

$$\begin{aligned}
 P(\text{choose same snack}) &= \frac{\text{number of ways to choose same snack}}{\text{total number of snacks}} \\
 &= \frac{1}{49} \\
 &\approx 0.0204
 \end{aligned}$$

Thus, there is about a 2% chance that each child will eat the same thing two days in a row.

4.3 Section Exercises

Independent Events

Determine whether the events are independent.

1. Finding the batteries in your calculator dead. Finding the battery in your car dead.
2. Getting a letter from your aunt. Getting a bank statement in the mail.
3. Claire's name being drawn in the school raffle, without replacement. Ben's name being drawn in the school raffle.
4. Buying a new shirt on sale. Having enough money for lunch that day.
5. Lois ordering a steak. Ann ordering a salad.
6. Winning the Mississippi state lottery. Winning the Florida state lottery.

Multiplication Rule for Independent Events

Calculate each probability.

7. Carriage rides in Charleston, South Carolina are unpredictable. You never know beforehand what part of the city you will see on your tour. Horse-drawn carriages pull up to a check-in gate at the start of the tour where they are randomly assigned one of the city's four routes. A monitor chooses a ball with a number on it assigning your carriage a route. What is the probability that three carriages in a row receive the same route assignment if balls are replaced after each assignment?
8. At the end of each month, two of the 221 employees at SpeedChart are randomly chosen to receive gift cards. Because of a computer glitch in April, receiving the first gift card did not exclude an employee from also receiving the second gift card that month. Find the probability that the same employee received both gift cards in the month of April.
9. There are 15 different colored crayons in a new box. What is the probability that the orange and then the green will be chosen at random, without replacement?
10. Insulin pens used to administer a patient's insulin at hospitals have a malfunction rate of 9%. This means that out of a box of 200 pens, 18 are defective in some way and must be thrown away. Find the probability of randomly selecting 3 defective insulin pens in a row from a brand new box of 200 pens, if a defective pen is immediately discarded.
11. Ashley's Internet service is terribly unreliable. In fact, on any given day, there is a 15% chance that her Internet connection will be lost at some point that day. What is the probability that her Internet service is not broken for five days in a row?
12. On a five-day vacation, the forecast is a 50% chance of rain every day. What's the probability that it rains every day?
13. On awards day at the end of the year, Jasmine has an 85% chance of winning the top award in English and a 4 out of 5 chance of winning an award for athletics. What's the probability that Jasmine wins both awards?

14. Suppose in any given year, the probability of a cactus blooming is 0.15 and the probability of an orchid blooming is 0.09. Determine the probability that both of these plants will bloom in the same year, assuming that they are independent events.

Conditional Probability

Calculate each conditional probability.

15. A high school swim team consists of 3 seniors, 2 juniors, 4 sophomores, and 2 freshmen. A relay team of four swimmers is chosen at random from the team members. What is the probability that the last swimmer chosen is a sophomore given that there is senior, a junior and a freshman already chosen?
16. A box of markers contains 10 black-inked (4 wide-tipped and 6 fine-tipped) and 15 red-inked (3 wide-tipped and 12 fine-tipped). What's the probability that a randomly chosen marker will be red, given that it is fine-tipped?
17. A six-sided die is rolled. What is the probability of rolling a two, assuming that you rolled an even number?
18. Josh is playing backgammon, a game played with two six-sided dice. What is the probability that the sum of the two dice he rolls is less than 4 given that he rolls an odd number?
19. Mrs. Harvey's algebra class has 42 students, classified by academic year and method of instruction as follows.

Mrs. Harvey's Algebra Class		
	In-Class Instruction	Online Instruction
Freshman	9	13
Sophomore	4	5
Junior	4	2
Senior	2	3

Mrs. Harvey randomly chooses one student's homework to grade first.

- What is the probability that she selects an in-class student, given that she chooses from only the sophomores?
 - What is the probability that she selects a junior, given that she chooses an online student?
 - What is the probability that she selects an online student, given that she chooses a junior?
20. The following table displays the breakdown of attendees at an International Biology conference by country and their role in the company they were representing.

International Biology Conference Attendees						
	Canada	France	South Korea	United Kingdom	United States	Total
CEO	138	45	4	19	117	323
Director	8	4	25	6	63	106
Partner	23	7	3	20	103	156
Chairman	12	9	3	9	62	95
Other	112	146	154	143	2103	2658
Total	293	211	189	197	2448	3338

A random attendee is selected for an interview.

- What is the probability that a Partner is selected, given that the attendee is from South Korea?
- What is the probability that a Canadian is selected, given that the attendee is a director of the company?

- c. What is the probability that a director is selected, given that the attendee is Canadian?
- d. What is the probability that a CEO is selected, given that the attendee is from the continent of North America?

Multiplication Rule for Dependent Events

Calculate each probability.

- 21. David likes to keep a jar of change on his desk. Right now his jar contains 26 pennies, 19 nickels, 11 dimes, and 16 quarters. What is the probability that David reaches in and randomly grabs a quarter and then a nickel?
- 22. As part of an incentive, World Autos is offering any salesperson with at least 15 car sales in each month a chance to win one of three \$50 gift cards. For every additional 5 cars, your name is entered again. The chart below shows the number of sales for each team member. Winning names are drawn without replacement from all entries.

Monthly Sales at World Autos					
Salesperson	15 cars sold	20 cars sold	25 cars sold	30 cars sold	35 cars sold
B. Carple	✓	✓			
R. Henry	✓				
M. Trent					
J. Owhan	✓	✓	✓	✓	
L. Prince	✓	✓	✓		
S. Smith	✓	✓	✓	✓	✓
H. Mowis	✓				
T. Hilson	✓				

- a. Find the probability of S. Smith winning all three gift cards.
 - b. Find the probability of S. Smith winning the first gift card and M. Trent winning the second gift card.
 - c. Find the probability that all three winners are salespeople with only one entry in the drawing.
23. In a biology lab, vials considered defective must be thrown away. The following chart shows the breakdown of vials in a testing center by distributor.

Lab Vials by Distributor		
Lab Vials	BioVial	I.B.C.
Usable	1762	2001
Defective	3	2

- a. Find the probability that two lab partners both randomly choose a defective vial, one after another, if all the vials are stored together.
 - b. Find the probability that a usable vial distributed by I.B.C. is selected followed by a usable vial distributed by BioVial.
24. Winning lottery numbers are randomly chosen from 101 balls. There are balls numbered 1- 99, along with 2 unnumbered blank balls.
- a. What is the probability that the two blank balls are drawn first?
 - b. What is the probability that the ball numbered 99 is chosen first and then a blank ball is chosen?
 - c. What is the probability that a blank ball is not drawn if 5 balls are drawn in total?

Fundamental Counting Principle

Use the Fundamental Counting Principle to determine the total number of outcomes.

25. Determine the number of five-digit ZIP codes that can be made from the digits 0–9. (Assume that digits may repeat.)
26. Henry is setting a six-character password on his computer. He is told that the first two characters must be letters and the last four must be numbers. No character may be used twice. How many choices does Henry have for his password?
27. There are six children, three 1st graders and three 2nd graders, singing in the school program. As they line up to perform, the choral director insists that the first person be a 1st grader and the last a 2nd grader. How many ways can the children line up?
28. How many even four-digit PINs can be created from the digits 0–9?
29. How many odd six-digit PINs can be created from the digits 0–9?
30. As Candy is trying to decide what to wear, she can choose from eight blouses, three skirts and four pairs of shoes. Assuming everything coordinates, how many different possible outfits does she have?

Fundamental Counting Principle and Probability

Use the Fundamental Counting Principle to determine the total number of outcomes and then calculate the probability.

31. In the game of Clue, the guilty person can be chosen from 6 people, and there are 9 different possible weapons and 9 possible rooms. What is the probability of making a random guess of the guilty person, location, and murder weapon, and the guess being correct?
32. When ordering his new office equipment, Joe must choose one of 5 monitors, one of 4 printers, and one of 6 scanners. Joe likes 2 of the monitors, 1 of the printers, and 3 of the scanners. If his boss randomly chooses his office equipment for him, what is the probability that Joe will receive a system that makes him happy?
33. A couple having twins is deciding on names. They narrowed their choices to 5 family names and 7 non-family names. The new father's parents like only 1 of the family names and 2 of the non-family names. Assuming that the new parents chose one family name and one non-family name, what is the probability that the names they choose will make the new grandparents happy?
34. Stephanie has 11 different outfits in her closet that she wears on Sundays. Ann has 14 different outfits, of which 3 are the same as Stephanie's. What is the probability that they wear the same outfit on a particular Sunday?