

have to do is guess which side of the coin will be facing up after it is tossed. You are assured that the coin is fair, meaning that each of the two sides has an equally likely chance of occurring. You think back about what you learned in your statistics class about probability before you decide what to bet on. Answer the following questions about the coin-tossing game.

1. What is the sample space?
2. What are the possible outcomes?
3. What does the classical approach to probability say about computing probabilities for this type of problem?

You decide to bet on heads, believing that it has a 50% chance of coming up. A friend of yours, who had been playing the game for awhile before you got there, tells you that heads has come up the last 9 times in a row. You remember the law of large numbers.

4. What is the law of large numbers, and does it change your thoughts about what will occur on the next toss?
5. What does the empirical approach to probability say about this problem, and could you use it to solve this problem?
6. Can subjective probabilities be used to help solve this problem? Explain.
7. Assume you could win \$1 million if you could guess what the results of the next toss will be. What would you bet on? Why?

See page 234 for the answers.

Exercises 4-2

1. What is a probability experiment? *A probability experiment is a chance process that leads to well-defined outcomes.*
2. Define *sample space*. *The set of all possible outcomes of a probability experiment is called a sample space.*
3. What is the difference between an outcome and an event? *An outcome is the result of a single trial of a probability experiment, but an event can consist of more than one outcome.*
4. What are equally likely events? *Equally likely events have the same probability of occurring.*
5. What is the range of the values of the probability of an event? *The range of values is 0 to 1 inclusive.*
6. When an event is certain to occur, what is its probability? *1*
7. If an event cannot happen, what value is assigned to its probability? *0*
8. What is the sum of the probabilities of all the outcomes in a sample space? *1*
9. If the probability that it will rain tomorrow is 0.20, what is the probability that it won't rain tomorrow? Would you recommend taking an umbrella?
10. A probability experiment is conducted. Which of these cannot be considered a probability of an outcome?

a. $\frac{1}{3}$	d. -0.59	g. 1
b. $-\frac{1}{5}$	e. 0	h. 33%
c. 0.80	f. 1.45	i. 112%
11. Classify each statement as an example of classical probability, empirical probability, or subjective probability.
 - The probability that a person will watch the 6 o'clock evening news is 0.15. *Empirical*
 - The probability of winning at a Chuck-a-Luck game is $\frac{5}{36}$. *Classical*
 - The probability that a bus will be in an accident on a specific run is about 6%. *Empirical*
 - The probability of getting a royal flush when five cards are selected at random is $\frac{1}{649,740}$. *Classical*
 - The probability that a student will get a C or better in a statistics course is about 70%. *Empirical*
 - The probability that a new fast-food restaurant will be a success in Chicago is 35%. *Empirical*
 - The probability that interest rates will rise in the next 6 months is 0.50. *Subjective*

12. (ans) If a die is rolled one time, find these probabilities.

- Of getting a 4 $\frac{1}{6}$
- Of getting an even number $\frac{1}{2}$
- Of getting a number greater than 4 $\frac{1}{3}$
- Of getting a number less than 7 1
- Of getting a number greater than 0 1
- Of getting a number greater than 3 or an odd number $\frac{5}{6}$
- Of getting a number greater than 3 and an odd number $\frac{1}{6}$

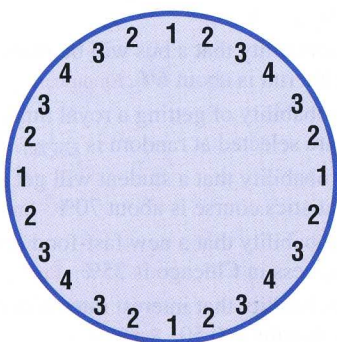
13. If two dice are rolled one time, find the probability of getting these results.

- A sum of 6 $\frac{5}{36}$
- Doubles $\frac{1}{6}$
- A sum of 7 or 11 $\frac{2}{9}$
- A sum greater than 9 $\frac{1}{6}$
- A sum less than or equal to 4 $\frac{1}{6}$

14. (ans) If one card is drawn from a deck, find the probability of getting these results.

- An ace $\frac{1}{13}$
- A diamond $\frac{1}{4}$
- An ace of diamonds $\frac{1}{52}$
- A 4 or a 6 $\frac{2}{13}$
- A 4 or a club $\frac{4}{13}$
- A 6 or a spade $\frac{4}{13}$
- A heart or a club $\frac{1}{2}$
- A red queen $\frac{1}{26}$
- A red card or a 7 $\frac{7}{13}$
- A black card and a 10 $\frac{1}{26}$

15. A shopping mall has set up a promotion as follows. With any mall purchase, the customer gets to spin the wheel shown here. If the number 1 comes up, the customer wins \$10. If the number 2 comes up, the customer wins \$5, and if the number 3 or 4 comes up, the customer wins a discount coupon. Find the following probabilities.



- The customer wins \$10. $\frac{1}{6}$
- The customer wins money. $\frac{1}{2}$
- The customer wins a coupon. $\frac{1}{2}$

16. Choose one of the 50 states at random.

- What is the probability that it begins with M? $\frac{4}{25}$
- What is the probability that it doesn't begin with a vowel? $\frac{19}{25}$

17. In a college class of 250 graduating seniors, 50 have jobs waiting, 10 are going to medical school, 20 are going to law school, and 80 are going to various other kinds of graduate schools. Select one graduate at random.

- What is the probability that the student is going to graduate school? 0.44
- What is the probability that the student is going to medical school? 0.04
- What is the probability that the student will have to start paying back her deferred student loans after 6 months (i.e., does not continue in school)? 0.56

18. Sixty-nine percent of adults favor gun licensing in general. Choose one adult at random. What is the probability that the selected adult doesn't believe in gun licensing? 0.31

Source: Time magazine.

19. For a recent year, 51% of the families in the United States had no children under the age of 18; 20% had one child; 19% had two children; 7% had three children; and 3% had four or more children. If a family is selected at random, find the probability that the family has

- Two or three children 0.26, or 26%
- More than one child 0.29, or 29%
- Less than three children 0.9, or 90%
- Based on the answers to parts a, b, and c, which is most likely to occur? Explain why. The event in part c is most likely to occur since it has the highest probability of occurring.

Source: U.S. Census Bureau.

20. In a recent year, of the 1,184,000 bachelor's degrees conferred, 233,000 were in the field of business, 125,000 were in the social sciences, and 106,000 were in education. If one degree is selected at random, find the following probabilities.

- The degree was awarded in education. 0.0895
- The degree was not awarded in business. 0.8032

Source: National Center for Education Statistics.

21. A couple has three children. Find each probability.

- All boys $\frac{1}{8}$
- All girls or all boys $\frac{1}{4}$
- Exactly two boys or two girls $\frac{3}{4}$
- At least one child of each gender $\frac{3}{4}$

22. In the game of craps using two dice, a person wins on the first roll if a 7 or an 11 is rolled. Find the probability of winning on the first roll. $\frac{2}{9}$
23. In a game of craps, a player loses on the roll if a 2, 3, or 12 is tossed on the first roll. Find the probability of losing on the first roll. $\frac{1}{9}$

24. For a specific year a total of 2541 postal workers were bitten by dogs. The top six cities for crunching canines were as follows.

Houston	49	Chicago	37
Miami	35	Los Angeles	32
Brooklyn	22	Cleveland	20

If one bitten postal worker is selected at random, what is the probability that he was bitten in Houston, Chicago, or Los Angeles? What is the probability that he was bitten in some other city? 0.0464; 0.9536

Source: *N.Y. Times Almanac*.

25. A roulette wheel has 38 spaces numbered 1 through 36, 0, and 00. Find the probability of getting these results.
- An odd number (Do not count 0 or 00.) $\frac{9}{19}$
 - A number greater than 27 $\frac{9}{38}$
 - A number that contains the digit 0 $\frac{5}{38}$
 - Based on the answers to parts a, b, and c, which is most likely to occur? Explain why.

26. Thirty-nine of fifty states are currently under court order to alleviate overcrowding and poor conditions in one or more of their prisons. If a state is selected at random, find the probability that it is currently under such a court order. 0.78

Source: *Harper's Index*.

27. A CBS News/*New York Times* poll found that of 764 adults surveyed nationwide, 34% felt that we are spending too much on space exploration, 19% felt that we are spending too little, 35% felt that we are spending the right amount, and the rest said "don't know" or had no answer. If one of the respondents is selected at random, what is the probability that the person felt that we are spending the right amount or too little? 0.54

Source: www.pollingreport.com.

28. In a survey, 16 percent of American children said they use flattery to get their parents to buy them things. If a child is selected at random, find the probability that the child said he or she does not use parental flattery. 84%

Source: *Harper's Index*.

29. Roll two dice and multiply the numbers together.

- Write out the sample space.
- What is the probability that the product is a multiple of 6? $\frac{5}{12}$
- What is the probability that the product is less than 10? $\frac{17}{36}$

30. The source of federal government revenue for a specific year is

50% from individual income taxes
32% from social insurance payroll taxes
10% from corporate income taxes
3% from excise taxes
5% other

If a revenue source is selected at random, what is the probability that it comes from individual or corporate income taxes? 0.6

Source: *N.Y. Times Almanac*.

31. A box contains a \$1 bill, a \$5 bill, a \$10 bill, and a \$20 bill. A bill is selected at random, and it is not replaced; then a second bill is selected at random. Draw a tree diagram and determine the sample space.
32. Draw a tree diagram and determine the sample space for tossing four coins.
33. Four balls numbered 1 through 4 are placed in a box. A ball is selected at random, and its number is noted; then it is replaced. A second ball is selected at random, and its number is noted. Draw a tree diagram and determine the sample space.
34. Kimberly decides to have a computer custom-made. She can select one option from each category:
- | Megabytes | Monitor | Color |
|-----------|-----------|-------|
| 128 | 15 inches | Tan |
| 256 | 17 inches | Ivory |
| 512 | | |
- Draw a tree diagram for all possible types of computers she can select.
35. Betty and Claire play a tennis tournament consisting of three games. Draw a tree diagram for all possible outcomes of the tournament.
36. A coin is tossed; if it falls heads up, it is tossed again. If it falls tails up, a die is rolled. Draw a tree diagram and determine the outcomes.