教材主要有以下特点：

第一，教材体系设计完整。本系列教材全部为国外知名出版公司的优秀教材，涵盖了经济类专业的所有主要课程。

第二，保持英文原版教材特色。本系列教材依据国内实际教学需要以及广泛的适应性，部分对原版教材进行了全文影印，部分在保持原版教材体系结构和内容特色的基础上进行了适当删减。

第三，内容紧扣学科前沿。本系列教材在原著选择上紧扣国外教学前沿，基本上都是国外最流行教材的最新版本。

第四，篇幅合理、价格适中。本系列教材一方面在内容和篇幅上很好地适应了国内双语教学的实际需要，另一方面，低定价策略又避免了国外原版图书高额的购买费用。

第五，提供强大的教学支持。依托国外知名出版公司的资源，本系列教材为教师提供丰富的配套教辅资源，如教师手册、PPT 课堂演示文稿、试题库等，并配套有内容丰富的网络资源，使教学更为便利。

本系列教材既适合高等院校经济类专业的本科教学使用，也适合从事经济类工作和研究的广大从业者阅读和学习。我们在选书、改编过程中虽然全面听取了专家、学者和教师的意见，努力做到满足广大读者的需求，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，我们真诚希望广大读者提出宝贵意见和建议，以便我们在以后的版本中不断改进和完善。

中国人民大学出版社

PREFACE

Businesses are increasingly using statistical techniques to convert data into information. For students preparing for the business world, it is not enough merely to focus on mastering a diverse set of statistical techniques and calculations. A course and its attendant textbook must provide a complete picture of statistical concepts and their applications to the real world. *Managerial Statistics* is designed to demonstrate that statistics methods are vital tools for today's managers and economists.

To fulfill this objective requires several features that I have built into this book. First, I have included data-driven examples, exercises, and cases that demonstrate statistical applications that are and can be used by marketing managers, financial analysts, accountants, economists, operations managers, and others. Many are accompanied by large and real or realistic data sets. Second, I reinforce the applied nature of the discipline by teaching students how to choose the correct statistical technique. Third, I teach students the concepts that are essential to interpreting the statistical results.

Why I Wrote This Book

Business is complex and requires effective management to succeed. Managing complexity requires many skills. There are more competitors, more places to sell products, and more places to locate workers. As a consequence, effective decision making is more crucial than ever before. On the other hand, managers have more access to larger and more detailed data that are potential sources of information. However, to achieve this potential requires that managers know how to convert data into information. This knowledge extends well beyond the arithmetic of calculating statistics. Unfortunately, this is what most textbooks offer—a series of unconnected techniques illustrated mostly using manual calculations. This continues a pattern that goes back many years. What is required is a complete approach to applying statistical techniques.

When I started teaching statistics in 1971, books demonstrated how to calculate statistics and, in some cases, how various formulas were derived. One reason for doing so was the belief that by doing calculations by hand, students would be able to understand the techniques and concepts. When the first edition of this book was published in 1988, an important goal was to teach students to identify the correct technique. Through the next seven editions, I refined my approach to emphasize interpretation and decision making equally. I divide the solution of statistical problems into three stages and include them in every appropriate example: (1) *identify* the technique, (2) *compute* the statistics, and (3) *interpret* the results. The *compute* stage can be completed in any or all of three ways: manually (with the aid of a calculator), using Excel, and using Minitab. For those courses that wish to use the computer extensively, manual calculations can be played down or omitted completely. Conversely, those that wish to emphasize manual calculations may easily do so, and the computer solutions can be selectively introduced or skipped entirely. This approach is designed to provide maximum flexibility and leaves to the instructor the decision of if and when to introduce the computer.

I believe that my approach offers several advantages.

- Emphasis on identification and interpretation provides students with practical skills they can apply to real problems they will face whether a course uses manual or computer calculations.
- Students learn that statistics is a method of converting data into information. With many data files and corresponding problems that ask students to interpret statistical results, students are provided ample opportunities to practice data analysis and decision making.
- The optional use of the computer allows for larger and more realistic exercises and examples.

Placing calculations in the context of a larger problem allows instructors to focus on more important aspects of the decision problem. For example, more attention needs to be devoted to interpreting statistical results. To properly interpret statistical results requires an understanding of the probability and statistical concepts that underlie the techniques and an understanding of the context of the problems. An essential aspect of my approach is teaching students the concepts. I do so in two ways:

- First, there are 14 Java applets that allow students to see for themselves how statistical techniques are derived without going through the sometimes complicated mathematical derivations.
- Second, I have created a number of Excel worksheets that allow students to perform "what-if" analyses. Students can easily see the effect of changing the components of a statistical technique, such as the effect of increasing the sample size.

Efforts to teach statistics as a valuable and necessary tool in business and economics are made more difficult by the positioning of the statistics course in most curricula. The required statistics course in most undergraduate programs appears in the first or second year. In many graduate programs, the statistics course is offered in the first semester of a three-semester program and the first year of a two-year program. Accounting, economics, finance, human resource management, marketing, and operations management are usually taught after the statistics course. Consequently, most students will not be able to understand the general context of the statistical application. This deficiency is addressed in this book by "Applications in . . ." sections, subsections, and boxes. Illustrations of statistical applications in business with which students are unfamiliar are preceded by an explanation of the background material.

- For example, to illustrate graphical techniques, we use an example that compares the histograms of the returns on two different investments. To explain what financial analysts look for in the histograms requires an understanding that risk is measured by the amount of variation in the returns. The example is preceded by an "Applications in Finance" box that discusses how return on investment is computed and used.
- Later when I present the normal distribution, I feature another "Applications in Finance" box to show why the standard deviation of the returns measures the risk of that investment.
- Many application boxes are scattered throughout the book.

Some applications are so large that I devote an entire section or subsection to the topic. For example, in the chapter that introduces the confidence interval estimator of a proportion, I also present market segmentation. In that section, I show how the confidence

interval estimate of a population proportion can yield estimates of the sizes of market segments. In other chapters, I illustrate various statistical techniques by showing how marketing managers can apply these techniques to determine the differences that exist between market segments. There are several such sections and subsections in this book. The "Applications in . . ." segments provide great motivation to the student who asks, How will I ever use this technique?

New in This Edition

In the first seven editions of this book, we offered two review chapters. The first reviewed inference about one and two populations of interval and nominal data. This was originally designed to be a pre-midterm test review. The second appeared at the end of the book and was used to review all the inferential material before the final exam. I decided that in this edition two reviews were not enough. Consequently, I have more review appendixes. These appear at the ends of Chapters 8, 9, 10, and so on, and each provides a list of the techniques covered to that point, a flowchart, exercises, and cases.

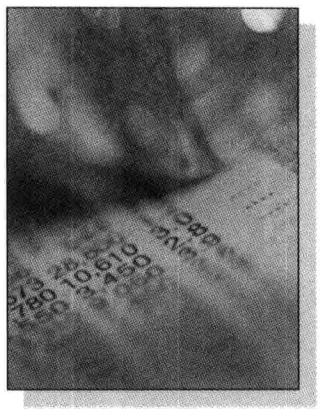
Chapter 2 now features more real data. These include the following:

1. The question of global warming (monthly temperature anomalies from three sources dating back to 1880 and carbon-dioxide readings)
2. Updated team payrolls and the number of team wins in baseball, football, basketball, and hockey
3. The actual prices of gasoline and oil, allowing students to see whether real prices have risen and the relationship between the price of oil and the price of gasoline
4. The market model has been moved from Chapter 17 (in the 7th edition) to Chapter 2 with actual data from the NYSE, NASDAQ, and the TSE

GUIDED BOOK TOUR

Data-Driven: The Big Picture

Solving statistical problems begins with a problem and data. The ability to select the right method by problem objective and data type is **a valuable tool for business.** Since business decisions are driven by data, students will leave this course equipped with the tools they need to make effective, informed decisions in all areas of the business world.



EXAMPLE 8.4

Comparing Salary Offers for Finance and Marketing MBA Majors, Part 1

DATA
Xm8-04

In the last few years a number of web-based companies that offer job placement services have been created. The manager of one such company wanted to investigate the job offers recent MBAs were obtaining. In particular, she wanted to know whether finance majors were being offered higher salaries than marketing majors. In a preliminary study, she randomly sampled 50 recently graduated MBAs, half of whom majored in finance and half in marketing. From each she obtained the highest salary offer (including benefits). These data are listed here. Can we infer that finance majors obtain higher salary offers than do marketing majors among MBAs?

Highest Salary Offer Made to Finance Majors

61,228	51,836	20,620	73,356	84,186	79,782	29,523	80,645	76,125
62,531	77,073	86,705	70,286	63,196	64,358	47,915	86,792	75,155
65,948	29,392	96,382	80,644	51,389	61,955	63,573		

Highest Salary Offer Made to Marketing Majors

73,361	36,956	63,627	71,069	40,203	97,097	49,442	75,188	59,854
79,816	51,943	35,272	60,631	63,567	69,423	68,421	56,276	47,510
58,925	78,704	62,553	81,931	30,867	49,091	48,843		

SOLUTION

IDENTIFY

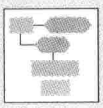
The objective is to compare two populations of interval data. The parameter is the difference between two means $\mu_1 - \mu_2$ (where μ_1 = mean highest salary offer to finance majors and μ_2 = mean highest salary offer to marketing majors). Because we want to

Identify the Correct Technique

Examples introduce the first crucial step in this three-step (Identify-Compute-Interpret) approach. Every example's solution begins by examining the data type and problem objective and then identifying the right technique to solve the problem.

Factors That Identify the *t*-Test and Estimator of μ_D

1. **Problem objective:** Compare two populations
2. **Data type:** Interval
3. **Descriptive measurement:** Central location
4. **Experimental design:** Matched pairs



Factors That Identify . . . boxes are found in each chapter after a technique or concept has been introduced. These boxes allow students to see a technique's essential requirements and give them a way to easily review their understanding. These essential requirements are revisited in the review appendixes, where they are illustrated in flowcharts.

APPENDIX 9 / REVIEW OF CHAPTERS 7 TO 9

The number of techniques introduced in Chapters 7 to 9 is up to 23. As we did in Appendix 8, we provide a table of the techniques with formulas and required conditions, a flowchart to help you identify the correct technique, and 18 exercises to give you practice in how to choose the appropriate method. The table and the flowchart have been amended to include the three analysis of variance techniques introduced in this chapter and the three multiple comparison methods.

TABLE **A9.1** Summary of Statistical Techniques in Chapters 7 to 9

t-test of μ
Estimator of μ (including small population estimator of μ and large and small population estimators of $N\mu$)
χ^2-test of σ^2
Estimator of σ^2
z-test of p
Estimator of p (including small population estimator of p and large and small population estimators of Np)
Equal-variances t-test of $\mu_1 - \mu_2$
Equal-variances estimator of $\mu_1 - \mu_2$
Unequal-variances t-test of $\mu_1 - \mu_2$
Unequal-variances estimator of $\mu_1 - \mu_2$
t-test of μ_D
Estimator of μ_D
F-test of σ_1^2/σ_2^2
Estimator of σ_1^2/σ_2^2
z-test of $p_1 - p_2$ (Case 1)
z-test of $p_1 - p_2$ (Case 2)
Estimator of $p_1 - p_2$
One-way analysis of variance (including multiple comparisons)
Two-way (randomized blocks) analysis of variance
Two-factor analysis of variance

Review of Descriptive Techniques shows how the different types of data can be described graphically. Exercises on the CD-ROM let students practice what they've learned.

A GUIDE TO STATISTICAL TECHNIQUES

DATA TYPES	Problem Objectives: Describe a Population	Compare Two Populations	Compare Two or More Populations	Analyze Relationship between Two Variables
Interval	Box plot **Section 2.3** Mean, median, and mode **Section 2.1** Range, variance, and standard deviation **Section 2.2** Percentiles and quartiles **Section 2.3** t-test and estimator of a mean **Section 7.1** Chi-squared test and estimator of a variance **Section 7.2**	Equal-variances t-test and estimator of the difference between two means: independent samples **Section 8.1** Unequal-variances t-test and estimator of the difference between two means: independent samples **Section 8.1** t-test and estimator of mean difference **Section 8.3** F-test and estimator of ratio of two variances **Section 8.4**	One-way analysis of variance **Section 9.1** LSD multiple comparison method **Section 9.2** Tukey's multiple comparison method **Section 9.2** Two-way analysis of variance **Section 9.4** Two-factor analysis of variance **Section 9.5**	Covariance **Section 2.4** Coefficient of correlation **Section 2.4** Coefficient of determination **Section 2.4** Least squares line **Section 2.4** Simple linear regression and correlation **Chapter 10**
Nominal	z-test and estimator of a proportion **Section 7.3**	z-test and estimator of the difference between two proportions **Section 8.5**		
Ordinal	Box plot **Section 2.3** Median **Section 2.1** Percentiles and quartiles **Section 2.3**			

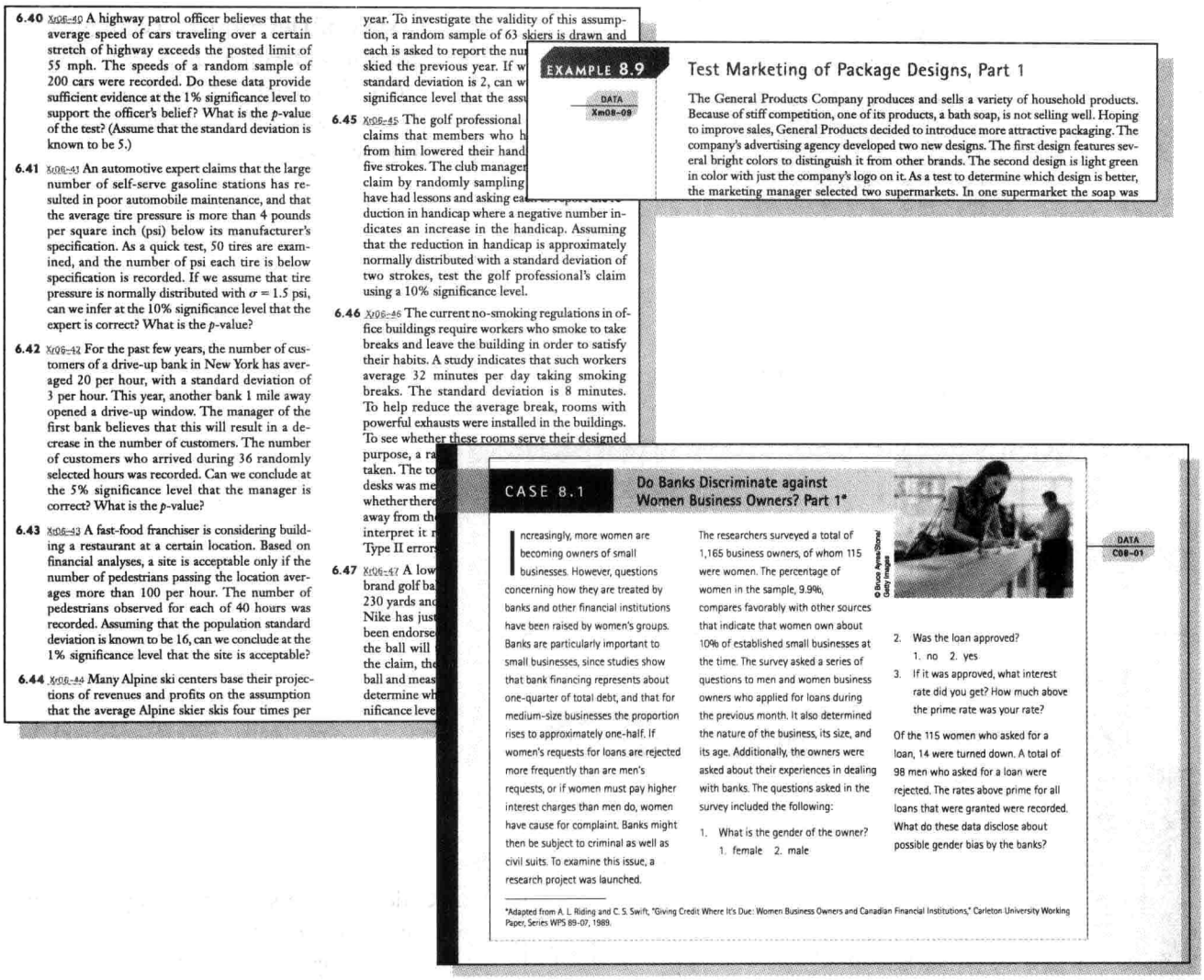
A Guide to Statistical Techniques, found on the inside front cover of the text, pulls everything together into one useful table that helps students identify which technique to perform based on the problem objective and data type.

More Data Sets

Many data sets available on the CD-ROM provide ample practice. These data sets often contain real or realistic data, are typically large, and are formatted for Excel, Minitab, SPSS, SAS, JMP IN, and ASCII.

DATA C08-01

Prevalent use of data in examples, exercises, and cases is highlighted by the accompanying data icon, which alerts students to go to the CD.



6.40 XrQ6-40 A highway patrol officer believes that the average speed of cars traveling over a certain stretch of highway exceeds the posted limit of 55 mph. The speeds of a random sample of 200 cars were recorded. Do these data provide sufficient evidence at the 1% significance level to support the officer's belief? What is the *p*-value of the test? (Assume that the standard deviation is known to be 5.)

6.41 XrQ6-41 An automotive expert claims that the large number of self-serve gasoline stations has resulted in poor automobile maintenance, and that the average tire pressure is more than 4 pounds per square inch (psi) below its manufacturer's specification. As a quick test, 50 tires are examined, and the number of psi each tire is below specification is recorded. If we assume that tire pressure is normally distributed with $\sigma = 1.5$ psi, can we infer at the 10% significance level that the expert is correct? What is the *p*-value?

6.42 XrQ6-42 For the past few years, the number of customers of a drive-up bank in New York has averaged 20 per hour, with a standard deviation of 3 per hour. This year, another bank 1 mile away opened a drive-up window. The manager of the first bank believes that this will result in a decrease in the number of customers. The number of customers who arrived during 36 randomly selected hours was recorded. Can we conclude at the 5% significance level that the manager is correct? What is the *p*-value?

6.43 XrQ6-43 A fast-food franchiser is considering building a restaurant at a certain location. Based on financial analyses, a site is acceptable only if the number of pedestrians passing the location averages more than 100 per hour. The number of pedestrians observed for each of 40 hours was recorded. Assuming that the population standard deviation is known to be 16, can we conclude at the 1% significance level that the site is acceptable?

6.44 XrQ6-44 Many Alpine ski centers base their projections of revenues and profits on the assumption that the average Alpine skier skis four times per year. To investigate the validity of this assumption, a random sample of 63 skiers is drawn and each is asked to report the nu
skied the previous year. If w
standard deviation is 2, can w
significance level that the ass

6.45 XrQ6-45 The golf professional
claims that members who h
from him lowered their hand
five strokes. The club manage
claim by randomly sampling
have had lessons and asking ea
duction in handicap where a negative number indicates an increase in the handicap. Assuming that the reduction in handicap is approximately normally distributed with a standard deviation of two strokes, test the golf professional's claim using a 10% significance level.

6.46 XrQ6-46 The current no-smoking regulations in office buildings require workers who smoke to take breaks and leave the building in order to satisfy their habits. A study indicates that such workers average 32 minutes per day taking smoking breaks. The standard deviation is 8 minutes. To help reduce the average break, rooms with powerful exhausts were installed in the buildings. To see whether these rooms serve their designed purpose, a ra
taken. The to
desks was me
whether there
away from th
interpret it r
Type II error

6.47 XrQ6-47 A low
brand golf ba
230 yards an
Nike has just
been endorse
the ball will
the claim, th
ball and meas
determine wh
nificance leve

EXAMPLE 8.9

DATA Xm08-09

Test Marketing of Package Designs, Part 1

The General Products Company produces and sells a variety of household products. Because of stiff competition, one of its products, a bath soap, is not selling well. Hoping to improve sales, General Products decided to introduce more attractive packaging. The company's advertising agency developed two new designs. The first design features several bright colors to distinguish it from other brands. The second design is light green in color with just the company's logo on it. As a test to determine which design is better, the marketing manager selected two supermarkets. In one supermarket the soap was

CASE 8.1

Do Banks Discriminate against Women Business Owners? Part 1*

Increasingly, more women are becoming owners of small businesses. However, questions concerning how they are treated by banks and other financial institutions have been raised by women's groups. Banks are particularly important to small businesses, since studies show that bank financing represents about one-quarter of total debt, and that for medium-size businesses the proportion rises to approximately one-half. If women's requests for loans are rejected more frequently than are men's requests, or if women must pay higher interest charges than men do, women have cause for complaint. Banks might then be subject to criminal as well as civil suits. To examine this issue, a research project was launched.

The researchers surveyed a total of 1,165 business owners, of whom 115 were women. The percentage of women in the sample, 9.9%, compares favorably with other sources that indicate that women own about 10% of established small businesses at the time. The survey asked a series of questions to men and women business owners who applied for loans during the previous month. It also determined the nature of the business, its size, and its age. Additionally, the owners were asked about their experiences in dealing with banks. The questions asked in the survey included the following:

1. What is the gender of the owner?
   1. female 2. male

© Bruce Ayres/Stone/Getty Images

DATA C08-01

2. Was the loan approved?
   1. no 2. yes
3. If it was approved, what interest rate did you get? How much above the prime rate was your rate?

Of the 115 women who asked for a loan, 14 were turned down. A total of 98 men who asked for a loan were rejected. The rates above prime for all loans that were granted were recorded. What do these data disclose about possible gender bias by the banks?

*Adapted from A. L. Riding and C. S. Swift, "Giving Credit Where It's Due: Women Business Owners and Canadian Financial Institutions," Carleton University Working Paper, Series WPS 89-07, 1989.

Flexible to Use

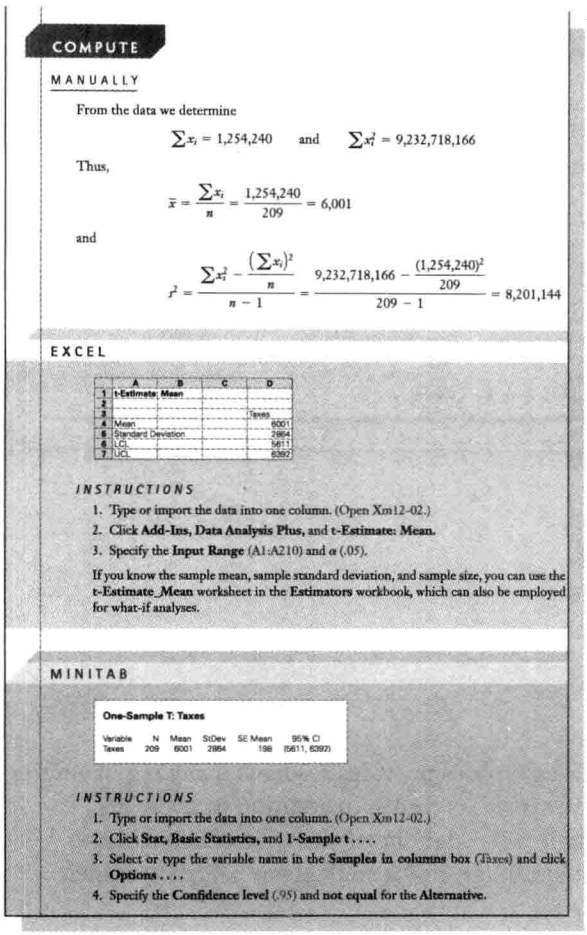
Although many texts today incorporate the use of the computer, ***Managerial Statistics*** is designed for maximum flexibility and ease of use for both instructors and students. To this end, parallel illustration of both manual and computer printouts is provided throughout the text. This approach **allows you to choose** which, if any, computer program to use. Regardless of the method or software you choose, the output and instructions that you need are provided! Also, instructions for both SPSS and JMP IN can be found on the Keller Online Book Companion Website at international.cengage.com.

Compute the Statistics

Once the correct technique has been identified, examples take students to the next level within the solution by asking them to compute the statistics.

Manual calculation of the problem is presented first in each "Compute" section of the examples.

Step-by-step instructions in the use of **Excel** and **Minitab** immediately follow the manual presentation. Instructions appear in the book with the printouts—there's no need to incur the extra expense for separate software manuals. SPSS and JMP IN are also available at no cost on the Keller companion Website.



COMPUTE

MANUALLY

From the data we determine

$$\sum x_i = 1{,}254{,}240 \quad \text{and} \quad \sum x_i^2 = 9{,}232{,}718{,}166$$

Thus,

$$\bar{x} = \frac{\sum x_i}{n} = \frac{1{,}254{,}240}{209} = 6{,}001$$

and

$$s^2 = \frac{\sum x_i^2 - \frac{(\sum x_i)^2}{n}}{n-1} = \frac{9{,}232{,}718{,}166 - \frac{(1{,}254{,}240)^2}{209}}{209-1} = 8{,}201{,}144$$

EXCEL

	A	B	C	D
1	t-Estimate: Mean			
2				
3				Taxes
4	Mean			6001
5	Standard Deviation			2864
6	LCL			5611
7	UCL			6392

INSTRUCTIONS

1. Type or import the data into one column. (Open Xm12-02.)
2. Click **Add-Ins, Data Analysis Plus,** and **t-Estimate: Mean.**
3. Specify the **Input Range** (A1:A210) and α (.05).

If you know the sample mean, sample standard deviation, and sample size, you can use the **t-Estimate_Mean** worksheet in the **Estimators** workbook, which can also be employed for what-if analyses.

MINITAB

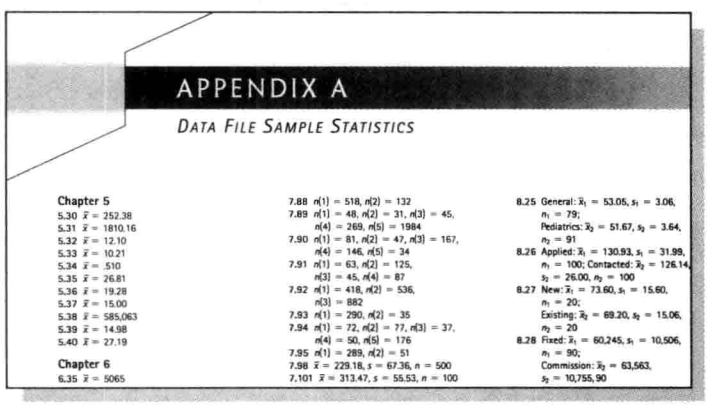
One-Sample T: Taxes

Variable	N	Mean	StDev	SE Mean	95% CI
Taxes	209	6001	2864	198	(5611, 6392)

INSTRUCTIONS

1. Type or import the data into one column. (Open Xm12-02.)
2. Click **Stat, Basic Statistics,** and **1-Sample t . . . .**
3. Select or type the variable name in the **Samples in columns** box (Taxes) and click **Options . . . .**
4. Specify the **Confidence level** (.95) and **not equal** for the **Alternative.**

Appendix A provides summary statistics that allow students to solve applied exercises with data files by hand. Offering unparalleled flexibility, this feature allows virtually *all* exercises to be solved by hand!



APPENDIX A

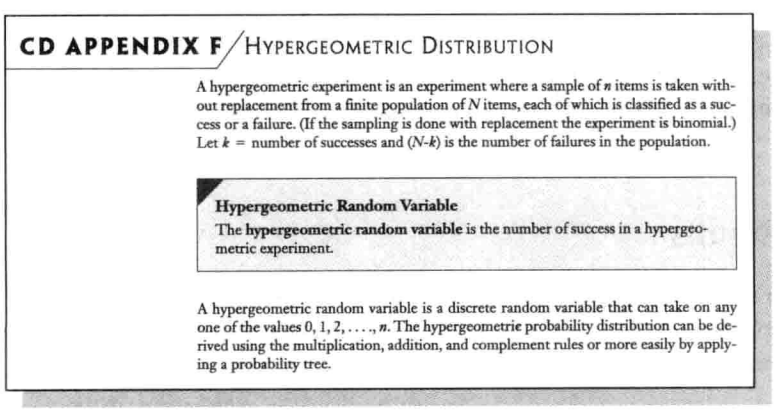
DATA FILE SAMPLE STATISTICS

Chapter 5

5.30 $\bar{x} = 252.38$
5.31 $\bar{x} = 1810.16$
5.32 $\bar{x} = 12.10$
5.33 $\bar{x} = 10.21$
5.34 $\bar{x} = .510$
5.35 $\bar{x} = 26.81$
5.36 $\bar{x} = 19.28$
5.37 $\bar{x} = 15.00$
5.38 $\bar{x} = 585,063$
5.39 $\bar{x} = 14.98$
5.40 $\bar{x} = 27.19$

Chapter 6

6.35 $\bar{x} = 5065$
7.88 $n(1) = 518, n(2) = 132$
7.89 $n(1) = 48, n(2) = 31, n(3) = 45, n(4) = 269, n(5) = 1984$
7.90 $n(1) = 81, n(2) = 47, n(3) = 167, n(4) = 146, n(5) = 34$
7.91 $n(1) = 63, n(2) = 125, n(3) = 45, n(4) = 87$
7.92 $n(1) = 418, n(2) = 536, n(3) = 882$
7.93 $n(1) = 290, n(2) = 35$
7.94 $n(1) = 72, n(2) = 77, n(3) = 37, n(4) = 50, n(5) = 176$
7.95 $n(1) = 289, n(2) = 51$
7.98 $\bar{x} = 229.18, s = 67.36, n = 500$
7.101 $\bar{x} = 313.47, s = 55.53, n = 100$
8.25 General: $\bar{x}_1 = 53.05, s_1 = 3.06, n_1 = 79$; Pediatrics: $\bar{x}_2 = 51.67, s_2 = 3.64, n_2 = 91$
8.26 Applied: $\bar{x}_1 = 130.93, s_1 = 31.99, n_1 = 100$; Contacted: $\bar{x}_2 = 126.14, s_2 = 26.00, n_2 = 100$
8.27 New: $\bar{x}_1 = 73.60, s_1 = 15.60, n_1 = 20$; Existing: $\bar{x}_2 = 69.20, s_2 = 15.06, n_2 = 20$
8.28 Fixed: $\bar{x}_1 = 60,245, s_1 = 10,506, n_1 = 90$; Commission: $\bar{x}_2 = 63,563, s_2 = 10,755.90$



CD APPENDIX F / HYPERGEOMETRIC DISTRIBUTION

A hypergeometric experiment is an experiment where a sample of n items is taken without replacement from a finite population of N items, each of which is classified as a success or a failure. (If the sampling is done with replacement the experiment is binomial.) Let k = number of successes and $(N-k)$ is the number of failures in the population.

Hypergeometric Random Variable

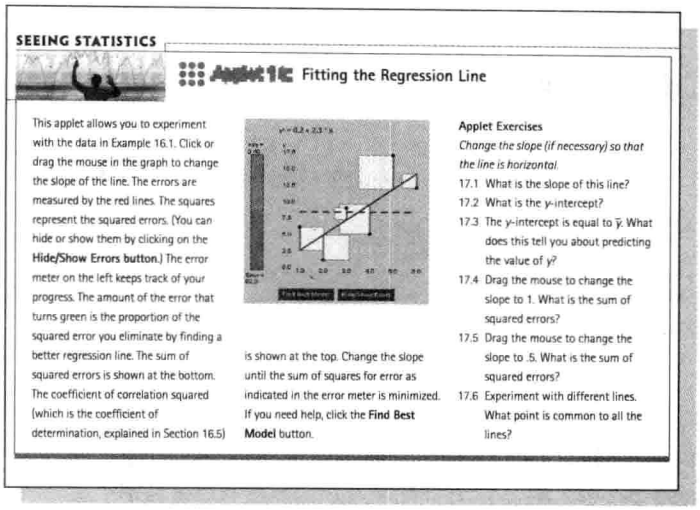
The **hypergeometric random variable** is the number of success in a hypergeometric experiment.

A hypergeometric random variable is a discrete random variable that can take on any one of the values $0, 1, 2, \ldots, n$. The hypergeometric probability distribution can be derived using the multiplication, addition, and complement rules or more easily by applying a probability tree.

In addition, **CD Appendixes** are included on the CD-ROM. There are many appendixes covering such topics as the hypergeometric distribution, index numbers, and more detailed instructions for Excel and Minitab.

Flexible Learning

For visual learners, the **Seeing Statistics** feature refers to online Java applets developed by Gary McClelland of the University of Colorado, which use the interactive nature of the Web to illustrate key statistical concepts. With many applets and follow-up exercises, students can explore and interpret statistical concepts, leading them to greater intuitive understanding. All Seeing Statistics applets can be found on the accompanying CD-ROM.



SEEING STATISTICS

Applet 16 Fitting the Regression Line

This applet allows you to experiment with the data in Example 16.1. Click or drag the mouse in the graph to change the slope of the line. The errors are measured by the red lines. The squares represent the squared errors. (You can hide or show them by clicking on the **Hide/Show Errors button.**) The error meter on the left keeps track of your progress. The amount of the error that turns green is the proportion of the squared error you eliminate by finding a better regression line. The sum of squared errors is shown at the bottom. The coefficient of correlation squared (which is the coefficient of determination, explained in Section 16.5) is shown at the top. Change the slope until the sum of squares for error as indicated in the error meter is minimized. If you need help, click the **Find Best Model** button.

Applet Exercises

Change the slope (if necessary) so that the line is horizontal.

17.1 What is the slope of this line?

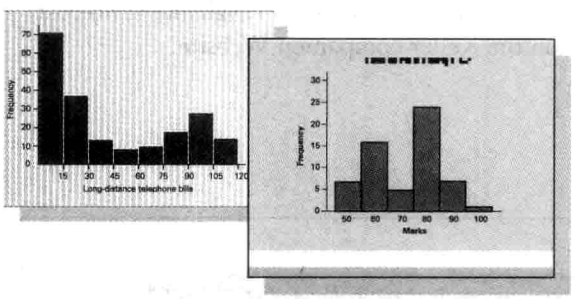
17.2 What is the *y*-intercept?

17.3 The *y*-intercept is equal to $\bar{y}$. What does this tell you about predicting the value of *y*?

17.4 Drag the mouse to change the slope to 1. What is the sum of squared errors?

17.5 Drag the mouse to change the slope to .5. What is the sum of squared errors?

17.6 Experiment with different lines. What point is common to all the lines?



Ample use of graphics provides students many opportunities to see statistics in all its forms. In addition to manually presented figures throughout the text, Excel and Minitab graphic outputs are given for students to compare to their own results.

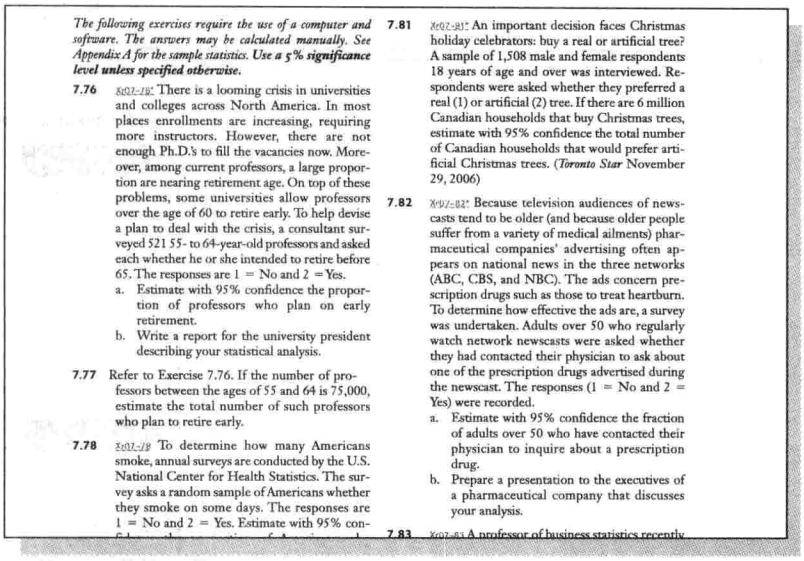
APPLIED: BRIDGING THE GAP

In the real world, it is not enough to know *how* to generate the statistics. To be truly effective, a business person must also know how to **interpret and articulate** the results. Furthermore, students need a framework to understand and apply statistics **within a realistic setting** by using realistic data in exercises, examples, and case studies.

Interpret the Results

Examples round out the final component of the Identify-Compute-Interpret approach by asking students to interpret the results in the context of a business-related decision. This final step motivates and shows how statistics is used in everyday business situations.

New coverage of writing reports and creating presentations sets up exercises that ask students to articulate their findings to nonstatisticians.



The following exercises require the use of a computer and software. The answers may be calculated manually. See Appendix A for the sample statistics. ***Use a 5% significance level unless specified otherwise.***

7.76 XR07-76 There is a looming crisis in universities and colleges across North America. In most places enrollments are increasing, requiring more instructors. However, there are not enough Ph.D.'s to fill the vacancies now. Moreover, among current professors, a large proportion are nearing retirement age. On top of these problems, some universities allow professors over the age of 60 to retire early. To help devise a plan to deal with the crisis, a consultant surveyed 521 55- to 64-year-old professors and asked each whether he or she intended to retire before 65. The responses are 1 = No and 2 = Yes.

a. Estimate with 95% confidence the proportion of professors who plan on early retirement.

b. Write a report for the university president describing your statistical analysis.

7.77 Refer to Exercise 7.76. If the number of professors between the ages of 55 and 64 is 75,000, estimate the total number of such professors who plan to retire early.

7.78 XR07-78 To determine how many Americans smoke, annual surveys are conducted by the U.S. National Center for Health Statistics. The survey asks a random sample of Americans whether they smoke on some days. The responses are 1 = No and 2 = Yes. Estimate with 95% con-

7.81 XR07-81 An important decision faces Christmas holiday celebrators: buy a real or artificial tree? A sample of 1,508 male and female respondents 18 years of age and over was interviewed. Respondents were asked whether they preferred a real (1) or artificial (2) tree. If there are 6 million Canadian households that buy Christmas trees, estimate with 95% confidence the total number of Canadian households that would prefer artificial Christmas trees. (*Toronto Star* November 29, 2006)

7.82 XR07-82 Because television audiences of newscasts tend to be older (and because older people suffer from a variety of medical ailments) pharmaceutical companies' advertising often appears on national news in the three networks (ABC, CBS, and NBC). The ads concern prescription drugs such as those to treat heartburn. To determine how effective the ads are, a survey was undertaken. Adults over 50 who regularly watch network newscasts were asked whether they had contacted their physician to ask about one of the prescription drugs advertised during the newscast. The responses (1 = No and 2 = Yes) were recorded.

a. Estimate with 95% confidence the fraction of adults over 50 who have contacted their physician to inquire about a prescription drug.

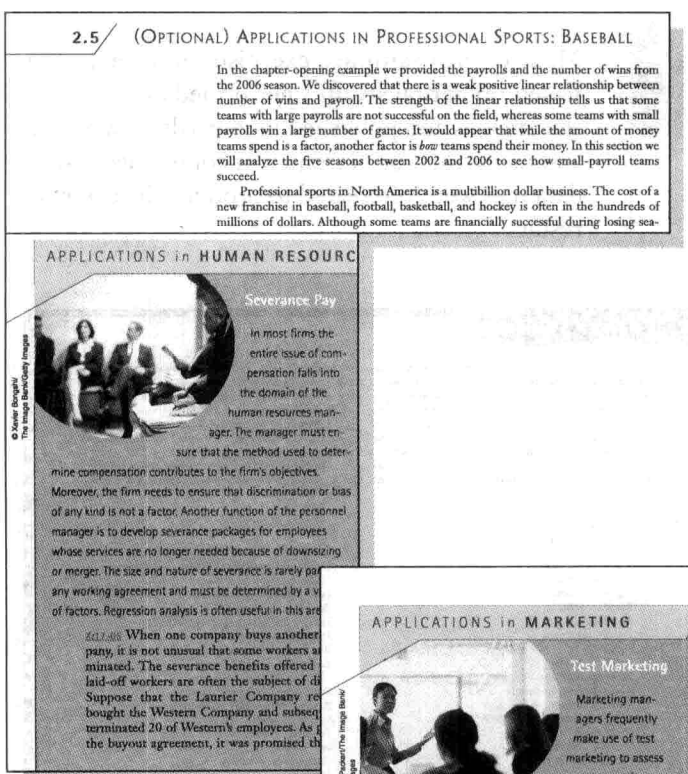
b. Prepare a presentation to the executives of a pharmaceutical company that discusses your analysis.

7.83 XR07-83 A professor of business statistics recently

An Applied Approach

With **Applications in . . .** sections and boxes, ***Managerial Statistics*** now includes many **applications** (in finance, marketing, operations management, human resources, economics, and accounting) highlighting how statistics is used in those professions. For example, "Applications in Accounting: Auditing" shows how statistics are used to estimate several parameters in auditing and uses a real application (GAO). An optional section, "Applications in Professional Sports: Baseball" contains a subsection on the success of the Oakland Athletics.

In addition to sections and boxes, **Applications in . . . exercises** can be found within the exercise sections to further reinforce the big picture.



2.5 (OPTIONAL) APPLICATIONS IN PROFESSIONAL SPORTS: BASEBALL

In the chapter-opening example we provided the payrolls and the number of wins from the 2006 season. We discovered that there is a weak positive linear relationship between number of wins and payroll. The strength of the linear relationship tells us that some teams with large payrolls are not successful on the field, whereas some teams with small payrolls win a large number of games. It would appear that while the amount of money teams spend is a factor, another factor is *how* teams spend their money. In this section we will analyze the five seasons between 2002 and 2006 to see how small-payroll teams succeed.

Professional sports in North America is a multibillion dollar business. The cost of a new franchise in baseball, football, basketball, and hockey is often in the hundreds of millions of dollars. Although some teams are financially successful during losing sea-

APPLICATIONS in HUMAN RESOURC

Severance Pay

© Xavier Borgelt/The Image Bank/Getty Images

In most firms the entire issue of compensation falls into the domain of the human resources manager. The manager must ensure that the method used to determine compensation contributes to the firm's objectives. Moreover, the firm needs to ensure that discrimination or bias of any kind is not a factor. Another function of the personnel manager is to develop severance packages for employees whose services are no longer needed because of downsizing or merger. The size and nature of severance is rarely pa any working agreement and must be determined by a v of factors. Regression analysis is often useful in this ar

XR17-06 When one company buys another pany, it is not unusual that some workers a minated. The severance benefits offered laid-off workers are often the subject of d Suppose that the Laurier Company re bought the Western Company and subseq terminated 20 of Western's employees. As the buyout agreement, it was promised th

APPLICATIONS in MARKETING

Test Marketing

© White Packert/The Image Bank/Getty Images

Marketing managers frequently make use of test marketing to assess consumer reaction to a change in a characteristic (such as price or packaging) of an existing product, or to assess consumers' preferences regarding a proposed new product. *Test marketing* involves experimenting with changes to the marketing mix in a small, limited test market and assessing consumers' reaction in the test market before undertaking costly changes in production and distribution for the entire market.

SSA Envelope Plan

DATA Xm06-00

Federal Express (FedEx) sends invoices to customers requesting payment within 30 days. The bill lists an address and customers are expected to use their own envelopes to return their payments. Currently the mean and standard deviation of the amount of time taken to pay bills are 24 days and 6 days, respectively. The chief financial officer (CFO) believes that including a stamped self-addressed (SSA) envelope would decrease the amount of time. She calculates that the improved cash flow from a 2-day decrease in the payment period would pay for the costs of the envelopes and stamps. Any further decrease in the payment period would generate a profit. To test her belief, she randomly selects 220 customers and includes a stamped self-addressed envelope with their invoices. The numbers of days until payment is received were recorded. Can the CFO conclude that the plan will be profitable?

© Mark Richards/PhotoEdit

After we've introduced the required tools, we'll return to this question and answer it. (See page 358).

Chapter-opening examples and solutions present compelling discussions of how the techniques and concepts introduced in that chapter are applied to real-world problems. These examples are then revisited with a solution as each chapter unfolds, applying the methodologies introduced in the chapter.

SSA Envelope Plan: Solution

© Mark Richards/PhotoEdit

IDENTIFY

The objective of the study is to draw a conclusion about the mean payment period. Thus, the parameter to be tested is the population mean μ. We want to know whether there is enough statistical evidence to show that the population mean is less than 22 days. Thus, the alternative hypothesis is

H_1: $\mu < 22$

The null hypothesis is

H_0: $\mu = 22$

The test statistic is the only one we've presented thus far. It is

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$

COMPUTE

MANUALLY

To solve this problem manually we need to define the rejection region, which requires us to specify a significance level. A 10% significance level is deemed to be appropriate. (We'll discuss our choice later.)

CASE 8.1 Do Banks Discriminate against Women Business Owners? Part 1*

Increasingly, more women are becoming owners of small businesses. However, questions concerning how they are treated by banks and other financial institutions have been raised by women's groups. Banks are particularly important to small businesses, since studies show that bank financing represents about one-quarter of total debt, and that for

The researchers surveyed a total of 1,165 business owners, of whom 115 were women. The percentage of women in the sample, 9.9%, compares favorably with other sources that indicate that women own about 10% of established small businesses at the time. The survey asked a series of questions to men and women business owners who applied for loans during


© Bruce Ayres/Stone/Getty Images

2. Was the loan approved?
   1. no 2. yes
3. If it was approved, what interest rate did you get? How much above th[illegible]

Many of the **examples, exercises, and cases are based on actual studies** performed by statisticians and published in journals, newspapers, and magazines, or presented at conferences. Many data files were re-created to produce the original results.

CHAPTER SUMMARY

The analysis of variance allows us to test for differences between populations when the data are interval. The analyses of the results of three different experimental designs were presented in this chapter. They were the one-way analysis of variance. The second experimental design also defines the treatments on the basis of one factor. However, the randomized block design uses data gathered by observing the results of a matched or blocked experiment (two-way analysis of variance). The third design is the two-factor experiment wherein the treatments are defined as the combinations of the levels of two factors. All the analyses of variance are based on partitioning the total sum of squares into sources of variation from which the mean squares and F-statistics are computed.

Additionally, we introduced three multiple comparison methods, which allow us to determine which means differ in the one-way analysis of variance.

Finally, we described an important application in operations management that employs the analysis of variance.

IMPORTANT TERMS

Analysis of variance
Treatment means
One-way analysis of variance
Response variable
Responses
Experimental units
Factor
Level
Between-treatments variation
Sum of squares for treatments (SST)
Within-treatments variation
Sum of squares for error (SSE)
Mean squares
Mean square for treatments
Mean square for error
F-Statistic
Analysis of variance (ANOVA) table
Total variation
SS(Total)
Completely randomized design
Multiple comparisons
Least Significance Difference
Bonferroni adjustment
Tukey's multiple comparison method
Multifactor experiment
Randomized block design
Repeated measures
Two-way analysis of variance
Fixed effects analysis of variance
Random effects analysis of variance
Sum of squares for blocks
Factorial experiment
Interactions
Complete factorial experiment
Replicate
Balanced

A total of about 1,000 exercises, many of them new or updated, offer ample practice for students to use statistics in an applied context.

RESOURCES

Learning Resources

Student's Suite CD-ROM (ISBN 0-324-56956-4). Included with every new copy of the text, this learning tool includes interactive concept simulation exercises from *Seeing Statistics*, *Data Analysis Plus* add-in, as well as a new Treeplan add-in, many data sets, optional topics, and 35 CD appendixes.

Companion Website accessible at international.cengage.com. View a host of resources, including SPSS and JMP software instruction and data sets, relevant links and resources, and more.

Student Solutions Manual. Students can check their understanding with this manual, which includes worked solutions of even-numbered exercises from the text. The Student Solutions Manual can be found at international.cengage.com.

Teaching Resources

For a complete listing of our extensive instructor resources, please go to international.cengage.com or contact your local Cengage sales representative.

ACKNOWLEDGMENTS

Although there is only one name on the cover of this book, the number of people who made contributions is large. I would like to acknowledge the work of all of them, with particular emphasis on the following.

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CONTENTS