3-2 Basic Skills and Concepts

In Exercises 1 and 2, express the indicated degree of likelihood as a probability value.

1. Identifying Probability Values
   a. “You have a 50-50 chance of choosing the correct road.”
   b. “There is a 20% chance of rain tomorrow.”
   c. “You have a snowball’s chance in hell of marrying my daughter.”

2. Identifying Probability Values
   a. “There is a 90% chance of snow tomorrow.”
   b. “It will definitely become dark tonight.”
   c. “You have one chance in ten of being correct.”

3. Identifying Probability Values Which of the following values cannot be probabilities?
   0, 1, −1, 2, 0.0123, 3/5, 5/3, √2

4. Identifying Probability Values
   a. What is the probability of an event that is certain to occur?
   b. What is the probability of an impossible event?
   c. A sample space consists of 10 separate events that are equally likely. What is the probability of each?
   d. On a true/false test, what is the probability of answering a question correctly if you make a random guess?
   e. On a multiple-choice test with five possible answers for each question, what is the probability of answering a question correctly if you make a random guess?

5. Gender of Children In this section, we gave an example that included a list of the eight outcomes that are possible when a couple has three children. Refer to that list, and find the probability of each event.
   a. Among three children, there is exactly one girl.
   b. Among three children, there are exactly two girls.
   c. Among three children, all are girls.

6. Cell Phones and Brain Cancer In a study of 420,000 cell phone users in Denmark, it was found that 135 developed cancer of the brain or nervous system. Estimate the probability that a randomly selected cell phone user will develop such a cancer. Is the result very different from the probability of 0.000340 that was found for the general population? What does the result suggest about cell phones as a cause of such cancers, as has been claimed?

7. Probability of a Home Run Baseball player Barry Bonds broke a major record when he hit 73 home runs in the 2001 season. During that season, he was at bat 476 times. If one of those “at bats” is randomly selected, find the probability that it is one of the times he hit a home run. Is the result very different from the probability of 0.0715 that results from his 567 career home runs in 7932 “at bats”?

8. Being Struck by Lightning In a recent year, 389 of the 281,421,906 people in the United States were struck by lightning. Estimate the probability that a randomly selected person in the United States will be struck by lightning this year.

Using Probability to Identify Unusual Events. In Exercises 9–16, consider an event to be “unusual” if its probability is less than or equal to 0.05. (This is equivalent to the same...
9. Probability of a Wrong Result  Table 3-1 shows that among 85 women who were pregnant, the test for pregnancy yielded the wrong conclusion 5 times.
   a. Based on the available results, find the probability of a wrong test conclusion for a woman who is pregnant.
   b. Is it “unusual” for the test conclusion to be wrong for women who are pregnant?

10. Probability of a Wrong Result  Table 3-1 shows that among 14 women who were not pregnant, the test for pregnancy yielded the wrong conclusion 3 times.
   a. Based on the available results, find the probability of a wrong test conclusion for a woman who is not pregnant.
   b. Is it “unusual” for the test conclusion to be wrong for women who are not pregnant?

11. Smoking Survey  In one Gallup poll, 1038 adults were asked about the effects of secondhand smoke, and 52 of them indicated that the effects are “not at all harmful.”
   a. If you randomly select one of the surveyed adults, what is the probability of getting someone who feels that secondhand smoke is not at all harmful?
   b. Is it “unusual” for someone to believe that secondhand smoke is not at all harmful?

12. Cholesterol Reducing Drug  In a clinical trial of Lipitor, a common drug used to lower cholesterol, one group of patients was given a treatment of 10 mg Atorvastatin tablets. That group consists of 19 patients who experienced flu symptoms and 844 patients who did not (based on data from Pfizer, Inc.).
   a. Estimate the probability that a patient taking the drug will experience flu symptoms.
   b. Is it “unusual” for a patient taking the drug to experience flu symptoms?

13. Bumping Airline Passengers  In a recent year, 2624 American Airlines passengers were involuntarily denied boarding their flights, and 168,262 other passengers volunteered for bumping in exchange for cash or vouchers.
   a. Estimate the probability that a randomly selected bumped American Airlines passenger is one who was involuntarily bumped.
   b. Are involuntary bumpings “unusual”? 

14. On-Time Flight Arrivals  A study of 150 randomly selected American Airlines flights showed that 108 arrived on time (based on data from the Department of Transportation).
   a. What is the estimated probability of an American Airlines flight arriving late?
   b. Is it “unusual” for an American Airlines flight to arrive late?

15. Guessing Birthdays  On their first date, Kelly asks Mike to guess the date of her birth, not including the year.
   a. What is the probability that Mike will guess correctly? (Ignore leap years.)
   b. Would it be “unusual” for him to guess correctly on his first try?
   c. If you were Kelly, and Mike did guess correctly on his first try, would you believe his claim that he made a lucky guess, or would you be convinced that he already knew when you were born?
   d. If Kelly asks Mike to guess her age, and Mike’s guess is too high by 15 years, what is the probability that Mike and Kelly will have a second date?

16. Lottery  In the old New York State Lottery, you had to select six numbers between 1 and 54 inclusive. There were 25,827,165 different possible six-number combinations,
and you had to select the correct combination of all six numbers to win the grand prize. For a $1 bet, you selected two different six-number combinations. (You could not select a single six-number combination; you had to select two.)

a. If you placed a $1 bet and selected two different six-number combinations, what was the probability of winning the grand prize?

b. Was it unusual to win the grand prize?

17. Probability of a Birthday
   a. If a person is randomly selected, find the probability that his or her birthday is October 18, which is National Statistics Day in Japan. Ignore leap years.
   b. If a person is randomly selected, find the probability that his or her birthday is in October. Ignore leap years.
   c. If a person is randomly selected, find the probability that he or she was born on a day of the week that ends with the letter y.

18. Probability of Brand Recognition
   a. In a study of brand recognition, 831 consumers knew of Campbell’s Soup, and 18 did not (based on data from Total Research Corporation). Use these results to estimate the probability that a randomly selected consumer will recognize Campbell’s Soup.
   b. Estimate the probability that a randomly selected adult American consumer will recognize the brand name of McDonald’s, most notable as a fast-food restaurant chain.
   c. Estimate the probability that a randomly selected adult American consumer will recognize the brand name of Veeco Instruments, a manufacturer of microelectronic products.

19. Fruitcake Survey In a Bruskin-Goldring Research poll, respondents were asked how a fruitcake should be used. One hundred thirty-two respondents indicated that it should be used for a doorstop, and 880 other respondents cited other uses, including birdfeed, landfill, and a gift. If one of these respondents is randomly selected, what is the probability of getting someone who would use the fruitcake as a doorstop?

20. Probability of a Car Crash Among 400 randomly selected drivers in the 20–24 age bracket, 136 were in a car accident during the last year (based on data from the National Safety Council). If a driver in that age bracket is randomly selected, what is the approximate probability that he or she will be in a car accident during the next year? Is the resulting value high enough to be of concern to those in the 20–24 age bracket?

21. Probability of Winning Solitaire Refer to Data Set 27 in Appendix B and assume that the same Microsoft solitaire game is played.
   a. Estimate the probability of winning when a game is played.
   b. Estimate the probability of running the whole deck by winning $208.

22. Probability of an Adverse Drug Reaction When the drug Viagra was clinically tested, 117 patients reported headaches and 617 did not (based on data from Pfizer, Inc.). Use this sample to estimate the probability that a Viagra user will experience a headache. Is the probability high enough to be of concern to Viagra users?

23. Gender of Children: Constructing Sample Space Section 3-2 included a table summarizing the gender outcomes for a couple planning to have three children.
   a. Construct a similar table for a couple planning to have two children.
   b. Assuming that the outcomes listed in part (a) are equally likely, find the probability of getting two girls.
   c. Find the probability of getting exactly one child of each gender.
24. Genetics: Constructing Sample Space  Both parents have the brown/blue pair of eye-color genes, and each parent contributes one gene to a child. Assume that if the child has at least one brown gene, that color will dominate and the eyes will be brown. (The actual determination of eye color is somewhat more complicated.)
   a. List the different possible outcomes. Assume that these outcomes are equally likely.
   b. What is the probability that a child of these parents will have the blue/blue pair of genes?
   c. What is the probability that the child will have brown eyes?

25. Kentucky Derby Odds  When the horse Monarchos won the 127th Kentucky Derby, a $2 bet that Monarchos would win resulted in a return of $23.
   a. How much net profit was made from a $2 win bet on Monarchos?
   b. What were the payoff odds against a Monarchos win?
   c. Based on preliminary wagering before the race, bettors collectively believed that Monarchos had a 1/15 probability of winning. Assuming that 1/15 was the true probability of a Monarchos victory, what were the actual odds against his winning?
   d. If the payoff odds were the actual odds found in part (c), how much would a $2 ticket be worth after the Monarchos win?

26. Finding Odds in Roulette  A roulette wheel has 38 slots. One slot is 0, another is 00, and the others are numbered 1 through 36, respectively. You are placing a bet that the outcome is an odd number.
   a. What is your probability of winning?
   b. What are the actual odds against winning?
   c. When you bet that the outcome is an odd number, the payoff odds are 1:1. How much profit do you make if you bet $18 and win?
   d. How much profit would you make on the $18 bet if you could somehow convince the casino to change its payoff odds so that they are the same as the actual odds against winning? (Recommendation: Don’t actually try to convince any casino of this; their sense of humor is remarkably absent when it comes to things of this sort.)

3-2 Beyond the Basics

27. Interpreting Effectiveness  A double-blind experiment is designed to test the effectiveness of the drug Statisticzene as a treatment for number blindness. When treated with Statisticzene, subjects seem to show improvement. Researchers calculate that there is a 0.04 probability that the treatment group would show improvement if the drug has no effect. What should you conclude about the effectiveness of Statisticzene?

28. Determining Whether a Jury Is Random  An attorney is defending a client accused of not meeting his alimony obligations. The pool of 20 potential jurors consists of all women, and the attorney calculates that there is a probability of 1/1,048,576 that 20 randomly selected people will be all women. Is there justification for arguing that the jury pool is unfair to his client?

29. Finding Probability from Odds  If the actual odds against event A are a:b, then
   \[ P(A) = \frac{b}{a + b} \]. Find the probability of Millennium winning his next race, given that the actual odds against his winning are 3:5.