9. Determine whether the following is a probability model.

Outcome	Probability
Linda	0.3
Jean	0.2
Grant	0.1
Ron	0.3

10. Determine whether the following is a probability model.

Outcome	Probability
Lanny	0.3
Joanne	0.2
Nelson	0.1
Rich	0.5
Judy	−0.1

In Problems 11–16, construct a probability model for each experiment.

11. Tossing a fair coin twice

12. Tossing two fair coins once

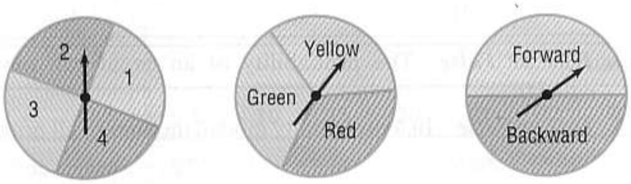
13. Tossing two fair coins, then a fair die

14. Tossing a fair coin, a fair die, and then a fair coin

15. Tossing three fair coins once

16. Tossing one fair coin three times

In Problems 17–22, use the following spinners to construct a probability model for each experiment.



Spinner I (4 equal areas) Spinner II (3 equal areas) Spinner III (2 equal areas)

17. Spin spinner I, then spinner II. What is the probability of getting a 2 or a 4, followed by Red?

18. Spin spinner III, then spinner II. What is the probability of getting Forward, followed by Yellow or Green?

19. Spin spinner I, then II, then III. What is the probability of getting a 1, followed by Red or Green, followed by Backward?

20. Spin spinner II, then I, then III. What is the probability of getting Yellow, followed by a 2 or a 4, followed by Forward?

21. Spin spinner I twice, then spinner II. What is the probability of getting a 2, followed by a 2 or a 4, followed by Red or Green?

22. Spin spinner III, then spinner I twice. What is the probability of getting Forward, followed by a 1 or a 3, followed by a 2 or a 4?

In Problems 23–26, consider the experiment of tossing a coin twice. The table lists six possible assignments of probabilities for this experiment. Using this table, answer the following questions.

	Sample Space			
Assignments	HH	HT	TH	TT
A	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$
B	0	0	0	1
C	$\frac{3}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{3}{16}$
D	$\frac{1}{2}$	$\frac{1}{2}$	$-\frac{1}{2}$	$\frac{1}{2}$
E	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{8}$
F	$\frac{1}{9}$	$\frac{2}{9}$	$\frac{2}{9}$	$\frac{4}{9}$

23. Which of the assignments of probabilities is(are) consistent with the definition of a probability model?

24. Which of the assignments of probabilities should be used if the coin is known to be fair?

25. Which of the assignments of probabilities should be used if the coin is known to always come up tails?

26. Which of the assignments of probabilities should be used if tails is twice as likely as heads to occur?

27. Assigning Probabilities A coin is weighted so that heads is four times as likely as tails to occur. What probability should we assign to heads? to tails?

28. Assigning Probabilities A coin is weighted so that tails is twice as likely as heads to occur. What probability should we assign to heads? to tails?

29. Assigning Probabilities A die is weighted so that an odd-numbered face is twice as likely to occur as an even-numbered face. What probability should we assign to each face?

30. Assigning Probabilities A die is weighted so that a six cannot appear. The other faces occur with the same probability. What probability should we assign to each face?

For Problems 31–34, the sample space is $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$. *Suppose that the outcomes are equally likely.*

31. Compute the probability of the event $E = \{1, 2, 3\}$.

32. Compute the probability of the event $F = \{3, 5, 9, 10\}$.

33. Compute the probability of the event E: "an even number."

34. Compute the probability of the event F: "an odd number."

For Problems 35 and 36, an urn contains 5 white marbles, 10 green marbles, 8 yellow marbles, and 7 black marbles.

35. If one marble is selected, determine the probability that it is white.

36. If one marble is selected, determine the probability that it is black.

In Problems 37–40, assume equally likely outcomes.

37. Determine the probability of having 3 boys in a 3-child family.

38. Determine the probability of having 3 girls in a 3-child family.

39. Determine the probability of having 1 girl and 3 boys in a 4-child family.

40. Determine the probability of having 2 girls and 2 boys in a 4-child family.

For Problems 41–44, two fair dice are rolled.

41. Determine the probability that the sum of the two dice is 7.

42. Determine the probability that the sum of the two dice is 11.

43. Determine the probability that the sum of the two dice is 3.

44. Determine the probability that the sum of the two dice is 12.

In Problems 45–48, find the probability of the indicated event if $P(A) = 0.25$ and $P(B) = 0.45$.

45. $P(A \cup B)$ if $P(A \cap B) = 0.15$

46. $P(A \cap B)$ if $P(A \cup B) = 0.6$

47. $P(A \cup B)$ if A, B are mutually exclusive

48. $P(A \cap B)$ if A, B are mutually exclusive

49. If $P(A) = 0.60$, $P(A \cup B) = 0.85$, and $P(A \cap B) = 0.05$, find $P(B)$.

50. If $P(B) = 0.30$, $P(A \cup B) = 0.65$, and $P(A \cap B) = 0.15$, find $P(A)$.

51. **Automobile Theft** According to the Insurance Information Institute, in 2004 there was a 13% probability that an automobile theft in the United States would be cleared by arrests. If an automobile theft case is randomly selected, what is the probability that it was not cleared by an arrest?

52. **Pet Ownership** According to the American Pet Products Manufacturers Association's *2005–2006 National Pet Owners Survey,* there is a 63% probability that a U.S. household owns a pet. If a U.S. household is randomly selected, what is the probability that it does not own a pet?

53. **Cat Ownership** According to the American Pet Products Manufacturers Association's *2005–2006 National Pet Owners Survey,* in 2004 there was a 34% probability that a U.S. pet owner owned a cat. If a U.S. pet owner is randomly selected, what is the probability that he or she does not own a cat?

54. **Doctorate Degrees** According to the National Science Foundation, in 2004 there was a 13.7% probability that a doctoral degree awarded at a U.S. university was awarded in engineering. If a 2004 U.S. doctoral recipient is randomly selected, what is the probability that his or her degree was not in engineering?

55. **Online Gambling** According to a Harris poll (January 12–17, 2006), 5% of U.S. adults admitted to having spent money gambling online. If a U.S. adult is selected at random, what is the probability that he or she has never spent any money gambling online?

56. **Girl Scout Cookies** According to the Girl Scouts of America, in March 2006, 9% of all Girl Scout cookies sold are shortbread/trefoils. If a box of Girl Scout cookies is selected at random, what is the probability that it is not shortbread/trefoils?

For Problems 57–60, a golf ball is selected at random from a container. If the container has 9 white balls, 8 green balls, and 3 orange balls, find the probability of each event.

57. The golf ball is white or green.

58. The golf ball is white or orange.

59. The golf ball is not white.

60. The golf ball is not green.

61. On the "Price is Right" there is a game in which a bag is filled with 3 strike chips and 5 numbers. Let's say that the numbers in the bag are 0, 1, 3, 6, and 9. What is the probability of selecting a strike chip or the number 1?

62. Another game on the "Price is Right" requires the contestant to spin a wheel with numbers 5, 10, 15, 20, ..., 100. What is the probability that the contestant spins 100 or 30?

Problems 63–66, are based on a consumer survey of annual incomes in 100 households. The following table gives the data.

Income	\$0–9999	\$10,000–19,999	\$20,000–29,999	\$30,000–39,999	\$40,000 or more
Number of households	5	35	30	20	10

63. What is the probability that a household has an annual income of \$30,000 or more?

64. What is the probability that a household has an annual income between \$10,000 and \$29,999, inclusive?

65. What is the probability that a household has an annual income of less than \$20,000?

66. What is the probability that a household has an annual income of \$20,000 or more?

67. **Surveys** In a survey about the number of TV sets in a house, the following probability table was constructed:

Number of TV sets	0	1	2	3	4 or more
Probability	0.05	0.24	0.33	0.21	0.17

Find the probability of a house having:

(a) 1 or 2 TV sets (b) 1 or more TV sets

(c) 3 or fewer TV sets (d) 3 or more TV sets

(e) Fewer than 2 TV sets (f) Fewer than 1 TV set

(g) 1, 2, or 3 TV sets (h) 2 or more TV sets

68. **Checkout Lines** Through observation, it has been determined that the probability for a given number of people waiting in line at the "5 items or less" checkout register of a supermarket is as follows:

Number waiting in line	0	1	2	3	4 or more
Probability	0.10	0.15	0.20	0.24	0.31

3. $\left\{\ln\left(\frac{5}{2}\right)\right\}$ **4.** $y = 5x - 10$ **5.** $x^2 + y^2 + 2x - 4y - 20 = 0$

6. (a) 5 **(b)** 13 **(c)** $\frac{6x+3}{2x-1}$ **(d)** $\left\{x \middle| x \neq \frac{1}{2}\right\}$ **(e)** $\frac{7x-2}{x-2}$ **(f)** $\{x|x \neq 2\}$ **(g)** $g^{-1}(x) = \frac{1}{2}(x-1)$; all reals **(h)** $f^{-1}(x) = \frac{2x}{x-3}$; $\{x|x \neq 3\}$

7. $\frac{x^2}{7} + \frac{y^2}{16} = 1$ **8.** $(x+1)^2 = 4(y-2)$ **9.** $r = 8\sin\theta$; $x^2 + (y-4)^2 = 16$ **10.** $\left\{\frac{3\pi}{2}\right\}$ **11.** $\frac{2\pi}{3}$

12. (a) $-\frac{\sqrt{15}}{4}$ **(b)** $-\frac{\sqrt{15}}{15}$ **(c)** $-\frac{\sqrt{15}}{8}$ **(d)** $\frac{7}{8}$ **(e)** $\sqrt{\frac{1+\frac{\sqrt{15}}{4}}{2}} = \frac{\sqrt{4+\sqrt{15}}}{2\sqrt{2}}$

CHAPTER 14 Counting and Probability

14.1 Assess Your Understanding *(page 978)*

5. $n(A) + n(B) - n(A \cap B)$ **6.** F **7.** $\emptyset, \{a\}, \{b\}, \{c\}, \{d\}, \{a,b\}, \{a,c\}, \{a,d\}, \{b,c\}, \{b,d\}, \{c,d\}, \{a,b,c\}, \{b,c,d\}, \{a,c,d\}, \{a,b,d\}, \{a,b,c,d\}$ **9.** 25 **11.** 40 **13.** 25 **15.** 37 **17.** 18 **19.** 5 **21.** 15 different arrangements **23.** 9000 numbers **25.** 175; 125
27. (a) 15 **(b)** 15 **(c)** 15 **(d)** 25 **(e)** 40 **29. (a)** 11,597 thousand **(b)** 74.083 thousand **31.** 480 portfolios

14.2 Assess Your Understanding *(page 985)*

3. permutation **4.** combination **5.** T **6.** T **7.** 30 **9.** 24 **11.** 1 **13.** 1680 **15.** 28 **17.** 35 **19.** 1 **21.** 10,400,600 **23.** {*abc, abd, abe, acb, acd, ace, adb, adc, ade, aeb, aec, aed, bac, bad, bae, bca, bcd, bce, bda, bdc, bde, bea, bec, bed, cab, cad, cae, cba, cbd, cbe, cda, cdb, cde, cea, ceb, ced, dab, dac, dae, dba, dbc, dbe, dca, dcb, dce, dea, deb, dec, eab, eac, ead, eba, ebc, ebd, eca, ecb, ecd, eda, edb, edc*}; 60 **25.** {123, 124, 132, 134, 142, 143, 213, 214, 231, 234, 241, 243, 312, 314, 321, 324, 341, 342, 412, 413, 421, 423, 431, 432}; 24 **27.** {*abc, abd, abe, acd, ace, ade, bcd, bce, bde, cde*}; 10
29. {123, 124, 134, 234}; 4 **31.** 16 **33.** 8 **35.** 24 **37.** 60 **39.** 18,278 **41.** 35 **43.** 1024 **45.** 120 **47.** 132,860 **49.** 336 **51.** 90,720
53. (a) 63 **(b)** 35 **(c)** 1 **55.** 1.157×10^{76} **57.** 362,880 **59.** 660 **61.** 15 **63. (a)** 125,000; 117,600 **(b)** A better name for a *combination* lock would be a *permutation* lock because the order of the numbers matters.

Historical Problems *(page 995)*

1. (a) {*AAAA, AAAB, AABA, AABB, ABAA, ABAB, ABBA, ABBB, BAAA, BAAB, BABA, BABB, BBAA, BBAB, BBBA, BBBB*}
(b) $P(A \text{ wins}) = \frac{C(4,2) + C(4,3) + C(4,4)}{2^4} = \frac{6+4+1}{16} = \frac{11}{16}$; $P(B \text{ wins}) = \frac{C(4,3) + C(4,4)}{2^4} = \frac{4+1}{16} = \frac{5}{16}$

2. (a) $\$\frac{3}{2} = \$1.50$ **(b)** $\$\frac{1}{2} = \$0.50$

14.3 Assess Your Understanding *(page 995)*

1. equally likely **2.** complement **3.** F **4.** T **5.** 0, 0.01, 0.35, 1 **7.** Probability model **9.** Not a probability model

11. $S = \{\text{HH, HT, TH, TT}\}$; $P(\text{HH}) = \frac{1}{4}, P(\text{HT}) = \frac{1}{4}, P(\text{TH}) = \frac{1}{4}, P(\text{TT}) = \frac{1}{4}$ **13.** S = {HH1, HH2, HH3, HH4, HH5, HH6, HT1, HT2, HT3, HT4, HT5, HT6, TH1, TH2, TH3, TH4, TH5, TH6, TT1, TT2, TT3, TT4, TT5, TT6}; each outcome has the probability of $\frac{1}{24}$.

15. S = {HHH, HHT, HTH, HTT, THH, THT, TTH, TTT}; each outcome has the probability of $\frac{1}{8}$.

17. S = { 1 Yellow, 1 Red, 1 Green, 2 Yellow, 2 Red, 2 Green, 3 Yellow, 3 Red, 3 Green, 4 Yellow, 4 Red, 4 Green}; each outcome has the probability of $\frac{1}{12}$; thus, $P(\text{2 Red}) + P(\text{4 Red}) = \frac{1}{12} + \frac{1}{12} = \frac{1}{6}$.

19. S = {1 Yellow Forward, 1 Yellow Backward, 1 Red Forward, 1 Red Backward, 1 Green Forward, 1 Green Backward, 2 Yellow Forward, 2 Yellow Backward, 2 Red Forward, 2 Red Backward, 2 Green Forward, 2 Green Backward, 3 Yellow Forward, 3 Yellow Backward, 3 Red Forward, 3 Red Backward, 3 Green Forward, 3 Green Backward, 4 Yellow Forward, 4 Yellow Backward, 4 Red Forward, 4 Red Backward, 4 Green Forward, 4 Green Backward}; each outcome has the probability of $\frac{1}{24}$; thus, $P(\text{1 Red Backward}) + P(\text{1 Green Backward}) = \frac{1}{24} + \frac{1}{24} = \frac{1}{12}$.

21. S = {11 Red, 11 Yellow, 11 Green, 12 Red, 12 Yellow, 12 Green, 13 Red, 13 Yellow, 13 Green, 14 Red, 14 Yellow, 14 Green, 21 Red, 21 Yellow, 21 Green, 22 Red, 22 Yellow, 22 Green, 23 Red, 23 Yellow, 23 Green, 24 Red, 24 Yellow, 24 Green, 31 Red, 31 Yellow, 31 Green, 32 Red, 32 Yellow, 32 Green, 33 Red, 33 Yellow, 33 Green, 34 Red, 34 Yellow, 34 Green, 41 Red, 41 Yellow, 41 Green, 42 Red, 42 Yellow, 42 Green, 43 Red, 43 Yellow, 43 Green, 44 Red, 44 Yellow, 44 Green}; each outcome has the probability of $\frac{1}{48}$; thus, E = {22 Red, 22 Green, 24 Red, 24 Green}; $P(E) = \frac{n(E)}{n(S)} = \frac{4}{48} = \frac{1}{12}$.

23. A, B, C, F **25.** B **27.** $P(\text{H}) = \frac{4}{5}$; $P(\text{T}) = \frac{1}{5}$ **29.** $P(1) = P(3) = P(5) = \frac{2}{9}$; $P(2) = P(4) = P(6) = \frac{1}{9}$ **31.** $\frac{3}{10}$ **33.** $\frac{1}{2}$ **35.** $\frac{1}{6}$ **37.** $\frac{1}{8}$

39. $\frac{1}{4}$ **41.** $\frac{1}{6}$ **43.** $\frac{1}{18}$ **45.** 0.55 **47.** 0.70 **49.** 0.30 **51.** 0.87 **53.** 0.66 **55.** 0.95 **57.** $\frac{17}{20}$ **59.** $\frac{11}{20}$ **61.** $\frac{1}{2}$ **63.** $\frac{3}{10}$ **65.** $\frac{2}{5}$

67. (a) 0.57 **(b)** 0.95 **(c)** 0.83 **(d)** 0.38 **(e)** 0.29 **(f)** 0.05 **(g)** 0.78 **(h)** 0.71 **69. (a)** $\frac{25}{33}$ **(b)** $\frac{25}{33}$ **71.** 0.167 **73.** 0.000033069