

Solution

- a. The probability that imported walnuts purchased in the United States during this period were from Austria is found by dividing the weight of walnuts imported from Austria by the total weight of walnuts imported during this time period. The first number is given in the table as 1938 pounds. To find the total weight of walnuts imported, we need to add together all of the weights of walnuts imported.

$$\text{total walnut weight} = 4373 + 1268 + 5239 + 1533 + 1938 + 4157 = 18,508$$

The probability that the walnuts were from Austria is then found by

$$P(\text{walnuts from Austria}) = \frac{1938}{18,508} \approx 0.104711.$$

- b. We could find the probability that the walnuts came from somewhere other than Austria by combining all the remaining places together. However, given that we just calculated the probability that the walnuts were from Austria, it is easier for us to just use the complement.

$$P(\text{not from Austria}) = 1 - P(\text{walnuts from Austria}) \approx 1 - 0.104711 = 0.895289$$

- c. Again, it will be easier for us to use the complement here. First calculate the probability that the pistachios you purchased came from either Italy or Switzerland.

$$\text{total pistachio weight} = 2012 + 2030 + 262 + 64 + 115 + 323 = 4806$$

$$P(\text{from Italy or Switzerland}) = \frac{\text{Italy} + \text{Switzerland}}{\text{total pistachio imports}} = \frac{115 + 64}{4806} \approx 0.037245$$

Now, to calculate the probability that the pistachios came from somewhere other than Switzerland or Italy, we'll find the probability of the complement.

$$\begin{aligned} P(\text{not from Italy or Switzerland}) &= 1 - P(\text{from Italy or Switzerland}) \\ &\approx 1 - 0.037245 \\ &= 0.962755 \end{aligned}$$

Skill Check Answers

1. e. All of the above

8.5 EXERCISES

PRACTICE

- Describe the complement of the set of odd numbers greater than 0 within the set of positive integers.
- Let the event E be the sum of a pair of dice that is divisible by 3. List the events in E^c .

3. The following is a table of the ages of boys on a soccer team.

Let $A = \{\text{soccer players older than 9}\}$. How many players are in the complement of A ?

Ages of Boys on Soccer Team	
Age	Number of Boys
8	3
9	6
10	7
11	2

4. Describe the complement of the set of face cards in a standard deck of cards.
5. In a company, all employees who have worked there for more than five years receive a gift. Describe the complement of this group of employees.

APPLICATIONS

Find the classical probability for each scenario. Round your answer to the nearest millionth when necessary.

6. Find the probability of obtaining exactly one head when flipping four coins.
7. There are two sets of balls numbered 1 through 5 placed in a bowl. If two balls are randomly chosen without replacement, find the probability that the balls have the same number.
8. William and Gavin are going to play video games after work. Together they have 48 games. If they decide to randomly choose two games to play, what is the probability that the two games they choose consist of William's favorite game and Gavin's favorite game? Assume they have different favorites.
9. A local pizza parlor has the following list of toppings available for selection. The parlor is running a special to encourage patrons to try new combinations of toppings. They list all possible three-topping pizzas (three distinct toppings) on individual cards and give away a free pizza every hour to a lucky winner.

Pizza Toppings			
Green Peppers	Onions	Pepperoni	Sausage
Baby Portabello Mushrooms	Black Olives	Ham	Spicy Italian Sausage
Roma Tomatoes	Pineapple	Beef	Grilled Chicken
Jalapeño Peppers	Banana Peppers	Bacon	Extra Cheese

- a. How many three-topping pizza cards are there?
- b. Find the probability that the first winner randomly selects the card with the pizza containing green peppers, ham, and bacon on it.

10. A combination padlock is a lock in which a sequence of numbers is used as the “key” to open the lock. Suppose a combination padlock has 10 digits to choose from for each of the four sections of the lock.
 - a. Does the “key” for a combination padlock involve permutations or combinations?
 - b. How many possible “keys” are there for the combination padlock?
 - c. What is the probability that you randomly buy one of these locks whose “key” is made of 4 of the same digit?

11. Four students, three girls and a boy, have arranged to meet on the first day of class and sit in the front row. Suppose they agree to sit in the first four seats in the order that they arrive.
 - a. How many possible seating arrangements are there for the four friends?
 - b. What is the probability that all three girls end up sitting next to one another?

12. A committee of four is being formed randomly from the employees at a school: 5 administrators, 37 teachers, and 4 staff.
 - a. How many ways can the committee be formed?
 - b. What is the probability that all four members are staff?
 - c. What is the probability that no member is an administrator?

13. A hand of poker is made up of five cards from a standard deck of cards.
 - a. How many possible hands of poker are there in a standard deck of 52 cards?
 - b. A royal flush consists of the cards ace, king, queen, jack, and ten, all in the same suit. What is the probability of being dealt a royal flush?

14. Find the probability that three people randomly line up to buy tickets in order of their height (tallest, middle, shortest). Assume that no two people in the line are of the exact same height.

15. Matthew needs to set the passcode on his smartphone. It must be a four-digit number and repeated digits are allowed.
 - a. How many possible passcodes are there for Matthew to choose from?
 - b. How many possible passcodes are there for Matthew if he decides to choose four distinct numbers?
 - c. A spy sneaks a look at Matthew’s phone and sees his fingerprints on the screen over four numbers. What is the probability that the spy is able to unlock the phone on his first try?
 - d. The spy knows the fingerprint trick and so on his phone he uses a repeated digit in his code. If you could see the three fingerprints on the spy’s phone, what is the probability that you could unlock the phone on your first attempt?
 - e. Based on parts c. and d., is it better to repeat a digit or have four distinct digits in the code on your phone for security purposes?

16. A hand of blackjack consists of two cards. The dealer deals you a hand from a fresh deck.
 - a. What is the probability that the two cards have the same face value, for instance, both cards are kings or both cards are 5s?
 - b. If aces count 1 or 11, picture cards count 10, and card numbers 2 through 10 are equal to their face value, what is the probability that the two cards sum to 21?

17. One option to play the lottery is called “3-way any order.” In order to play this method, you select three digits, from 0 to 9, such that precisely two of the digits are the same (for example, 1, 1, 2). You’re a winner if your three digits show up in any order in the lottery’s three randomly chosen digits. Digits may be repeated when the lottery chooses the winning number. Find the probability of winning with the “3-way any order” method.
18. Another option of playing the lottery is to choose three numbers (allowing repetition) in the exact order they will appear. Find the probability of winning the lottery with one ticket.
19. Ian is playing Scrabble. What is the probability that the next three letters he draws from the bag spell out his name in the order that he draws them? Assume there is one of each letter in the alphabet left in the bag.
20. For a pickup game of basketball, jerseys are in a box and people start grabbing them. The box contains three extra-large, seven large, and four medium jerseys. If you are first to the box and grab two jerseys, what is the probability that you randomly grab two extra-large jerseys?
21. A junk drawer at home contains a half dozen pens, two of which work. What is the probability that you randomly grab two pens from the drawer and don’t end up with a pen that works?

Find each probability using complements.

22. A bag contains each letter of the alphabet. Find the probability that a randomly selected letter from the bag will not be one of the five vowels.
23. Find the probability of randomly choosing a letter other than the letter O from a bag that contains the eighteen letters of the Italian city GUIDONIA MONTECELIO.

24. Using the table containing the breakdown of all employees on nonfarm payrolls in the United States during March 2014, find the probability that a randomly selected US nonfarm worker was not in either retail trade or wholesale trade.

Employees on Nonfarm Payrolls (in Thousands), March 2014		
	Area of Employment	Number of Employees (in Thousands)
Private Sector	Goods-Producing	18,558.2
	Wholesale Trade	5803.7
	Retail Trade	15,004.0
	Transportation and Warehousing	4524.8
	Utilities	550.3
	Information	2653.0
	Financial Activities	7870.0
	Professional and Business Services	18,832.0
	Education and Health Services	21,481.0
	Leisure and Hospitality	14,143.0
	Other Private Service-Providing Services	5464.0
Public Sector	Federal Government	2705.0
	State Government	5217.0
	Local Government	14,341.0
	Total Nonfarm Employees	137,147.0
Source: Bureau of Labor Statistics. "Table B-1. Employees on nonfarm payrolls by industry sector and selected industry detail." Accessed June 2014. http://www.bls.gov/news.release/empst.t17.htm		

25. In June 2011, the week of the final mission of the US space shuttle program, a Pew Research poll asked 1502 US adults whether the United States must continue to be a world leader in space exploration. The following table gives a breakdown of their opinions.

The United States Continuing to be a World Leader in Space Exploration Is. . .		
Essential	Not Essential	Don't Know
871	571	60
Source: Pew Research Center. "Majority Sees U.S. Leadership in Space Essential." July 5, 2011. http://www.people-press.org/2011/07/05/majority-sees-u-s-leadership-in-space-as-essential/		

- a. Find the probability that someone responded "essential."
 b. Find the probability that someone did not respond "essential."
26. Find the probability of rolling two dice and not getting the same number on both dice.
27. Suppose a family has five pets. Find the probability that at least one of the pets is male.