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

While a number of important changes have been made to the sixth edition, the learning system remains untouched and provides students with a useful framework in which to learn and apply concepts. Some of the retained features include the following:

- **Over 1800** 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 and 13 additional data sets using real data are 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 Sixth Edition

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

- **Over 300** new exercises have been added, **most using real data,** and many questions now incorporate thought-provoking questions requiring students to interpret their results.
- The text is updated throughout with current data and statistics including **44** new *Unusual Stats* and *Interesting Facts;* **7** new *Speaking of Statistics;* **5** new *Critical Thinking Challenges;* **2** new *Statistics Today* openers; **8** new worked examples; **14** new *Data Analysis Exercises;* and **5** new Data Sets.
- A new feature, *Applying the Concepts,* is added to each section and gives students an opportunity to think about the concepts and to apply them to hypothetical examples and scenarios similar to those found in newspapers, magazines, and news programs.
- The text layout and color palette have been redesigned to increase the readability and ease of use by students and instructors.

Based on user suggestions and reviewer comments on the fifth edition, the following improvements were made:

Chapter 1 Another example of interval-level data has been added. The explanation of random sampling was expanded so students would not have to refer to Chapter 14.

Chapter 2 The explanation of class, frequency, relative frequency, and open-ended frequency distributions was expanded. An explanation was given on how to analyze frequency distributions.

Chapter 3 A greater explanation was given of the mode, including bimodal and multimodal data sets. Also added were the range rule of thumb and an exercise on finding the median for grouped data.

Chapter 4 More detailed explanation was added on the use of the words *and* and *or* in classical probability. A tree diagram was included to help determine the sample space for Exercise 4–40.

Chapter 5 Coverage of discrete variables was expanded.

Chapter 6 An explanation was included on how the area under a continuous curve relates to a probability by using a uniform distribution. More information on the distribution of sample means was given.

Chapter 7 A brief explanation of the sampling distribution of a sample proportion was added.

Chapter 8 The explanation on using the *P*-value is now boxed.

Chapter 10 The concepts of independent and dependent variables and simple and multiple relationships were expanded. The topic of the relationship of the scatter plot to the strength of the correlation coefficient was moved from Section 10–4 to Section 10–3.

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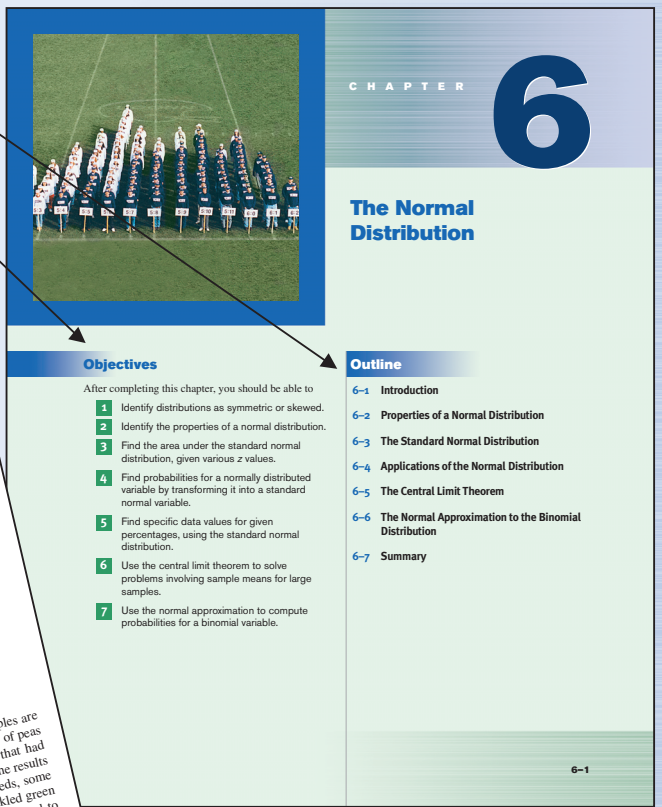
Guided Tour: Features and Supplements

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.



CHAPTER 6

The Normal Distribution

Objectives

After completing this chapter, you should be able to

1. Identify distributions as symmetric or skewed.
2. Identify the properties of a normal distribution.
3. Find the area under the standard normal distribution, given various *z* values.
4. Find probabilities for a normally distributed variable by transforming it into a standard normal variable.
5. Find specific data values for given percentages, using the standard normal distribution.
6. Use the central limit theorem to solve problems involving sample means for large samples.
7. Use the normal approximation to compute probabilities for a binomial variable.

Outline

6–1

Statistics Today

Statistics and Heredity

An Austrian monk, Gregor Mendel (1822–1884) studied genetics, and his principles are the foundation for modern genetics. Mendel used his spare time to grow a variety of peas at the monastery. One of his many experiments involved crossbreeding peas that had smooth yellow seeds with peas that had wrinkled green seeds. He noticed that the results occurred with regularity. That is, some of the offspring had smooth yellow seeds, some had smooth green seeds, some had wrinkled yellow seeds, and some had wrinkled green seeds. Furthermore, after several experiments, the percentages of each type seemed to remain approximately the same. Mendel formulated his theory based on the assumption of dominant and recessive traits and tried to predict the results. He then crossbred his peas and examined 556 seeds over the next generation.

Finally, he compared the actual results with the theoretical results to see if his theory was correct. To do this, he used a "simple" chi-square test, which is explained in this chapter. See Statistics Today—Revisited.

Source: J. Hodges, Jr., D. Krech, and R. Crutchfield, *Stat Lab, An Empirical Introduction to Statistics* (New York: McGraw-Hill, 1975), pp. 228–229. Used with permission.

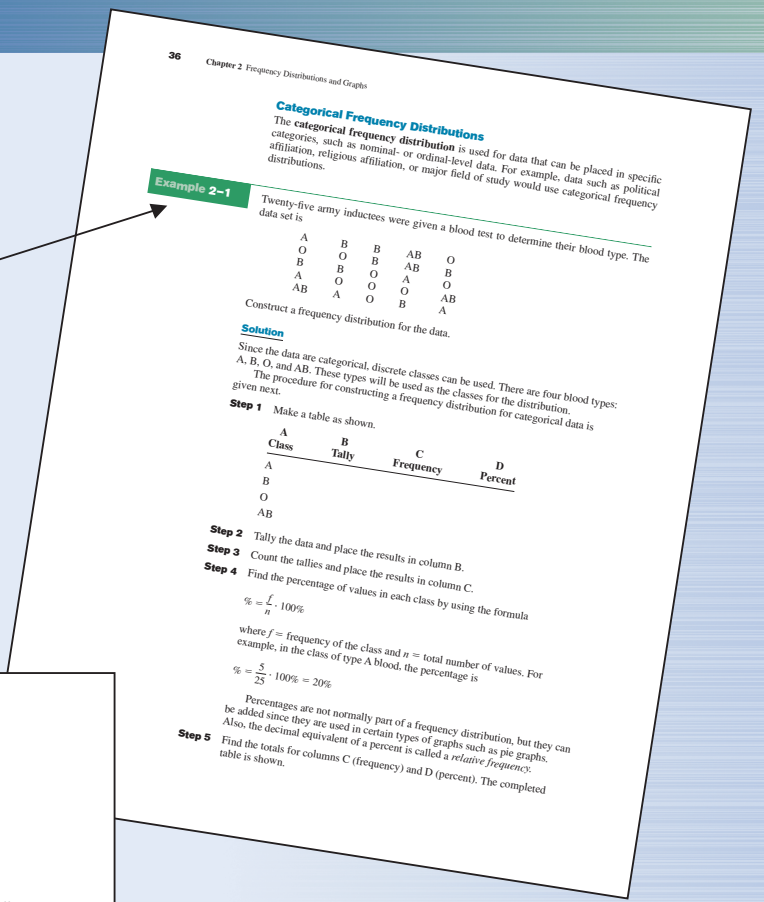
11–1 Introduction

The chi-square distribution was used in Chapters 7 and 8 to find a confidence interval for a variance or standard deviation and to test a hypothesis about a single variance or standard deviation.

It can also be used for tests concerning *frequency distributions*, such as "If a sample of buyers is given a choice of automobile colors, will each color be selected with the same frequency?" The chi-square distribution can be used to test the *independence* of

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.

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.



36 Chapter 2 Frequency Distributions and Graphs

Categorical Frequency Distributions

The **categorical frequency distribution** is used for data that can be placed in specific categories, such as nominal- or ordinal-level data. For example, data such as political affiliation, religious affiliation, or major field of study would use categorical frequency distributions.

Example 2–1

Twenty-five army inductees were given a blood test to determine their blood type. The data set is

A	B	B	AB	O
O	O	B	AB	B
B	B	O	A	O
A	O	O	O	AB
AB	A	O	B	A

Construct a frequency distribution for the data.

Solution

Since the data are categorical, discrete classes can be used. There are four blood types: A, B, O, and AB. These types will be used as the classes for the distribution.

The procedure for constructing a frequency distribution for categorical data is given next.

Step 1 Make a table as shown.

A Class	B Tally	C Frequency	D Percent
A			
B			
O			
AB			

Step 2 Tally the data and place the results in column B.

Step 3 Count the tallies and place the results in column C.

Step 4 Find the percentage of values in each class by using the formula

$$\% = \frac{f}{n} \cdot 100\%$$

where f = frequency of the class and n = total number of values. For example, in the class of type A blood, the percentage is

$$\% = \frac{5}{25} \cdot 100\% = 20\%$$

Percentages are not normally part of a frequency distribution, but they can be added since they are used in certain types of graphs such as pie graphs. Also, the decimal equivalent of a percent is called a *relative frequency*.

Step 5 Find the totals for columns C (frequency) and D (percent). The completed table is shown.

414 Chapter 8 Hypothesis Testing

55	42	125	62	134	73
39	69	23	94	73	24
51	55	26	66	41	67
15	53	56	91	20	78
70	25	62	115	17	36
58	56	33	75	20	16

Source: Based on information from the National Insurance Crime Bureau.

Using this information, answer these questions.

1. What are the hypotheses that you would use?
2. Is the sample considered small or large?
3. What assumption must be met before the hypothesis test can be conducted?
4. Which probability distribution would you use?
5. Would you select a one- or two-tailed test? Why?
6. What critical value(s) would you use?
7. Conduct a hypothesis test.
8. What is your decision?
9. What is your conclusion?
10. Write a brief statement summarizing your conclusion.
11. If you lived in a city whose population was about 50,000, how many automobile thefts per year would you expect to occur?

See page 460 for the answers.

Exercises 8–3

For Exercises 1 through 13, perform each of the following steps.

a. State the hypotheses and identify the claim.
b. Find the critical value(s).
c. Compute the test value.
d. Make the decision.
e. Summarize the results.

Use diagrams to show the critical region (or regions), and use the traditional method of hypothesis testing unless otherwise specified.

1. A survey claims that the average cost of a hotel room in Atlanta is $69.21. To test the claim, a researcher selects a sample of 30 hotel rooms and finds that the average cost is $68.43. The standard deviation of the population is $3.72. At $\alpha = 0.05$, is there enough evidence to reject the claim?

Source: *USA TODAY.*

2. It has been reported that the average credit card debt for college seniors is $3262. The student senate at a large university feels that their seniors have a debt much less than this, so it conducts a study of 50 randomly selected seniors and finds that the average debt is $2995 with a sample standard deviation of $1100. With $\alpha = 0.05$, is the student senate correct?

Source: *USA TODAY.*

3. A researcher estimates that the average revenue of the largest businesses in the United States is greater than $24 billion. A sample of 50 companies is selected, and the revenues (in billions of dollars) are shown. At $\alpha = 0.05$, is there enough evidence to support the researcher's claim?

178	122	91	44	35
61	56	46	20	32
30	28	28	20	27
29	16	16	19	15
41	38	36	15	25
31	30	19	19	19
24	16	15	15	19
25	25	18	14	15
24	23	17	17	22
22	21	20	17	20

Source: *N.Y. Times Almanac.*

4. Full-time Ph.D. students receive an average salary of $12,837 according to the U.S. Department of Education. The dean of graduate studies at a large state university feels that Ph.D. students in his state earn more than this. He surveys 44 randomly selected students and finds their average salary is $14,445 with a standard deviation of $1500. With $\alpha = 0.05$, is the dean correct?

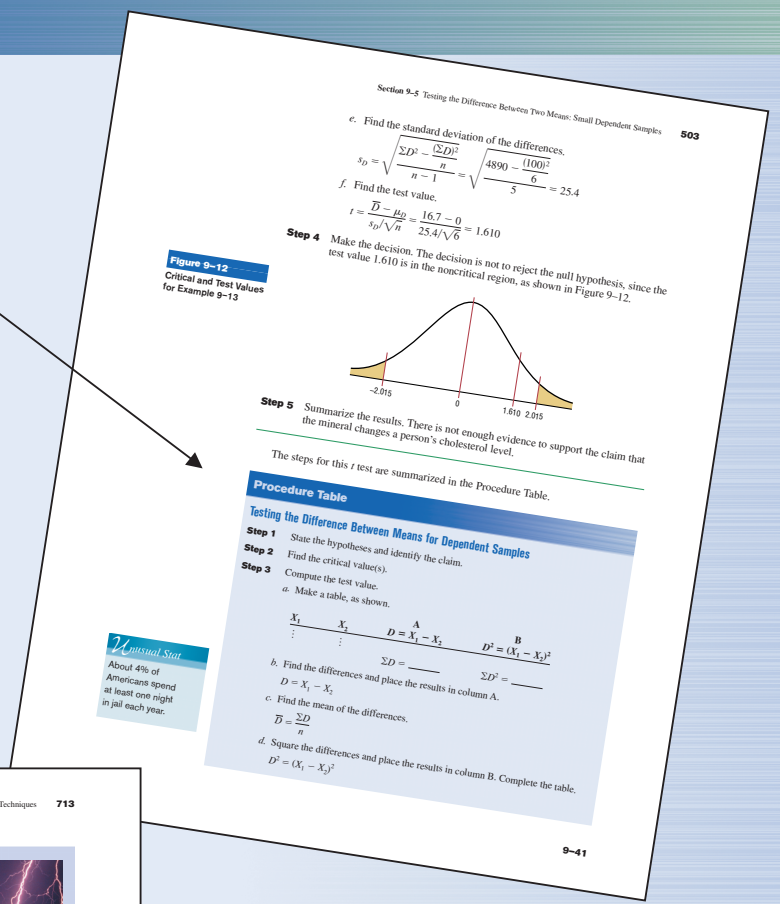
Source: U.S. Department of Education/*Chronicle of Higher Education.*

5. A report in *USA TODAY* stated that the average age of commercial jets in the United States is 14 years. An

8–24

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.

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



e. Find the standard deviation of the differences.

$$s_D = \sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{n}}{n-1}} = \sqrt{\frac{4890 - \frac{(100)^2}{6}}{5}} = 25.4$$

f. Find the test value.

$$t = \frac{\overline{D} - \mu_D}{s_D/\sqrt{n}} = \frac{16.7 - 0}{25.4/\sqrt{6}} = 1.610$$

Step 4 Make the decision. The decision is not to reject the null hypothesis, since the test value 1.610 is in the noncritical region, as shown in Figure 9–12.

Figure 9–12
Critical and Test Values for Example 9–13

Step 5 Summarize the results. There is not enough evidence to support the claim that the mineral changes a person's cholesterol level.

The steps for this *t* test are summarized in the Procedure Table.

Procedure Table

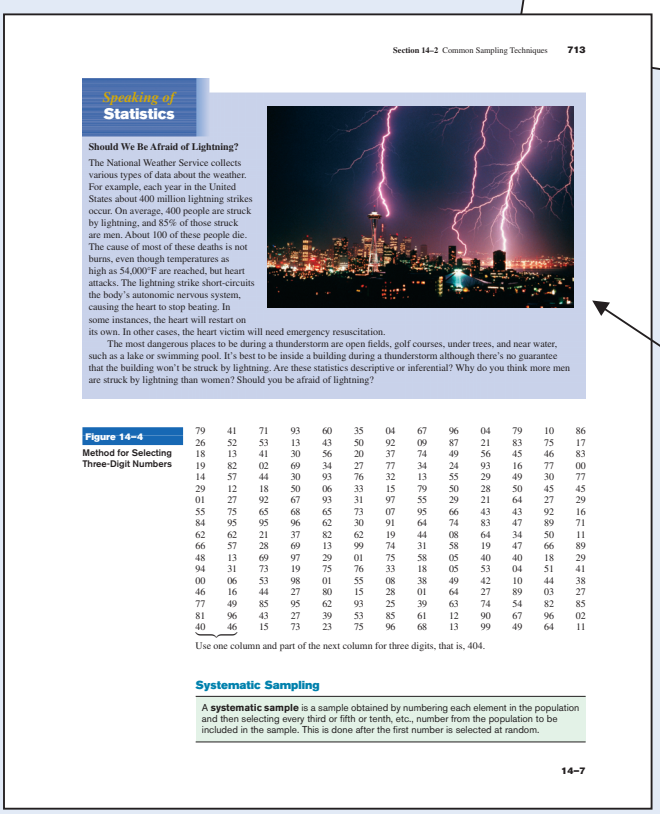
Testing the Difference Between Means for Dependent Samples

Step 1 State the hypotheses and identify the claim.
Step 2 Find the critical value(s).
Step 3 Compute the test value.
a. Make a table, as shown.

X_1	X_2	A $D = X_1 - X_2$	B $D^2 = (X_1 - X_2)^2$
⋮	⋮		
		$\Sigma D =$ ____	$\Sigma D^2 =$ ____

b. Find the differences and place the results in column A.
$D = X_1 - X_2$
c. Find the mean of the differences.
$\overline{D} = \frac{\Sigma D}{n}$
d. Square the differences and place the results in column B. Complete the table.
$D^2 = (X_1 - X_2)^2$

Unusual Stat
About 4% of Americans spend at least one night in jail each year.



Speaking of **Statistics**

Should We Be Afraid of Lightning?

The National Weather Service collects various types of data about the weather. For example, each year in the United States about 400 million lightning strikes occur. On average, 400 people are struck by lightning, and 85% of those struck are men. About 100 of these people die. The cause of most of these deaths is not burns, even though temperatures as high as 54,000°F are reached, but heart attacks. The lightning strike short-circuits the body's autonomic nervous system, causing the heart to stop beating. In some instances, the heart will restart on its own. In other cases, the heart victim will need emergency resuscitation.

The most dangerous places to be during a thunderstorm are open fields, golf courses, under trees, and near water, such as a lake or swimming pool. It's best to be inside a building during a thunderstorm although there's no guarantee that the building won't be struck by lightning. Are these statistics descriptive or inferential? Why do you think more men are struck by lightning than women? Should you be afraid of lightning?

Figure 14–4
Method for Selecting Three-Digit Numbers

79	41	71	93	60	35	04	67	96	04	79	10	86
26	52	53	13	43	50	92	09	87	21	83	75	17
18	13	41	30	56	20	37	74	49	56	45	46	83
19	82	02	69	34	27	77	34	24	93	16	77	00
14	57	44	30	93	76	32	13	55	29	49	30	77
29	12	18	50	06	33	15	79	50	28	50	45	45
01	27	92	67	93	31	97	55	29	21	64	27	29
55	75	65	68	65	73	07	95	66	43	43	92	16
84	95	95	96	62	30	91	64	74	83	47	89	71
62	62	21	37	82	62	19	44	08	64	34	50	11
66	57	28	69	13	99	74	31	58	19	47	66	89
48	13	69	97	29	01	75	58	05	40	40	18	29
94	31	73	19	75	76	33	18	05	53	04	51	41
00	06	53	98	01	55	08	38	49	42	10	44	38
46	16	44	27	80	15	28	01	64	27	89	03	27
77	49	85	95	62	93	25	39	63	74	54	82	85
81	96	43	27	39	53	85	61	12	90	67	96	02
40	46	15	73	23	75	96	68	13	99	49	64	11

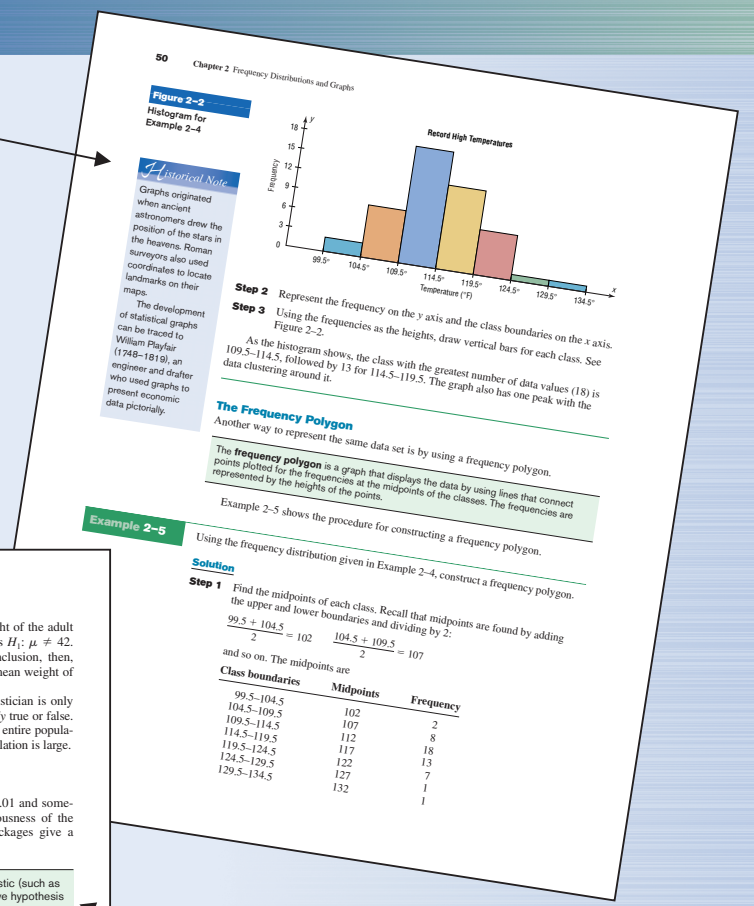
Use one column and part of the next column for three digits, that is, 404.

Systematic Sampling

A **systematic sample** is a sample obtained by numbering each element in the population and then selecting every third or fifth or tenth, etc., number from the population to be included in the sample. This is done after the first number is selected at random.

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.

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



50 Chapter 2 Frequency Distributions and Graphs

Figure 2–2 Histogram for Example 2–4

Historical Note

Graphs originated when ancient astronomers drew the position of the stars in the heavens. Roman surveyors also used coordinates to locate landmarks on their maps.

The development of statistical graphs can be traced to William Playfair (1748–1819), an engineer and drafter who used graphs to present economic data pictorially.

Step 2 Represent the frequency on the *y* axis and the class boundaries on the *x* axis.

Step 3 Using the frequencies as the heights, draw vertical bars for each class. See Figure 2–2.

As the histogram shows, the class with the greatest number of data values (18) is 109.5–114.5, followed by 13 for 114.5–119.5. The graph also has one peak with the data clustering around it.

The Frequency Polygon

Another way to represent the same data set is by using a frequency polygon.

The **frequency polygon** is a graph that displays the data by using lines that connect points plotted for the frequencies at the midpoints of the classes. The frequencies are represented by the heights of the points.

Example 2–5

Example 2–5 shows the procedure for constructing a frequency polygon.

Using the frequency distribution given in Example 2–4, construct a frequency polygon.

Solution

Step 1 Find the midpoints of each class. Recall that midpoints are found by adding the upper and lower boundaries and dividing by 2:

$$\frac{99.5 + 104.5}{2} = 102 \qquad \frac{104.5 + 109.5}{2} = 107$$

and so on. The midpoints are

Class boundaries	Midpoints	Frequency
99.5–104.5	102	2
104.5–109.5	107	8
109.5–114.5	112	18
114.5–119.5	117	13
119.5–124.5	122	7
124.5–129.5	127	1
129.5–134.5	132	1

410 Chapter 8 Hypothesis Testing

On the other hand, suppose the researcher claims that the mean weight of the adult animals is not 42 pounds. The claim would be the alternative hypothesis H_1: $\mu \neq 42$. Furthermore, suppose that the null hypothesis is not rejected. The conclusion, then, would be that there is not enough evidence to support the claim that the mean weight of the adult animals is not 42 pounds. See Figure 8–17(b).

Again, remember that nothing is being proved true or false. The statistician is only stating that there is or is not enough evidence to say that a claim is *probably* true or false. As noted previously, the only way to prove something would be to use the entire population under study, and usually this cannot be done, especially when the population is large.

P-Value Method for Hypothesis Testing

Statisticians usually test hypotheses at the common α levels of 0.05 or 0.01 and sometimes at 0.10. Recall that the choice of the level depends on the seriousness of the type I error. Besides listing an α value, many computer statistical packages give a *P*-value for hypothesis tests.

The ***P*-value** (or probability value) is the probability of getting a sample statistic (such as the mean) or a more extreme sample statistic in the direction of the alternative hypothesis when the null hypothesis is true.

In other words, the *P*-value is the actual area under the standard normal distribution curve (or other curve, depending on what statistical test is being used) representing the probability of a particular sample statistic or a more extreme sample statistic occurring if the null hypothesis is true.

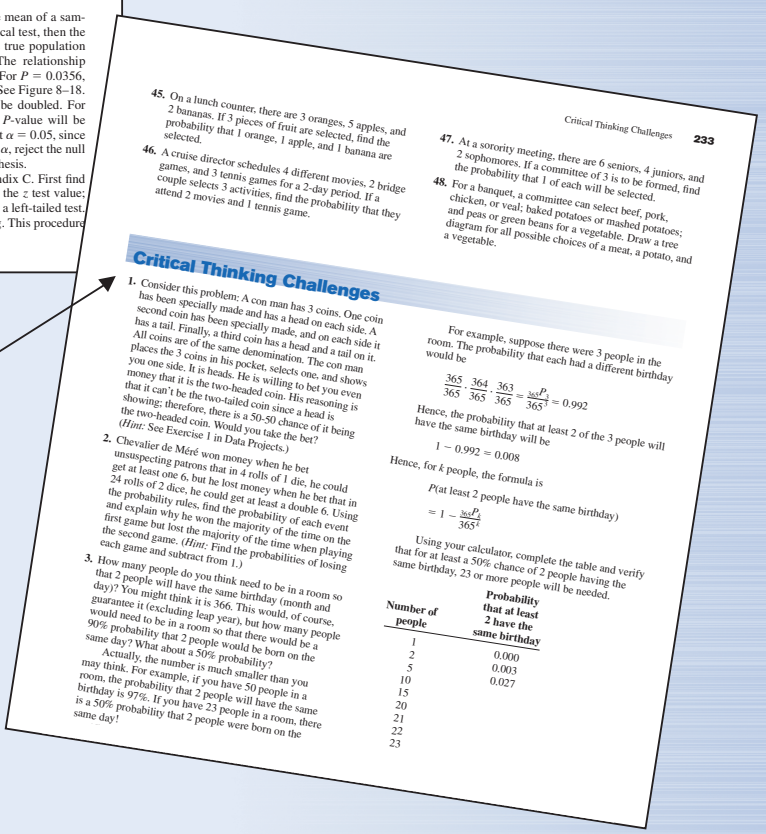
For example, suppose that a null hypothesis is H_0: $\mu \leq 50$ and the mean of a sample is $\bar{X} = 52$. If the computer printed a *P*-value of 0.0356 for a statistical test, then the probability of getting a sample mean of 52 or greater is 0.0356 if the true population mean is 50 (for the given sample size and standard deviation). The relationship between the *P*-value and the α value can be explained in this manner. For $P = 0.0356$, the null hypothesis would be rejected at $\alpha = 0.05$ but not at $\alpha = 0.01$. See Figure 8–18.

When the hypothesis test is two-tailed, the area in one tail must be doubled. For a two-tailed test, if α is 0.05 and the area in one tail is 0.0356, the *P*-value will be $2(0.0356) = 0.0712$. That is, the null hypothesis should not be rejected at $\alpha = 0.05$, since 0.0712 is greater than 0.05. In summary, then, if the *P*-value is less than α, reject the null hypothesis. If the *P*-value is greater than α, do not reject the null hypothesis.

The *P*-values for the *z* test can be found by using Table E in Appendix C. First find the area under the standard normal distribution curve corresponding to the *z* test value; then subtract this area from 0.5000 to get the *P*-value for a right-tailed or a left-tailed test. To get the *P*-value for a two-tailed test, double this area after subtracting. This procedure is shown in step 3 of Examples 8–6 and 8–7.

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

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 233

45. On a lunch counter, there are 3 oranges, 5 apples, and 2 bananas. If 3 pieces of fruit are selected, find the probability that 1 orange, 1 apple, and 1 banana are selected.

46. A cruise director schedules 4 different movies, 2 bridge games, and 3 tennis games for a 2-day period. If a couple selects 3 activities, find the probability that they attend 2 movies and 1 tennis game.

47. At a sorority meeting, there are 6 seniors, 4 juniors, and 2 sophomores. If a committee of 3 is to be formed, find the probability that 1 of each will be selected.

48. For a banquet, a committee can select beef, pork, chicken, or veal; baked potatoes or mashed potatoes; and peas or green beans for a vegetable. Draw a tree diagram for all possible choices of a meat, a potato, and a vegetable.

Critical Thinking Challenges

1. Consider this problem: A con man has 3 coins. One coin has been specially made and has a head on each side. A second coin has been specially made, and on each side it has a tail. Finally, a third coin has a head and a tail on it. All coins are of the same denomination. The con man places the 3 coins in his pocket, selects one, and shows you one side. It is heads. He is willing to bet you even money that it is the two-headed coin. His reasoning is that it can't be the two-tailed coin since a head is showing; therefore, there is a 50-50 chance of it being the two-headed coin. Would you take the bet? (*Hint:* See Exercise 1 in Data Projects.)

2. Chevalier de Méré won money when he bet unsuspecting patrons that in 4 rolls of 1 die, he could get at least one 6, but he lost money when he bet that in 24 rolls of 2 dice, he could get at least a double 6. Using the probability rules, find the probability of each event and explain why he won the majority of the time on the first game but lost the majority of the time when playing the second game. (*Hint:* Find the probabilities of losing each game and subtract from 1.)

3. How many people do you think need to be in a room so that 2 people will have the same birthday (month and day)? You might think it is 366. This would, of course, guarantee it (excluding leap year), but how many people would need to be in a room so that there would be a 90% probability that 2 people would be born on the same day? What about a 50% probability?

Actually, the number is much smaller than you may think. For example, if you have 50 people in a room, the probability that 2 people will have the same birthday is 97%. If you have 23 people in a room, there is a 50% probability that 2 people were born on the same day!

For example, suppose there were 3 people in the room. The probability that each had a different birthday would be

$$\frac{365}{365} \cdot \frac{364}{365} \cdot \frac{363}{365} = \frac{365P_3}{365^3} = 0.992$$

Hence, the probability that at least 2 of the 3 people will have the same birthday will be

$$1 - 0.992 = 0.008$$

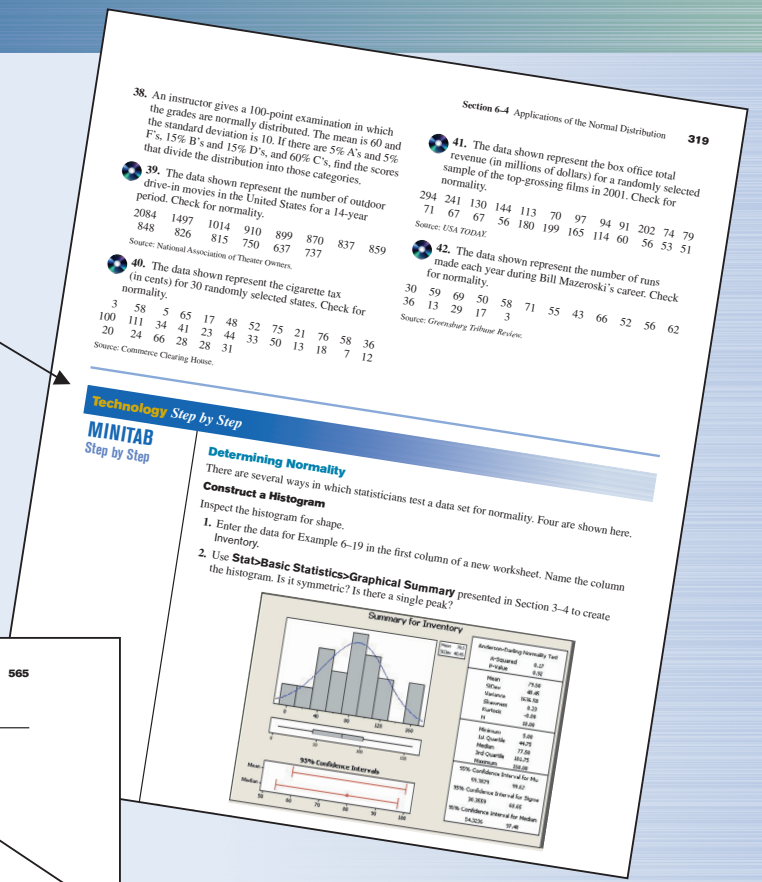
Hence, for *k* people, the formula is

$$P(\text{at least 2 people have the same birthday}) = 1 - \frac{365P_k}{365^k}$$

Using your calculator, complete the table and verify that for at least a 50% chance of 2 people having the same birthday, 23 or more people will be needed.

Number of people	Probability that at least 2 have the same birthday
1	0.000
2	0.003
5	0.027
10	
15	
20	
21	
22	
23	

At the end of appropriate sections, **Technology Step by Step** boxes show students how to use MINITAB, the TI-83 Plus and TI-84 Plus graphing calculators, 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.



Section 6–4 Applications of the Normal Distribution 319

38. An instructor gives a 100-point examination in which the grades are normally distributed. The mean is 60 and the standard deviation is 10. If there are 5% A's and 5% F's, 15% B's and 15% D's, and 60% C's, find the scores that divide the distribution into those categories.

39. The data shown represent the number of outdoor drive-in movies in the United States for a 14-year period. Check for normality.

2084 1497 1014 910 899 870 837 859
848 826 815 750 637 737

Source: National Association of Theater Owners.

40. The data shown represent the cigarette tax (in cents) for 30 randomly selected states. Check for normality.

3 58 5 65 17 48 52 75 21 76 58 36
100 111 34 41 23 44 33 50 13 18 7 12
20 24 66 28 28 31

Source: Commerce Clearing House.

41. The data shown represent the box office total revenue (in millions of dollars) for a randomly selected sample of the top-grossing films in 2001. Check for normality.

294 241 130 144 113 70 97 94 91 202 74 79
71 67 67 56 180 199 165 114 60 56 53 51

Source: USA TODAY.

42. The data shown represent the number of runs made each year during Bill Mazeroski's career. Check for normality.

30 59 69 50 58 71 55 43 66 52 56 62
36 13 29 17 3

Source: Greensburg Tribune Review.

Technology Step by Step

MINITAB Step by Step

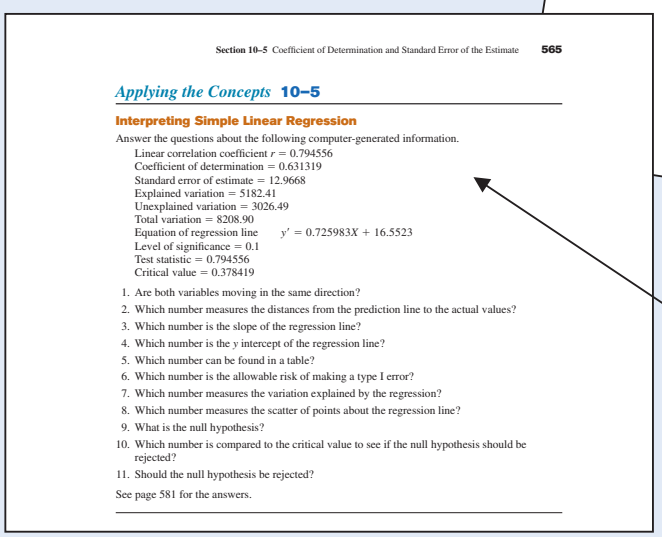
Determining Normality

There are several ways in which statisticians test a data set for normality. Four are shown here.

Construct a Histogram

Inspect the histogram for shape.

1. Enter the data for Example 6–19 in the first column of a new worksheet. Name the column Inventory.
2. Use **Stat>Basic Statistics>Graphical Summary** presented in Section 3–4 to create the histogram. Is it symmetric? Is there a single peak?



Section 10–5 Coefficient of Determination and Standard Error of the Estimate 565

Applying the Concepts **10–5**

Interpreting Simple Linear Regression

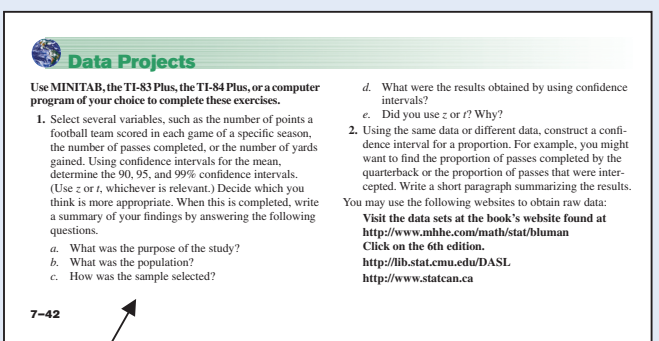
Answer the questions about the following computer-generated information.

Linear correlation coefficient $r = 0.794556$
Coefficient of determination = 0.631319
Standard error of estimate = 12.9668
Explained variation = 5182.41
Unexplained variation = 3026.49
Total variation = 8208.90
Equation of regression line $y' = 0.725983X + 16.5523$
Level of significance = 0.1
Test statistic = 0.794556
Critical value = 0.378419

1. Are both variables moving in the same direction?
2. Which number measures the distances from the prediction line to the actual values?
3. Which number is the slope of the regression line?
4. Which number is the y intercept of the regression line?
5. Which number can be found in a table?
6. Which number is the allowable risk of making a type I error?
7. Which number measures the variation explained by the regression?
8. Which number measures the scatter of points about the regression line?
9. What is the null hypothesis?
10. Which number is compared to the critical value to see if the null hypothesis should be rejected?
11. Should the null hypothesis be rejected?

See page 581 for the answers.

A new feature called **Applying the Concepts** has been added to the Sixth Edition. These exercises are found at the end of each section, and their purpose is to reinforce the concepts explained in the section. They give the student an opportunity to think about the concepts and apply them to hypothetical examples similar to real-life ones found in newspapers, magazines, and professional journals. Most contain open-ended questions—questions that require interpretation and may have more than one correct answer. These exercises can also be used as classroom discussion topics for instructors who like to use this type of teaching technique. The majority of these exercises were written and class-tested by Dr. James A. Condor and were previously published in *Critical Thinking Workbook.* The rest were written by the author.



Data Projects

Use MINITAB, the TI-83 Plus, the TI-84 Plus, or a computer program of your choice to complete these exercises.

1. Select several variables, such as the number of points a football team scored in each game of a specific season, the number of passes completed, or the number of yards gained. Using confidence intervals for the mean, determine the 90, 95, and 99% confidence intervals. (Use z or t, whichever is relevant.) Decide which you think is more appropriate. When this is completed, write a summary of your findings by answering the following questions.
   a. What was the purpose of the study?
   b. What was the population?
   c. How was the sample selected?
   d. What were the results obtained by using confidence intervals?
   e. Did you use z or t? Why?
2. Using the same data or different data, construct a confidence interval for a proportion. For example, you might want to find the proportion of passes completed by the quarterback or the proportion of passes that were intercepted. Write a short paragraph summarizing the results.

You may use the following websites to obtain raw data:

Visit the data sets at the book's website found at http://www.mhhe.com/math/stat/bluman
Click on the 6th edition.
http://lib.stat.cmu.edu/DASL
http://www.statcan.ca

7–42

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.

Supplements

Multimedia Supplements

MathZone—www.mathzone.com

McGraw-Hill's **MathZone 3.0** is a complete **web-based tutorial and course management system** for mathematics and statistics, designed for greater ease of use than any other system available. Free upon adoption of a McGraw-Hill textbook, the system enables instructors to **create and share courses and assignments** with colleagues, adjunct faculty members, and teaching assistants with only a few mouse clicks. All **assignments, exercises, e-Professor multimedia tutorials, video lectures, and NetTutor® live tutors** follow the textbook's learning objectives and problem-solving style and notation. Using MathZone's **assignment builder,** instructors can **edit questions and algorithms, import their own content,** and **create announcements and due dates** for homework and quizzes. MathZone's **automated grading function** reports the results of easy-to-assign algorithmically generated homework, quizzes, and tests. All student activity within MathZone is recorded and available through a **fully integrated gradebook** that can be downloaded to Microsoft Excel®. MathZone also is available on CD-ROM. (See "Supplements for the Student" for descriptions of the elements of MathZone.)

ALEKS

ALEKS (**A**ssessment and **LE**arning in **K**nowledge **S**paces) is an artificial intelligence-based system for mathematics learning, available over the web 24/7. Using unique adaptive questioning, ALEKS accurately assesses what topics each student knows and then determines exactly what each student is ready to learn next. ALEKS interacts with the students 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, and helping them master the course content more quickly and easily. Moreover, the new ALEKS 3.0 now links to text-specific videos, multimedia tutorials, and text book pages in PDF format. ALEKS also offers a robust classroom management system that allows instructors to monitor and direct student progress toward mastery of curricular goals. See www.highed.aleks.com.

Instructor's Testing and Resource CD-ROM (instructors only)

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, printable tests, and a print version of the test bank.

Text-Specific Videos

Available with this edition are text-specific DVDs that demonstrate key concepts and worked-out exercises from the text plus tutorials in using the TI-83 Plus and TI-84 Plus calculators, 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 through MathZone.

MINITAB Student Release 14

The student version of MINITAB statistical software is available with copies of the text. Ask your McGraw-Hill representative for details.

SPSS Student Version 13 for Windows

A student version of SPSS statistical software is available with copies of this text. Consult your McGraw-Hill representative for details.

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-13: 978–0–07–240094–6 (ISBN-10: 0–07–240094–3); CD only, ISBN-13: 978–0–07–240012–0 (ISBN-10: 0–07–240012–9). And remember, too, that the CD actually contains a printable, pdf-formatted version of the entire workbook!

Additional Videos Series (instructors only)

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.

Print Supplements

Annotated Instructors Edition (instructors only)

The Annotated Instructor's Edition contains answers to all exercises and tests. The answers to most questions are printed in red next to each problem. Answers not appearing on the page can be found in the Answer Appendix at the end of the book.

Instructor's Solutions Manual (instructors only)

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

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

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 Plus and TI-84 Plus Graphing Calculator Manual

This friendly, practical manual teaches students to learn about statistics and solve problems by using these calculators while following each text chapter.

Excel Manual

This workbook, specially designed to accompany the text, provides additional practice in applying the chapter concepts while using Excel.

Index of Applications

Elementary Statistics: A Step by Step Approach contains a large number of applications—in the text's Examples, Exercises, and Critical Thinking Challenges—to illuminate students' understanding of **how statistical concepts are practiced and incorporated into many diverse personal, professional, and academic fields.** You will find these applications on the pages listed.

CHAPTER 3

Data Description

CHAPTER 4

Probability and Counting Rules