10-7 Simulations

1. **GRADES** Clara got an A on 80% of her first semester Biology quizzes. Design and conduct a simulation using a geometric model to estimate the probability that she will get an A on a second semester Biology quiz. Report the results using appropriate numerical and graphical summaries.

2. **FITNESS** The table shows the percent of members participating in four classes offered at a gym. Design and conduct a simulation to estimate the probability that a new gym member will take each class. Report the results using appropriate numerical and graphical summaries.

Class	Sign-Up %
tae kwon do	45%
yoga	30%
swimming	15%
kick-boxing	10%

3. **CARNIVAL GAMES** The object of the game shown is to accumulate points by using a dart to pop the balloons. Assume that each dart will hit a balloon.

a. Calculate the expected value from each throw.
b. Design a simulation and estimate the average value of this game.
c. How do the expected value and average value compare?

Design and conduct a simulation using a geometric probability model. Then report the results using appropriate numerical and graphical summaries.

4. **BOWLING** Bridget is a member of the bowling club at her school. Last season she bowled a strike 60% of the time.

5. **VIDEO GAMES** Ian works at a video game store. Last year he sold 95% of the new-release video games.

6. **MUSIC** Kadisha is listening to a CD with her CD player set on the random mode. There are 10 songs on the CD.

7. **BOARD GAMES** Pilar is playing a board game with eight different categories, each with questions that must be answered correctly in order to win.

CCSS MODELING Design and conduct a simulation using a random number generator. Then report the results using appropriate numerical and graphical summaries.

8. **MOVIES** A movie theater reviewed sales from the previous year to determine which genre of movie sold the most tickets.

Genre	Ticket %
Drama	40%
Mystery	30%
Comedy	25%
Action	5%

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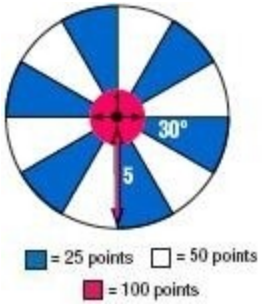
9. **BASEBALL** According to a baseball player's on-base percentages, he gets a single 60% of the time, a double 25% of the time, a triple 10% of the time, and a home run 5% of the time.

10. **VACATION** According to a survey done by a travel agency, 45% of their clients went on vacation to Europe, 25% went to Asia, 15% went to South America, 10% went to Africa, and 5% went to Australia.

11. **TRANSPORTATION** A car dealership's analysis indicated that 35% of the customers purchased a blue car, 30% purchased a red car, 15% purchased a white car, 15% purchased a black car, and 5% purchased any other color.

DARTBOARDS The dimensions of each dartboard below are given in inches. There is only one shot per game. Calculate the expected value of each dart game. Then design a simulation to estimate each game's average value. Compare the average and expected values.

12. 

13. 

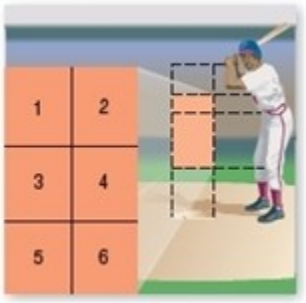
14. 

15. **CARDS** You are playing a team card game where a team can get 0 points, 1 point, or 3 points for a hand. The probability of your team getting 1 point for a hand is 60% and of getting 3 points for a hand is 5%.
    a. Calculate your team's expected value for a hand.
    b. Design a simulation and estimate your team's average value per hand.
    c. Compare the values for parts a and b.

16. **DECISION MAKING** The object of the game shown is to win money by rolling a ball up an incline into regions with different payoff values. The probability that Susana will get \$0 in a roll is 55%, \$1 is 20%, \$2 is 20%, and \$3 is 5%.

a. Suppose Susana pays \$1 to play. Calculate the expected payoff, which is the expected value minus the cost to play, for each roll.
b. Design a simulation to estimate Susana's average payoff for this game after she plays 10 times.
c. Should Susana play this game? Explain your reasoning.

17. **BASEBALL** Of his pitches thrown for strikes, a baseball pitcher wants to track which areas of the strike zone have a higher probability. He divides the strike zone into six congruent boxes as shown.



a. If a strike is equally likely to hit each box, what is the probability that he will throw a strike in each box?
b. Design a simulation to estimate the probability of a strike being thrown in each box.
c. Compare the values for parts a and b.

18. **CCSS MODELING** Cynthia used her statistics from last season to design a simulation using a random number generator to predict what she would score each time she got possession of the ball.

Integer Values	Points Scored	Frequency
1–14	0	31
15	1	0
16–28	2	17
29–30	3	2

a. Based on the frequency table, what did she assume was the theoretical probability that she would score two points in a possession?
b. What is Cynthia's average value for a possession? her expected value?
c. Would you expect the simulated data to be different? If so, explain how. If not, explain why

19. **MULTIPLE REPRESENTATIONS** In this problem, you will investigate expected value.
a. CONCRETE Roll two dice 20 times and record the sum of each roll.

b. NUMERICAL Use the random number generator on a calculator to generate 20 pairs of integers between 1 and 6. Record the sum of each pair.
c. TABULAR Copy and complete the table below using your results from parts a and b.

Trial	Sum of Die Roll	Sum of Output from Random Number Generator
1		
2		
...		
20		

d. GRAPHICAL Use a bar graph to graph the number of times each possible sum occurred in the first 5 rolls. Repeat the process for the first 10 rolls and then all 20 outcomes.
e. VERBAL How does the shape of the bar graph change with each additional trial?
f. GRAPHICAL Graph the number of times each possible sum occurred with the random number generator as a histogram.
g. VERBAL How do the graphs of the die trial and the random number trial compare?
h. ANALYTICAL Based on the graphs, what do you think the expected value of each experiment would be? Explain your reasoning.

20. **CCSS ARGUMENTS** An experiment has three equally likely outcomes *A*, *B*, and *C*. Is it possible to use the spinner shown in a simulation to predict the probability of outcome *C*? Explain your reasoning.

21. **REASONING** Can tossing a coin *sometimes*, *always*, or *never* be used to simulate an experiment with two possible outcomes? Explain.

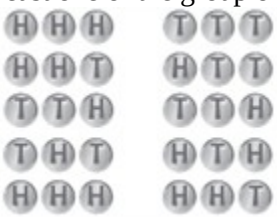
22. **DECISION MAKING** A lottery consists of choosing 5 winning numbers from 31 possible numbers (0–30). The person who matches all 5 numbers, in any sequence, wins $1 million.
a. If a lottery ticket costs $1, should you play? Explain your reasoning by computing the expected payoff value, which is the expected value minus the ticket cost.
b. Would your decision to play change if the winnings increased to $5 million? if the winnings were only $0.5 million, but you chose from 21 numbers instead of 31 numbers? Explain.

23. **REASONING** When designing a simulation where darts are thrown at targets, what assumptions need to be made and why are they needed?

24. **OPEN ENDED** Describe an experiment in which the expected value is not a possible outcome. Explain.

25. **WRITING IN MATH** How is expected value different from probability?

26. **PROBABILITY** Kaya tosses three coins at the same time and repeats the process 9 more times. Her results are shown below where H represents heads and T represents tails. Based on Kaya's data, what is the probability that at least one of the group of 3 coins will land with heads up?



A 0.1
B 0.2
C 0.3
D 0.9

27. **ALGEBRA** Paul collects comic books. He has 20 books in his collection, and he adds 3 per month. In how many months will he have a total of 44 books in his collection?
F 5
G 6
H 8
J 15

28. **SHORT RESPONSE** Alberto designed a simulation to determine how many times a player would roll a number higher than 4 on a die in a board game with 5 rolls. The table below shows his results for 50 trials. What is the probability that a player will roll a number higher than 4 two or more times in 5 rolls?

Number of Rolls Greater Than 4	Frequency
0	8
1	15
2	18
3	9
4	0
5	0

29. **SAT/ACT** If a jar contains 150 peanuts and 60 cashews, what is the approximate probability that a nut selected from the jar at random will be a cashew?

A 0.25
B 0.29
C 0.33
D 0.4
E 0.71

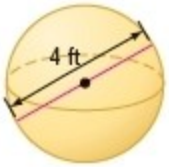
Point *X* is chosen at random on $\overline{QT}$. Find the probability of each event.

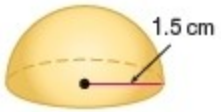
30. *P*(*X* is on $\overline{QS}$)

31. *P*(*X* is on $\overline{RT}$)

32. **BOOKS** Paige is choosing between 10 books at the library. What is the probability that she chooses 3 particular books to check out from the 10 initial books?

Find the surface area of each figure. Round to the nearest tenth.

33. 

34. 

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36. **RECREATION** A group of 150 students was asked what they like to do during their free time.

a. How many students like going to the movies or shopping?
b. Which activity was mentioned by 37 students?
c. How many students did *not* say they like movies?