Essentials of Statistics for Business and Economics 10th edition Camm Solutions Manual

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Solution and Answer Guide

Camm/Cochran/Fry/Ohlmann/Anderson/Sweeney/Williams, *Essentials of Statistics for Business and Economics*, 10e 9780357716014; Chapter 1: Data and Statistics

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Supplementary Exercises

1. ***Wall Street Journal* Subscriber Characteristics.** A *Wall Street Journal* (*WSJ*) subscriber survey asked 46 questions about subscriber characteristics and interests. State whether each of the following questions provides categorical or quantitative data. **LO 2**

   a. What is your age?

   b. Are you married?

   c. When did you first start reading the *WSJ*? High school, college, early career, midcareer, late career, or retirement?

   d. How long have you been in your present job or position?

   e. What type of vehicle are you considering for your next purchase? Nine response categories include sedan, sports car, SUV, minivan, and so on.

   Solutions:

   a. Quantitative

   b. Categorical

   c. Categorical

   d. Quantitative

   e. Categorical

2. **Comparing Tablet Computers.** Tablet PC Comparison provides a wide variety of information about tablet computers. The company's website enables consumers to easily compare different tablets using factors such as cost, type of operating system, display size, battery life, and CPU manufacturer. A sample of 10 tablet computers is shown in Table 1.6 (Tablet PC Comparison website). **LO 1, 2**

   a. How many elements are in this data set?

   b. How many variables are in this data set?

   c. Which variables are categorical and which variables are quantitative?

   d. What type of measurement scale is used for each of the variables?

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Table 1.6 Product Information for 10 Tablet Computers

Tablet	Cost ($)	Operating System	Display Size (inches)	Battery Life (hours)	CPU Manufacturer
Acer Iconia W510	599	Windows	10.1	8.5	Intel
Amazon Kindle Fire HD	299	Android	8.9	9	TI OMAP
Apple iPad 4	499	iOS	9.7	11	Apple
HP Envy X2	860	Windows	11.6	8	Intel
Lenovo ThinkPad Tablet	668	Windows	10.1	10.5	Intel
Microsoft Surface Pro	899	Windows	10.6	4	Intel
Motorola Droid XYboard	530	Android	10.1	9	TI OMAP
Samsung Ativ Smart PC	590	Windows	11.6	7	Intel
Samsung Galaxy Tab	525	Android	10.1	10	Nvidia
Sony Tablet S	360	Android	9.4	8	Nvidia

Solutions:

a. The 10 elements are the 10 tablet computers.

b. Five variables: Cost ($), Operating System, Display Size (inches), Battery Life (hours), and CPU Manufacturer

c. Categorical variables: Operating System and CPU Manufacturer

Quantitative variables: Cost ($), Display Size (inches), and Battery Life (hours)

d.

Variable	Measurement Scale
Cost ($)	Ratio
Operating system	Nominal
Display size (inches)	Ratio
Battery life (hours)	Ratio
CPU manufacturer	Nominal

3. **Tablet PCs: Cost, CPU, and Operating System.** Refer to Table 1.6. **LO 3**

a. What is the average cost for the tablets?

b. Compare the average cost of tablets with a Windows operating system to the average cost of tablets with an Android operating system.

c. What percentage of tablets use a CPU manufactured by TI OMAP?

d. What percentage of tablets use an Android operating system?

Solutions:

a. Average cost = 5829/10 = $582.90

b. Average cost with a Windows operating system = 3616/5 = $723.20

Average cost with an Android operating system = 1714/4 = $428.5

The average cost with a Windows operating system is much higher.

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c. Ten of 10 or 20% use a CPU manufactured by TI OMAP

d. Four of 10 or 40% use an Android operating system

4. **Comparing Phones.** Table 1.7 shows data for eight phones (*Consumer Reports*). The Overall Score, a measure of the overall quality for the phone, ranges from 0 to 100. Voice Quality has possible ratings of poor, fair, good, very good, and excellent. Talk Time is the manufacturer's claim of how long the phone can be used when it is fully charged. **LO 1, 2**

a. How many elements are in this data set?

b. For the variables Price, Overall Score, Voice Quality, and Talk Time, which variables are categorical and which variables are quantitative?

c. What scale of measurement is used for each variable?

Table 1.7 Data for Eight Phones

Brand	Model	Price ($)	Overall Score	Voice Quality	Talk Time (hours)
AT&T	CL84100	60	73	Excellent	7
AT&T	TL92271	80	70	Very Good	7
Panasonic	4773B	100	78	Very Good	13
Panasonic	6592T	70	72	Very Good	13
Uniden	D2997	45	70	Very Good	10
Uniden	D1788	80	73	Very Good	7
Vtech	DS6521	60	72	Excellent	7
Vtech	CS6649	50	72	Very Good	7

Solutions:

a. There are eight elements in this data set; each element corresponds to one of the eight models of cordless telephones.

b. Categorical variables: Voice Quality and Handset on Base

Quantitative variables: Price, Overall Score, and Talk Time

c. Price: ratio measurement

Overall score: interval measurement

Voice quality: ordinal measurement

Handset on base: nominal measurement

Talk time: ratio measurement

5. **Summarizing Phone Data.** Refer to the data set in Table 1.7. **LO 3**

a. What is the average price for the phones?

b. What is the average talk time for the phones?

c. What percentage of the phones have a voice quality of excellent?

Solutions:

a. Average price = 545/8 = $68.13

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b. Average talk time = 71/8 = 8.875 hours

c. Percentage rated Excellent: 2 of 8, 2/8 = 0.25, or 25%

6. **New Automobile Owners Survey.** J.D. Power and Associates surveys new automobile owners to learn about the quality of recently purchased vehicles. The following questions were asked in a J.D. Power Initial Quality Survey.

   a. Did you purchase or lease the vehicle?

   b. What price did you pay?

   c. What is the overall attractiveness of your vehicle's exterior? (Unacceptable, Average, Outstanding, or Truly Exceptional)

   d. What is your average miles per gallon?

   e. What is your overall rating of your new vehicle? (1- to 10-point scale with 1 Unacceptable and 10 Truly Exceptional)

   Indicate whether each question provides categorical or quantitative data. **LO 2**

   Solutions:

   a. Categorical

   b. Quantitative

   c. Categorical

   d. Quantitative

   e. Quantitative

7. **Airline Customer Satisfaction.** Many service companies collect data via a follow-up survey of their customers. For example, to ascertain customer sentiment, Delta Air Lines sends an email to customers immediately following a flight. Among other questions, Delta asks:

   How likely are you to recommend Delta Air Lines to others?

   The possible responses are:

Definitely Will	Probably Will	May or May Not	Probably Will Not	Definitely Will Not
❍	❍	❍	❍	❍

   Use this information to answer the following questions. **LO 2**

   a. Are the data collected by Delta in this example quantitative or categorical?

   b. What measurement scale is used?

   Solutions:

   a. Because there are five choices, the response is a categorical response.

   b. The five responses are the labels for the customer responses. A nominal scale is being used.

8. **Readership Poll.** *The Tennessean*, an online newspaper located in Nashville, Tennessee, conducts a daily poll to obtain reader opinions on a variety of current issues. In a recent poll, 762 readers responded to the following question: "If a constitutional amendment to ban a state

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income tax is placed on the ballot in Tennessee, would you want it to pass?" Possible responses were Yes, No, or Not Sure (*The Tennessean* website). **LO 1, 2, 3**

a. What was the sample size for this poll?

b. Are the data categorical or quantitative?

c. Would it make more sense to use averages or percentages as a summary of the data for this question?

d. Of the respondents, 67% said Yes, they would want it to pass. How many individuals provided this response?

Solutions:

a. 762

b. Categorical

c. Percentages

d. 0.67(762) = 510.54

510 or 511 respondents said they want the amendment to pass.

9. **College-Educated Workers.** Based on data from the U.S. Census Bureau, a Pew Research study showed that the percentage of employed individuals ages 25–29 who are college educated is at an all-time high. The study showed that the percentage of employed individuals aged 25–29 with at least a bachelor's degree in 2016 was 40%. In the year 2000, this percentage was 32%, in 1985 it was 25%, and in 1964 it was only 16% (Pew Research website). **LO 4**

a. What is the population being studied in each of the four years in which Pew has data?

b. What question was posed to each respondent?

c. Do responses to the question provide categorical or quantitative data?

Solutions:

a. The population is employed individuals in the United States aged 25–29.

b. Have you earned a bachelor's degree (or higher)?

c. Because the response is yes or no, the response is categorical.

10. **Driving with Cell Phones.** The Bureau of Transportation Statistics Omnibus Household Survey is conducted annually and serves as an information source for the U.S. Department of Transportation. In one part of the survey, the person being interviewed was asked to respond to the following statement: "Drivers of motor vehicles should be allowed to talk on a handheld cell phone while driving." Possible responses were strongly agree, somewhat agree, somewhat disagree, and strongly disagree. Forty-four respondents said that they strongly agree with this statement, 130 said that they somewhat agree, 165 said they somewhat disagree, and 741 said they strongly disagree with this statement (Bureau of Transportation website). **LO 2, 3**

a. Do the responses for this statement provide categorical or quantitative data?

b. Would it make more sense to use averages or percentages as a summary of the responses for this statement?

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c. What percentage of respondents strongly agree with allowing drivers of motor vehicles to talk on a handheld cell phone while driving?

d. Do the results indicate general support for or against allowing drivers of motor vehicles to talk on a handheld cell phone while driving?

Solutions:

a. Categorical

b. Percentages

c. 44 of 1080 respondents, approximately 4%, strongly agree with allowing drivers of motor vehicles to talk on a hand-held cell phone while driving.

d. 165 of the 1080 respondents or 15% of said they somewhat disagree and 741 or 69% said they strongly disagree. Thus, there does not appear to be general support for allowing drivers of motor vehicles to talk on a hand-held cell phone while driving.

11. **Driverless Cars Expected Soon.** A Gallup Poll utilizing a random sample of 1,503 adults ages 18 or older was conducted in April 2018. The survey indicated a majority of Americans (53%) say driverless cars will be common in the next 10 years (Gallup). The question asked was:

> Thinking about fully automated, "driverless cars," cars that use technology to drive and do not need a human driver, based on what you have heard or read, how soon do you think driverless cars will be commonly used in the [United States]?

Figure 1.7 shows a summary of results of the survey in a histogram indicating the percentage of the total responses in different time intervals. **LO 2, 3**

a. Are the responses to the survey question quantitative or categorical?

b. How many of the respondents said that they expect driverless cars to be common in the next 10 years?

c. How many respondents answered in the range 16–20 years?

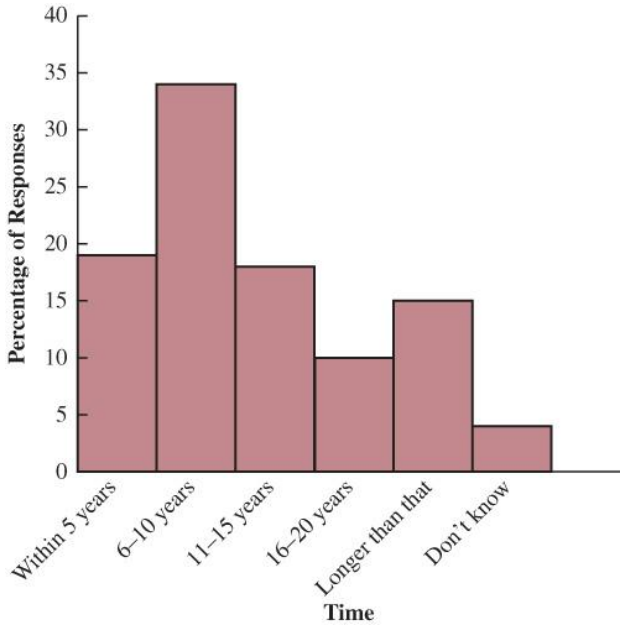


Figure 1.7 Histogram of Survey Results on Driverless Cars

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Solutions:

a. Since these are years, categorical.

b. 0.53(1503) = 796.59 or approximately 797

c. 0.10(1503) = 150.3 or approximately 150

12. **Hawaii Visitors Poll.** The Hawaii Visitors Bureau collects data on visitors to Hawaii. The following questions were among 16 asked in a questionnaire handed out to passengers during incoming airline flights.
    - This trip to Hawaii is my: first, second, third, fourth, etc.
    - The primary reason for this trip is: (10 categories, including vacation, convention, honeymoon)
    - Where I plan to stay: (11 categories, including hotel, apartment, relatives, camping)
    - Total days in Hawaii

    Use this information to answer the following questions. **LO 2, 4**

    a. What is the population being studied?

    b. Is the use of a questionnaire a good way to reach the population of passengers on incoming airline flights?

    c. Comment on each of the four questions in terms of whether it will provide categorical or quantitative data.

    Solutions:

    a. The population is all visitors coming to the state of Hawaii.

    b. Because airline flights carry the vast majority of visitors to the state, the use of questionnaires for passengers during incoming flights is a good way to reach this population. The questionnaire actually appears on the back of a mandatory plants and animals declaration form that passengers must complete during the incoming flight. A large percentage of passengers complete the visitor information questionnaire.

    c. The first and fourth questions provide quantitative data indicating the number of visits and the number of days in Hawaii. The second and third questions provide categorical data indicating the categories of reason for the trip and where the visitor plans to stay.

13. **Netflix Subscribers.** Figure 1.8 provides a bar chart showing the number of Netflix subscribers from 2011 to 2020 *(nscreenmedia.com).* **LO 1, 2**

    a. What is the variable of interest?

    b. Are the data categorical or quantitative?

    c. Are the data time series or cross-sectional?

    d. Comment on the trend in Netflix subscribers over time.

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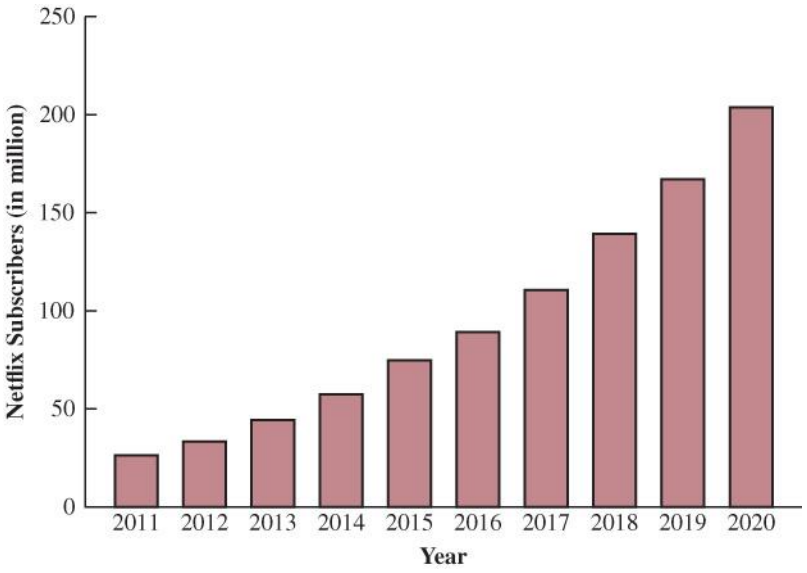


Figure 1.8 Netflix Subscribers (millions)

Solutions:

a. Number of Netflix subscribers.

b. Quantitative

c. Time series

d. The number of Netflix subscribers is increasing at an increasing rate over time.

14. **Rental Car Fleet Size.** The following data show the number of rental cars in service (in thousands) for three rental car companies: Hertz, Avis, and Dollar over a four-year period *(Auto Rental News* website). **LO 2**

	Cars in Service (1000s)			
Company	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Hertz	327	311	286	290
Dollar	167	140	106	108
Avis	204	220	300	270

a. Construct a time series graph for years 1 through 4 showing the number of rental cars in service for each company. Show the time series for all three companies on the same graph.

b. Comment on who appears to be the market share leader and how the market shares are changing over time.

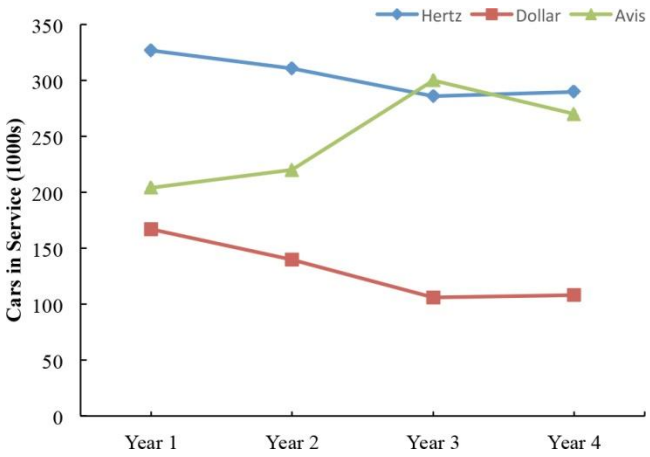
c. Construct a bar chart showing rental cars in service for year 4. Is this chart based on cross-sectional or time series data?

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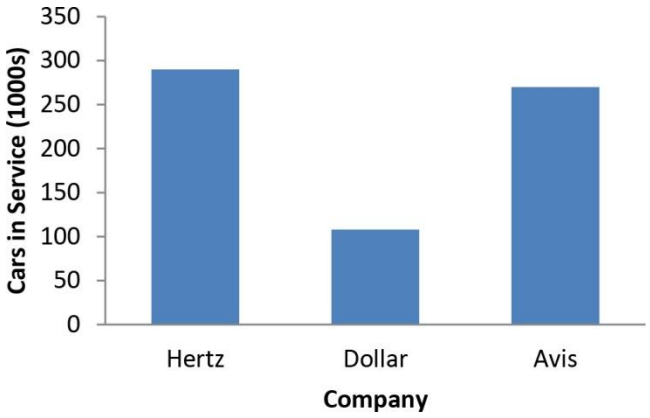
Solutions:

a. The graph of the time series follows:



b. In year 1 and year 2, Hertz was the clear market share leader. In year 3 and year 4, Hertz and Avis have approximately the same market share. The market share for Dollar appears to be declining.

c. The bar chart for year 4 follows, based on cross-sectional data.



15. **Worldwide Robot Supply.** The International Federation of Robotics estimates the worldwide supply of industrial robots each year. Figure 1.9 shows estimates of the worldwide supply of industrial robots for the years 2015 to 2021. **LO 1, 2**

a. What is the variable of interest?

b. Are the data quantitative or categorical?

c. Are the data cross-sectional or time series?

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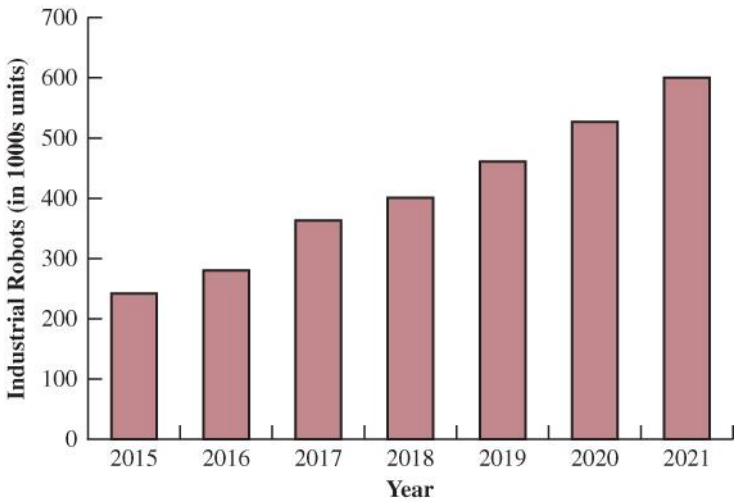


Figure 1.9 Estimated Industrial Robot Supply (1000s units)

Solutions:

a. Estimated supply of industrial robots worldwide.

b. Quantitative

c. Time series

16. **Athletic Shoe Sales.** Skechers U.S.A., Inc., is a performance footwear company headquartered in Manhattan Beach, California. The sales revenue for Skechers over a four-year period are as follows:

Year 1	Sales ($ billion)
Year 1	2.30
Year 2	3.15
Year 3	3.56
Year 4	4.16

Use this information to answer the following questions. **LO 2, 3**

a. Are these cross-sectional or time-series data?

b. Construct a bar graph similar to Figure 1.2 B.

c. What can you say about how Skecher's sales are changing over these four years?

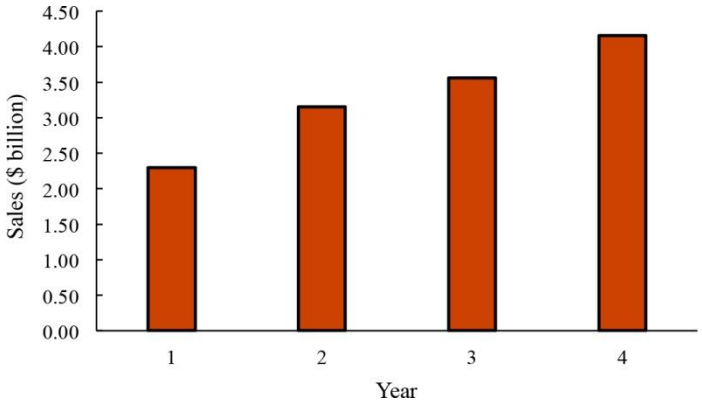
Solutions:

a. Time series

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b.



c. Sales appear to be increasing in a linear fashion.

17. **Deciding on a Salary Increase.** A manager of a large corporation recommends a $10,000 raise be given to keep a valued subordinate from moving to another company. What internal and external sources of data might be used to decide whether such a salary increase is appropriate? **LO 5**

Solutions:
Internal data on salaries of other employees can be obtained from the personnel department. External data might be obtained from the Department of Labor or industry associations.

18. **Tax Survey.** A random telephone survey of 1021 adults (aged 18 and older) was conducted by Opinion Research Corporation on behalf of CompleteTax, an online tax preparation and e-filing service. The survey results showed that 684 of those surveyed planned to file their taxes electronically (CompleteTax Tax Prep Survey). **LO 3**

a. Develop a descriptive statistic that can be used to estimate the percentage of all taxpayers who file electronically.

b. The survey reported that the most frequently used method for preparing the tax return is to hire an accountant or professional tax preparer. If 60% of the people surveyed had their tax return prepared this way, how many people used an accountant or professional tax preparer?

c. Other methods that the person filing the return often used include manual preparation, use of an online tax service, and use of a software tax program. Would the data for the method for preparing the tax return be considered categorical or quantitative?

Solutions:
a. 684/1021; or approximately 67%

b. 612

c. Categorical

19. **Magazine Subscriber Survey.** A *Bloomberg Businessweek* North American subscriber study collected data from a sample of 2,861 subscribers. Fifty-nine percent of the respondents indicated an annual income of $75,000 or more, and 50% reported having an American Express credit card. **LO 2, 4, 5, 6**

a. What is the population of interest in this study?

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b. Is annual income a categorical or quantitative variable?

c. Is ownership of an American Express card a categorical or quantitative variable?

d. Does this study involve cross-sectional or time series data?

e. Describe any statistical inferences *Bloomberg Businessweek* might make on the basis of the survey.

Solutions:

a. All subscribers of *Businessweek* in North America at the time the survey was conducted.

b. Quantitative

c. Categorical (yes or no)

d. Cross-sectional: All data relate to the same time.

e. Using the sample results, we could infer or estimate 59% of the population of subscribers has an annual income of $75,000 or more and 50% of the population of subscribers has an American Express credit card.

20. **Investment Manager Survey.** A survey of 131 investment managers in *Barron's* Big Money poll revealed the following:

- 43% of managers classified themselves as bullish or very bullish on the stock market.
- The average expected return over the next 12 months for equities was 11.2%.
- 21% selected health care as the sector most likely to lead the market in the next 12 months.
- When asked to estimate how long it would take for technology and telecom stocks to resume sustainable growth, the managers' average response was 2.5 years.

Use this information to answer the following questions. **LO 3, 7**

a. Cite two descriptive statistics.

b. Make an inference about the population of all investment managers concerning the average return expected on equities over the next 12 months.

c. Make an inference about the length of time it will take for technology and telecom stocks to resume sustainable growth.

Solutions:

a. 43% of managers were bullish or very bullish; 21% of managers expected health care to be the leading industry over the next 12 months.

b. We estimate the average 12-month return estimate for the population of investment managers to be 11.2%.

c. We estimate the average over the population of investment managers to be 2.5 years.

21. Cancer Research. A seven-year medical research study reported that women whose mothers took the drug diethylstilbestrol (DES) during pregnancy were twice as likely to develop tissue abnormalities that might lead to cancer as were women whose mothers did not take the drug. **LO 3, 4, 5**

a. This study compared two populations. What were the populations?

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b. Do you suppose the data were obtained in a survey or an experiment?

c. For the population of women whose mothers took the drug DES during pregnancy, a sample of 3980 women showed that 63 developed tissue abnormalities that might lead to cancer. Provide a descriptive statistic that could be used to estimate the number of women out of 1000 in this population who have tissue abnormalities.

d. For the population of women whose mothers did not take the drug DES during pregnancy, what is the estimate of the number of women out of 1000 who would be expected to have tissue abnormalities?

e. Medical studies often use a relatively large sample (in this case, 3980). Why?

Solutions:

a. The two populations are the population of women whose mothers took the drug DES during pregnancy and the population of women whose mothers did not take the drug DES during pregnancy.

b. It was a survey.

c. 63/3.980 = 15.8 women out of each 1000 developed tissue abnormalities.

d. The article reported "twice" as many abnormalities in the women whose mothers had taken DES during pregnancy. Thus, a rough estimate would be 15.8/2 = 7.9 abnormalities per 1000 women whose mothers had *not* taken DES during pregnancy.

e. In many situations, disease occurrences are rare and affect only a small portion of the population. Large samples are needed to collect data on a reasonable number of cases where the disease exists.

22. **Why People Move.** A survey conducted by Better Homes and Gardens Real Estate LLC showed that one in five U.S. homeowners has either moved from their home or would like to move because their neighborhood or community isn't ideal for their lifestyle (Better Homes and Gardens Real Estate website). The top lifestyle priorities of respondents when searching for their next home include ease of commuting by car, access to health and safety services, family-friendly neighborhood, availability of retail stores, access to cultural activities, public transportation access, and nightlife and restaurant access. Suppose a real estate agency in Denver, Colorado, hired you to conduct a similar study to determine the top lifestyle priorities for clients that currently have a home listed for sale with the agency or have hired the agency to help them locate a new home. **LO 4, 5**

a. What is the population for the survey you will be conducting?

b. How would you collect the data for this study?

Solutions:

a. The population consists of all clients who currently have a home listed for sale with the agency or who have hired the agency to help them locate a new home.

b. Some of the ways that could be used to collect the data are as follows:
- A survey could be mailed to each of the agency's clients.
- Each client could be sent an e-mail with a survey attached.
- The next time one of the firms agents meets with a client they could conduct a personal interview to obtain the data.

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23. Investment in Cryptocurrency. Pew Research Center is a nonpartisan polling organization that provides information about issues, attitudes, and trends. In a poll of 10,371 adults in the United States, Pew found that 16% of those polled have used, invested in, or traded digital currency known as cryptocurrency. Of those who responded to the poll, 22% of men and 10% of women indicated that they had used, invested in, or traded cryptocurrency. **LO 4**

a. To what population does the statistic 16% refer?

b. To what population does the statistic 10% refer?

c. Do you think Pew researchers conducted a census or took a sample to obtain their results? Explain your answer.

Solutions:

a. The population is all adults in the United States.

b. The population is all adult women in the United States.

c. Pew Research conducted a sample survey. It would not be practical to conduct a census because it would take too much time and money to do so.

24. Midterm Grades. A sample of midterm grades for five students showed the following results: 72, 65, 82, 90, 76. Which of the following statements are correct, and which should be challenged as being too generalized? **LO 3, 4**

a. The average midterm grade for the sample of five students is 77.

b. The average midterm grade for all students who took the exam is 77.

c. An estimate of the average midterm grade for all students who took the exam is 77.

d. More than half of the students who take this exam will score between 70 and 85.

e. If five other students are included in the sample, their grades will be between 65 and 90.

Solutions:

a. This is a statistically correct descriptive statistic for the sample.

b. An incorrect generalization because the data were not collected for the entire population.

c. An acceptable statistical inference based on the use of the word *estimate*.

d. Although this statement is true for the sample, it is not a justifiable conclusion for the entire population.

e. This statement is not statistically supportable. Although it is true for the particular sample observed, it is entirely possible and even highly likely that at least some students will be outside the 65 to 90 range of grades.

25. Comparing Compact SUVs. *Consumer Reports* evaluates products for consumers. The file *CompactSUV* contains the data shown in Table 1.8 for 15 compact sports utility vehicles (SUVs) from the 2018 model line (*Consumer Reports* website):

Make—manufacturer
Model—name of the model
Overall score—awarded based on a variety of measures, including those in this data set
Recommended—*Consumer Reports* recommends the vehicle or not

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Owner satisfaction—satisfaction on a five-point scale based on the percentage of owners who would purchase the vehicle again (– –, –, 0, +, ++).
Overall miles per gallon—miles per gallon achieved in a 150-mile test trip Acceleration (0–60 sec)—time in seconds it takes vehicle to reach 60 miles per hour from a standstill with the engine idling **LO 1, 2, 3**

a. How many variables are in the data set?

b. Which of the variables are categorical, and which are quantitative?

c. What percentage of these 15 vehicles are recommended?

d. What is the average of the overall miles per gallon across all 15 vehicles?

e. For owner satisfaction, construct a bar chart similar to Figure 1.4.

f. Show the frequency distribution for acceleration using the following intervals: 7.0–7.9, 8.0–8.9, 9.0–9.9, and 10.0–10.9. Construct a histogram similar to Figure 1.5.

Table 1.8 *Consumer Reports* Data Set for 15 Compact Sports Utility Vichicles

Make	Model	Overall Score	Recommended	Owner Satisfaction	Overall Miles Per Gallon	Acceleration (0–60) Sec
Subaru	Forester	84	Yes	+	26	8.7
Honda	CRV	83	Yes	++	27	8.6
Toyota	Rav4	81	Yes	++	24	9.3
Nissan	Rogue	73	Yes	+	24	9.5
Mazda	CX-5	71	Yes	++	24	8.6
Kia	Sportage	71	Yes	+	23	9.6
Ford	Escape	69	Yes	0	23	10.1
Volkswagen	Tiguan Limited	67	No	0	21	8.5
Volkswagen	Tiguan	65	No	+	25	10.3
Mitsubishi	Outlander	63	No	0	24	10.0
Chevrolet	Equinox	63	No	0	31	10.1
Hyundai	Tucson	57	No	0	26	8.4
GMC	Terrain	57	No	0	22	7.2
Jeep	Cherokee	55	No	–	22	10.9
Jeep	Compass	50	No	0	24	9.8

Solutions:

a. There are five variables: Overall Score, Recommended, Owner Satisfaction, Overall Miles Per Gallon, and Acceleration (0–60) Sec.

b. Categorical variables: Recommended, Owner Satisfaction

Quantitative variables: Overall Score, Overall Miles Per Gallon, Acceleration (0–60) Sec

c. 7/15 or 47% are recommended

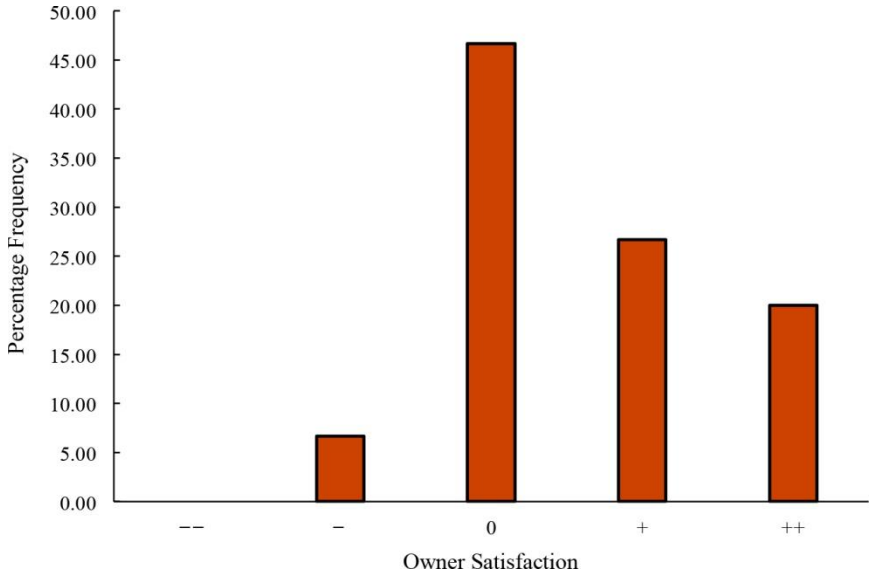
d. 24.4 miles per gallon

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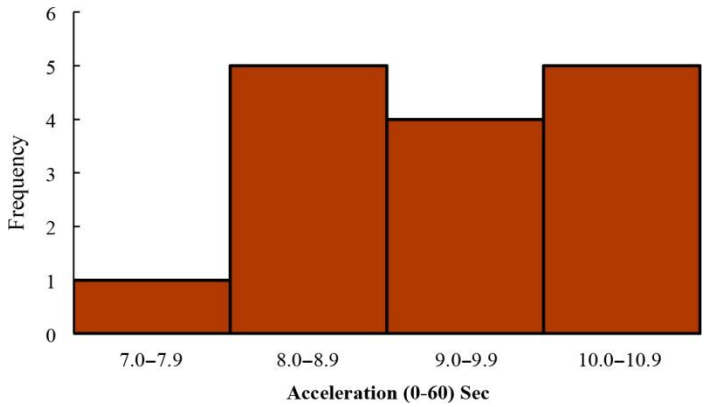
e.

Response	Percentage
– –	0.00
–	6.67
0	46.67
+	26.67
++	20.00



f.

Acceleration (0–60) Sec	Frequency
7.0–7.9	1
8.0–8.9	5
9.0–9.9	4
10.0–10.9	5



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Chapter 1 – Data and Statistics

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Purpose and Perspective of the Chapter

The term statistics refers to numerical facts such as averages, medians, percentages, and maximums that help us understand a variety of business and economic situations. Statistics can also refer to the art and science of collecting, analyzing, presenting, and interpreting data. In this text, we emphasize the use of statistics for business and economic decision-making.

Section 1.1 begins by introducing applications of statistics in business and economics. In Section 1.2, we define the term data, and introduce the concept of a data set and how it is characterized. Section 1.3 discusses how data can be obtained from existing sources or through surveys and experimental studies designed to obtain new data. Sections 1.4 and 1.5 describe the uses of data in developing descriptive statistics and making statistical inferences. The chapter closes with miscellaneous introductory topics in statistics.

Cengage Supplements

Additional instructor and student resources for this product are available online at www.cengage.com.

List of Instructor Downloads

The following product-level supplements provide additional information that may help you prepare for your course. They are available in the Instructor Resource Center.

- Solutions and Answers Guide.
- Educator's Guide.
- PowerPoint slides
- Test bank powered by Cognero.

List of Student Downloads

Students should download the following items from the Student Companion Center to complete the activities and assignments:

- Excel datasets.
- Excel workbooks.

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Chapter Objectives

This chapter addresses the following objectives:

LO 1-1 Identify the elements, variables, and observations in a data set.

LO 1-2 Identify categorical, quantitative, cross-sectional, and time-series data and their scale of measurement.

LO 1-3 Identify and create descriptive statistics of a data set.

LO 1-4 Distinguish between a population and a sample and identify the population being studied.

LO 1-5 Distinguish between data generated from a survey versus an experiment and when each is appropriate.

LO 1-6 Describe the data and sources of data that might be needed to answer a question.

LO 1-7 Make an inference based on descriptive statistics.

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Complete List of Chapter Activities and Assessments

For additional guidance, refer to the Teaching Online Guide.

Chapter Objective	PPT slide	Activity/Assessment	Duration
1-1	6-7	Activity in PPT	20 minutes
1-2	8-11	Activity in PPT	40 minutes
1-3	15	Activity in PPT	10 minutes
1-4	16	Activity in PPT	10 minutes
1-5	13	Activity in PPT	10 minutes
1-6	12-13	Activity in PPT	20 minutes
1-7	16-17	Activity in PPT	20 minutes

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Key Terms

Analytics The scientific process of transforming data into insight for making better decisions.

Big Data A set of data that cannot be managed, processed, or analyzed with commonly available software in a reasonable amount of time. Big data are characterized by great volume (a large amount of data), high velocity (fast collection and processing), or wide variety (could include nontraditional data such as video, audio, and text).

Categorical data Labels or names used to identify an attribute of each element. Categorical data use either the nominal or ordinal scale of measurement and may be nonnumeric or numeric.

Categorical variable A variable with categorical data.

Census A survey to collect data on the entire population.

Cross-sectional data Data collected at the same or approximately the same point in time.

Data The facts and figures collected, analyzed, and summarized for presentation and interpretation.

Data mining The process of using procedures from statistics and computer science to extract useful information from extremely large databases.

Data set All the data collected in a particular study.

Descriptive Analytics The set of analytical techniques that describe what has happened in the past.

Descriptive statistics Tabular, graphical, and numerical summaries of data.

Elements The entities on which data are collected.

Interval scale The scale of measurement for a variable if the data demonstrate the properties of ordinal data and the interval between values is expressed in terms of a fixed unit of measure. Interval data are always numeric.

Nominal scale The scale of measurement for a variable when the data are labels or names used to identify an attribute of an element. Nominal data may be non-numeric or numeric.

Observation The set of measurements obtained for a particular element.

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Ordinal scale The scale of measurement for a variable if the data exhibit the properties of nominal data and the order or rank of the data is meaningful. Ordinal data may be nonnumeric or numeric.

Population The set of all elements of interest in a particular study.

Predictive Analytics The set of analytical techniques that use models constructed from past data to predict the future or assess the impact of one variable on another.

Prescriptive Analytics The set of analytical techniques that yield a best course of action.

Quantitative data Numeric values that indicate how much or how many of something. Quantitative data are obtained using either the interval or ratio scale of measurement.

Quantitative variable A variable with quantitative data.

Ratio scale The scale of measurement for a variable if the data demonstrate all the properties of interval data and the ratio of two values is meaningful. Ratio data are always numerical.

Sample A subset of the population.

Sample survey A survey to collect data on a sample.

Statistical inference The process of using data obtained from a sample to make estimates or test hypotheses about the characteristics of a population.

Statistics The art and science of collecting, analyzing, presenting, and interpreting data.

Time series data Data collected over several time periods.

Variable A characteristic of interest for the elements.

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Chapter Outline

I. Introduction (PPT slide 4)

1. The term **statistics** refers to numerical facts such as averages, medians, percentages, and maximums that help us understand a variety of business and economic situations.
2. Statistics can also refer to the art and science of collecting, analyzing, presenting, and interpreting data.
3. In this text, we emphasize the use of statistics for business and economic decision-making.
   (1) Section 1.1 begins by introducing applications of statistics in business and economics.
   (2) In Section 1.2, we define the term data, and introduce the concept of a data set and how it is characterized.
   (3) Section 1.3 discusses how data can be obtained from existing sources or through surveys and experimental studies designed to obtain new data.
   (4) Sections 1.4 and 1.5 describe the uses of data in developing descriptive statistics and making statistical inferences.
   (5) The chapter closes with miscellaneous introductory topics in statistics.

II. 1.1 Applications in Business and Economics (PPT slides 5)

1. **Accounting**: public accounting firms use statistical sampling procedures when conducting audits for their clients.
2. **Economics**: economists use statistical information in making forecasts about the future of the economy or some aspect of it.
3. **Finance**: financial advisors use price-earnings ratios and dividend yields to guide their investment advice.
4. **Marketing**: electronic point-of-sale scanners at retail checkout counters are used to collect data for a variety of marketing research applications.
5. **Production**: a variety of statistical quality control charts are used to monitor the output of a production process.
6. **Information Systems**: a variety of statistical information helps administrators assess the performance of computer networks.

III. 1.2 Data (PPT slides 6-11)

a. 1.2 Data

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1. **Data** are the facts and figures collected, analyzed, and summarized for presentation and interpretation.
2. **Elements** are the entities on which data are collected.
3. A **variable** is a characteristic of interest for the elements.
4. A **data set** consists of all the data collected for a particular study.
    (1) The total number of data values in a complete data set is the number of elements multiplied by the number of variables.
5. An **observation** is the set of **measurements** obtained for a particular element.
    (1) A data set with *n* elements contains *n* observations.

b. 1.2 Data Set for 60 Nations in the World Trade Organization
1. DATAfile: *Nations*
2. Shown here are the first five nations out of 60 (rows) of a table including several variables (columns.)
    (1) The first observation (Armenia) contains the measurements: Member, 4,267, B+, and Stable.
    (2) The second observation (Australia) contains the measurements: Member, 51,812, AAA, and Negative.
    (3) And so on.

c. 1.2 Nominal and Ordinal Scales of Measurement
1. **Nominal scale**: the data are labels or names used to identify an attribute of the element.
    (1) Example: the WTO Status variable in the Nations table has a nominal scale of measurement because it uses the data "Member" and "Observer" are labels used to identify the status category for a nation.
    (2) Note: a numeric code may also be used. For example, we could use the label "1" to identify a "Member" status category and "2" to identify an "Observer" status category.
2. **Ordinal scale**: the data have the properties of nominal data, and the order or rank of the data is meaningful.
    (1) Example: the Fitch Rating variable in the Nations table has an ordinal scale of measurement because the labels, which range from AAA to F, are rank-ordered by credit rating.
    (2) Note: ordinal data can also be recorded by a numerical code, such as a student's class rank in school.

d. 1.2 Interval and Ratio Scales of Measurement

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1. **Interval scale**: the data have the properties of ordinal data, and the interval between observations is expressed in terms of a fixed unit of measure. Data with an interval scale of measurement are always numerical.
    (1) Example: College admission SAT scores have an interval scale of measurement.
    (2) Note: the difference between the values of a variable with an interval scale of measurement are always meaningful.
2. **Ratio scale**: the data have the properties of interval data, and the ratio of two values is meaningful.
    (1) Example: variables such as distance, height, weight, and time use the ratio scale of measurement.
    (2) Note: the ratio scale of measurement requires that a zero value be included to indicate that nothing exists for the variable at the zero point.

e. 1.2 Categorical and Quantitative Data
1. Data can be further classified as **categorical** or **quantitative**.
2. The statistical analysis that is appropriate depends on whether the data for the variable are categorical or quantitative.
3. Categorical Data
    (1) A **categorical variable** is a variable with categorical data.
    (2) Statistical analyses are rather limited.
    (3) We can summarize categorical data by:
        (a) counting the number of observations in each category
        (b) computing the proportion of the observations in each category
4. Quantitative Data
    (1) A **quantitative variable** is a variable with quantitative data.
    (2) Quantitative data indicate *how many* or *how much* and are always numerical.
    (3) Ordinary arithmetic operations are meaningful for quantitative data.
    (4) More alternatives for statistical analysis are available when the data are quantitative.

f. 1.2 Cross-Sectional and Time Series Data
1. **Cross-sectional data** are collected at the same or approximately the same point in time.

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(1) Example: The data in the previously shown Nations data file are cross-sectional because they describe the five variables for the 60 WTO nations at the same point in time.

2. **Time series data** are instead collected over several time periods.
3. Graphs of time series data, such as the U.S. average price per gallon of regular gasoline between 2015 and 2021 shown to the right, help understand:
   (1) what happened in the past
   (2) identify any trends over time
   (3) project future levels for the time series

IV. 1.3 Data Sources (PPT slides 12-14)

a. 1.3 Existing Data Sources
   1. In some cases, data needed for a particular application already exist.
   2. The most important categories of existing data sources and related examples are:
      (1) Internal company records – employee records, production records, inventory records, sales records, credit records, and customer profiles
      (2) Business database services – Dun & Bradstreet, Bloomberg, and Dow Jones & Co.
      (3) Government agencies – Census Bureau, Federal Reserve Board, Office of Management & Budget, Department of Commerce, Bureau of Labor Statistics, and DATA.gov
      (4) Industry associations – U.S. Travel Association
      (5) Special-interest organizations – Graduate Management Admission Council (GMAT)
      (6) Internet – Google, Yahoo, Twitter, etc.

b. 1.3 Statistical Studies
   1. Observational Study
      (1) In *an observational study*, no attempt is made to control or influence the variables of interest.
      (2) Examples:
         (a) Recording data on demographics and shopping habits of a random group of Walmart customers.
         (b) Recording CEO gender and return on equity (ROE) for a sample of Fortune 500 companies to investigate the

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relationship between CEO gender and company performance.

(c) Surveys and public opinion polls.

2. Experiment
   (1) Because an *experiment* is conducted under controlled conditions, its data can provide more information compared to data obtained from existing sources or observational studies.
   (2) In experiments, first, a variable of interest is identified, and then one or more other variables are identified and controlled. The collected data are then analyzed to investigate how they influence the variable of interest.
   (3) Example – a pharmaceutical company administers different dosages of a new drug to groups of randomly selected individuals and monitors how they are affected by it.

c. 1.3 Considerations on Data Acquisition
   1. **Time Requirement**
      (1) Searching for information can be time-consuming.
      (2) Information may no longer be useful by the time it is available.
   2. **Cost of Acquisition**
      (1) Organizations often charge for information even when it is not their primary business activity.
   3. **Data Errors**
      (1) Using any data that happen to be available.
      (2) Data acquired with little care can lead to misleading information.

V. 1.4 Descriptive Statistics (PPT slides 15)
   1. Most of the statistical information in publications consists of data that are summarized and presented in a form that is easy to understand.
   2. Such summaries of data, which may be tabular, graphical, or numerical, are referred to as **descriptive statistics**.
   3. Examples:
      (1) The variable Fitch Outlook in the WTO Nations table can be summarized as a table or bar chart.
      (2) Numerical descriptive statistics such as the mean (or average.)

VI. 1.5 Statistical Inference (PPT slides 16-17)
   a. 1.5 Statistical Inference

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1. When the collection of information about a large group of elements (individuals, companies, voters, households, products, customers, and so on) is not feasible because of time, cost, and other considerations, data can be collected from only a small portion of the group.
2. Formally, we use the following definitions of the larger and smaller groups of elements:
   (1) **Population**: the set of all elements of interest in a study.
   (2) **Sample**: a subset of the population.
3. We also formally define the following statistical processes:
   (1) **Statistical inference**: the process of using data obtained from a sample to make estimates and test hypotheses about the characteristics of a population.
   (2) **Census**: the process of collecting data for the entire population.
   (3) **Sample survey**: a process of collecting data for a sample.

b. 1.5 The Rogers Industries Example

1. DATAfile: *Rogers*
2. Rogers Industries has developed a new solid-state lithium battery that should last longer and be safer to use.
3. Researchers want to evaluate the advantages of the new battery using statistical inference.
4. The sample average battery life of 18.84 hours can be used as an estimate (inference) of the population average.

VII. 1.6 Analytics (PPT slide 18)

1. **Analytics** is the scientific process of transforming data into insight for making better decisions.
2. Analytics is now generally thought to comprise three broad categories of techniques:
   (1) **Descriptive analytics** describes what happened in the past.
      (a) Examples – data queries, reports, descriptive statistics, data visualization, data dashboards, and basic what-if spreadsheet models.
   (2) **Predictive analytics** uses models constructed from past data to predict the future or to assess the impact of one variable on another.
      (a) Examples – linear regression, time series analysis, forecasting models, and simulation.

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(3) **Prescriptive analytics** yield the best course of action.

(a) Examples – optimization models and decision analysis.

VIII. 1.7 Big Data and Data Mining (PPT slide 19)

1. **Big data** are larger and more complex data sets that cannot be managed, processed, or analyzed with commonly available software in a reasonable amount of time.
2. Analysts often define *big data by* referring to the **Three V's**:
   (1) *volume*: the amount of available data; *velocity*: the speed at which data is collected and processed; *variety*: different data types.
3. **Data warehousing** is the process of capturing, storing, and maintaining data.
   (1) Computing power and data collection tools have reached the point where it is now feasible to store and retrieve extremely large quantities of data in seconds.
4. **Data mining** methods help develop useful decision-making information from large databases.
   (1) Analysts use a combination of automated procedures to "mine the data" and convert it into useful information.
   (2) The most effective data mining procedures are multiple regression, logistic regression, and machine learning, which discover relationships in the data and predict future outcomes.

IX. 1.8 Computers and Statistical Analysis (PPT slide 20)

1. Statisticians use computer software to perform tedious and time-consuming statistical computations and analyses.
2. End-of-chapter appendixes cover the step-by-step procedures for using Microsoft Excel and the statistical package JMP to implement the statistical techniques presented in each chapter.
3. Big data requires special data manipulation and analysis tools such as:
   (1) Hadoop – open-source software for the distributed processing of large data sets
   (2) R and Python – open-source programming languages
   (3) SAS and SPSS – commercially available packages

X. 1.9 Ethical Guidelines for Statistical Practice (PPT slide 21)

1. In a statistical study, unethical behavior can take a variety of forms:
   (1) Improper sampling

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(2) Inappropriate analysis of the data
(3) Development of misleading graphs
(4) Use of inappropriate summary statistics
(5) Biased interpretation of the statistical results

2. One should strive to be fair, thorough, objective, and neutral in collecting, analyzing, and presenting data.
3. As a consumer of statistics, one should also be aware of the possibility of unethical behavior by others.
4. The American Statistical Association developed a report on "Ethical Guidelines for Statistical Practice" that contains 67 guidelines organized into 8 topic areas of professionalism and responsibilities that address the major stakeholders of statistical analysis and research.

XI. Summary (PPT slide 22)

1. Statistics is the art and science of collecting, analyzing, presenting, and interpreting data.
2. Data consists of the facts and figures that are collected and analyzed.
3. The four scales of measurement used to obtain data on a particular variable include nominal, ordinal, interval, and ratio.
4. For purposes of statistical analysis, data can be classified as categorical or quantitative.
   (1) Categorical data use labels or names to identify an attribute of each element and use either the nominal or ordinal scale of measurement.
   (2) Quantitative data are numeric values that indicate how much or how many and use either the interval or ratio scale of measurement.
5. Descriptive statistics are the tabular, graphical, and numerical methods used to summarize data. The process of statistical inference uses data obtained from a sample to make estimates or test hypotheses about the characteristics of a population.
6. The last sections of the chapter introduced analytics, big data, data mining, the role of computers in statistical analysis, and a summary of ethical guidelines for statistical practice.

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Appendix

Generic Rubrics

Providing students with rubrics helps them understand the expectations and components of assignments. Rubrics help students become more aware of their learning process and progress, and they improve students' work through timely and detailed feedback. Customize these rubrics as you wish. The writing rubric indicates 40 points, and the discussion rubric indicates 30 points.

Standard Writing Rubric

Criteria	Meets Requirements	Needs Improvement	Incomplete
Content	The assignment clearly and comprehensively addresses all questions in the assignment. 15 points	The assignment partially addresses some or all questions in the assignment. 8 points	The assignment does not address the questions in the assignment. 0 points
Organization and Clarity	The assignment presents ideas in a clear manner and with a strong organizational structure. The assignment includes an appropriate introduction, content, and conclusion. The coverage of facts, arguments, and conclusions is logically related and consistent. 10 points	The assignment presents ideas in a mostly clear manner and with a mostly strong organizational structure. The assignment includes an appropriate introduction, content, and conclusion. The coverage of facts, arguments, and conclusions are most logically related and consistent. 7 points	The assignment does not present ideas in a clear manner and with a strong organizational structure. The assignment includes an introduction, content, and conclusion, but coverage of facts, arguments, and conclusions are not logically related and consistent. 0 points
Research	The assignment is based upon appropriate and adequate academic literature, including peer-reviewed journals and other scholarly work. 5 points	The assignment is based upon adequate academic literature but does not include peer-reviewed journals and other scholarly work. 3 points	The assignment is not based upon appropriate and adequate academic literature and does not include peer-reviewed journals and other scholarly work. 0 points
Research	The assignment follows the required citation guidelines. 5 points	The assignment follows some of the required citation guidelines. 3 points	The assignment does not follow the required citation guidelines. 0 points
Grammar and Spelling	The assignment has two or fewer grammatical and spelling errors. 5 points	The assignment has three to five grammatical and spelling errors. 3 points	The assignment is incomplete or unintelligible. 0 points

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Standard Discussion Rubric

Criteria	Meets Requirements	Needs Improvement	Incomplete
Participation	Submits or participates in the discussion by the posted deadlines. Follows all the assignment's instructions for the initial post and responses. 5 points	Does not participate or submit discussion by the posted deadlines. Does not follow instructions for initial post and responses. 3 points	Does not participate in the discussion. 0 points
Contribution Quality	Comments stay on task. Comments add value to the discussion topic. Comments motivate other students to respond. 20 points	Comments may not stay on task. Comments may not add value to the discussion topic. Comments may not motivate other students to respond. 10 points	Does not participate in the discussion. 0 points
Etiquette	Maintains appropriate language. Constructively offers criticism. Provides both positive and negative feedback. 5 points	Does not always maintain the appropriate language. Offers criticism offensively. Provides only negative feedback. 3 points	Does not participate in the discussion. 0 points

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