

## SECTION 5.2

## Exercises

pg 299 39. **Role-playing games** Computer games in which the players take the roles of characters are very popular. They go back to earlier tabletop games such as Dungeons & Dragons. These games use many different types of dice. A four-sided die has faces with 1, 2, 3, and 4 spots.

- List the sample space for rolling the die twice (spots showing on first and second rolls).
- What is the assignment of probabilities to outcomes in this sample space? Assume that the die is perfectly balanced.

40. **Tossing coins** Imagine tossing a fair coin 3 times.

- What is the sample space for this chance process?
- What is the assignment of probabilities to outcomes in this sample space?

41. **Role-playing games** Refer to Exercise 39. Define event A: sum is 5. Find  $P(A)$ .

42. **Tossing coins** Refer to Exercise 40. Define event B: get more heads than tails. Find  $P(B)$ .







43. **Probability models?** In each of the following situations, state whether or not the given assignment of probabilities to individual outcomes is legitimate, that is, satisfies the rules of probability. If not, give specific reasons for your answer.

(a) Roll a die and record the count of spots on the up-face:  $P(1) = 0$ ,  $P(2) = 1/6$ ,  $P(3) = 1/3$ ,  $P(4) = 1/3$ ,  $P(5) = 1/6$ ,  $P(6) = 0$ .

(b) Choose a college student at random and record gender and enrollment status:  $P(\text{female full-time}) = 0.56$ ,  $P(\text{male full-time}) = 0.44$ ,  $P(\text{female part-time}) = 0.24$ ,  $P(\text{male part-time}) = 0.17$ .

(c) Deal a card from a shuffled deck:  $P(\text{clubs}) = 12/52$ ,  $P(\text{diamonds}) = 12/52$ ,  $P(\text{hearts}) = 12/52$ ,  $P(\text{spades}) = 16/52$ .

44. **Rolling a die** The following figure displays several possible probability models for rolling a die. We can learn which model is actually *accurate* for a particular die only by rolling the die many times. However, some of the models are not *legitimate*. That is, they do not obey the rules. Which are legitimate and which are not? In the case of the illegitimate models, explain what is wrong.

Outcome	Probability			
	Model 1	Model 2	Model 3	Model 4
	1/7	1/3	1/3	1
	1/7	1/6	1/6	1
	1/7	1/6	1/6	2
	1/7	0	1/6	1
	1/7	1/6	1/6	1
	1/7	1/6	1/6	2

pg 302 45. **Blood types** All human blood can be typed as one of O, A, B, or AB, but the distribution of the types varies a bit with race. Here is the distribution of the blood type of a randomly chosen black American:

Blood type:	O	A	B	AB
Probability:	0.49	0.27	0.20	?

- What is the probability of type AB blood? Why?
- What is the probability that the person chosen does not have type AB blood?
- Maria has type B blood. She can safely receive blood transfusions from people with blood types O and B. What is the probability that a randomly chosen black American can donate blood to Maria?

46. **Languages in Canada** Canada has two official languages, English and French. Choose a Canadian at random and ask, "What is your mother tongue?" Here is the distribution of responses, combining many separate languages from the broad Asia/Pacific region.<sup>6</sup>

Language:	English	French	Asian/Pacific	Other
Probability:	0.63	0.22	0.06	?

- What probability should replace "?" in the distribution? Why?
- What is the probability that a Canadian's mother tongue is not English?
- What is the probability that a Canadian's mother tongue is a language other than English or French?



47. **Education among young adults** Choose a young adult (aged 25 to 29) at random. The probability is 0.13 that the person chosen did not complete high school, 0.29 that the person has a high school diploma but no further education, and 0.30 that the person has at least a bachelor's degree.

(a) What must be the probability that a randomly chosen young adult has some education beyond high school but does not have a bachelor's degree? Why?

(b) What is the probability that a randomly chosen young adult has at least a high school education? Which rule of probability did you use to find the answer?

48. **Preparing for the GMAT** A company that offers courses to prepare students for the Graduate Management Admission Test (GMAT) has the following information about its customers: 20% are currently undergraduate students in business; 15% are undergraduate students in other fields of study; 60% are college graduates who are currently employed; and 5% are college graduates who are not employed. Choose a customer at random.

(a) What's the probability that the customer is currently an undergraduate? Which rule of probability did you use to find the answer?

(b) What's the probability that the customer is not an undergraduate business student? Which rule of probability did you use to find the answer?

49. **Who eats breakfast?** Students in an urban school were curious about how many children regularly eat breakfast. They conducted a survey, asking, "Do you eat breakfast on a regular basis?" All 595 students in the school responded to the survey. The resulting data are shown in the two-way table below.<sup>7</sup>

	Male	Female	Total
Eats breakfast regularly	190	110	300
Doesn't eat breakfast regularly	130	165	295
Total	320	275	595

(a) Who are the individuals? What variables are being measured?

(b) If we select a student from the school at random, what is the probability that we choose

- a female?
- someone who eats breakfast regularly?
- a female who eats breakfast regularly?
- a female or someone who eats breakfast regularly?

50. **Sampling senators** The two-way table below describes the members of the U.S. Senate in a recent year.

	Male	Female
Democrats	47	13
Republicans	36	4

(a) Who are the individuals? What variables are being measured?

(b) If we select a U.S. senator at random, what's the probability that we choose

- a Democrat?
- a female?
- a female Democrat?
- a female or a Democrat?

51. **Roulette** An American roulette wheel has 38 slots with numbers 1 through 36, 0, and 00, as shown in the figure. Of the numbered slots, 18 are red, 18 are black, and 2—the 0 and 00—are green. When the wheel is spun, a metal ball is dropped onto the middle of the wheel. If the wheel is balanced, the ball is equally likely to settle in any of the numbered slots. Imagine spinning a fair wheel once. Define events  $B$ : ball lands in a black slot, and  $E$ : ball lands in an even-numbered slot. (Treat 0 and 00 as even numbers.)



(a) Make a two-way table that displays the sample space in terms of events  $B$  and  $E$ .

(b) Find  $P(B)$  and  $P(E)$ .

(c) Describe the event " $B$  and  $E$ " in words. Then find  $P(B \text{ and } E)$ .

(d) Explain why  $P(B \text{ or } E) \neq P(B) + P(E)$ . Then use the general addition rule to compute  $P(B \text{ or } E)$ .

52. **Playing cards** Shuffle a standard deck of playing cards and deal one card. Define events  $J$ : getting a jack, and  $R$ : getting a red card.

(a) Construct a two-way table that describes the sample space in terms of events  $J$  and  $R$ .



- (b) Find  $P(J)$  and  $P(R)$ .  
(c) Describe the event " $J$  and  $R$ " in words. Then find  $P(J \text{ and } R)$ .  
(d) Explain why  $P(J \text{ or } R) \neq P(J) + P(R)$ . Then use the general addition rule to compute  $P(J \text{ or } R)$ .

53. **Who eats breakfast?** Refer to Exercise 49.

- (a) Construct a Venn diagram that models the chance process using events  $B$ : eats breakfast regularly, and  $M$ : is male.  
(b) Find  $P(B \cup M)$ . Interpret this value in context.  
(c) Find  $P(B^c \cap M^c)$ . Interpret this value in context.

54. **Sampling senators** Refer to Exercise 50.

- (a) Construct a Venn diagram that models the chance process using events  $R$ : is a Republican, and  $F$ : is female.  
(b) Find  $P(R \cup F)$ . Interpret this value in context.  
(c) Find  $P(R^c \cap F^c)$ . Interpret this value in context.

55. **MySpace versus Facebook** A recent survey suggests that 85% of college students have posted a profile on Facebook, 54% use MySpace regularly, and 42% do both. Suppose we select a college student at random.

- (a) Assuming that there are 20 million college students, make a two-way table for this chance process.  
(b) Construct a Venn diagram to represent this setting.  
(c) Consider the event that the randomly selected college student has posted a profile on at least one of these two sites. Write this event in symbolic form using the two events of interest that you chose in (b).  
(d) Find the probability of the event described in (c). Explain your method.

56. **Mac or PC?** A recent census at a major university revealed that 40% of its students primarily used Macintosh computers (Macs). The rest mainly used PCs. At the time of the census, 67% of the school's students were undergraduates. The rest were graduate students. In the census, 23% of respondents were graduate students who said that they used PCs as their main computers. Suppose we select a student at random from among those who were part of the census.

- (a) Assuming that there were 10,000 students in the census, make a two-way table for this chance process.  
(b) Construct a Venn diagram to represent this setting.  
(c) Consider the event that the randomly selected student is a graduate student who uses a Mac. Write this event in symbolic form using the two events of interest that you chose in (b).  
(d) Find the probability of the event described in (c). Explain your method.

**Multiple choice:** Select the best answer for Exercises 57 to 60.

57. In government data, a household consists of all occupants of a dwelling unit. Choose an American household at random and count the number of people it contains. Here is the assignment of probabilities for your outcome:

Number of persons:	1	2	3	4	5	6	7
Probability:	0.25	0.32	???	???	0.07	0.03	0.01

The probability of finding 3 people in a household is the same as the probability of finding 4 people. These probabilities are marked ??? in the table of the distribution. The probability that a household contains 3 people must be

- (a) 0.68. (b) 0.32. (c) 0.16. (d) 0.08.  
(e) between 0 and 1, and we can say no more.

58. In a table of random digits such as Table D, each digit is equally likely to be any of 0, 1, 2, 3, 4, 5, 6, 7, 8, or 9. What is the probability that a digit in the table is 7 or greater?

- (a)  $7/10$  (c)  $4/10$  (e)  $1/10$   
(b)  $6/10$  (d)  $3/10$

59. Twenty of a sample of 275 students say they are vegetarians. Of the vegetarians, 9 eat both fish and eggs, 3 eat eggs but not fish, and 8 eat neither. Choose one of the vegetarians at random. What is the probability that the chosen student eats neither fish nor eggs?

- (a)  $8/275 = 0.03$  (c)  $8/20 = 0.4$  (e) 1  
(b)  $20/275 = 0.07$  (d) 0.5

60. The casino game craps is based on rolling two dice. Here is the assignment of probabilities to the sum of the numbers on the up-faces when two dice are rolled:

Outcome:	2	3	4	5	6	7	8	9	10	11	12
Probability:	$1/36$	$2/36$	$3/36$	$4/36$	$5/36$	$6/36$	$5/36$	$4/36$	$3/36$	$2/36$	$1/36$

The most common bet in craps is the "pass line." A pass line bettor wins immediately if either a 7 or an 11 comes up on the first roll. This is called a *natural*. What is the probability of a natural?

- (a)  $2/36$  (c)  $8/36$  (e)  $20/36$   
(b)  $6/36$  (d)  $12/36$

61. **Crawl before you walk** (3.2) At what age do babies learn to crawl? Does it take longer to learn in the winter, when babies are often bundled in clothes that restrict their movement? Perhaps there might even be an association between babies' crawling age and the average temperature during the month they first try to