6. You roll two dice. Based on the probabilities shown in Table 7.3, which of the following has a probability *greater* than 0.5?
   a. rolling a sum of 2 or 3 or 4 or 5
   b. rolling a sum of 2 or 3 or 4 or 10 or 11 or 12
   c. rolling a sum of 5 or 6 or 7 or 8
7. You roll two dice twice. Based on the probabilities shown in Table 7.3, what is the probability that you'll get a sum of 3 on the first roll and a sum of 4 on the second roll?
   a. $2/36 \times 3/36$
   b. $2/36 + 3/36$
   c. $(2/36 \times 3/36)^2$
8. You toss two coins ten times, and you want to know the probability of getting two heads at least once in the ten trials. To get the answer in the easiest possible way, what is the first thing you should calculate?
   a. the probability of getting two heads exactly once during the ten trials
   b. the probability of *not* getting two heads in a single trial
   c. the probability of getting two heads on both of the first two trials
9. You purchase 25 lottery tickets for which the probability of winning some prize on a single ticket is 1 in 100. Your probability of having at least one winner among your 25 tickets is
   a. 25 in 100.
   b. 0.25^{10}.
   c. $1 - (0.99)^{25}$.
10. One in 100 tennis balls produced at a factory is defective. If you randomly select five tennis balls, what is the probability that at least one will be defective?
    a. 5×0.01^5 b. 0.99^5 c. $1 - 0.99^5$

Exercises

REVIEW QUESTIONS

1. How did the gambling habits of the Chevalier de Mère help launch the mathematical study of probability?
2. Give an example in which we would be interested in an *and* probability. How do we determine whether the events are independent or dependent? Give examples of each case, and explain how we calculate the probabilities.
3. Give an example in which we would be interested in an *either/or* probability. How do we determine whether the events are overlapping or non-overlapping? Give examples of each case, and explain how we calculate the probabilities.
4. What is the *at least once* rule? Explain how the *at least once* rule can be used to find the correct probabilities in the games of the Chevalier de Mère.

DOES IT MAKE SENSE?

Decide whether each of the following statements makes sense (or is clearly true) or does not make sense (or is clearly false). Explain your reasoning.

5. The probability of getting heads *and* tails when you toss a coin is 0, but the probability of getting heads *or* tails is 1.
6. If you toss a coin and get heads three times in a row, you're due to get tails on the next toss.
7. The probability of drawing an ace or a spade from a deck of cards is the same as the probability of drawing the ace of spades.
8. I can't believe you chose the lottery numbers 1-2-3-4-5-6. Getting six numbers in a row is much less likely than getting other random numbers.
9. My chance of getting a 5 on the roll of one die is 1/6, so my chance of getting at least one 5 when I roll three dice is 3/6.
10. To find the probability that at least one of my 25 lottery tickets is a winner, I calculated the probability that none of my tickets is a winner and subtracted it from 1.

BASIC SKILLS & CONCEPTS

11–26: *And* Probabilities. Determine whether the following events are independent or dependent. Then find the probability of the event.

11. The next four births at a hospital all being girls

12. Discovering that your three best friends all have a birthday in April
13. Rolling two 2s followed by one 6 on three tosses of a fair die
14. Drawing three queens in a row from a standard deck of cards when the drawn card is returned to the deck each time

15. Drawing three queens in a row from a standard deck of cards when the drawn card is not returned to the deck each time
16. Drawing three hearts in a row from a regular deck of cards when the drawn card is not returned to the deck each time
17. Rolling four fair dice and getting an even number on all four dice
18. Rolling four fair dice and getting four 6s
19. Drawing three spades in a row from a regular deck of cards when the drawn card is returned to the deck each time
20. Being dealt four red cards off the top of a regular deck of well-shuffled cards
21. Purchasing four winning lottery tickets in a row when each ticket has a 1 in 10 chance of being a winner
22. Randomly selecting a three-person committee consisting entirely of Americans from a pool of 12 British people and 18 Americans
23. Selecting all women for a seven-person jury from a pool of 15 men and 15 women
24. Selecting three fully charged batteries in a row from a large batch in which 5% of the batteries are dead
25. Randomly meeting three international students in a row on a campus where 1 in 12 students is an international student
26. Four rainy days in a row when the forecast calls for a "20% chance of rain" each day

27–38: ***Either/Or* Probabilities.** Determine whether the following events are overlapping or non-overlapping. Then find the probability of the event.

27. Drawing either a red 6 or a black 8 on one draw from a regular deck of cards
28. Getting a sum of either 6 or 8 on a roll of two dice
29. Drawing either a jack or a spade from a regular deck of cards
30. Drawing either a face card (jack, queen, or king) or a diamond from a regular deck of cards
31. Getting a sum of either 10, 11, or 12 on a roll of two dice
32. Drawing either a jack or a king from a regular deck of cards
33. Rolling a 2 or a red number on a die on which the even numbers are red and the odd numbers are black
34. Rolling a 3 or a red number on a die on which the even numbers are red and the odd numbers are black
35. Randomly meeting either a woman or a Republican in a group composed of 20 Democratic men, 40 Republican men, 60 Democratic women, and 80 Republican women
36. Randomly meeting either a man or an American in a group composed of 20 English women, 15 English men, 10 American women, and 5 American men
37. Randomly selecting a three-child family with either one or two boy children
38. Randomly selecting a girl or a non–soccer player from a sixth-grade class of 12 boys, 7 of whom play soccer, and 15 girls, 10 of whom play soccer

39–50: ***At Least Once* Problems.** Use the *at least once* rule to find the probabilities of the following events.

39. Getting at least one 6 in four rolls of a single die
40. Getting at least one 1 in eight rolls of a single die
41. Getting at least one 3 when rolling three fair dice
42. Getting at least one head when tossing six fair coins
43. Drawing at least one king when you draw a card from a standard deck 8 times (replacing the card each time you draw, so there are always 52 cards in the deck)
44. Drawing at least one king when you draw a card from a standard deck 20 times (replacing the card each time you draw, so there are always 52 cards in the deck)
45. Getting rain at least once in six days if the probability of rain on each single day is 0.2
46. Getting high winds at least once in 20 days if the probability of high winds on each single day is 0.1
47. Meeting at least one person with flu in 12 random encounters on campus when the infection rate is 4% (4 in 100 people have flu)
48. Meeting at least one left-handed person in eight random encounters on campus when the incidence rate is 11% (11 in 100 people are left-handed)
49. Getting at least one parking ticket in five occasions when you do not pay the parking meter, when the chances of getting a ticket when not paying are 0.3
50. Getting at least one false test for strep throat in five trials when the false report probability is 0.025

FURTHER APPLICATIONS

51. **Probability and Court.** The data in the following table show the outcomes of guilty and not-guilty pleas in 1028 criminal court cases.

	Guilty Plea	Not-Guilty Plea
Sent to prison	392	58
Not sent to prison	564	14

Source: Brereton and Casper, *Law and Society Review*, Vol. 16, No. 7.

a. What is the probability that a randomly selected defendant either pled guilty or was sent to prison?

b. What is the probability that a randomly selected defendant either pled not guilty or was not sent to prison?

52. **Testing a Drug.** A new cold medication was tested by giving 120 people the drug and 100 people a placebo. A control group consisted of 120 people who were given no treatment. The number of people in each group who showed improvement is shown in the table below.

	Cold Drug	Placebo	Control	Total
Improvement	70	55	40	165
No improvement	50	45	80	175
Total	120	100	120	340