

Exercises 1.1

Understanding the Concepts and Skills

1.1 Define the following terms:

- Population
- Sample

1.2 What are the two major types of statistics? Describe them in detail.

1.3 Identify some methods used in descriptive statistics.

1.4 Explain two ways in which descriptive statistics and inferential statistics are interrelated.

1.5 Define the following terms:

- Observational study
- Designed experiment

1.6 Fill in the following blank: Observational studies can reveal only association, whereas designed experiments can help establish _____.

Applying the Concepts and Skills

In Exercises 1.7–1.12, classify each of the studies as either descriptive or inferential. Explain your answers.

1.7 **TV Viewing Times.** Data from a sample of Americans yielded the following estimates of average TV viewing time per month for all Americans 2 years old and older. The times are in hours and minutes; Q1 stands for first quarter. [SOURCE: *The Cross-Platform Report*, Quarter 1, 2011. Published by *The Nielsen Company*, © 2011.]

Viewing method	Q1 2011	Q1 2010	Change (%)
Watching TV in the home	158:47	158:25	0.2
Watching timeshifted TV	10:46	9:36	12.2
DVR playback	26:14	25:48	1.7
Using the Internet on a computer	25:33	25:54	-1.4
Watching video on the Internet	4:33	3:23	34.5
Mobile subscribers watching video on a mobile phone	4:20	3:37	20.0

1.8 **Professional Athlete Salaries.** From the *Statistical Abstract of the United States* and the article “Average Salaries in the NBA, NFL, MLB and NHL” by J. Dorish, published on the *Yahoo! Contributor Network*, we obtained the following data on average professional athletes’ salaries for the years 2005 and 2011.

Sport	Average salary (\$millions)	
	2005	2011
Baseball (MLB)	2.48	3.31
Basketball (NBA)	4.04	5.15
Football (NFL)	1.40	1.90

1.9 **Home Sales.** *Zillow.com* is an online database that provides real estate information for U.S. homes that are for rent or sale. It also presents statistics on recently sold homes. The following table gives various information on all homes sold in several different cities across the United States for the month of September 2012.

City	Price per square foot	Sale to list price ratio	% foreclosure re-sales
Scottsdale, AZ	\$167	0.973	12.43%
Washington, DC	\$436	0.990	2.88%
San Francisco, CA	\$636	1.026	6.55%
Las Vegas, NV	\$ 74	1.000	19.45%
Nashville, TN	\$106	0.973	18.09%

1.10 **Drug Use.** The *U.S. Substance Abuse and Mental Health Services Administration* collects and publishes data on nonmedical drug use, by type of drug and age group, in *National Survey on Drug Use and Health*. The following table provides data for the years 2003 and 2008. The percentages shown are estimates for the entire nation based on information obtained from a sample (NA, not available).

Type of drug	Percentage, 18–25 years old			
	Ever used		Current user	
	2003	2008	2003	2008
Any illicit drug	60.5	56.6	20.3	19.6
Marijuana and hashish	53.9	50.4	17.0	16.5
Cocaine	15.0	14.4	2.2	1.5
Hallucinogens	23.3	17.7	1.7	1.7
Inhalants	14.9	10.4	0.4	0.3
Any psychotherapeutic	29.0	29.2	6.0	5.9
Alcohol	87.1	85.6	61.4	61.2
“Binge” alcohol use	NA	NA	41.6	41.8
Cigarettes	70.2	64.2	40.2	35.7
Smokeless tobacco	22.0	20.3	4.7	5.4
Cigars	45.2	41.4	11.4	11.3

1.11 **Dow Jones Industrial Averages.** From the *Stock Performance Guide*, published online by *1stock1* on the website *1Stock1.com*, we found the closing values of the Dow Jones Industrial Averages as of the end of December for the years 2004 through 2013.

Year	Closing
2004	10,783.01
2005	10,717.50
2006	12,463.15
2007	13,264.82
2008	8,776.39
2009	10,428.05
2010	11,577.51
2011	12,217.56
2012	13,104.14
2013	16,576.66

1.12 In-Demand College Majors. In a June 2013 article, published online by *The Street*, B. O’Connell discussed the results of a survey on opportunities for graduating college students. In one aspect of the survey, the following percentage estimates were reported on which college majors were in demand among U.S. firms. [SOURCE: “The Most In-Demand College Majors This Year.” Published by *Career-Builder*, LLC, © 2013.]

Major	Percentage of U.S. firms
Business studies	31%
Computer sciences	24%
Engineering	17%
Health care sciences	10%
Engineering technologies	9%
Math and statistics	9%
Communications	7%
Education	7%
Science technology	6%
Liberal arts	6%

1.13 Thoughts on Evolution. In an article titled “Who has designs on your student’s minds?” (*Nature*, Vol. 434, pp. 1062–1065), author G. Brumfiel postulated that support for Darwinism increases with level of education. The following table provides percentages of U.S. adults, by educational level, who believe that evolution is a scientific theory well supported by evidence.

Education	Percentage
Postgraduate education	65%
College graduate	52%
Some college education	32%
High school or less	20%

- Do you think that this study is descriptive or inferential? Explain your answer.
- If, in fact, the study is inferential, identify the sample and population.

1.14 Judgment of Faces. In a psychological study linking a person’s attitude with his or her perception of human faces, 165 subjects were asked to judge the attributes of each of two unknown faces. It was proven that manipulated attitude significantly influences the judgment of facial dimensions that are evaluatively loaded (e.g., smiling or frowning mouth).

- Do you think this study is descriptive or inferential? Explain your answer.
- If, in fact, the study is inferential, identify the sample and population.

1.15 Genocide. The document “American Attitudes about Genocide” provided highlights of a nationwide poll with 1000 participants. The survey, conducted by *Penn Schoen Berland* between June 30 and July 10, 2012, revealed that “66% of respondents believe that genocide is preventable.”

- Is the statement in quotes an inferential or a descriptive statement? Explain your answer.
- Based on the same information, what if the statement had been “66% of Americans believe that genocide is preventable”?

1.16 Vasectomies and Prostate Cancer. Refer to the vasectomy/prostate cancer study discussed in Example 1.5 on page 28.

- How could the study be modified to make it a designed experiment?
- Comment on the feasibility of the designed experiment that you described in part (a).

In Exercises 1.17–1.22, state whether the investigation in question is an observational study or a designed experiment. Justify your answer in each case.

1.17 The Salk Vaccine. In the 1940s and early 1950s, the public was greatly concerned about polio. In an attempt to prevent this disease, Jonas Salk of the University of Pittsburgh developed a polio vaccine. In a test of the vaccine’s efficacy, involving nearly 2 million grade-school children, half of the children received the Salk vaccine; the other half received a placebo, in this case an injection of salt dissolved in water. Neither the children nor the doctors performing the diagnoses knew which children belonged to which group, but an evaluation center did. The center found that the incidence of polio was far less among the children inoculated with the Salk vaccine. From that information, the researchers concluded that the vaccine would be effective in preventing polio for all U.S. school children; consequently, it was made available for general use.

1.18 Do Left-Handers Die Earlier? According to a study published in the *Journal of the American Public Health Association*, left-handed people do not die at an earlier age than right-handed people, contrary to the conclusion of a highly publicized report done 2 years earlier. The investigation involved a 6-year study of 3800 people in East Boston older than age 65. Researchers at *Harvard University* and the *National Institute of Aging* found that the “lefties” and “righties” died at exactly the same rate. “There was no difference, period,” said Dr. J. Guralnik, an epidemiologist at the institute and one of the coauthors of the report.

1.19 Sex, Sleep, and PTSD. In the article, “One’s Sex, Sleep, and Posttraumatic Stress Disorder” (*Biology of Sex Differences*, Vol. 3, No. 29, pp. 1–7), I. Kobayashi et al. study the relationship between one’s sex, sleep patterns, and posttraumatic stress disorder (PTSD) after trauma exposure. The authors report that women have a higher lifetime prevalence of PTSD as well as a greater risk of developing PTSD following trauma exposure. Relationships between sleep and physical health have been documented in a number of studies, and the authors explore the possibility that disruptive sleep habits are common among people with PTSD and also a possible risk factor for the development of PTSD. A questionnaire of men and women with and without PTSD produced data on their sleep habits.

1.20 Aspirin and Cardiovascular Disease. In the article by P. Ridker et al. titled “A Randomized Trial of Low-dose Aspirin in the Primary Prevention of Cardiovascular Disease in Women” (*New England Journal of Medicine*, Vol. 352, pp. 1293–1304), the researchers noted that “We randomly assigned 39,876 initially healthy women 45 years of age or older to receive 100 mg of aspirin or placebo on alternate days and then monitored them for 10 years for a first major cardiovascular event (i.e., nonfatal myocardial infarction, nonfatal stroke, or death from cardiovascular causes).”

1.21 Heart Failure. In the paper “Cardiac-Resynchronization Therapy with or without an Implantable Defibrillator in Advanced Chronic Heart Failure” (*New England Journal of Medicine*, Vol. 350, pp. 2140–2150), M. Bristow et al. reported the results of a study of methods for treating patients who had advanced heart failure due to ischemic or nonischemic cardiomyopathies. A total of 1520 patients were randomly assigned in a 1:2:2 ratio to receive optimal pharmacologic therapy alone or in combination with either a pacemaker or a pacemaker–defibrillator combination. The patients were then observed until they died or were hospitalized for any cause.

1.22 Starting Salaries. The *National Association of Colleges and Employers* (NACE) compiles information on salary offers to new college graduates and publishes the results in *Salary Survey*.

INSTRUCTIONS 1.1 Steps for generating Output 1.1**MINITAB**

- 1 Store the numbers 1–728 in a column named REGNO[†]
- 2 Choose **Calc** ► **Random Data** ► **Sample From Columns...**
- 3 Press the F3 key to reset the dialog box
- 4 Type 15 in the **Number of rows to sample** text box
- 5 Specify REGNO in the **From columns** text box
- 6 Type SAMPLE in the **Store samples in** text box
- 7 Click **OK**
- 8 The required sample is in the column named SAMPLE

EXCEL

- 1 Store the numbers 1–728 in a column named REGNO[‡]
- 2 Choose **XLSTAT** ► **Preparing data** ► **Data sampling**
- 3 Click the reset button (↺) in the lower left corner of the dialog box
- 4 Click in the **Data** selection box
- 5 Select the column of the worksheet that contains the REGNO data

- 6 Click the arrow button at the right of the **Sampling** drop-down list box and select **Random without replacement**
- 7 Type 15 in the **Sample size** text box
- 8 Click **OK**
- 9 Click the **Continue** button in the **XLSTAT – Selections** dialog box

TI-83/84 PLUS

- 1 Press **PRGM**
- 2 Arrow down to SRS and press **ENTER** twice
- 3 Type 1 for **MIN** (the smallest possible value) and press **ENTER**
- 4 Type 728 for **MAX** (the largest possible value) and press **ENTER**
- 5 Type 15 for **SAMPLE SIZE** and press **ENTER**
- 6 After the program completes, press **STAT** and then **ENTER**
- 7 The required sample is in **L1** (List 1)

[†] There are several ways to accomplish this task. Consult your instructor or search “Patterned data” in the Index tab of Minitab’s Help facility.

[‡] There are several ways to accomplish this task. Consult your instructor for his or her preferred method.

Exercises 1.2**Understanding the Concepts and Skills**

1.27 Explain why a census is often not the best way to obtain information about a population.

1.28 Identify two statistical methods other than a census for obtaining information.

1.29 In sampling, explain why obtaining a representative sample is important.

1.30 Provide a scenario of your own in which a sample is not representative.

1.31 Regarding probability sampling:

- a. What is it?
- b. Does probability sampling always yield a representative sample? Explain your answer.
- c. Identify some advantages of probability sampling.

1.32 Regarding simple random sampling:

- a. What is simple random sampling?
- b. What is a simple random sample?
- c. Identify two forms of simple random sampling and explain the difference between the two.

1.33 The inferential procedures discussed in this book are intended for use with only one particular sampling procedure. What sampling procedure is that?

1.34 Identify two methods for obtaining a simple random sample.

1.35 What is the acronym used for simple random sampling without replacement?

1.36 The members of a population are numbered 1–5.

- a. List the 10 possible samples (without replacement) of size 3 from this population.
- b. If an SRS of size 3 is taken from the population, what are the chances of selecting 1, 3, and 5? Explain your answer.
- c. Use Table I in Appendix A to obtain an SRS of size 3 from the population. Start at the single-digit number in line number 5 and column number 20, read down the column, up the next, and so on.

1.37 The members of a population are numbered 1–6.

- a. List the 15 possible samples (without replacement) of size 2 from this population.
- b. If an SRS of size 2 is taken from the population, what are the chances of selecting 3 and 6? Explain your answer.
- c. Use Table I in Appendix A to obtain an SRS of size 2 from the population. Start at the single-digit number in line number 17 and column number 7, read down the column, up the next, and so on.

1.38 The members of a population are numbered 1–90.

- a. Use Table I in Appendix A to obtain an SRS of size 5 from the population. Start at the two-digit number in line number 15 and column numbers 25–26, read down the column, up the next, and so on.
- b. If you have access to a random-number generator, use it to solve part (a).

- 1.39** The members of a population are numbered 1–50.
- Use Table I in Appendix A to obtain an SRS of size 6 from the population. Start at the two-digit number in line number 10 and column numbers 10–11, read down the column, up the next, and so on.
 - If you have access to a random-number generator, use it to solve part (a).

Applying the Concepts and Skills

1.40 Survey. In 2011–2012, *Australian Health Survey* conducted a survey regarding the most popular beverages consumed. A total of 12,000 people participated in the survey. Among water, coffee, tea, soft drinks, flavored mineral waters, and alcoholic drinks, 87% chose water. Discuss this poll with regard to its suitability.

1.41 Estimating Median Income. Explain why a sample of 30 dentists from Seattle taken to estimate the median income of all Seattle residents is not representative.

1.42 Oklahoma State Officials. The five top Oklahoma state officials are displayed in Table 1.2 on page 33. Use that table to solve the following problems.

- List the possible samples of size 1 that can be obtained from the population of five officials.
- What is the difference between obtaining a simple random sample of size 1 and selecting one official at random?
- List the possible samples (without replacement) of size 5 that can be obtained from the population of five officials.
- What is the difference between obtaining a simple random sample of size 5 and taking a census of the five officials?

1.43 Oklahoma State Officials. The five top Oklahoma state officials are displayed in Table 1.2 on page 33. Use that table to solve the following problems.

- List the 10 possible samples (without replacement) of size 3 that can be obtained from the population of five officials.
- If a simple random sampling procedure is used to obtain a sample of three officials, what are the chances that it is the first sample on your list in part (a)? the second sample? the tenth sample?

1.44 Best-Selling Albums. The *International Federation of the Phonographic Industry (IFPI)* provides data on the best-selling albums of the year. The top six best-selling albums of 2012 were by the artists Adele (A), Taylor Swift (T), One Direction (O), Lana Del Rey (L), Pink (P), and Rod Stewart (R).

- List the 15 possible samples (without replacement) of two artists that can be selected from the six. For brevity, use the initial provided.
- Describe a procedure for taking a simple random sample of two artists from the six.
- If a simple random sampling procedure is used to obtain two artists, what are the chances of selecting O and A? T and P?

1.45 Best-Selling Albums. Refer to Exercise 1.44.

- List the 15 possible samples (without replacement) of four artists that can be selected from the six.
- Describe a procedure for taking a simple random sample of four artists from the six.
- If a simple random sampling procedure is used to obtain four artists, what are the chances of selecting P, A, L, and R? O, R, T, and P?

1.46 Best-Selling Albums. Refer to Exercise 1.44.

- List the 20 possible samples (without replacement) of three artists that can be selected from the six.

- Describe a procedure for taking a simple random sample of three artists from the six.
- If a simple random sampling procedure is used to obtain three artists, what are the chances of selecting T, A, and L? O, R, and P?

1.47 Social Networking Websites. From Wikipedia.com, we obtained the top seven major active social networking websites in the United States, excluding dating websites. Ranked according to registered users, as of April 2013, from most popular to least popular, they are Facebook (F), Twitter (T), Goggle+ (G), Habbo (H), LinkedIn (L), Bebo (B), and Tagged (A).

- List the 21 possible samples (without replacement) of two social media websites that can be selected from the seven. For brevity, use the initial provided.
- If a simple random sampling procedure is used to obtain two of these social media websites, what are the chances of selecting B and A? T and G?

1.48 Keno. In the game of keno, 20 balls are selected at random from 80 balls numbered 1–80.

- Use Table I in Appendix A to simulate one game of keno by obtaining 20 random numbers between 1 and 80. Start at the two-digit number in line number 5 and column numbers 31–32, read down the column, up the next, and so on.
- If you have access to a random-number generator, use it to solve part (a).

1.49 The International 500. Each year, *Fortune Magazine* publishes an article titled “The International 500” that provides a ranking by sales of the top 500 firms outside the United States. Suppose that you want to examine various characteristics of successful firms. Further suppose that, for your study, you decide to take a simple random sample of 10 firms from *Fortune Magazine*’s list of “The International 500.”

- Use Table I in Appendix A to obtain 10 random numbers that you can use to specify your sample. Start at the three-digit number in line number 14 and column numbers 10–12, read down the column, up the next, and so on.
- If you have access to a random-number generator, use it to solve part (a).

1.50 Megacities Risk. In an issue of *Discover* (Vol. 26, No. 5, p. 14), A. Casselman looked at the natural-hazards risk index of megacities to evaluate potential loss from catastrophes such as earthquakes, storms, and volcanic eruptions. Urban areas have more to lose from natural perils, technological risks, and environmental hazards than rural areas. The top 10 megacities in the world are Tokyo, San Francisco, Los Angeles, Osaka, Miami, New York, Hong Kong, Manila, London, and Paris.

- Suppose that you decide to take a simple random sample of five of these 10 megacities. Use Table I in Appendix A to obtain five random numbers that you can use to specify your sample.
- If you have access to a random-number generator, use it to solve part (a).

1.51 Element Hunters. In the article “Element Hunters” (*National Geographic*, Vol. 233, No. 5, pp. 112–120), R. Dunn reports about the search for new undiscovered elements. Since 1940, scientists have been synthesizing elements one by one. The first was neptunium (Np), element number 93. There are, as of this writing, a total of 26 new synthetic elements. The following table provides their element numbers and symbols.