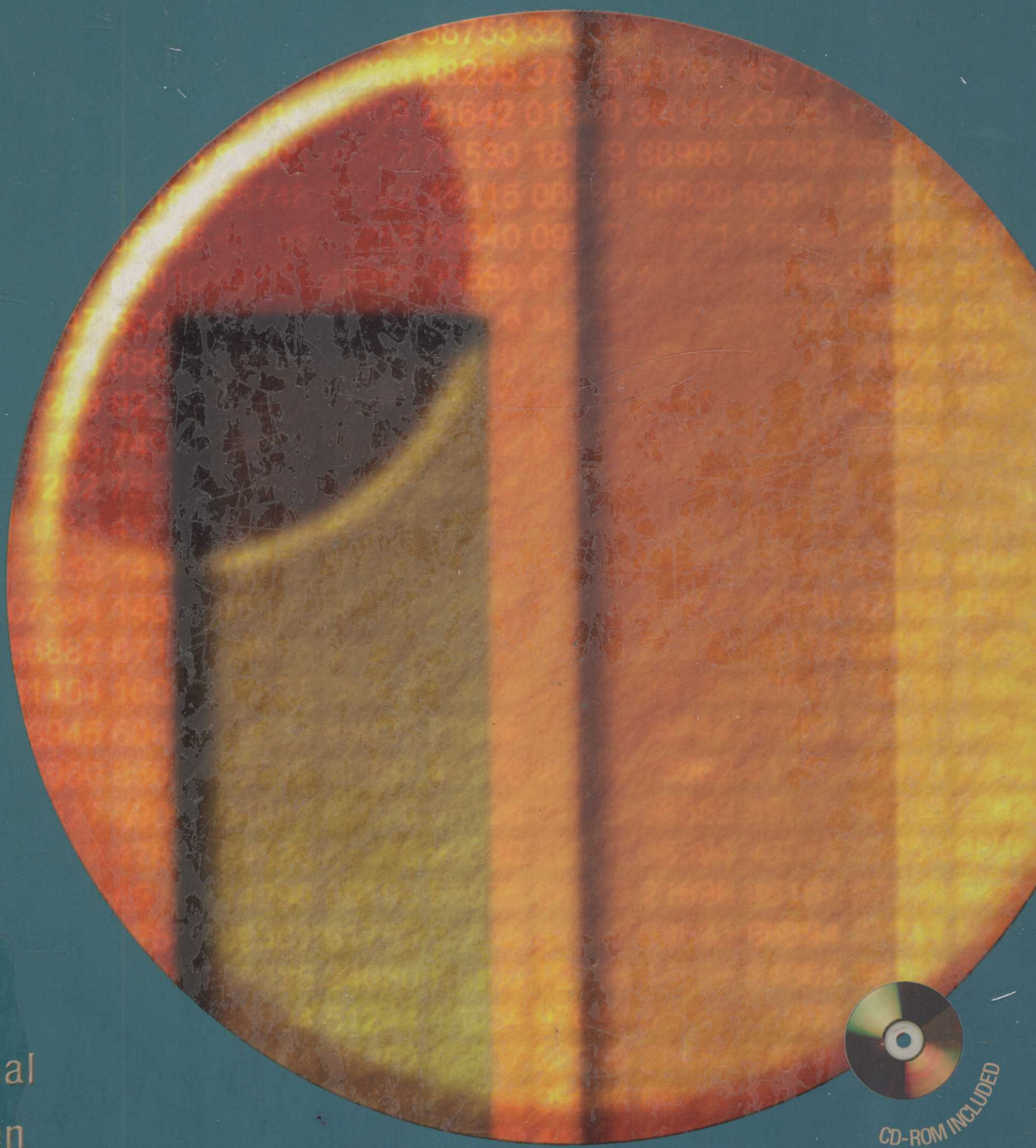
Instructor's Edition

# Basic Statistics for Business & Economics

Fourth Edition



Lind
Marchal
Wathen

CD-ROM INCLUDED

# Basic Statistics for Business & Economics

**Instructor's Edition**


Douglas A. Lind
Coastal Carolina University and The University of Toledo

William G. Marchal
The University of Toledo

Samuel A. Wathen
Coastal Carolina University

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Instructor's Edition

# Basic Statistics for Business & Economics

# A Note to Instructors

If you used previous editions of this textbook, thank you. If you are looking at it for the first time, we appreciate your consideration.

The amount of information available and the speed at which calculations are made have changed the way we do statistics. We have tried to capture these changes in this revision. We emphasize the interpretation of data and minimize calculations. We suggest the use of computer software. It does the work faster and more accurately.

## New in the Fourth Edition

### Major Content Changes

We take a great deal of pride in the success and reputation established in the previous three editions. We believe that the revisions in this edition further improve the text. Major revisions in this edition are:

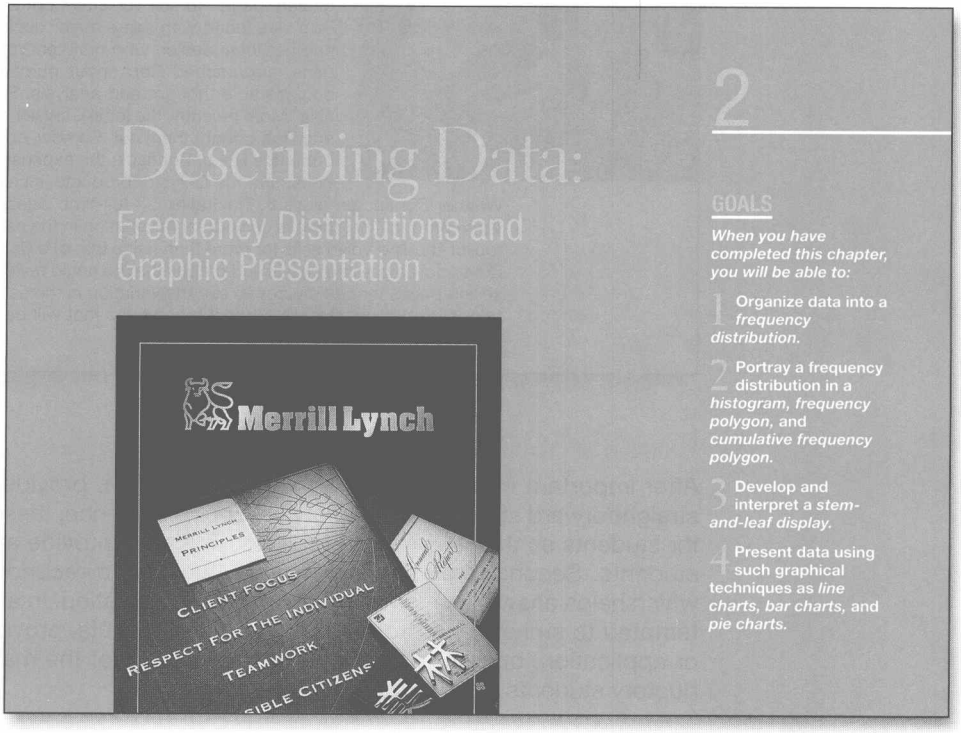
- Sampling and confidence intervals are now covered in separate chapters, 7 and 8. Separating the topics makes the chapter sizes more manageable and the additional exercises will help students understand the concepts.
- The breakdown of hypothesis testing is now based on populations sampled rather than the size of the sample. This allows the better coverage of and emphasis on the assumptions required for various tests.
- There is increased coverage of skewness. The additional explanation shows the students how to produce the same results as Excel.
- A new improved version of the MegaStat for Excel add-in software, along with a User Manual is included on the Student CD-ROM. We have also integrated MegaStat into the text where appropriate.
- There are many new data sets built into examples and problems.
- There is more Excel and MINITAB integration within the text.
- Visual Statistics 2.0 by Doane, Tracy, and Mathieson is included free on the student CD-ROM.

### Retained Pedagogical Features

- Computer examples using Excel, MegaStat, and MINITAB software have been interspersed throughout the text. The explanations of the software commands are placed at the end of the chapters to allow the students to focus first on the statistical concepts as they are introduced and explained.
- A pronunciation key lists each mathematical symbol, its meaning, and how to pronounce it. We believe this will help the student retain the meaning of the symbol and generally enhance course communications.
- Almost all of the chapters include references to Internet websites for companies, government organizations, or university data sets. These websites contain information to enhance the exercises at the end of the chapters and can be used for projects or for keeping your course up to date.

## Text Features

As in previous editions, we continue to make every effort to support student learning and provide motivation. We present the concepts as clearly as we can for students, and we support those immediately with examples and exercises to make the text as useful as possible for students. The basic structure of each chapter is as follows:




## Goals

Each chapter begins with a set of learning objectives designed to provide focus for the chapter and motivate student learning. These objectives indicate what the student should be able to do after completing the chapter. The photo on the first page of each chapter ties to one of the exercises in the chapter.

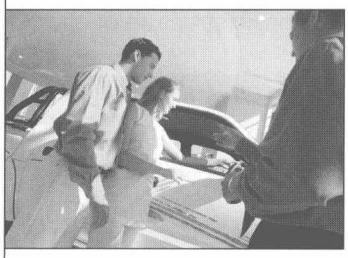
## Introduction

At the start of each chapter, we review the important concepts of the previous chapter(s) and describe how these concepts will apply to those of the current chapter.

## Photographs

There are photographs interspersed throughout the text. We hope these help students see statistics with imagination and enthusiasm and help overcome the intimidation some students have of statistics.

## Introduction



Rob Whitner is the owner of Whitner Pontiac in Columbia, South Carolina. Rob's father founded the dealership in 1964, and for more than 30 years they sold exclusively Pontiacs. In the early 1990s Rob's father's health began to fail, and Rob took over more of the day-to-day operation of the dealership. At this same time, the automobile business began to change—dealers began to sell vehicles from several manufacturers—and Rob was faced with some major decisions. The first came when another local dealer, who handled Volvos, Saabs, and Volkswagens, approached Rob about purchasing his dealership. After considerable thought and analysis, Rob purchased that dealership. More recently, the local Chrysler dealership got into difficulty and Rob bought them out. So now, on the same lot, Rob sells the complete line of Pontiacs, the expensive Volvos, Saabs, Volkswagens, and the Chrysler products, including the popular Jeep line. Whitner Pontiac employs 83, including 23 full-time salespeople. Because of the diverse product line, there is considerable variation in the selling price of the vehicles. A top-of-the-line Volvo sells for more than twice that of a Pontiac Grand Am. Rob would like to develop some charts and graphs that he could review monthly to see where the selling prices tend to cluster, to see the variation in the selling prices, and to note any trends. In this chapter we present techniques that will be useful to Rob or someone like him in managing his business.

## Example/Solution

After important concepts are introduced, we always provide a solved example in a straightforward student-oriented style. In our experience, these are a key learning tool for students as they serve two purposes. First they provide a "how to" illustration for students. Second, they show a relevant business or economics based application which helps answer the "what will I use this for" question. In all examples, we have attempted to strike the appropriate balance for students, providing a realistic scenario or application, but also making the size and scale of the math reasonable for introductory students.

## Self-Reviews

Self-Reviews are interspersed throughout the chapter and closely patterned after the preceding examples. They help the student monitor his or her progress and provide immediate reinforcement for that particular technique. The worked-out solutions are provided at the end of each chapter.

**EXAMPLE**

The population of Haarlan, Alaska, in 1992 was 2 persons, by 2002 it was 22. What is the average annual rate of percentage increase during the period?

**SOLUTION**

There are 10 years between 1992 and 2002 so $n = 10$. The formula (3–5) for the geometric mean as applied to this type of problem is:

$$GM = \sqrt[n]{\frac{\text{Value at end of period}}{\text{Value at beginning of period}}} - 1$$

$$= \sqrt[10]{\frac{22}{2}} - 1 = 1.271 - 1 = 0.271$$

The final value is 0.271. So the annual rate of increase is 27.1 percent. This means that the rate of population growth in Haarlan is 27.1 percent per year.

**Self-Review 3–5**

1. The annual dividends, in percent, for the last four years at Combs Cosmetics are: 4.91, 5.75, 8.12, and 21.60.
   (a) Find the geometric mean dividend.
   (b) Find the arithmetic mean dividend.
   (c) Is the arithmetic mean equal to or greater than the geometric mean?
2. Production of Cablos trucks increased from 23,000 units in 1982 to 120,520 units in 2002. Find the geometric mean annual percent increase.

## Definitions

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

## Margin Notes

There are more than 200 concise notes in the margin. Each is aimed at reemphasizing the key concepts presented immediately adjacent to it.

## Formulas

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

Variance and standard deviation are based on squared deviations from the mean.

## Variance and Standard Deviation

The **variance** and **standard deviation** are also based on the deviations from the mean. However, instead of using the absolute value of the deviations, the variance and the standard deviation square the deviations.

VARIANCE The arithmetic mean of the squared deviations from the mean.

Note that the variance is nonnegative, and it is zero only if all observations are the same.

STANDARD DEVIATION The square root of the variance.

**Population Variance** The formulas for the population variance and the sample variance are slightly different. The population variance is considered first. (Recall that a population is the totality of all observations being studied.) The **population variance** is found by:

POPULATION VARIANCE $$\sigma^2 = \frac{\Sigma(X - \mu)^2}{N} \qquad [3\text{–}8]$$

# Statistics in Action

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

**Statistics in Action**

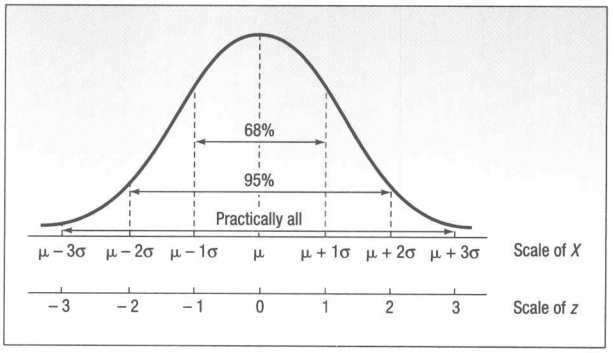
An individual's skills depend on a combination of many hereditary and environmental factors, each having about the same amount of weight or influence on the skills. Thus, much like a binomial distribution with a large number of trials, many skills and attributes follow the normal distribution. For example, scores on the Scholastic Aptitude Test (SAT) are normally distributed with a mean of 1,000 and a standard deviation of 140.

## The Empirical Rule

Before examining various applications of the standard normal probability distribution, we will consider three areas under the normal curve that will be used extensively in the following chapters. They are also called the Empirical Rule in Chapter 3.

1. About 68 percent of the area under the normal curve is within one standard deviation of the mean. This can be written as $\mu \pm 1\sigma$.
2. About 95 percent of the area under the normal curve is within two standard deviations of the mean, written $\mu \pm 2\sigma$.
3. Practically all of the area under the normal curve is within three standard deviations of the mean, written $\mu \pm 3\sigma$.

This information is summarized in the following graph.



## Pronunciation Key

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

### Pronunciation Key

| SYMBOL | MEANING | PRONUNCIATION |
|---|---|---|
| $\mu$ | Population mean | *mu* |
| $\Sigma$ | Operation of adding | *sigma* |
| $\Sigma X$ | Adding a group of values | *sigma X* |
| $\bar{X}$ | Sample mean | *X bar* |
| $\bar{X}_w$ | Weighted mean | *X bar sub w* |
| *GM* | Geometric mean | *G M* |
| $\Sigma fM$ | Adding the product of the frequencies and the class midpoints | *sigma f M* |

## Exercises

We include exercises within the chapter and at the end of the chapter. Generally, the end-of-chapter exercises are the most challenging and integrative of the chapter concepts. The answers and worked-out solutions for all odd-numbered exercises appear in an appendix at the end of the book. For exercises with more than 20 observations, the data can be found on the CD-ROM included with the text. These files are in three formats: Excel, MINITAB, and ASCII. This Instructor's Edition includes answers to all even-numbered exercises printed next to the problem in color for your convenience.

### Chapter Exercises

**29.** The net sales and the number of employees for aluminum fabricators with similar characteristics are organized into frequency distributions. Both are normally distributed. For the net sales, the mean is \$180 million and the standard deviation is \$25 million. For the number of employees, the mean is 1,500 and the standard deviation is 120. Clarion Fabricators had sales of \$170 million and 1,850 employees.

**a.** Convert Clarion's sales and number of employees to *z* values.

**b.** Locate the two *z* values.

**c.** Compare Clarion's sales and number of employees with those of the other fabricators.

30. **a.** −1.5, 1.0, .3413
**b.** .7745
**c.** .0495
**d.** 35.3

**30.** The accounting department at Weston Materials, Inc., a national manufacturer of unattached garages, reports that it takes two construction workers a mean of 32 hours and a standard deviation of 2 hours to erect the Red Barn model. Assume the assembly times follow the normal distribution.

**a.** Determine the *z* values for 29 and 34 hours. What percent of the garages take between 32 hours and 34 hours to erect?

**b.** What percent of the garages take between 29 hours and 34 hours to erect?

**c.** What percent of the garages take 28.7 hours or less to erect?

**d.** Of the garages, 5 percent take how many hours or more to erect?

## Computer Output

We added computer examples using Excel spreadsheets, including the use of MegaStat and MINITAB software in the text where appropriate. Over 100 screen captures are highlighted with either a MINITAB or Excel logo in the margin.

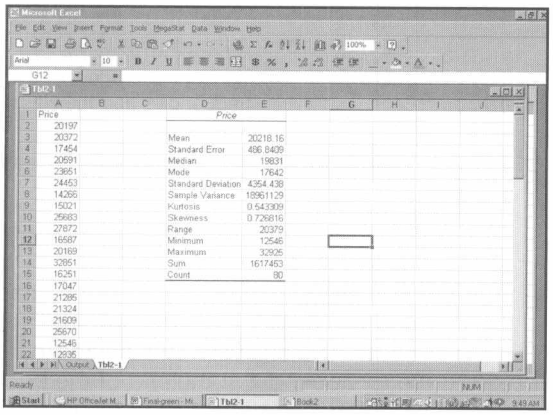
**EXAMPLE**

Table 2–1 on page 23 shows the prices of the 80 vehicles sold last month at Whitner Pontiac. Determine the mean and the median selling price.

**SOLUTION**

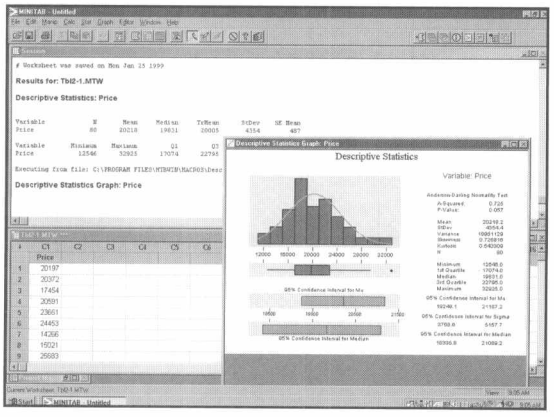
The mean and the median selling prices are reported in the following Excel output. (Remember: The instructions to create the output appear in the **Computer Commands** section at the end of the chapter.) There are 80 vehicles in the study so the calculations with a calculator would be tedious and prone to error.

**EXCEL**




**MINITAB**

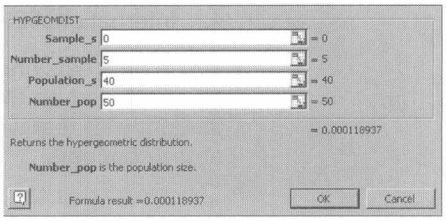
With a computer software package, it is quite easy to sort the data from smallest to largest and to locate percentiles and deciles. Both MINITAB and Excel output summary statistics. Listed below is the MINITAB output. It includes the first and third quartiles, as well as the mean, median, standard deviation, and coefficient of skewness for the Whitner Pontiac data (see Table 2–1). We conclude that 25 percent of the vehicles sold for less than $17,074 and that 75 percent sold for less than $22,795.



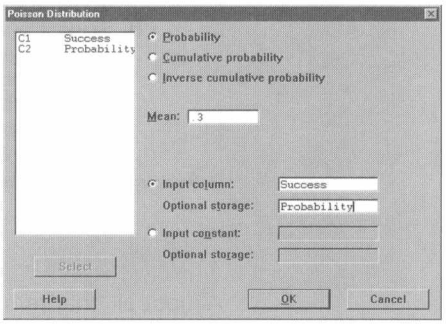
## Computer Commands

In addition, the explanations of the computer commands are placed at the end of the chapter allowing students to focus on the statistical techniques and the explanation rather than how to input commands.

3. The Excel commands necessary to determine the hypergeometric distribution on page 179 are:
   a. On a blank Excel worksheet write the word *Members* in cell A1 and the word *Probability* in B1. In cells A2 to A7 write the integers 0 to 5. Enter *B2* as the active cell.
   b. From the toolbar choose **Insert** and **Function**.
   c. In the first dialog box select **Statistical** and **HYPGEOMDIST**, and then click **OK**.
   d. In the second dialog box enter the four items necessary to compute a hypergeometric probability.
      1. Enter *0* for the number of successes.
      2. Enter *5* for the number of trials.
      3. Enter *40* for the number of successes in the population.
      4. Enter *50* for the size of the population.
      5. Excel will compute the probability of 0 successes in 5 trials (.000118937) and store that result in cell B2.




4. The MINITAB commands to generate the Poisson distribution on page 182 are:
   a. Label column C1 as *Successes* and C2 as *Probability.* Enter the integers 0 though 5 in the first column.
   b. Select **Calc**, then **Probability Distributions,** and **Poisson.**
   c. In the dialog box click on **Probability,** set the mean equal to *.3,* and select *C1* as the Input column. Designate *C2* as Optional storage, and then click **OK.**




## Chapter Outline

As a summary, each chapter includes a Chapter Outline. This learning aid provides an opportunity for students to review material, particularly vocabulary, and see the critical formulas again.

### Chapter Outline

I. A measure of location is a value used to describe the center of a set of data.
   A. The arithmetic mean is the most widely reported measure of location.
      1. It is calculated by adding the values of the observations and dividing by the total number of observations.
         a. The formula for a population mean of ungrouped or raw data is:

$$\mu = \frac{\Sigma X}{N} \qquad [3\text{–}1]$$

         b. The formula for the mean of a sample is

$$\bar{X} = \frac{\Sigma X}{n} \qquad [3\text{–}2]$$

         c. The formula for the sample mean of data in a frequency distribution is

$$\bar{X} = \frac{\Sigma fX}{n} \qquad [3\text{–}17]$$

## Computer Data Exercises

The last several exercises at the end of each chapter are based on four large data sets:

1. Real Estate
2. Major League Baseball
3. Wages and Wage Earners
4. International Economic and Demographic Data

These data sets are printed in Appendixes H through K at the end of the book and are also included on the CD-ROM packaged with the text. These data sets present the student with real-world applications of statistics and with more complex applications of the concepts.

### Computer Data Exercises

**101.** Refer to the Real Estate data, which reports information on homes sold in the Venice, Florida area last year.

- **a.** Select the variable selling price.
  1. Find the mean, median, and the standard deviation.
  2. Determine the coefficient of skewness. Is the distribution positively or negatively skewed?
  3. Develop a box plot. Are there any outliers? Estimate the first and third quartiles.
  4. Write a brief summary of the distribution of selling prices.
- **b.** Select the variable referring to the area of the home in square feet.
  1. Find the mean, median, and the standard deviation.
  2. Determine the coefficient of skewness. Is the distribution positively or negatively skewed?
  3. Develop a box plot. Are there any outliers? Estimate the first and third quartiles.
  4. Write a brief summary of the distribution of the area of homes.

## Web Exercises

Almost all chapters have references to Internet websites for companies, government organizations, and university data sets. These websites contain interesting and relevant information to enhance the exercises at the end of the chapters. They also introduce students to this important business research tool for data. The addresses for these sites are included on the student CD-ROM for convenience.

### exercises.com

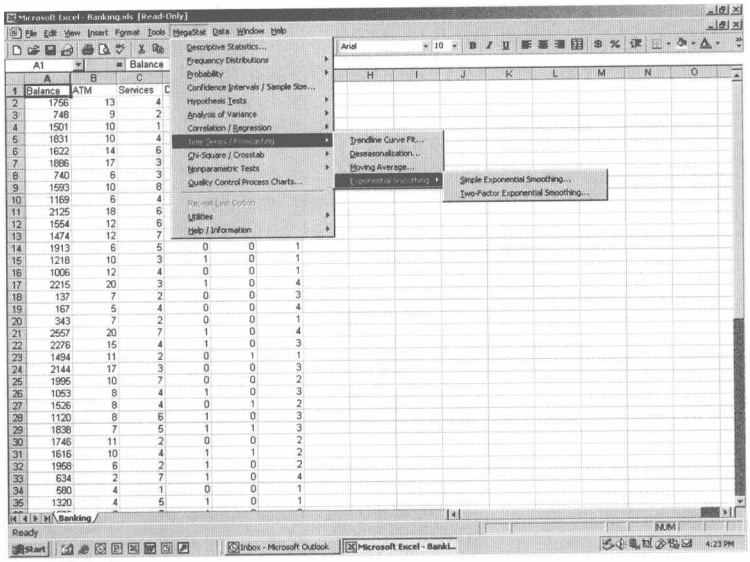
98. See IM.

**98.** The National Center for Health Statistics maintains a website at: http://www.cdc.gov/nchs. Under the section labeled **Tabulated State Data**, click on **Births**. Go to that page and locate the table "Live Births by Race and Hispanic Origin of Mother: U.S., Each State, Puerto Rico, Virgin Islands, and Guam." Suppose you are interested in birth rates for the 50 states. Develop a box plot of the data. Compute the mean, median, standard deviation, and coefficient of skewness. What can you conclude about the shape of the distribution?

## Ancillary Materials

A **Student CD-ROM,** packaged free with all copies of the text, features chapter quizzes, PowerPoint slides, data files (in MINITAB, Excel, and ASCII formats) for the large data sets and exercises, video clips, practice problems, electronic tutorials, and Internet links to the text website and other online statistics resources. Also included is **MegaStat for Excel** by J. B. Orris of Butler University. **MegaStat version 8.9,** an

Excel add-in, includes new routines for nonparametrics, time series, regression modeling, control charts, and box plots. Help files are built in and an introductory user's manual is also included on the CD-ROM.




Also included *free* on the student CD-ROM is **Visual Statistics, 2.0,** by Doane, Mathieson, and Tracy. This package of 21 software programs and hundreds of data files and examples is designed for teaching and learning basic statistics. The modules of Visual Statistics provide an interactive, highly graphical, experimental format in which to explore statistics. The software and worktext promote active learning through competency building exercises, individual and team projects, and built-in databases. Over 400 data sets from business settings are included within the package, and the Visual Statistics CD includes the worktext in electronic files.

A comprehensive **Study Guide** (0-07-247110-7) written by Walter Lange, is organized much like the textbook. Each chapter includes objectives, a brief summary, a glossary, problems and their solutions, self-review exercises, and assignments. The Study Guide is set up in an easy-to-use format so that instructors can grade assignments easily if they choose. The assignment answers are in the Instructor's Manual.

**Instructor's Resource CD-ROM** (0-07-247109-3) This comprehensive resource provides instructors with electronic versions of the Instructor's Manual, Test Bank, PowerPoint Lecture Slides, video clips, and data files.

**Instructor's Manual** This manual prepared by Denise Heban and the authors contains the complete solutions to all exercises, as well as the exercises in the Study Guide. Also included are syllabi for a one-semester or two-quarter course.

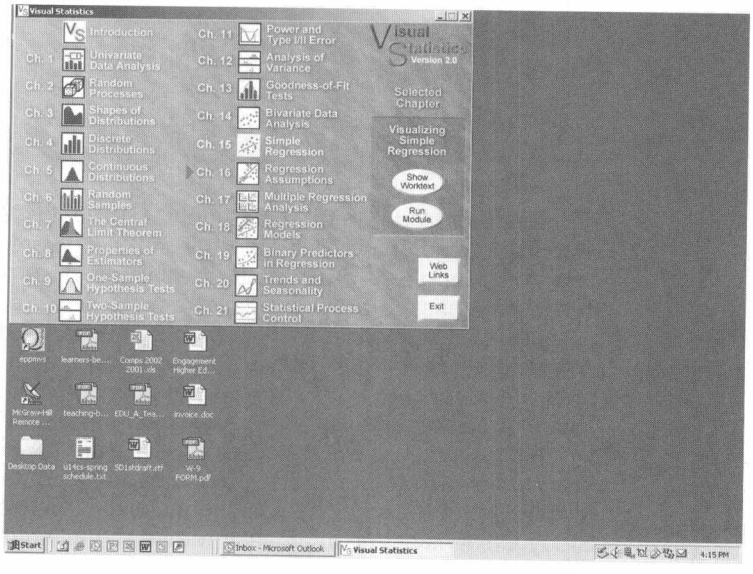
**Test Bank** Developed by Samuel Wathen, it contains multiple-choice, true/false, and short answer questions and problems. The answers to all questions are given, along with a rating of the level of difficulty and what chapter goal the question contains.

**PowerPoint Lecture Slides** Developed by Jane Lind, these full color slides include chapter objectives, definitions of key terms, graphics, and additional examples. These slides are also included on the Student CD-ROM. Students may use them as a chapter review tool, or as a source of additional solved examples. Instructors can use them to enhance their lectures or add additional material of their own.

**Basic Statistics Using Excel for Office 2000** (0-07-248161-7) by Merchant, Goffinet, and Koehler is a workbook that introduces students to Excel and shows how to apply it to introductory statistics. This manual presumes no prior familiarity with Excel or statistics and provides step-by-step directions in a how-to style using Excel 2000 and text examples and problems.

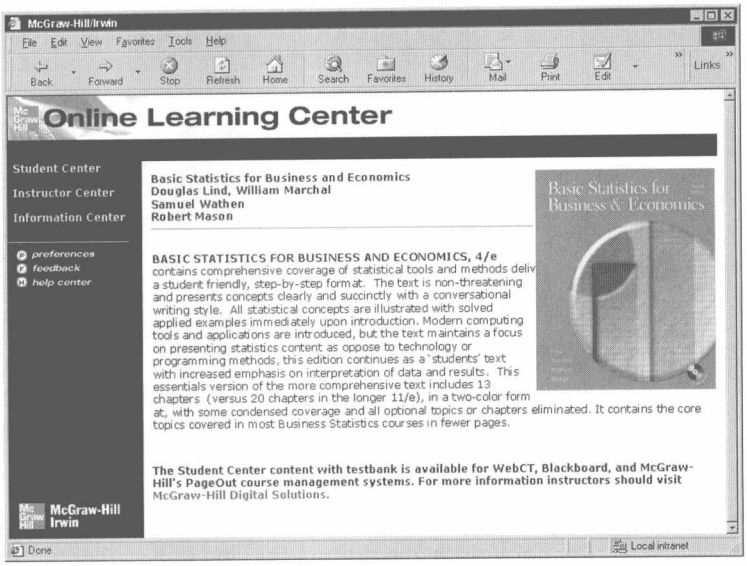
## With the fourth edition of *Basic Statistics for Business and Economics*, special discounts are available for combination packages. Check with your sales representative or bookstore for pricing:

Text with MINITAB Student Version 12.0 (0-07-419922-6)
Text with Basic Statistics Using Excel for Office 2000 (0-07-418289-7)
Text with Study Guide (0-07-419920-X)
Text with McGraw-Hill Pocket Dictionary of Statistics by Sahai and Khurshid (0-07-419921-8)
Text with ALEKS for Business Statistics (1 semester) (0-07-419933-1)



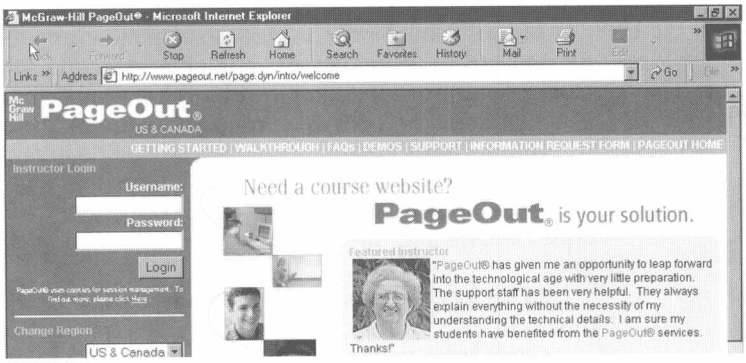

## Online Learning Center

The Online Learning Center includes online content for both instructors and students. Based on the Study Guide, the site provides text-specific resources for student reference and assistance. This site includes a summary, glossary, solved problems, data files, web links, and more. The Instructor's Center provides updates, the Instructor's Manual, and other teaching support materials (http://www.mhhe.com/lindbasics4e).



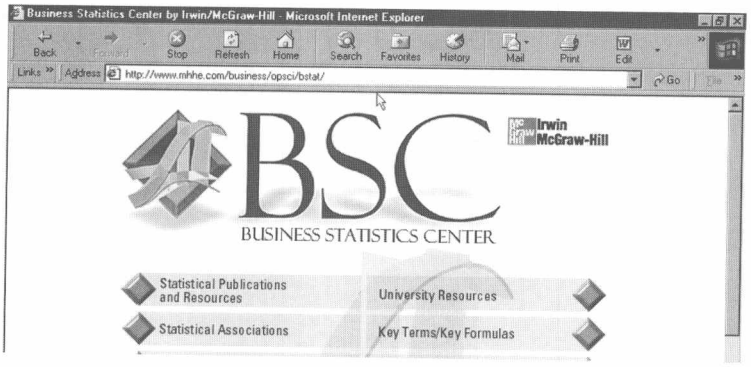

## Pageout

Pageout is an exclusive McGraw-Hill product that allows instructors to quickly create a professional course website. You simply fill in the template provided with your specific course information, click on one of the designs, and the website is complete. The interactive course syllabus allows you to post content to coincide with your lectures and assignments. When students visit the site, they are directed to McGraw-Hill web content or your own specific material. The online grade book automatically stores quiz and test grades and allows scores to be posted to the entire class or individually. The discussion board allows for exchange of ideas, questions, or discussion of topic.




## Business Statistics Center

The McGraw-Hill Business Statistics Center of BSC is a comprehensive collection of Internet-based resources for teaching and learning about statistics. This site is located at http://www.mhhe.com/bstat.




From this portal, you and your students can link to thousands of statistics resources available on the Web. Also included are McGraw-Hill resources such as the Online Statistics Dictionary, ALEKS, text sites, and more.

## ALEKS® for Business Statistics

ALEKS (**A**ssessment and **LE**arning in **K**nowledge **S**paces) is an artificial intelligence–based system for individualized learning, available from McGraw-Hill over the World Wide Web.

ALEKS delivers precise, qualitative diagnostic assessments of students' knowledge, guides them in the selection of appropriate new study material, and records their progress toward mastery of curricular goals in a robust classroom management system.

ALEKS interacts with the student much as a skilled human tutor would, moving between explanation and practice as needed, correcting and analyzing errors, defining terms and changing topics on request. By sophisticated modeling of a student's knowledge state for a given subject, ALEKS can focus clearly on what the student is most ready to learn next. When students focus on exactly what they are ready to learn, they build confidence and a learning momentum that fuels success.

ALEKS totally individualizes assessment and learning. After a brief assessment, typically 15 to 20 questions, students enter the ALEKS Learning Mode where each student is given topics that the student is *exactly* ready to learn next. This results in efficient learning and drives learning momentum.

ALEKS frees instructor's time by helping students on an individual basis.

ALEKS also includes extensive course management tools. ALEKS assesses students continually and keeps a record of exactly what topics each student, and the class, knows and doesn't know. This information is available to the instructor in real time.

ALEKS is customizable—instructors choose topics from a comprehensive list to match ALEKS to their syllabus.

Class testing shows that students who use ALEKS achieve a higher class grade, 1.5 grade points higher on average, and that far fewer students drop or fail the course.

Visit the ALEKS website at http://www.business.aleks.com.