Table 10.3.3: 2020 WNBA Finals Odds and Probability

Team	Odds	Probability of Losing Money
Seattle Storm	1 : 2	$\frac{1}{3} \approx 0.3333$
Las Vegas Aces	9 : 2	$\frac{9}{11} \approx 0.8182$
Connecticut Sun	11 : 2	$\frac{11}{13} \approx 0.8462$
Minnesota Lynx	18 : 1	$\frac{18}{19} \approx 0.9474$

Notice that these probabilities add to more than 1 and we've only included 4 of the 12 teams. Remember that this is not the probability that a team will win the WNBA finals, but an assessment by the bookie of the probability that you will lose a money on a bet for that team.

b. The team that has the smallest probability of losing money for a bet is the team most likely to win. Therefore, the Seattle Storm was the team most likely to win the 2020 WNBA finals. Their odds of 1 : 2 mean that for each \$2 bet, you would win \$1.

c. Since the odds for the Connecticut Sun are 11 : 2, for every \$2 bet, a bet would win \$11. Therefore, we need to divide the bet by \$2 and then multiply by \$11 to determine the amount that would be won.

$$\text{Winnings for a \$50 Bet on the Connecticut Sun: } \frac{\$50}{\$2} \cdot \$11 = \$275$$

✔ Skill Check 10.3.3

If the odds on a bet are 4 : 1 against, what is the probability of winning?

Skill Check Answers

1. $P(E) \approx 0.000292$ **2.** e **3.** $\frac{1}{5}$ or 20%

10.3 Exercises

✔ CONCEPT CHECK

1. If you combine the outcomes from a set and its _____, you will have the entire sample space.

2. The sum of all the probabilities of all the outcomes in a sample space must equal _____.

3. There are two ways that odds are given: odds _____ and odds _____.

4. When you are given the odds _____ (when it comes to betting) you are being told the ratio of the probability of losing money to the probability of winning money.

5. True or False: If the odds of something happening are 1:2, that means that the probability of it happening are 50%.

APPLICATIONS

6. 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.

7. 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.

8. 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.

9. 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.

10. 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.

11. 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.

12. 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.

13. 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?

14. 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?

15. A bakery has 20 unique donut flavors but only sells 5 flavors per day. If the flavors are chosen at random, determine the probability that the flavors selected for today are s'mores, crème brûlée, very vanilla, strawberry shortcake, and chocolate dream.

16. An introduction to rock climbing class is divided up into groups of 3 for rappelling practice. Out of the 12 people in the class, 3 are complete beginners. What is the probability that all three beginners are placed in the same group?

17. An instructor is creating the syllabus for the upcoming semester and must choose 5 chapters to cover out of a 10-chapter math textbook. What is the probability that the instructor chooses to cover topics in the following order: set theory, logic, finance, probability, and statistics?

18. Three friends, Allen, Paul, and Trey, are sitting in a room with nine other people waiting for their turn to audition for an upcoming reality show. What is the probability that the next three people called to audition are Allen, Paul, and then Trey?

19. In the game of Texas hold'em poker, a hand is made up of two cards from a deck of 52. What is the probability of being dealt a 2 of clubs and a 7 of hearts?

20. The drama department at a school is selecting plays to perform for the year. They can choose one play for the fall and another play for the spring. If the department holds the rights to perform 22 different plays, what is the probability that they select Romeo and Juliet and Clue?

21. As a sandwich aficionado, you believe that the order in which the ingredients are placed influences the overall flavor of the sandwich. If you order a turkey club sandwich, what is the probability that the ingredients are, from bottom to top, turkey, cheese, bacon, lettuce, tomato, and mayo?

22. The producers for an awards show plan to have a commercial break after every two awards presented. During the first hour, they decide to present the awards for best leading actor, best supporting actor, best leading actress, best supporting actress, best overall cast, and best script. What is the probability that the awards for best overall cast followed by best supporting actress are presented before the first commercial break?

23. 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?

24. 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?

25. Matthew needs to set the pass code on his smartphone. It must be a four-digit number and repeated digits are allowed.

a. How many possible pass codes are there for Matthew to choose from?

b. How many possible pass codes 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?

26. 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?

27. For a pick-up 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?

28. 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?

29. A city activity committee is planning to show one movie per week at a local park for five weeks during the summer. The committee decides that this year's theme is comedy movies and can choose from five PG rated comedies and six G rated comedies.

a. In how many ways can the movies be selected?

b. In how many ways can the movies be selected if three must be G rated and the other two must be PG rated?

c. Suppose that the movies are selected at random with no restrictions. What is the probability that three G rated movies are selected and two PG movies are selected?

30. A book club reads one book per month. The book selection committee of the club is assigning the books they will read over the next six months. The overall book selection includes six fiction books and seven nonfiction books.

a. In how many ways can the books be selected?

b. In how many ways can the books be selected if three books must be fiction and three books must be nonfiction.

c. Suppose the books are selected at random with no restrictions. What is the probability that the selection contains three fiction and three nonfiction books?

31. 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.

32. 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.

33. 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 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/empsit.t17.htm

34. 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."

35. Find the probability of rolling two dice and not getting the same number on both dice.

36. Suppose a family has five pets. Find the probability that at least one of the pets is male.

37. The weather report says there is a 25% chance of rain this evening. What is the probability that it does not rain this evening?

38. There is a 12% chance that all of the strawberries in a container are moldy. What is the probability that some of the strawberries are not moldy?

Use the data in the table to determine the following probabilities.

US Import Sources by Weight (in Pounds) for Frozen Blackberries in 2019

Chile	17,303,000
Mexico	4,542,000
Serbia	3,705,000
China	169,000
Other Countries	514,000

Source: USDA. "Fruit and Tree Nut Data." http://www.ers.usda.gov/data-products/fruit-and-tree-nut-data/data-by-commodity.aspx

39. What is the probability that frozen blackberries purchased in the United States during this period were from Serbia or China?

40. What is the probability that frozen blackberries purchased in the United States during this period were not from Chile?

41. If the odds on a bet are 6 : 1 against, what is the probability of winning?

42. Suppose the probability of a football team winning a playoff game is 0.25. What are the odds of winning?

43. The odds of a teenage male having an accident are 2 : 3. What is the probability of a teenage male having an accident?

44. An insurance company claims the probability of surviving a certain type of cancer is 95%. What are the odds of surviving?

45. The UVest investment company publishes that the odds of increasing your wealth with their company is 5 : 2. What is the probability of UVest increasing your investment?

46. Odds against being struck by lightning in one year are 1,000,000 to 1.

a. If you live to be 80, what are the odds against being struck by lightning over your lifetime? Assume each year has the same probability.

b. The National Weather Service gives the odds against being struck by lightning over an 80-year lifetime as 10,000 to 1. Why do you think this is different from the answer you got in part **a.**?

47. Overall odds in favor of winning in a state lottery game are 4.63 : 1.

a. Find the probability of winning in the lottery game.

b. The prize for this lottery game is $100. If the cost to play the game is $2.00, what is the expected value for playing this game?

48. Suppose the odds on a bet are 10 : 1 against. Your friend tells you he thinks the odds are too generous. Odds are considered less generous if the probability of losing is greater. Write down some less generous odds.

49. Some of the odds to win the 2021 Palmetto Championship are listed in the table.

Odds to Win 2021 Palmetto Championship

Player	Odds Against
Brooks Koepka	9 : 1
Dustin Johnson	8 : 1
Matthew Fitzpatrick	16 : 1
Sungjae Im	20 : 1
Tyrrell Hatton	14 : 1

Source: "Golf Futures Betting Odds," Vegas Insider, accessed June 11, 2021, https://www.vegasinsider.com/golf/odds/futures/

a. Determine the probability of losing money on a bet for each of the players listed.

b. Based on these odds, which player was most likely to win the 2021 Palmetto Championship?

50. Some of the odds to win the 2021 Kentucky Derby are listed in the table.

Odds to Win 2021 Kentucky Derby

Horse	Odds Against
Rock Your World	9 : 2
Essential Quality	3 : 1
Medina Spirit	12 : 1
Known Agenda	10 : 1
Hot Rod Charlie	6 : 1

Source: "2021 Kentucky Derby Betting Odds & Results," Vegas Insider, accessed June 11, 2021, https://www.vegasinsider.com/horse-racing/odds/kentucky-derby/

a. Determine the probability of losing money on a bet for each of the horses listed.

b. Based on these odds, which horse was most likely to win the 2021 Kentucky Derby?

WRITING & THINKING

51. Describe the complement of the set of odd numbers greater than 0 within the set of positive integers.

52. Let the event E be the sum of a pair of dice that is divisible by 3. List the events in E^c.

53. 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

54. Describe the complement of the set of face cards in a standard deck of cards.

55. 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.

56. In a bookstore, all books released in the past year that are currently on the best sellers list are placed on a table near the entrance. Describe the complement of this set of books.