

Preface

Approach

Elementary Statistics: A Step by Step Approach was written to help students in the beginning statistics course whose mathematical background is limited to basic algebra. The book follows a nontheoretical approach without formal proofs, explaining concepts intuitively and supporting them with abundant examples. The applications span a broad range of topics certain to appeal to the interests of students of diverse backgrounds and include problems in business, sports, health, architecture, education, entertainment, political science, psychology, history, criminal justice, the environment, transportation, physical sciences, demographics, eating habits, and travel and leisure.

About This Book

The learning system found in *Elementary Statistics* provides the student with a useful framework in which to learn and apply concepts.

- Each chapter begins with an outline and a list of **learning objectives**. The objectives are repeated at the beginning of each section to help students focus on the concepts presented within that section.

2-3

Histograms, Frequency Polygons, and Ogives

Objective 2. Represent data in frequency distributions using histograms, frequency polygons, and ogives.

After the data have been organized into a frequency distribution, they can be presented in graphical form. The purpose of graphs in statistics is to convey the data to the viewers in pictorial form. It is easier for most people to comprehend the meaning of data presented graphically than data presented numerically in tables or frequency distributions. This is especially true if the users have little or no statistical knowledge.

Statistical graphs can be used to describe the data set or to analyze it. Graphs are also useful in getting the audience's attention in a publication or a speaking presentation. They can be used to discuss an issue, reinforce a critical point, or summarize a data set. They can also be used to discover a trend or pattern in a situation over a period of time.

- The outline and learning objectives are followed by a feature titled **Statistics Today**, in which a **real-life problem** shows students the relevance of the material in the chapter. This problem is subsequently solved near the end of the chapter by using the statistical techniques presented in the chapter.



Statistics Today

Where Is All the Garbage Coming From?

Environmentalists are concerned about the amount of garbage that is being produced by our society. Garbage that is produced by the people living in a specific state must be disposed of in some way. This is becoming a major problem for some states. Even worse is the fact that some states *import* garbage from other states. One such state is Pennsylvania. The data shown give the amount of garbage (in thousands of tons) disposed of in Pennsylvania for the years 1990–2000. Looking at numbers presented in table form does not have the same impact as presenting the numbers in graphical form.

This chapter will show you how to construct appropriate graphs to represent data in a concise, easy-to-understand form, helping people to make sense of the numbers.

Pennsylvania waste disposal

Year	In-state	Out-of-state
1990	10,453	3,544
1991	10,145	3,449

- Over 300 **examples** with detailed solutions serve as models to help students solve problems on their own. Examples are solved by using a step-by-step explanation, and illustrations provide a clear display of results for students.

Example 3–23



Find the sample variance and standard deviation for the amount of European auto sales for a sample of 6 years shown. The data are in millions of dollars.

11.2, 11.9, 12.0, 12.8, 13.4, 14.3

Source: *USA TODAY*.

Solution

STEP 1 Find the sum of the values.

$$\Sigma X = 11.2 + 11.9 + 12.0 + 12.8 + 13.4 + 14.3 = 75.6$$

STEP 2 Square each value and find the sum.

$$\Sigma X^2 = 11.2^2 + 11.9^2 + 12.0^2 + 12.8^2 + 13.4^2 + 14.3^2 = 958.94$$

STEP 3 Substitute in the formulas and solve.

$$s^2 = \frac{\Sigma X^2 - [(\Sigma X)^2/n]}{n - 1} = \frac{958.94 - [(75.6)^2/6]}{5}$$

$$= 1.28$$

The variance of the sample is 1.28.

$$s = \sqrt{1.28} = 1.13$$

Hence, the sample standard deviation is 1.13.

- Numerous examples and exercises use **real data**. The icon shown here indicates that the data set for the exercise is available in a variety of file formats on the text's Online Learning Center and CD-ROM.



16. The Federal Highway Administration reported the number of deficient bridges in each state. Find the range, variance, and standard deviation.

15,458	1,055	5,008	3,598	8,984
1,337	4,132	10,618	17,361	6,081
6,482	25,090	12,681	16,286	18,832
12,470	17,842	16,601	4,587	47,196
23,205	25,213	23,017	27,768	2,686
7,768	25,825	4,962	22,704	2,694
4,131	13,144	15,582	7,279	12,613
810	13,350	1,208	22,242	7,477
10,902	2,343	2,333	2,979	6,578
14,318	4,773	6,252	734	13,220

Source: *USA TODAY*.

- Numerous **Procedure Tables** summarize processes for students' quick reference. All use the step-by-step method.

Procedure Table					
Finding the Sample Variance and Standard Deviation for Grouped Data					
STEP 1	Make a table as shown and find the midpoint of each class.				
	A	B	C	D	E
	Class	Frequency	Midpoint	$f \cdot X_m$	$f \cdot X_m^2$
STEP 2	Multiply the frequency by the midpoint for each class and place the products in column D.				
STEP 3	Multiply the frequency by the square of the midpoint and place the products in column E.				
STEP 4	Find the sums of columns B, D, and E. (The sum of column B is n . The sum of column D is $\sum f \cdot X_m$. The sum of column E is $\sum f \cdot X_m^2$.)				
STEP 5	Substitute in the formula and solve to get the variance.				
	$s^2 = \frac{\sum f \cdot X_m^2 - [(\sum f \cdot X_m)^2/n]}{n - 1}$				
STEP 6	Take the square root to get the standard deviation.				

- The **Speaking of Statistics** sections invite students to think about poll results and other statistics-related news stories in another connection between statistics and the real world.

Speaking of
STATISTICS

This study of Internet search sites was conducted by Nielsen/NetRatings. What type of sample do you think they used?

USA SNAPSHOTS®

Top internet search sites

Users¹ in millions for March:

	35.3
	33.7
	30.3
	24.5
	12.1

Source: Nielsen/Net Ratings 1 – Each visitor is counted only once.

Source: Copyright 2002, *USA TODAY*. Reprinted with permission.

- At the end of appropriate sections, **Technology Step by Step** boxes show students how to use MINITAB, the TI-83 Plus graphing calculator, and Excel to solve the types of problems covered in the section. Instructions are presented in numbered steps, usually in the context of examples—including examples from the main part of the section. Numerous computer or calculator screens are displayed, showing intermediate steps as well as the final answer.

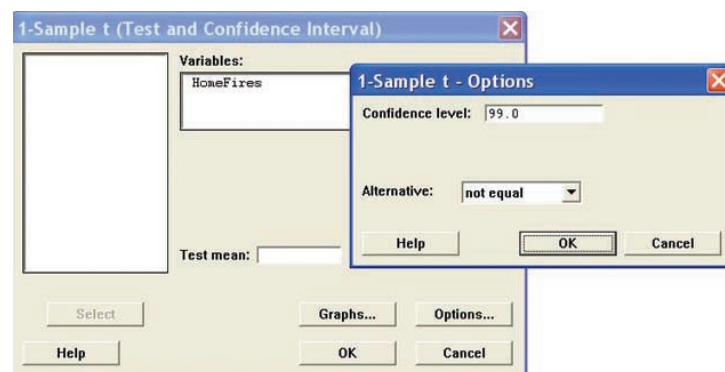
Technology Step by Step

MINITAB Step by Step

Find a t Interval for the Mean

For Example 7-7, find the 99% confidence interval for the mean number of home fires started by candles each year.

1. Type the data into **C1** of a MINITAB worksheet.
2. Select **Stat>Basic Statistics>1-Sample t**.



3. Double-click C1 Homefires for the Variable.
4. Click on [Options] and be sure the Confidence Level is 99. You may need to click inside the text box to change it.

Unusual Stats

According to the *Statistical Abstract of the United States*, 52% of Americans live within 50 miles of a coastal shoreline.

- **Historical Notes, Unusual Stats, and Interesting Facts**, located in the margins, make statistics come alive for the reader.

- **Rules and definitions** are set off for easy referencing by the student.

The Fundamental Counting Rule

Objective 5. Find the total number of outcomes in a sequence of events, using the fundamental counting rule.

Fundamental Counting Rule

In a sequence of n events in which the first one has k_1 possibilities and the second event has k_2 and the third has k_3 , and so forth, the total number of possibilities of the sequence will be

$$k_1 \cdot k_2 \cdot k_3 \cdot \dots \cdot k_n$$

Note: In this case *and* means to multiply.

- **Critical Thinking** sections at the end of each chapter challenge students to apply what they have learned to new situations. The problems presented are designed to deepen conceptual understanding and/or to extend topical coverage.


Critical Thinking Challenges

Sometimes a researcher must decide whether a variable is normally distributed. There are several ways to do this. One simple but very subjective method uses special graph paper, which is called *normal probability paper*. For the distribution of systolic blood pressure readings given in Chapter 3 of the textbook, the following method can be used:

1. Make a table, as shown.

Boundaries	Frequency	Cumulative frequency	Cumulative percent frequency
89.5–104.5	24		
104.5–119.5	62		
119.5–134.5	72		
134.5–149.5	26		

2. Find the cumulative frequencies for each class, and place the results in the third column.
3. Find the cumulative percents for each class by dividing each cumulative frequency by 200 (the total frequencies) and multiplying by 100%. (For the first class, it would be $24/200 \times 100\% = 12\%$.) Place these values in the last column.
4. Using the normal probability paper, label the x axis with the class boundaries as shown and plot the percents.
5. If the points fall approximately in a straight line, it can be concluded that the distribution is normal. Do you feel that this distribution is approximately normal? Explain your answer.
6. To find an approximation of the mean or median, draw a horizontal line from the 50% point on the y axis over to the curve.

- **Data projects** further challenge students' understanding and application of the material presented in the chapter. Many of these require the student to gather, analyze, and report on real data. These projects, which appear at the end of each chapter, may include a World Wide Web icon , indicating that websites are listed as possible sources of data.



Data Projects

Where appropriate, use MINITAB, the TI-83 Plus, or a computer program of your choice to complete the following exercises.

1. Select a variable and collect about 10 values for two groups. (For example, you may want to ask 10 men how many cups of coffee they drink per day and 10 women the same question.)

- Define the variable.
- Define the populations.
- Describe how the samples were selected.
- Write a paragraph describing the similarities and differences between the two groups, using appropriate descriptive statistics such as means, standard deviations, and so on.

2. Collect data consisting of at least 30 values.

- State the purpose of the project.
- Define the population.
- State how the sample was selected.
- Using appropriate descriptive statistics, write a paragraph summarizing the data.

You may use the following websites to obtain raw data:

<http://www.mhhe.com/math/stat/bluman>

<http://lib.stat.cmu.edu/DASL>

<http://www.statcan.ca/english/>

- **Over 1600** exercises are located at the end of major sections within each chapter.
- **Hypothesis-Testing Summaries** are found at the end of Chapter 9 (z , t , χ^2 , and F tests for testing means, proportions, and variances), Chapter 12 (correlation, chi-square, and ANOVA), and Chapter 13 (nonparametric tests) to show students the different types of hypotheses and the types of tests to use.
- A **Data Bank** listing various attributes (educational level, cholesterol level, gender, etc.) for 100 people is included and referenced in various exercises and projects throughout the book, including the projects presented in Data Projects sections.
- A **reference card** containing the formulas and the z , t , χ^2 , and PPMC tables is included with this textbook.
- End-of-chapter **Summaries, Important Terms, and Important Formulas** give students a concise summary of the chapter topics and provide a good source for quiz or test preparation.
- **Review Exercises** are found at the end of each chapter.
- Special sections called **Data Analysis** require students to work with a data set to perform various statistical tests or procedures and then summarize the results. The data are included in the Data Bank in Appendix D and can be downloaded from the book's website at www.mhhe.com/bluman.
- **Chapter Quizzes**, found at the end of each chapter, include multiple-choice, true/false, and completion questions along with exercises to test students' knowledge and comprehension of chapter content.
- The **Appendices** provide students with an essential algebra review, an outline for report writing, Bayes' Theorem, extensive reference tables, a glossary, and answers to all quiz questions, all odd-numbered exercises, selected even-numbered exercises, and an alternate method for using the standard normal distribution.



Changes in the Fifth Edition

This edition of *Elementary Statistics* is updated and improved for students and instructors in the following ways:

- **Over 250 new exercises** are added, **most using real data**, and the text is updated throughout with current data and statistics.
- The text is reduced to **a more manageable length**, from 15 to 14 chapters. (See chapter-by-chapter changes below for more information.)
- To help students master important concepts, there are 14 **new** worked-out examples, 11 **new** Critical Thinking Challenges, and 2 **new** Procedure Tables.
- To update the discussion of statistics in the real world, there are 27 **new** “Speaking of Statistics” and 3 **new** “Statistics Today” features.
- The calculator technology sections now show the **TI-83 Plus** calculator instead of the TI-83.
- The **MINITAB**® technology sections now instruct students in the use of **Release 14** (with transitional guidance for users of Releases 12 and 13 on the text’s Online Learning Center).
- **MegaStat**, a powerful and user-friendly add-in for Microsoft Excel® provided exclusively by McGraw-Hill, is now available on the text’s Online Learning Center and the student CD-ROM. The use of MegaStat is entirely optional, and it enables students to perform a wide variety of statistical procedures without having to input lengthy macros. See page 24 for installation instructions.
- The **cumulative normal distribution** is added to Appendix B along with an explanation of how to use it.
- The numbering system for exercises is revised to be easier to follow.

Based on users’ suggestions and instructors’ reviews of the Fourth Edition, the following improvements are also made to specific chapters:

- Chapter 1** A new topic, “Uses and Misuses of Statistics,” is added to make students more aware of how misleading conclusions can be drawn from faulty statistical thinking.
- Chapter 2** The new topic of distribution shapes is added to help students analyze the shapes of histograms and frequency polygons.
- Chapter 3** Two new Procedure Tables, one on finding quartiles and one on identifying outliers, is added to help students with the computational procedures.
- Chapter 4** The probability topics and the counting rules from Chapters 4 and 5 of the Fourth Edition are now combined in a single chapter to facilitate coverage. For example, Section 4–5 presents the counting rules, and then Section 4–6 shows how to use the counting rules with the probability rules.
- Chapter 6** Instructions on how to determine normality are added. Since many statistical tests require that the variable be approximately normally distributed, students will now be able to make a decision whether or not the normality assumption has been met.
- Chapter 10** Brief explanations of the concepts of extrapolation, lurking variables, marginal least-square line, residuals, and influential observations are added in order to enhance students’ understanding of correlation and regression.



Supplements

Online Learning Center

The Online Learning Center (OLC), located at www.mhhe.com/bluman, provides resources for students and instructors alike. The OLC Instructor's Edition is protected by a passcode available from your McGraw-Hill Education representative and offers

- PowerPoint® slides in full-color that enrich your lectures by highlighting chapter concepts, summarizing procedures, and illustrating examples
- The online Instructor's Edition of the Critical Thinking Workbook
- A correlation between Releases 12, 13, and 14 of MINITAB
- An online-only chapter on Quality Assurance
- Links to PageOut (described on p. xx)
- All the features of the Student Edition

The Student Edition of the OLC is also passcode-protected, and students will find their unique passcode at the front of *new* textbooks. Resources available to students include

- “e-Professor” multimedia tutorials complete with audio instruction
- Helpful practice quizzing with an algorithmic problem generator and personalized feedback
- Video lectures for every section of the text
- Links to ALEKS® for Statistics and NetTutor
- MegaStat, a powerful and user-friendly add-in for Microsoft Excel®
- Data sets for problems in the text marked by icons, available in multiple formats (Excel, MINITAB, TI Graph Link, SAS, SPSS, and Comma-Delimited ASCII)
- The Data Bank from Appendix D
- Resources for each chapter from PowerWeb, including current articles from Annual Editions for Statistics, weekly updates, and news feeds related to statistics. For more information on PowerWeb: Statistics, visit their website: www.dushkin.com/powerweb
- A reference card for key formulas in Adobe Acrobat format
- Links to career opportunities



For the Instructor

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xx Preface**PageOut**

PageOut is McGraw-Hill's unique, intuitive tool enabling instructors to create a full-featured, professional quality course website *without* being a technical expert. With PageOut you can post your syllabus online, assign content from the Bluman OLC, add links to important off-site resources, and maintain student results in the online grade book. PageOut is free for every McGraw-Hill Higher Education user and, if you're short on time, we even have a team ready to help you create your site. Contact your McGraw-Hill representative for further information.

Instructor's Solutions Manual

By Sally Robinson of South Plains College, this manual includes worked-out solutions to all of the exercises in the text and answers to all quiz questions.

Instructor's Testing and Resource CD-ROM

The computerized test bank contains a variety of questions, including true/false, multiple-choice, short answer, and short problems requiring analysis and written answers. The testing material is coded by type of question and level of difficulty. The Brownstone Diploma[®] system enables you to efficiently select, add, and organize questions, such as by type of question or level of difficulty. It also allows for printing tests along with answer keys as well as editing the original questions, and it is available for Windows and Macintosh systems. The CD-ROM also contains PowerPoint[®] slides and the digital Instructor's Edition of the Critical Thinking Workbook.

Videos Series

Against All Odds and *Decisions through Data* are video series available to qualified adopters. Please contact your local sales representative for more information about these programs.

For the Student**ALEKS[®] for Statistics**

New to this edition, ALEKS (Assessment and LEarning in Knowledge Spaces) uses artificial intelligence to assess and improve your students' math skills in a supportive, intuitive environment. This innovative and unrivaled web-based program moves between explanation and practice as necessary, correcting and analyzing errors, defining terms, and changing topics according to the specific, personal needs of each student.

CD-ROM

A CD-ROM is included FREE with every new copy of this textbook. With an easy-to-use interface that runs with *any* computer's web browser, this CD-ROM contains

- "e-Professor" multimedia tutorials complete with audio instruction
- Helpful practice quizzing with an algorithmic problem generator and personalized feedback
- MegaStat, a powerful and user-friendly add-in for Microsoft Excel[®]
- Data sets for problems in the text marked by icons and available in multiple formats (Excel, MINITAB, TI Graph Link, SAS, SPSS, and Comma-Delimited ASCII)
- The Data Bank from Appendix D
- A reference card for key formulas
- Links to ALEKS for Statistics, Net Tutor, and career opportunities.

Text-Specific Videos

New to this edition are text-specific videos available on VHS and CD-ROM that demonstrate key concepts and worked-out exercises from the text plus tutorials in using the TI-83 Plus Calculator, Excel, and MINITAB, in a dynamic, engaging format.

- NetTutor** NetTutor is a revolutionary system that enables students to interact with a live tutor over the Web by using NetTutor's Web-based, graphical chat capabilities. Students can also submit questions and receive answers, browse previously answered questions, and view previous live chat sessions. NetTutor can be accessed on the Online Learning Center through the Student Edition.
- MINITAB 14—Student Version** The student version of this professional software is available with copies of the text. Ask your McGraw-Hill representative for details.
- Critical Thinking Workbook** By James Condor of Manatee Community College, this workbook provides a number of additional challenging problems for students to solve that are drawn from real-world applications. Problems are tied to each chapter and highlight and reinforce key concepts.
- Student Study Guide** By Pat Foard of South Plains College, this study guide will assist students in understanding and reviewing key concepts and preparing for exams. It emphasizes all important concepts contained in each chapter, includes explanations, and provides opportunities for students to test their understanding by completing related exercises and problems.
- Student Solutions Manual** By Sally Robinson of South Plains College, this manual contains detailed solutions to all odd-numbered text problems and answers to all quiz questions.
- MINITAB 14 Manual** By Gerry Moultime of Northwood University, this manual provides the student with how-to information on data and file management, conducting various statistical analyses, and creating presentation-style graphics while following each text chapter.
- TI-83 and TI-83 Plus Graphing Calculator Manual** By Caroline Meitler of Concordia University Wisconsin, this patient, practical manual teaches students to learn about statistics and solve problems using these calculators while following each text chapter.
- Excel Manual for Office 2000** By Renee Goffinet and Virginia Koehler of Spokane Falls Community College, this workbook, specially designed to accompany the text, provides additional practice in applying the chapter concepts while using Excel.
- Visual Statistics** *Visual Statistics* is an easy-to-use interactive multimedia tool that is used to teach and learn statistical concepts graphically. It provides complete and thorough coverage of major statistical concepts, giving both student and instructor a visually oriented teaching and learning package to complement his or her text. It's available in two formats: CD with Student Workbook, ISBN #0-07-240094-3; CD only, ISBN #0-07-240012-9. And remember, too, that the CD actually contains a printable, pdf-formatted version of the entire workbook!



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