

- 5.7 Ideally, an experiment would use random sampling so that the data would accurately reflect the larger population. For practical reasons, this is difficult to do. How does random assignment help make up for a lack of random selection?
- 5.8 Statisticians use terms like *trial*, *outcome*, and *success* in a particular way in reference to probability. What do each of these three terms mean in this context?
- 5.9 We distinguish between probabilities and proportions. How does each capture the likelihood of an outcome?
- 5.10 How is the term *independent* used by statisticians?
- 5.11 One step in hypothesis testing is to randomly assign members of the sample into the control group and the experimental group. What is the difference between these two groups?
- 5.12 What is the difference between a null hypothesis and a research hypothesis?
- 5.13 What are the two decisions or conclusions we can make about our hypotheses based on the data?
- 5.14 What is the difference between a Type I error and a Type II error?
- 5.15, and read from left to right starting in the third row from the top.
- 5.19 What is the probability of hitting a target if, in the long run, 71 out of every 489 attempts actually hit the target?
- 5.20 On a game show, eight people have won the grand prize and a total of 266 people have competed. Estimate the probability of winning the grand prize.
- 5.21 Convert the following proportions to percentages:
- 0.0173
  - 0.8
  - 0.3719
- 5.22 Convert the following percentages to proportions:
- 62.7%
  - 0.3%
  - 4.2%
- 5.23 Using the random numbers table in Exercise 5.15, estimate the probability of the number 6 appearing in a random sequence of numbers. Base your answer on the numbers that appear in the first two rows.
- 5.24 Thirty-three skin samples are sent to a lab to test for the presence of irregular cells. Five results come back positive for irregular cells, when in fact nothing was wrong in any of the 33 samples. Estimate the probability of Type I errors.
- 5.25 Leaf samples are sent to a lab to check for a rare and deadly fungus. Of the 45 samples tested, the tests failed to show the presence of the fungus in six instances when in fact it was actually there in 16 instances. Estimate the probability of Type II errors.
- 5.26 Using the data from Exercise 5.24, if three results were negative for irregular cells when in fact they were present in all 33 examples, estimate the probability of Type II errors.
- 5.27 Using the data from Exercise 5.25, if one test result came back positive for the fungus when no fungus was present (out of 29 samples in which no fungus was present), estimate the Type I error rate.

### Calculating the Statistics

- 5.15 Forty-three tractor-trailers are parked for the night in a rest stop along a major highway. You assign each truck a number from 1 to 43. Moving from left to right and using the second line in the random numbers table below, select four trucks to weigh as they leave the rest stop in the morning.

00190	27157	83208	79446	92987	61357
23798	55425	32454	34611	39605	39981
85306	57995	68222	39055	43890	36956
99719	36036	74274	53901	34643	06157

- 5.16 Airport security makes random checks of passenger bags every day. If one in every 10 passengers is checked, use the random numbers table in Exercise 5.15 to determine the first six people to be checked. Work from top to bottom, starting in the 4th column, and allow the number 0 to represent the 10th person.
- 5.17 Randomly assign nine people to three conditions of a study using the random numbers table in Exercise 5.15. Read from right to left starting in the top row. (Note: Assign people to conditions without concern for having an equal number of people in each condition.)
- 5.18 You are running a study with five conditions. Assign the first seven participants who arrive at your lab to conditions, not worrying about equal assignment across conditions. Use the random numbers table in Exercise

### Applying the Concepts

- 5.28 Was selection or assignment random? In France in the fall of 2005, many communities of immigrants from the Middle East and North Africa experienced a great deal of violence, particularly car burnings, committed by their young people. Social science research can help to diminish or avoid such violence. Consider the following hypothetical research on the French riots: Of the cities that shared this demographic, Marseilles was one of the few that saw relatively little violence. A researcher

wants to compare Marseilles with Lyons, a city that saw a great deal of violence, to determine which characteristics may have moderated violence in Marseilles, specifically among high school students. Can she use random selection? Explain. Can she use random assignment? Explain.

- 5.29 Approximately 21,000 school psychologists are members of the U.S.-based National Association of School Psychologists. Of these, about 5000 have doctoral degrees. A researcher wants to randomly select 100 of the doctoral-level school psychologists for a survey study regarding aspects of their jobs, including the types of tasks in which they engage, settings in which they work, and attitudes about their careers. Use this excerpt from a random numbers table to answer the following questions:

04493 52494 75246 33824 45862 51025  
 00549 97654 64051 88159 96119 63896  
 35963 15307 26898 09354 33351 35462  
 59808 08391 45427 26842 83609 49700

- What is the population targeted by this study? How large is it?
- What is the sample desired by this researcher? How large is it?
- Describe how the researcher would select his sample. Be sure to explain how the members of the population would be numbered and what sets of digits the researcher should ignore when using the random numbers table.
- Beginning at the left-hand side of the top line and continuing with each succeeding line, list the first 10 participants that this researcher would select for his study.

5.30 Continuing with the study described in Exercise 5.29, once the researcher had randomly selected his sample of 100 school psychologists, he decided to randomly assign 50 of them to receive, as part of their survey materials, a newspaper article about the improving job market for school psychologists. He assigned the other 50 to receive a newspaper article about the declining job market for school psychologists. Unbeknownst to the participants (until the debriefing at the end of the survey), the articles were fictional. After reading the articles, the participants responded to questions about their attitudes toward their careers. The researcher wondered whether attitudes could be affected by external sources.

- What is the independent variable in this experiment, and what are its levels?
- What is the dependent variable in this experiment?
- Write a null hypothesis and a research hypothesis for this study.

- 5.31 Refer to Exercises 5.29 and 5.30 when responding to the following questions:

- Describe how the researcher would randomly assign the participants to the levels of the independent variable. Be sure to explain how the levels of the independent variable would be numbered and what sets of digits the researcher should ignore when using the random numbers table.
- Beginning at the left-hand side of the bottom line of the random numbers table in Exercise 5.29, and continuing with the left-hand side of the line above it, list the levels of the independent variable to which the first 10 participants would be assigned.
- Why do these numbers not appear to be random? Discuss the difference between short-run and long-run proportions.

5.32 Imagine that you have been hired by the Psychology Department at your school to administer a survey to psychology majors about their experiences in the department. You have been asked to randomly select 60 majors from the overall pool of 300. You are working on this project in your dorm room using a random numbers table because the server is down and you cannot use an online random numbers generator. Your roommate, who is patiently waiting for you to finish so you can go out, offers to write down a list of 60 random numbers between 001 and 300 for you so you can be done quickly. In about three to four sentences, explain to your roommate why she is not likely to create a list of random numbers.

- 5.33 For each of the following studies, state (i) whether random selection could have been used. Explain also to what population the researcher wanted to and could generalize, and state (ii) whether random assignment could have been used.

- A researcher recruited 1000 U.S. physicians through the American Medical Association (AMA) to participate in a study of standards of confidentiality with respect to patient information. He wanted to compare perceptions of the standards among men versus women.
- A developmental psychologist wondered whether children born preterm (premature) had different social skills at age five than children born full term.
- A counseling center director wanted to compare the length of therapy in weeks for students who came in for treatment for depression versus students who came in for treatment for anxiety. She wanted to report these data to the university administrators to help develop the next year's budget.
- An industrial/organizational psychologist wondered whether a new laptop design would affect people's response time when using the computer. He wanted

to compare response times when using the new laptop with response times when using two standard versions of laptops, a Mac and a PC.

**5.34** A volunteer sample is a kind of convenience sample in which participants select themselves to participate. On August 19, 2005, *USA Today* published an online poll on its Web site asking this question about U.S. college football: “Who is your pick to win the ACC conference this year?” Eight options—seven universities, including top vote-getters Virginia Tech and Miami, as well as “other”—were provided.

- Describe the typical person who might volunteer to be in this sample. Why might this sample be biased, even with respect to the population of U.S. college football fans?
- What is external validity? Why might external validity be limited in this sample?
- What other problem can you identify with this poll?

**5.35** *Cosmopolitan* magazine (*Cosmo* as it’s known popularly) publishes many of its well-known quizzes on its Web site. One quiz is titled “Are You Obsessed with Appearances?” As if the fact that one reads *Cosmo* isn’t enough to answer the question, the quiz poses 10 situations for which participants must choose how they’d act from among three limited options. A question about an invitation to a costume party for which one must dress as a musician offers these three choices: Lauryn Hill in “killer cargo pants,” one of the Indigo Girls in a flannel shirt, and Madonna in her “ultra-glam Marilyn Monroe phase.” Consider whether you want to use the quiz data to determine how obsessed women are with their appearance.

- Describe the typical person who might respond to this quiz. How might data from such a sample be biased, even with respect to the overall *Cosmo* readership?
- What is the danger of relying on volunteer samples in general?
- What other problems do you see with this quiz? Comment on the types of questions and responses.

**5.36** On its Web site, Advocates for Self-Government offers the “World’s Smallest Internet Political Quiz,” focusing on the U.S. political spectrum. Using just 10 questions, the quiz identifies an individual’s political leanings. As of May 23, 2007, a total of 9,464,924 people had taken the quiz, and the breakdown into the five possible categories was: centrist, 33.49%; conservative, 8.88%; libertarian, 32.64%; liberal, 17.09%; and statist (big government), 7.89%.

- Do you think these numbers are representative of the U.S. population? Why or why not?
- Describe the people most likely to volunteer for this sample. Why might this group be biased in comparison to the overall U.S. population?

c. The Web site says, “Libertarians support maximum liberty in both personal and economic matters.” Libertarians are not the predominant political group in the United States. Why, then, might libertarians form the largest category of quiz respondents?

d. This is a huge sample—9,464,924. Why is it not enough to have a large sample to conduct a study with high external validity? What would we need to change about this sample to increase external validity?

**5.37** For each of the following hypothetical scenarios, state whether selection or assignment is being described. Is the method of selection or assignment random? Explain your answer.

- A study of the services offered by counseling centers at Canadian universities studied 20 universities; every Canadian university had an equal chance of being in this study.
- In a study of phobias, 30 rhesus monkeys were either exposed to fearful stimuli or not exposed to fearful stimuli. Every monkey had an equal chance of being placed in either of the exposure conditions.
- A study of cell phone usage recruited participants by including an invitation to participate in their cell phone bills.
- A study of visual perception recruited 120 Introduction to Psychology students to participate.

**5.38** Short-run proportions are often quite different from long-run probabilities.

- In your own words, explain why we would expect short-run proportions to fluctuate but why long-run probabilities are more predictable.
- What is the expected long-run probability of heads if you flip a coin many, many times? Why?
- Flip a coin 10 times in a row. What proportion are heads? Do this 5 times (and actually do it, don’t just write down numbers!).

Proportion for first 10 flips:

Proportion for second 10 flips:

Proportion for third 10 flips:

Proportion for fourth 10 flips:

Proportion for fifth 10 flips:

- Do the proportions in part (c) match the expected long-run probability in part (b)? Why or why not?
- Imagine that a friend flipped a coin 10 times, got 9 out of 10 heads, and complained that the coin was biased. How would you explain to your friend the difference between short-term and long-term probability?

**5.39** A deck of playing cards has 4 suits and 13 cards in each suit, for a total of 52 cards. Imagine you draw one card from the deck, record what the card is, and then put it

back in the deck. Let's say you repeat this process 15 times, and 5 of the 15 cards are aces. Answer the following questions keeping this example in mind.

- What does the term *probability* refer to? What is the probability of drawing an ace?
- What does the term *proportion* refer to? What is the proportion of aces drawn?
- What does the term *percentage* refer to? What is the percentage of aces drawn?
- Based on these data (5 out of 15 cards were aces), do you have enough information to determine whether the deck is stacked (i.e., biased)? Why or why not? (Note: Four of the 52 cards should be aces.)

5.40 Gamblers often falsely predict the outcome of a future trial based on the outcome of previous trials. When trials are independent, we cannot predict the outcomes of a future trial based on the outcome of previous trials. For each of the following examples, (i) state whether the trials are independent or dependent and (ii) explain why. In addition, (iii) state whether it is possible that the quote is accurate or whether it is definitely fallacious, explaining how the independence or dependence of trials influences this.

- You are playing Monopoly and have rolled a pair of sixes in 4 out of 10 of your last rolls of the dice. You say, "Cool. I'm on a roll. I'm likely to get sixes again on my next turn."
- You are an Ohio State University football fan and are sad because they have lost two games in a row. You say, "That is really unusual; the Buckeyes are doomed this season. That's what happens with lots of early-season injuries."
- You have a 20-year-old car that often has trouble starting. It has started every day this week, and now it's Friday. You say, "I'm doomed. It's been reliable all week, and even though I did get a tune-up last week, today is bound to be the day it fails me."
- It's your first week at your corporate internship and you have to wear nylon stockings to the office if you're wearing a skirt. On the first and second days, you get a run in your stockings almost immediately, an indication of a defect. The third day, you put on yet another new pair of stockings and say, "OK, this pair has to be good. There's no way I'd have three bad pairs in a row. They're even from different stores!"

5.41 For each of the following studies, cite the likely null hypothesis and the likely research hypothesis.

- A forensic cognitive psychologist wondered whether repetition of false information would increase the tendency to develop false memories, on average.
- A clinical psychologist studied whether ongoing structured assessments of the therapy process would

lead to better outcome, on average, among outpatient therapy clients with depression.

- A corporation recruited an industrial/organizational psychologist to explore the effects of cubicles (versus enclosed offices) on employee morale.
- A team of developmental cognitive psychologists studied whether teaching a second language to children from birth affects children's ability to speak their native language.

5.42 For each of the following fictional outcomes, state whether you would reject or to fail to reject the null hypothesis (contingent, of course, on inferential statistics backing up the statement). Explain the rationale for your decision.

- When false information is repeated several times, people seem to be more likely, on average, to develop false memories than when the information is not repeated.
- Therapy clients with depression who have ongoing structured assessments of therapy seem to have lower depression levels post-therapy, on average, than do clients who do not have ongoing structured assessments.
- Employee morale does not seem to be different, on average, whether employees work in cubicles or enclosed offices.
- A child's native language does not seem to be different in strength, on average, based on whether the child is raised to be bilingual or not.

5.43 Examine the statements from Exercise 5.42, repeated here. If this conclusion is incorrect, what type of error have you made? Explain your answer.

- When false information is repeated several times, people seem to be more likely, on average, to develop false memories than when the information is not repeated.
- Therapy clients with depression who have ongoing structured assessments of therapy seem to have lower depression levels post-therapy, on average, than do clients who do not have ongoing structured assessments.
- Employee morale does not seem to be different, on average, whether employees work in cubicles or enclosed offices.
- A child's native language does not seem to be different in strength, on average, based on whether the child is raised to be bilingual or not.

5.44 Imagine you have made a new acquaintance in your statistics class with whom you study for tests. One day after hours of studying, your study partner asks you to go on a date. This invitation takes you by complete surprise and you have no idea what to say. You are not attracted to the person in a romantic way, but at the same time you do not want to hurt his or her feelings.