

## Sampling Distribution

- (1) The Statistical Abstract of the United States published by the U.S. Census Bureau reports that the average annual consumption of fresh fruit per person is 99.9 pounds. The standard deviation of fresh fruit consumption is about 30 pounds. Suppose an analyst took a random sample of 38 people and had them keep a record of the fresh fruit they ate for one year.
  - a. What is the probability that the sample average would be less than 90 pounds?
  - b. What is the probability that the sample average would be between 98 and 105 pounds?
  - c. What is the probability that the sample average would be less than 112 pounds?
  - d. What is the probability that the sample average would be between 93 and 96 pounds?
- (2) Suppose a subdivision on the southwest side of Denver, Colorado, contains 1500 houses. The subdivision was built in 1983. A sample of 100 houses is selected randomly and evaluated by an appraiser. If the mean appraised value of a house in this subdivision for all houses is \$415,000, with a standard deviation of \$8,500, what is the probability that the sample average is greater than \$417,000?
- (3) Suppose the average checkout tab at a large supermarket is \$65.12, with a standard deviation of \$21.45. Twenty-three percent of the time when a random sample of 45 customer tabs is examined, the sample average should exceed what value?
- (4) According to Nielsen Media Research, the average number of hours of TV viewing by adults (18 and over) per week in the United States is 33 hours. Suppose the standard deviation is 7.9 hours and a random sample of 42 adults is taken.
  - a. What is the probability that the sample average is more than 36 hours?
  - b. What is the probability that the sample average is less than 32 hours?
  - c. What is the probability that the sample average is less than 29 hours? If the sample average actually is less than 29 hours, what would it mean in terms of the Nielsen Media Research figures?
  - d. Suppose the population standard deviation is unknown and the sample size is still 42. If 71% of all sample means are greater than 32 hours and the population mean is still 33 hours, what is the value of the population standard deviation?
- (5) Candidate Jones believes she will receive .55 of the total votes cast in her county. However, in an attempt to validate this figure, her pollster contacts a random sample of 600 registered voters in the county. The poll results show that 298 of the voters say they are committed to voting for her. If she actually has .55 of the total votes, what is the probability of getting a sample proportion this small or smaller?
- (6) Determine a possible frame for conducting random sampling in each of the following studies.
  - a. The average amount of overtime per week for production workers in a plastics company in Gujarat.
  - b. The average number of employees in all D-Mart supermarkets in India

- c. A survey of commercial fishing boats in Karnataka
- (7) A particular automobile costs an average of \$21,755 in the Pacific Northwest. The standard deviation of prices is \$650. Suppose a random sample of 40 dealerships in Washington and Oregon is taken and their managers are asked what they charge for this automobile. What is the probability of getting a sample average cost of less than \$21,500? Assume that only 120 dealerships in the entire Pacific Northwest sell this automobile.
- (8) A company has 1250 employees, and you want to take a simple random sample of  $n = 60$  employees. Explain how you would go about selecting this sample by using the table of random numbers. Are there numbers that you cannot use? Explain.
- (9) Suppose the average client charge per hour for out-of-court work by lawyers in the state of Iowa is \$125. Suppose further that a random telephone sample of 32 lawyers in Iowa is taken and that the sample average charge per hour for out-of-court work is \$110. If the population variance is \$525, what is the probability of getting a sample mean of \$110 or larger? What is the probability of getting a sample mean larger than \$135 per hour? What is the probability of getting a sample mean of between \$120 and \$130 per hour?
- (10) A survey of 2645 consumers by DDB Needham Worldwide of Chicago for public relations agency Porter/Novelli showed that how a company handles a crisis when at fault is one of the top influences in consumer buying decisions, with 73% claiming it is an influence. Quality of product was the number-one influence, with 96% of consumers stating that quality influences their buying decisions. How a company handles complaints was number two, with 85% of consumers reporting it as an influence in their buying decisions. Suppose a random sample of 1100 consumers is taken and each is asked which of these three factors influence their buying decisions.
- What is the probability that more than 810 consumers claim that how a company handles a crisis when at fault is an influence in their buying decisions?
  - What is the probability that fewer than 1030 consumers claim that quality of product is an influence in their buying decisions?
  - What is the probability that between 82% and 84% of consumers claim that how a company handles complaints is an influence in their buying decisions?
- (11) Suppose you are sending out questionnaires to a randomly selected sample of 100 managers. The frame for this study is the membership list of the American Managers Association. The questionnaire contains demographic questions about the company and its top manager. In addition, it asks questions about the manager's leadership style. Research assistants are to score and enter the responses into the computer as soon as they are received.
- You are to conduct a statistical analysis of the data. Name and describe four non-sampling errors that could occur in this study.
- (12) A business analyst is conducting a study of a *Fortune* 500 company that has factories, distribution centers, and retail outlets across the country. How can she use cluster or area sampling to take a random sample of employees of this firm?

- (13) A directory of personal computer retail outlets in the United States contains 12,080 alphabetized entries. Explain how systematic sampling could be used to select a sample of 300 outlets.
- (14) In an effort to cut costs and improve profits, many U.S. companies have been turning to outsourcing. In fact, according to *Purchasing* magazine, 54% of companies surveyed outsourced some part of their manufacturing process in the past two to three years. Suppose 565 of these companies are contacted.
- What is the probability that 339 or more companies outsourced some part of their manufacturing process in the past two to three years?
  - What is the probability that 288 or more companies outsourced some part of their manufacturing process in the past two to three years?
  - What is the probability that 50% or less of these companies outsourced some part of their manufacturing process in the past two to three years?
- (15) The average cost of a one-bedroom apartment in a town is \$850 per month. What is the probability of randomly selecting a sample of 50 one-bedroom apartments in this town and getting a sample mean of less than \$830 if the population standard deviation is \$100?
- (16) The Aluminium Association reports that the average American uses 56.8 pounds of aluminium in a year. A random sample of 51 households is monitored for one year to determine aluminium usage. If the population standard deviation of annual usage is 12.3 pounds, what is the probability that the sample mean will be each of the following?
- More than 60 pounds
  - More than 58 pounds
  - Between 56 and 57 pounds
  - Less than 55 pounds
  - Less than 50 pounds
- (17) Use Table A.1 to select 20 three-digit random numbers. Did any of the numbers occur more than once? How is it possible for a number to occur more than once? Make a stem-and-leaf plot of the numbers with the stem being the left digit. Do the numbers seem to be equally distributed, or are they bunched together?
- (18) Direct marketing companies are turning to the Internet for new opportunities. A recent study by Gruppo, Levey, & Co. showed that 73% of all direct marketers conduct transactions on the Internet. Suppose a random sample of 300 direct marketing companies is taken.
- What is the probability that between 210 and 234 (inclusive) direct marketing companies are turning to the Internet for new opportunities?
  - What is the probability that 78% or more of direct marketing companies are turning to the Internet for new opportunities?
  - Suppose a random sample of 800 direct marketing companies is taken. Now what is the probability that 78% or more are turning to the Internet for new opportunities? How does this answer differ from the answer in part b? Why do the answers differ?

- (19) According to the U.S. Bureau of Labor Statistics, 20% of all people 16 years of age or older do volunteer work. In this age group, women volunteer slightly more than men, with 22% of women volunteering and 19% of men volunteering. What is the probability of randomly sampling 140 women 16 years of age or older and getting 35 or more who do volunteer work? What is the probability of getting 21 or fewer from this group? Suppose a sample of 300 men and women 16 years of age or older is selected randomly from the U.S. population. What is the probability that the sample proportion of those who do volunteer work is between 18% and 25%?
- (20) Suppose you work for a large firm that has 20,000 employees. The CEO calls you in and asks you to determine employee attitudes toward the company. She is willing to commit \$100,000 to this project. What are the advantages of taking a sample versus conducting a census? What are the trade-offs?
- (21) In a particular area of the Northeast, an estimated 75% of the homes use heating oil as the principal heating fuel during the winter. A random telephone survey of 150 homes is taken in an attempt to determine whether this figure is correct. Suppose 120 of the 150 homes surveyed use heating oil as the principal heating fuel. What is the probability of getting a sample proportion this large or larger if the population estimate is true?
- (22) The U.S. Bureau of Labor Statistics released hourly wage figures for various countries for workers in the manufacturing sector. The hourly wage was \$30.67 for Switzerland, \$20.20 for Japan, and \$23.82 for the United States. Assume that in all three countries, the standard deviation of hourly labor rates is \$3.00.
- Suppose 40 manufacturing workers are selected randomly from across Switzerland and asked what their hourly wage is. What is the probability that the sample average will be between \$30.00 and \$31.00?
  - Suppose 35 manufacturing workers are selected randomly from across Japan. What is the probability that the sample average will exceed \$21.00?
  - Suppose 50 manufacturing workers are selected randomly from across the United States. What is the probability that the sample average will be less than \$22.75?
- (23) Give a variable that could be used to stratify the population for each of the following studies. List at least four subcategories for each variable.
- A political party wants to conduct a poll prior to an election for the office of U.S. senator in Minnesota.
  - A soft-drink company wants to take a sample of soft-drink purchases in an effort to estimate market share.
  - A retail outlet wants to interview customers over a one-week period.
  - An eyeglasses manufacturer and retailer wants to determine the demand for prescription eyeglasses in its marketing region.
  - According to Runzheimer International, a typical business traveler spends an average of \$281 per day in Chicago. This cost includes hotel, meals, car rental, and incidentals. A survey of 65 randomly selected business travelers who have been to Chicago on business recently is taken. For the population mean of

\$281 per day, what is the probability of getting a sample average of more than \$273 per day if the population standard deviation is \$47?