

A Brief Version

Elementary Statistics

A Step by Step Approach

2nd Edition

Bluman

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Elementary Statistics

A Brief Version

Second Edition

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ELEMENTARY STATISTICS: A BRIEF VERSION SECOND EDITION

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Preface

Approach

Elementary Statistics: A Brief Version, Second Edition is a shorter version of the popular text *Elementary Statistics: A Step by Step Approach*, Fourth Edition. This softcover edition includes all the features of the longer book, but it is designed for a course in which the time available limits the number of topics covered. It offers a more portable, lower-cost alternative to the standard hardcover textbooks.

Elementary Statistics: A Brief Version, Second Edition is written for students in the beginning statistics course whose mathematical background is limited to basic algebra. The book uses a nontheoretical approach in which concepts are explained intuitively and supported by examples. There are no formal proofs in the book. The applications are general in nature, and the exercises include problems from agriculture, biology, business, economics, education, psychology, engineering, medicine, sociology, and computer science.

About This Book

- Every copy of *Elementary Statistics: A Brief Version* comes with a **data disk** that provides the data sets used in examples and exercises in a variety of formats including:
 - MINITAB
 - TI Graph Link files for TI-83 Plus
 - Microsoft Excel (for Windows and Macintosh)
 - SPSS
 - Comma-Delimited ASCII

This can save the student using a computer or calculator from having to enter data by hand, which takes up valuable time and increases the chances of error.

The learning system found in *Elementary Statistics: A Brief Version* provides the student with a valuable 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 graphic form. The purpose of graphs in statistics is to convey the data to the viewer 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 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 using the statistical techniques that were presented in the chapter.

Statistics Today

Why Are We Running Out of 800 Numbers?

Phone companies and other agencies that deal in numbers need to know how many phone numbers, ID tags, or license plates they can issue using certain combinations of various letters and numbers. The article shown below explains that the phone companies are running out of toll-free 800 numbers. The question is: How many phone numbers with the 800 prefix can be issued in the United States?

Toll-free call? Get ready to dial 888

By Becky Beyers
USA TODAY

Get ready to keep your finger on the 8 when you make a toll-free call.

Phone companies will run out of 800 numbers early next year and start issuing toll-free numbers beginning with 888.

Use of 800 numbers has grown so fast, "we're a victim of our own success," says Dennis Byrne of the U.S. Telephone Association.

Only about 1.7 million of the 7.6 million possible 800-prefix

combinations are still available. Why so few are left:

► Demand has taken off since May 1993, when the government allowed users to keep 800 numbers if they changed long-distance carriers.

► 800 numbers aren't just for big companies anymore. Small businesses use them, as do residential customers so family members can call home more cheaply than collect.

Such customers may pay 25 cents a minute for each call plus a monthly fee of \$5.

► Some toll-free numbers are

hoarded for promotional value or occasional use.

The industry's numbering council — phone companies and associations that set phone-number policies — is asking that little-used numbers be returned so they can be reissued.

Setting up a new toll-free access code involves the entire phone industry, Byrne says.

All internal systems must upgrade switching equipment so they can handle 888 calls.

What happens when the 888s are used up? It's on to 877, 866, and all the way down to 822.

Source: *USA Today*, February 13, 1995. Copyright 1995 *USA TODAY*. Used with permission.

In this chapter, you will learn the rule for counting, the differences between permutations and combinations, and how to figure out how many different combinations for specific situations exist.

- Over 200 **examples** with detailed solutions are provided to help students learn to solve problems. Examples are solved by using a step-by-step explanation. Illustrations provide a clear display of results for students.

Example 3-23

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

11.2, 11.9, 12.0, 12.8, 13.4, 14.3

Source: *USA Today*, March 22, 1999.

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.

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

$$s^2 = 1.28$$

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**.

3-132. These data represent the area in square miles of major islands in the Caribbean Sea and the Mediterranean Sea.

Caribbean Sea			Mediterranean Sea	
			Sea	
108	926	436	1,927	1,411
75	100	3,339	229	95
5,382	171	116	3,189	540
2,300	290	1,864	3,572	9,301
166	687	59	86	9,926
42,804	4,244	134		
29,389				

Source: *The World Almanac and Book of Facts*, 1999 edition, 454.

Find each of these.

- | | |
|-------------|-----------------------|
| a. Mean | e. Range |
| b. Median | f. Variance |
| c. Mode | g. Standard deviation |
| d. Midrange | |

- Numerous **Procedure Tables** summarize processes for the student. 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 $\Sigma f \cdot X_m$. The sum of column E is $\Sigma f \cdot X_m^2$.)

STEP 5 Substitute into the formula and solve to get the variance.

$$s^2 = \frac{\Sigma f \cdot X_m^2 - (\Sigma f \cdot X_m)^2 / n}{n - 1}$$

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.

Speaking of

STATISTICS

Here is a study of the snacks consumed during the 1998 Super Bowl. Suggest several ways that the data

might have been obtained.

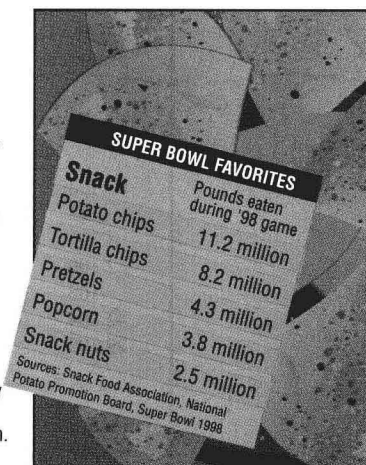
Super snack stats

■ **Snack fests:** Super Sunday, New Year's Eve and July Fourth are America's top snacking days.

■ **Eat up:** When it comes to the total amount of food eaten per person in a day, Super Sunday is No. 2, behind only Thanksgiving.

■ **Party on:** The Super Bowl is the No. 1 at-home party event of the year, says Hallmark Cards; the average party has 17 guests.

■ **The morning after:** Antacid sales increase 20 percent the day after the Super Bowl, reports the convenience store chain 7-Eleven.



Source: *USA WEEKEND*, January 22–24, 1999. Used with permission.

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

Unusual Stats

According to the book *100% American*, 23% of Americans 50 and over think their greatest achievements are still ahead of them.

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

Multiplication Rule

Objective 2. Find the total number of outcomes in a sequence of events using the multiplication 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

$$k_1 \cdot k_2 \cdot k_3 \cdot \cdots \cdot k_n$$

Note: “And” in this case means to multiply.

- Over 1200 **exercises** are located at the end of major sections within each chapter.
- 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. This feature will be valuable to students using any of these tools.

Technology Step by Step

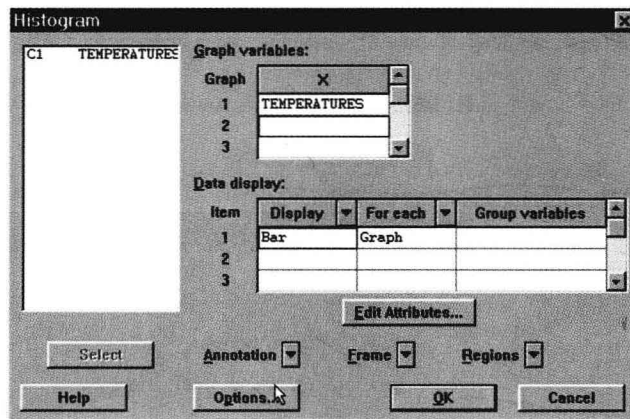
Minitab Step by Step

Constructing a Histogram

Example MT2-3

1. Enter the data from Example 2-4, the high temperatures for the 50 states.
2. Select **Graph>Histogram**.
3. In the dialog box double click C1 TEMPERATURES for the X variable.

Histogram Dialog Box



4. Click [Options].
 - a. In Type of Interval: check CutPoint: to use class boundaries instead of midpoints.
 - b. In Definition of Interval: click the button for Midpoint.

- **Critical Thinking** sections at the end of each chapter challenge the 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

1. Consider this problem: Mary and Bill play basketball. In the first game, Mary had a foul shot average of 0.60 (she made 12 of 20 shots), and Bill had a foul shot average of 0.50 (he made 5 of 10 shots). In the second game, Mary had a foul shot average of 0.80 (she made


8 out of 10 shots), and Bill had a foul shot average of 0.75 (he made 15 out of 20 shots). Now, who do you think has the best overall average? The answer may surprise you. *Hint:* Compute the averages for both games based on 30 shots for each player.

USA SNAPSHOTS®

A look at statistics that shape the nation

Paying for health care

The average American spent \$3,299 on health care in 1993.
Where the health care dollars go:

- **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, 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.)
 - a. Define the variable.
 - b. Define the populations.
 - c. Describe how the samples were selected.
 - d. 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.
 - a. State the purpose of the project.
 - b. Define the population.
 - c. State how the sample was selected.
 - d. 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/>

- **Hypothesis-Testing Summaries** are found at the end of Chapter 10 (z , t , and F tests for testing means, proportions, and variances), and Chapter 12 (correlation, chi-square, and ANOVA) 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 in Appendix D, as well as on the text's CD-ROM and Online Learning Center, 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 resource 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 is included in the Data Bank in Appendix D and can be retrieved from the text's CD-ROM or downloaded from the book's website at www.mhhe.com/blumanbrief2e.

- **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.

Content Changes for the Second Edition

To build on the success of the First Edition, the content and format have been maintained in the Second Edition, while changes based on suggestions of reviewers and the current thinking of those who are knowledgeable in the realm of statistical education have been integrated.

With this in mind, the major goals for this revision are to enable students to

1. Draw conclusions from data
2. Become more statistically literate
3. Have a better understanding of the “logic” of hypothesis testing
4. Know how to use the P -value method for hypothesis testing
5. Work with raw data as well as summary data

To achieve goal 1, questions based on interpreting the computational solutions for exercises have been included throughout the book. In addition, new problems that involve the comparisons of two data sets by frequency distributions, graphs, and summary statistics have been added. Examples and exercises comparing data sets using back-to-back stem and leaf plots and comparing data sets using two boxplots have been added. Also, students are asked to describe the nature of distributions with regard to their shape, spread, etc.

To achieve goal 2, topics in statistical literacy have been incorporated throughout the textbook where appropriate. These topics include

1. The nature of observational and experimental studies in Chapter 1
2. More material on misleading graphs in Chapter 2
3. Probability and risk-taking in Chapter 5
4. Expectation and gambling in Chapter 6

To achieve goal 3, material has been added at the beginning of Chapter 9 on the logic of hypothesis testing. This information includes comparing two distributions, one when the null hypothesis is true and the other when the null hypothesis is false. Also, material has been added comparing the hypothesis testing situation to a jury trial.

To achieve goal 4, explanations, examples, and exercises on the P -value method of hypothesis testing have been included in Chapters 9 through 12. A five-step procedure for testing hypotheses using P -values has been added to Chapter 9. Finding intervals from tables for P -values have been shown for the t , χ^2 , and F tests. To help students with this concept, the actual P -values obtained from a calculator have also been given with the interval values.

To achieve goal 5, examples and exercises using real data have been added to Chapters 2, 3, 8, 9, 10, 11, and 12.

Other changes have been made in the following chapters:

- Chapter 2: A new section (2–5) on bivariate data and scatter plots has been added. Instructors wishing to teach correlation and regression at this time can do so by teaching Sections 11–2 and 11–3 and omitting the subsection on testing the significance of the correlation coefficient.

Also in Chapter 2, the purpose of relative frequency graphs has been explained, and coverage of ungrouped frequency distributions were streamlined.

- Chapter 3: Back-to-back stem and leaf plots have been added for the comparison of data sets. Quartiles instead of hinges are used in boxplots since most calculators and computer programs and other textbooks use quartiles. An easy way to compute quartiles has been shown. Drawings for quartiles, deciles, and percentiles have been added. An explanation of how to compare boxplots has been added.
- Chapter 4: This chapter has been shortened considerably. There is only one multiplication rule, one permutation rule, and one combination rule. In addition, sections have been combined.
- Chapter 6: The title of this chapter has been changed from Probability Distributions to Discrete Probability Distributions.
- Chapter 7: The section on the finite population correction factor has been de-emphasized. The section on normal approximation to the binomial distribution has been rewritten, and a procedure table has been added to clarify the concept.
- Chapter 8: The definition of *confidence level* now comes before the definition of *confidence interval*.
- Chapter 9: In addition to the changes mentioned previously, the formula

$$z = \frac{\hat{p} - p}{\sqrt{pq/n}} \quad \text{instead of} \quad z = \frac{X - \mu}{\sigma}$$

is used to test hypotheses for a proportion. Some of the section titles have been changed to more accurately describe the material contained in the sections. The material on the power of a test has been rewritten and simplified.

- Chapter 10: The formula for finding the confidence interval for the difference of two proportions has been changed.
- Chapter 11: As previously stated, Section 11–2 on drawing and analyzing scatter plots can be taught with the other graphs in Chapter 2. A subsection on prediction intervals using the *t* distribution has been added.
- Chapter 12: Examples and exercises for hypothesis testing using *P*-values and raw data values have been added.

Altogether, the pedagogical improvements discussed have resulted in these changes to the Second Edition:

5 new “Speaking of Statistics” boxes
 Over 200 new or modified Exercises
 17 new Critical Thinking Challenges
 Many new Examples
 19 additional Data Analysis Problems

Finally, the technology material (MINITAB, TI-83 Plus, and Excel) is covered in new “Technology Step by Step” subsections at the end of the appropriate chapter sections.

Custom Publishing

If you require any topics covered in *Elementary Statistics: A Step by Step Approach*, Fourth Edition, that are not included in *Elementary Statistics: A Brief Version*, you may be able to supplement this book with sections or chapters from the Fourth Edition. For further information, contact Primis Custom Publishing at 800-962-9342, or visit www.mhhe.com/primis/online.

Supplements

The text is accompanied by an extensive set of supplements for use by you and your students, all of which are carefully coordinated with the text.

Website

The **website** for *Elementary Statistics, A Brief Version*, Second Edition, provides the data sets used in examples and exercises in a variety of formats including

- MINITAB
- TI Graph Link files for TI-83 Plus
- Excel (for Windows and Macintosh)
- SPSS
- Comma-Delimited ASCII

This can save the student using a computer or calculator from having to enter data by hand, which takes up valuable time and increases the chances of error. The “Data Bank” statistics that are used in the Data Analysis assignments at the ends of chapters are provided for download as well.

The website also provides links to data sources referred to in many of the Data Projects and links to dozens of other statistics-related sites. A PowerPoint presentation also found on the website is available for use in lectures or as a student study aid.

The website address is www.mhhe.com/blumanbrief2e.

For the Instructor

- *Instructor's Solutions Manual*, by Sally Robinson of South Plains College. This manual includes worked-out solutions to most of the exercises in the text.
- Solutions to the students' *Critical Thinking Workbook* (described later) are available in .pdf format on the text's website.
- The *Diploma* computerized test bank from the Brownstone research group enables you to efficiently select, add, and organize questions by type of question or level of difficulty. With its Test Generator, On-Line Testing Program, Internet Testing, and Grade Management Systems, *Diploma* is a very instructor-friendly software. It allows for printing tests along with answer keys, as well as editing the original questions, and each test is coded by type of question and level of difficulty. The test bank is compatible with Windows and Mac systems.
- Full-color lecture slides in PowerPoint format highlight chapter concepts, summarize main points, and illustrate examples. These files can be downloaded from the book's website at www.mhhe.com/blumanbrief2e. PowerPoint users can customize the slides to suit the specific needs of their course.

For the Student

- *Electronic Study Guide CD-ROM including data files.* This CD is packaged free with new copies of the text. The *Electronic Study Guide* is an interactive program with section-level quizzing, chapter pre- and post-tests, a handy calculator, and gradebook functionality, so students can track their progress. The data sets used in the text's examples and exercises are provided in a variety of formats, including MINITAB, TI Graph Link for TI-83 Plus, Microsoft Excel (for Windows and Macintosh), SPSS, and comma-delimited ASCII. These same data sets are also available for download on the book's Online Learning Center.)
- *Critical Thinking Workbook*, by James Condor of Manatee Community College, provides a number of additional challenging problems for students to solve that are drawn from real-world applications. Problems are keyed to each chapter and are designed to highlight and emphasize key concepts.
- *Student Study Guide* by Pat Foard of South Plains College 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, contains detailed solutions to all odd-numbered text problems.
- *MINITAB—Student Version.* This software and user manual provides the student with how-to information on data and file management, conducting various statistical analyses, and creating presentation-style graphics.
- *SPSS 10.0 CD-ROM with Ready, Set, Go!! A Student Guide to SPSS 10.0.* With this software and manual, students are guided step-by-step through ten assignments such as using frequency distribution, performing the *t*-test, using the one way ANOVA procedure, computing a correlation, and computing chi-square.

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