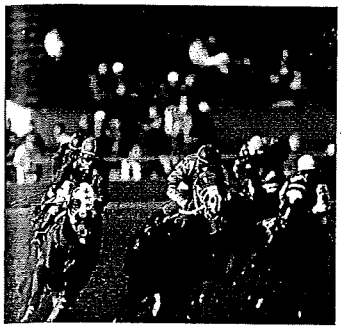
BLITZER BONUS

House Odds



The odds given at horse races and at all games of chance are usually *odds against*. The horse in Example 9, with odds of winning at 2 to 5, has odds against winning at 5 to 2. At a horse race, the odds on this particular horse are given simply as 5 to 2. These **house odds** tell a gambler what the payoff is on a bet. For every $2 bet on the horse, the gambler would win $5 if the horse won, in addition to having the $2 bet returned.

ODDS TO PROBABILITY

If the odds in favor of event E are a to b, then the probability of the event is given by

$$P(E) = \frac{a}{a+b}.$$

EXAMPLE 9 FROM ODDS TO PROBABILITY

The odds in favor of a particular horse winning a race are 2 to 5. What is the probability that this horse will win the race?

SOLUTION Because odds in favor, a to b, means a probability of $\frac{a}{a+b}$, then odds in favor, 2 to 5, means a probability of

$$\frac{2}{2+5} = \frac{2}{7}.$$

The probability that this horse will win the race is $\frac{2}{7}$.

○

CHECK POINT 9 The odds against a particular horse winning a race are 15 to 1. Find the odds in favor of the horse winning the race and the probability of the horse winning the race.

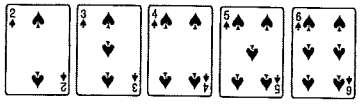
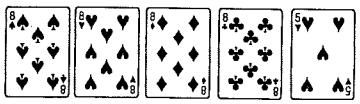
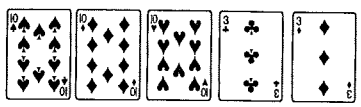
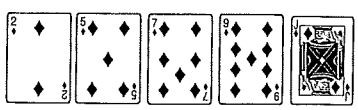
EXERCISE SET 11.6 ●●●●○●

• Practice and Application Exercises

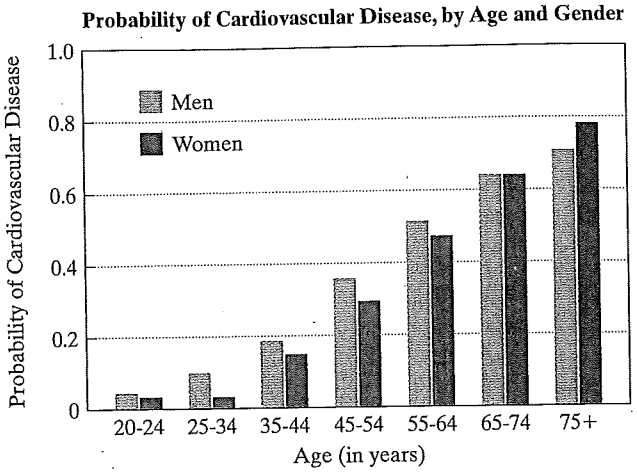
In Exercises 1–6, you are dealt one card from a 52-card deck. Find the probability that you are not dealt

1. an ace. **2.** a 3. **3.** a heart. **4.** a club. **5.** a picture card. **6.** a red picture card.

In 5-card poker, played with a standard 52-card deck, ${}_{52}C_5$, or 2,598,960, different hands are possible. The probability of being dealt various hands is the number of different ways they can occur divided by 2,598,960. Shown in Exercises 7–10 are various types of poker hands and their probabilities. In each exercise, find the probability of not being dealt this type of hand.

Type of Hand	Illustration	Number of Ways the Hand Can Occur	Probability
7. Straight flush: 5 cards with consecutive numbers, all in the same suit (excluding royal flush)		36	$\frac{36}{2{,}598{,}960}$
8. Four of a kind: 4 cards with the same number, plus 1 additional card		624	$\frac{624}{2{,}598{,}960}$
9. Full house: 3 cards of one number and 2 cards of a second number		3744	$\frac{3744}{2{,}598{,}960}$
10. Flush: 5 cards of the same suit (excluding royal flush and straight flush)		5108	$\frac{5108}{2{,}598{,}960}$

The graph shows the probability of cardiovascular disease, by age and gender. Use the information in the graph to solve Exercises 11–12. Express all probabilities as decimals, estimated to two decimal places.



Source: American Heart Association

11. a. What is the probability that a randomly selected man between the ages of 25 and 34 has cardiovascular disease?

b. What is the probability that a randomly selected man between the ages of 25 and 34 does not have cardiovascular disease?

12. a. What is the probability that a randomly selected woman, 75 or older, has cardiovascular disease?

b. What is the probability that a randomly selected woman, 75 or older, does not have cardiovascular disease?

The table shows the distribution, by annual income, of the 112 million households in the United States in 2003, with all numbers rounded to the nearest million. Use this distribution to solve Exercises 13–16.

INCOME DISTRIBUTION OF U.S. HOUSEHOLDS, IN MILLIONS

Annual Income	Number
Less than $10,000	10
$10,000–$14,999	8
$15,000–$24,999	15
$25,000–$34,999	13

Annual Income	Number
$35,000–$49,999	17
$50,000–$74,999	20
$75,000–$99,999	12
$100,000 or more	17

Source: U.S. Census Bureau

If one household is randomly selected from this population, find the probability, expressed as a simplified fraction, that

13. the household income is not in the $50,000–$74,999 range.

14. the household income is not in the $15,000–$24,999 range.

15. the household income is less than $100,000.

16. the household income is at least $10,000.

In Exercises 17–22, you randomly select one card from a 52-card deck. Find the probability of selecting

17. a 2 or a 3.

18. a 7 or an 8.

19. a red 2 or a black 3.

20. a red 7 or a black 8.

21. the 2 of hearts or the 3 of spades.

22. the 7 of hearts or the 8 of spades.

23. The mathematics faculty at a college consists of 8 professors, 12 associate professors, 14 assistant professors, and 10 instructors. If one faculty member is randomly selected, find the probability of choosing a professor or an instructor.

24. A political discussion group consists of 30 Republicans, 25 Democrats, 8 Independents, and 4 members of the Green party. If one person is randomly selected from the group, find the probability of choosing an Independent or a Green.

In Exercises 25–26, a single die is rolled. Find the probability of rolling

25. an even number or a number less than 5.

26. an odd number or a number less than 4.

In Exercises 27–30, you are dealt one card from a 52-card deck. Find the probability that you are dealt

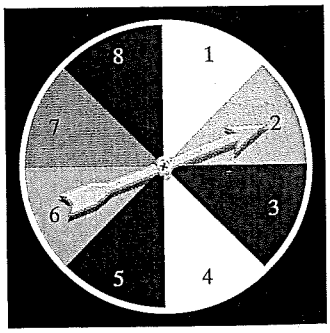
27. a 7 or a red card.

28. a 5 or a black card.

29. a heart or a picture card.

30. a card greater than 2 and less than 7, or a diamond.

In Exercises 31–34, it is equally probable that the pointer on the spinner shown will land on any one of the eight regions, numbered 1 through 8. If the pointer lands on a borderline, spin again.



Find the probability that the pointer will stop on

31. an odd number or a number less than 6.

32. an odd number or a number greater than 3.

33. an even number or a number greater than 5.

34. an even number or a number less than 4.

Use this information to solve Exercises 35–38. The mathematics department of a college has 8 male professors, 11 female professors, 14 male teaching assistants, and 7 female teaching assistants. If a person is selected at random from the group, find the probability that the selected person is

35. a professor or a male.

36. a professor or a female.

37. a teaching assistant or a female.

38. a teaching assistant or a male.

39. In a class of 50 students, 29 are Democrats, 11 are business majors, and 5 of the business majors are Democrats. If one student is randomly selected from the class, find the probability of choosing a Democrat or a business major.

40. A student is selected at random from a group of 200 students in which 135 take math, 85 take English, and 65 take both math and English. Find the probability that the selected student takes math or English.

The table shows the educational attainment of the U.S. population, ages 25 and over, in 2004. Use the data in the table, expressed in millions, to solve Exercises 41–48.

EDUCATIONAL ATTAINMENT OF THE U.S. POPULATION, AGES 25 AND OVER, IN MILLIONS

	Less Than 4 Years High School	4 Years High School Only	Some College (Less than 4 years)	4 Years College (or More)	Total
Male	14	28	22	26	90
Female	14	32	26	25	97
Total	28	60	48	51	187

Source: U.S. Census Bureau

Find the probability, expressed as a simplified fraction, that a randomly selected American, aged 25 or over,

41. has not completed four years (or more) of college.

42. has not completed four years of high school.

43. has completed four years of high school only or less than four years of college.

44. has completed less than four years of high school or four years of high school only.

45. has completed four years of high school only or is a man.

46. has completed four years of high school only or is a woman.

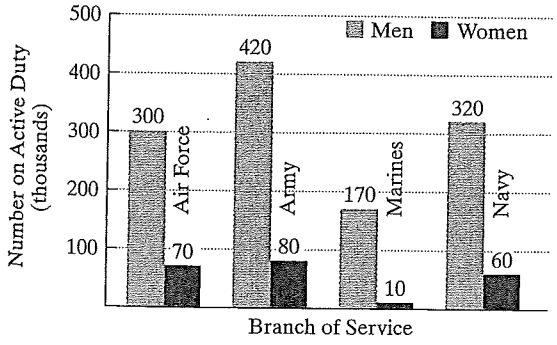
Find the odds in favor and the odds against a randomly selected American, aged 25 and over, with

47. four years (or more) of college.

48. less than four years of high school.

The graph shows the distribution, by branch and gender, of the 1.43 million, or 1430 thousand, active-duty personnel in the U.S. military in 2003. Numbers are given in thousands and rounded to the nearest ten thousand. Use the data to solve Exercises 49–60.

Active Duty U.S. Military Personnel



Source: U.S. Defense Department

If one person is randomly selected from the population represented in the bar graph in the previous column, find the probability, expressed as a simplified fraction, that the person

49. is not in the Army.

50. is not in the Marines.

51. is in the Navy or is a man.

52. is in the Army or is a woman.

53. is in the Air Force or the Marines.

54. is in the Army or the Navy.

Find the odds in favor and the odds against a randomly selected person from the population represented in the bar graph in the previous column being

55. in the Navy.

56. in the Army.

57. a woman in the Marines.

58. a woman in the Air Force.

59. a man.

60. a woman.

In Exercises 61–64, a single die is rolled. Find the odds

61. in favor of rolling a number greater than 2.

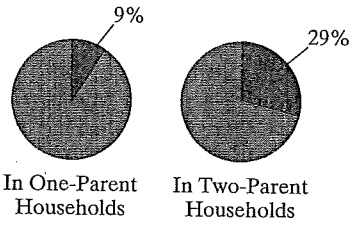
62. in favor of rolling a number less than 5.

63. against rolling a number greater than 2.

64. against rolling a number less than 5.

The circle graphs show the percentage of children in the United States whose parents are college graduates in one-parent households and two-parent households. Use the information shown to solve Exercises 65–66.

Percentage of U.S. Children Whose Parents Are College Graduates



Source: U.S. Census Bureau

65. a. What are the odds in favor of a child in a one-parent household having a parent who is a college graduate?

b. What are the odds against a child in a one-parent household having a parent who is a college graduate?

66. a. What are the odds in favor of a child in a two-parent household having parents who are college graduates?

b. What are the odds against a child in a two-parent household having parents who are college graduates?

In Exercises 67–76, one card is randomly selected from a deck of cards. Find the odds

67. in favor of drawing a heart.

68. in favor of drawing a picture card.

69. in favor of drawing a red card.

70. in favor of drawing a black card.

71. against drawing a 9.

72. against drawing a 5.

73. against drawing a black king.

74. against drawing a red jack.

75. against drawing a spade greater than 3 and less than 9.

76. against drawing a club greater than 4 and less than 10.

77. The winner of a raffle will receive a 21-foot outboard boat. If 1000 raffle tickets were sold and you purchased 20 tickets, what are the odds against your winning the boat?

78. The winner of a raffle will receive a 30-day all-expense-paid trip throughout Europe. If 5000 raffle tickets were sold and you purchased 30 tickets, what are the odds against your winning the trip?

Of the 38 plays attributed to Shakespeare, 18 are comedies, 10 are tragedies, and 10 are histories. In Exercises 79–86, one play is randomly selected from Shakespeare's 38 plays. Find the odds

79. in favor of selecting a comedy.

80. in favor of selecting a tragedy.

81. against selecting a history.

82. against selecting a comedy.

83. in favor of selecting a comedy or a tragedy.

84. in favor of selecting a tragedy or a history.

85. against selecting a tragedy or a history.

86. against selecting a comedy or a history.

87. If you are given odds of 3 to 4 in favor of winning a bet, what is the probability of winning the bet?

88. If you are given odds of 3 to 7 in favor of winning a bet, what is the probability of winning the bet?

89. Based on his skills in basketball, it was computed that when Michael Jordan shot a free throw, the odds in favor of his making it were 21 to 4. Find the probability that when Michael Jordan shot a free throw, he missed it. Out of every 100 free throws he attempted, on the average how many did he make?

90. The odds in favor of a person who is alive at age 20 still being alive at age 70 are 193 to 270. Find the probability that a person who is alive at age 20 will still be alive at age 70.

Exercises 91–92 give the odds against various flight risks. (Source: Men's Health, August 2005) Use these odds to determine the probability of the underlined event for those in flight.

91. odds against contracting an airborne disease: 999 to 1

92. odds against deep-vein thrombosis (blood clot in the leg): 28 to 1

• Writing in Mathematics

93. Explain how to find the probability of an event not occurring. Give an example.

94. What are mutually exclusive events? Give an example of two events that are mutually exclusive.

95. Explain how to find *or* probabilities with mutually exclusive events. Give an example.

96. Give an example of two events that are not mutually exclusive.

97. Explain how to find *or* probabilities with events that are not mutually exclusive. Give an example.

98. Explain how to find the odds in favor of an event if you know the probability that the event will occur.

99. Explain how to find the probability of an event if you know the odds in favor of that event.

• Critical Thinking Exercises

100. In Exercise 39, find the probability of choosing **a.** a Democrat who is not a business major; **b.** a student who is neither a Democrat nor a business major.

101. On New Year's Eve, the probability of a person driving while intoxicated or having a driving accident is 0.35. If the probability of driving while intoxicated is 0.32 and the probability of having a driving accident is 0.09, find the probability of a person having a driving accident while intoxicated.

102. The formula for converting from odds to probability is given in the box on page 649. Read the paragraph on the bottom of page 648 that precedes this box and derive the formula.