11-2 Probability

Content Standard
Prepares for S.IC.2 Decide if a specified model is consistent with results from a given data generating process, e.g., using simulation.

Probability measures how likely it is for an event to occur.

Essential Understanding The probability of an impossible event is 0 (or 0%). The probability of a certain event is 1 (or 100%). Otherwise, the probability of an event is a number between 0 and 1 (or a percent between 0% and 100%).

When you gather data from observations, you can calculate an *experimental probability*. Each observation is an experiment or a trial.

Theoretical Probability	Experimental Probability
$P(E) = \frac{\text{number of outcomes expected to be "favorable"}}{\text{total number of possible outcomes}}$	$P(E) = \frac{\text{number of observations that are "favorable"}}{\text{total number of observations}}$

Problem 1 Finding Experimental Probability

Gridded Response Of the 60 vehicles in a teachers' parking lot today, 15 are pickup trucks. What is the experimental probability that a vehicle in the lot is a pickup truck?

Got It? 1. A softball player got a hit in 20 of her last 50 times at bat. What is the experimental probability that she will get a hit in her next at bat?

Problem 3 Finding Theoretical Probability

What is the theoretical probability of each event?

A getting a 5 on one roll of a standard number cube

B getting a sum of 5 on one roll of two standard number cubes

Example 3: A spinner is divided into 8 equal regions, numbered 1 thru 8. Find the theoretical probability of each event for one spin.

a. P(< 6)

b. P(factor of 12)

c. P(multiple of 5)

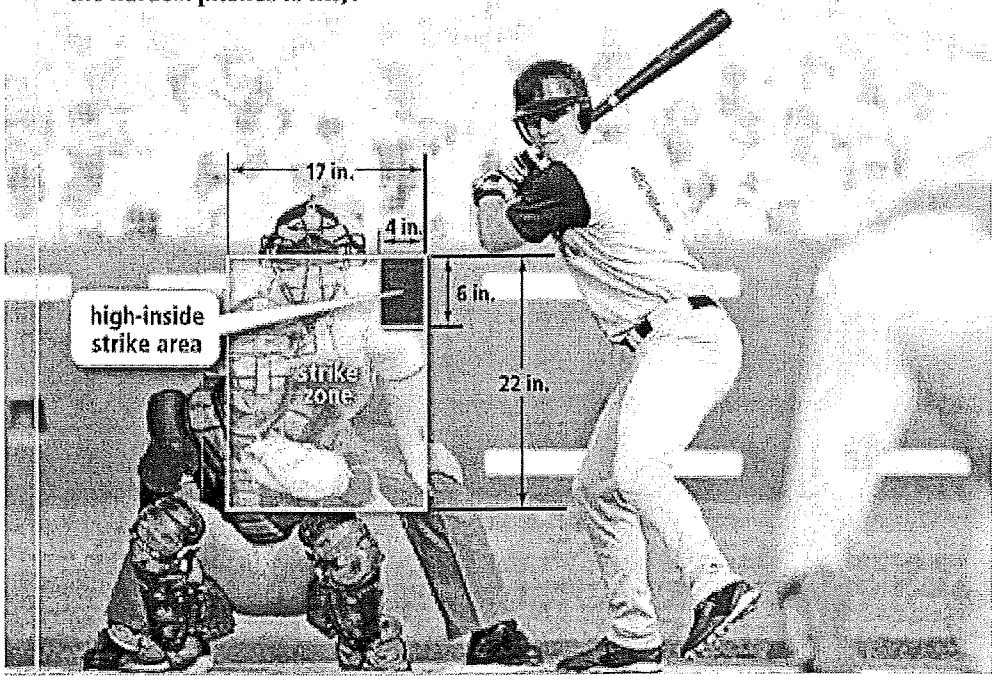
d. P(prime number)

Geometric Probability

$$P = \frac{\text{area of target region}}{\text{area of total region}}$$

Problem 5 **Finding Geometric Probability**

Geometry A batter's strike zone depends on the height and stance of the batter. What is the geometric probability that a baseball thrown at random within the batter's strike zone, as shown in the figure below, will be a high-inside strike (one of the hardest pitches to hit)?



Got It? 5. Suppose a batter's strike zone is 15 in.-by-20 in. and the high-inside strike zone is 3 in.-by-5 in. What is the probability that a baseball thrown at random within the strike zone will be a high-inside strike?

Algebra 2 – Year 2

Assignment: Lesson 11.2 worksheet

Name: _____

Date: _____ Hour: _____

1. A basketball player attempted 24 shots and made 13. Find the experimental probability that the player will make the next shot she attempts.

2. A baseball player attempted to steal a base 70 times and was successful 47 times. Find the experimental probability that the player will be successful on his next attempt to steal a base.

A group of five cards are numbered 1–5. You choose one card at random. Find each theoretical probability.

3. P(card is a 2)

4. P(even number)

5. P(prime number)

6. P(less than 5)

A bucket contains 15 blue pens, 35 black pens, and 40 red pens. You pick one pen at random. Find each theoretical probability.

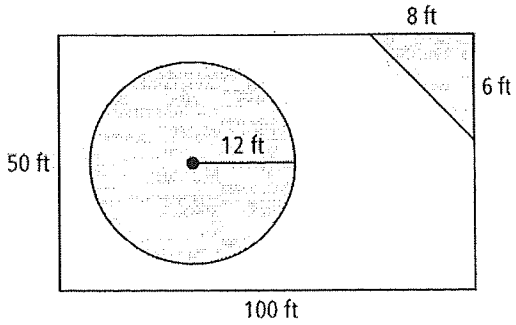
7. P(black pen)

8. P(blue pen or red pen)

9. P(not a blue pen)

10. P(black pen or not a red pen)

The rectangular yard shown below has a circular pool and a triangular garden. A ball from an adjacent golf course lands at a random point within the yard. Find each theoretical probability.



11. The ball lands in the pool.

12. The ball lands in the garden

13. The ball lands in the garden or the pool.

14. The ball does not land in the pool.

Find the probability of each event.

15. A letter chosen at random from the letters of the word *permutation* is a vowel.

16. A letter chosen at random from the letters of the work *mistletoe* is a consonant.

A spinner is divided into 12 equal regions, numbered 1 through 12. Find the probability of each event for one spin.

17. 2

18. 10

19. an even number

20. an odd number

21. a prime number

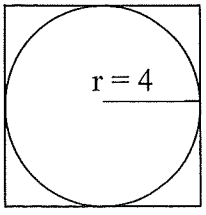
22. a number greater than 3

23. a number less than 8

24. a factor of 8

25. a multiple of 3

26. What is the probability that a randomly thrown dart that hits the square board will land in the circular region?



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Essential Understanding The probability of an impossible event is 0 (or 0%). The probability of a certain event is 1 (or 100%). Otherwise, the probability of an event is a number between 0 and 1 (or a percent between 0% and 100%).

When you gather data from observations, you can calculate an *experimental probability*. Each observation is an experiment or a trial.

Theoretical Probability	Experimental Probability
$P(E) = \frac{\text{number of outcomes expected to be "favorable"}}{\text{total number of possible outcomes}}$	$P(E) = \frac{\text{number of times the "event" occurs}}{\text{number of observations that are "favorable"}}$ / total number of observations = total number of trials

Problem 1 Finding Experimental Probability

Gridded Response Of the 60 vehicles in a teachers' parking lot today, 15 are pickup trucks. What is the experimental probability that a vehicle in the lot is a pickup truck?

$P(\text{pickup truck}) = \frac{\#\text{ of pickup trucks}}{\text{total \# of vehicles}} = \frac{15}{60} = .25 \downarrow 25\%$

Got It? 1. A softball player got a hit in 20 of her last 50 times at bat. What is the experimental probability that she will get a hit in her next at bat?

$P(\text{hit}) = \frac{\#\text{ of hits}}{\text{total at bats}} = \frac{20}{50} = .4 \downarrow 40\%$

Problem 3 Finding Theoretical Probability

What is the theoretical probability of each event?

A getting a 5 on one roll of a standard number cube (1, 2, 3, 4, 5, 6)

$P(\text{getting a 5}) = \frac{1}{6}$

B getting a sum of 5 on one roll of two standard number cubes

$P(\text{sum 5}) = \frac{4}{36} = \frac{1}{9}$ (1,4), (2,3), (3,2), (4,1)

6 choices per die ($6 \cdot 6 = 36$)

Example 3: A spinner is divided into 8 equal regions, numbered 1 thru 8. Find the theoretical probability of each event for one spin. (1,2,3,4,5,6,7,8)

a. P(< 6)
(1,2,3,4,5)
$\frac{5}{8}$

b. P(factor of 12)
(1,2,3,4,6)
$\frac{5}{8}$

c. P(multiple of 5)
(5)
$\frac{1}{8}$

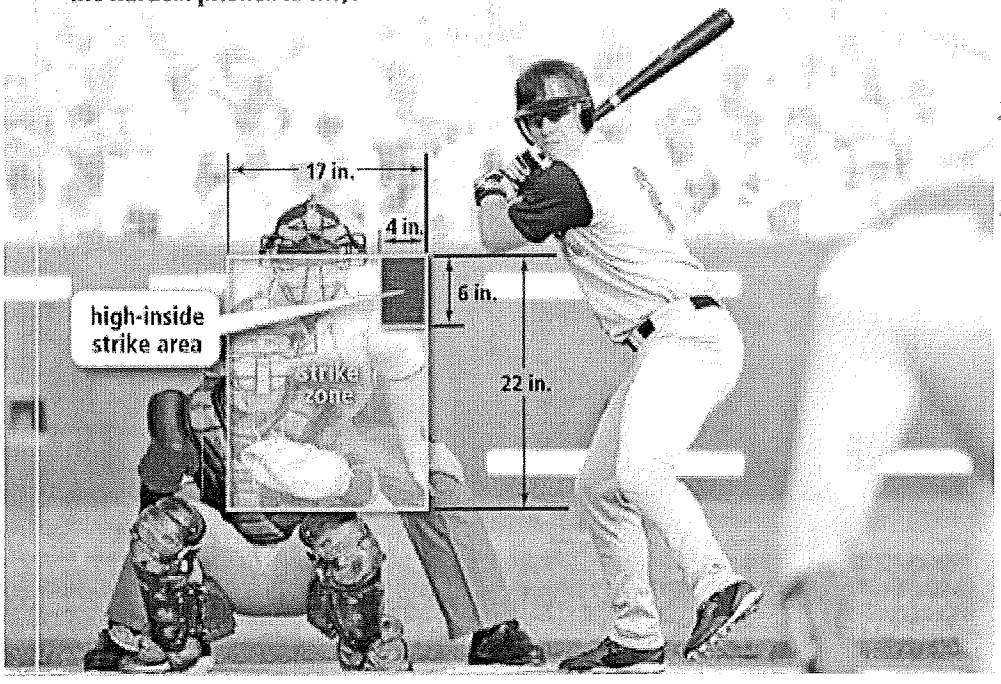
d. P(prime number)
(1,2,3,5,7)
$\frac{5}{8}$

Geometric Probability

$$P = \frac{\text{area of target region}}{\text{area of total region}}$$

Problem 5 **Finding Geometric Probability**

Geometry A batter's strike zone depends on the height and stance of the batter. What is the geometric probability that a baseball thrown at random within the batter's strike zone, as shown in the figure below, will be a high-inside strike (one of the hardest pitches to hit)?



P(high strike zone)
$= \frac{\text{area of high inside strike zone}}{\text{area of total strike zone}}$
$= \frac{4 \cdot 6}{17 \cdot 22} \approx 0.064$
$\approx 6.4\%$

Got It? 5. Suppose a batter's strike zone is 15 in.-by-20 in. and the high-inside strike zone is 3 in.-by-5 in. What is the probability that a baseball thrown at random within the strike zone will be a high-inside strike?

P(high strike zone) $= \frac{3 \cdot 5}{15 \cdot 20} = 0.05$
5%

Algebra 2 – Year 2

Assignment: Lesson 11.2 worksheet

Name: _____

Date: _____ Hour: _____

1. A basketball player attempted 24 shots and made 13. Find the experimental probability that the player will make the next shot she attempts.

$P(\text{make shot}) = \frac{\#\text{ of shots made}}{\text{total \# of shots}} = \frac{13}{24} \approx 0.54 \rightarrow 54\%$

2. A baseball player attempted to steal a base 70 times and was successful 47 times. Find the experimental probability that the player will be successful on his next attempt to steal a base.

$P(\text{stealing base}) = \frac{\#\text{ of successful stolen bases}}{\text{total \# of attempts}} = \frac{47}{70} \approx 0.67 \rightarrow 67\%$

A group of five cards are numbered 1–5. You choose one card at random. Find each theoretical probability. (1, 2, 3, 4, 5)

3. *P*(card is a 2)

$\frac{1}{5}$

4. *P*(even number)

(2, 4)

$\frac{2}{5}$

5. *P*(prime number)

(2, 3, 5) $\frac{3}{5}$

6. *P*(less than 5)

(1, 2, 3, 4)

$\frac{4}{5}$

A bucket contains 15 blue pens, 35 black pens, and 40 red pens. You pick one pen at random. Find each theoretical probability. Total pens = 90

7. *P*(black pen)

$\frac{35}{90} = \frac{7}{18}$

8. *P*(blue pen or red pen)

$15 + 40 = 55$

$\frac{55}{90} = \frac{11}{18}$

9. *P*(not a blue pen)

$35 + 40 = 75$

$\frac{75}{90} = \frac{5}{6}$

10. *P*(black pen or not a red pen)

$15 + 35 = 50$

$\frac{50}{90} = \frac{5}{9}$

The rectangular yard shown below has a circular pool and a triangular garden. A ball from an adjacent golf course lands at a random point within the yard. Find each theoretical probability.

$A(\text{circle}) = \pi r^2$

$A(\text{triangle}) = \frac{1}{2}bh$

11. The ball lands in the pool.

$P(\text{lands in pool}) = \frac{144\pi}{5000} \approx 0.09 \rightarrow 9\%$

12. The ball lands in the garden.

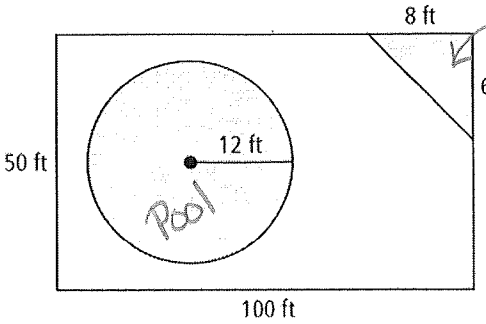
$P(\text{lands in garden}) = \frac{24}{5000} \approx 0.005 \rightarrow 0.5\%$

13. The ball lands in the garden or the pool.

$P(\text{pool or garden}) = \frac{144\pi + 24}{5000} \approx 0.095 \rightarrow 9.5\%$

14. The ball does not land in the pool.

$P(\text{not in pool}) = \frac{5000 - 144\pi}{5000} \approx 0.91 \rightarrow 91\%$



Total area = $50 \cdot 100 = 5000$

Area(pool) = $\pi(12)^2 = 144\pi \approx 4524$

Area(triangle) = $\frac{1}{2}(8)(6) = 24$

Find the probability of each event.

15. A letter chosen at random from the letters of the word *permutation* is a vowel.

(e, u, a, i, o)

$P(\text{vowel}) = \frac{5}{11}$

16. A letter chosen at random from the letters of the work *mistletoe* is a consonant.

$P(\text{consonant}) = \frac{5}{9}$

A spinner is divided into 12 equal regions, numbered 1 through 12. Find the probability of each event for one spin. (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)

17. 2

$P(2) = \frac{1}{12}$

18. 10

$P(10) = \frac{1}{12}$

19. an even number

(2, 4, 6, 8, 10, 12)

$P(\text{even}) = \frac{6}{12} = \frac{1}{2}$

20. an odd number

(1, 3, 5, 7, 9, 11)

$P(\text{odd}) = \frac{6}{12} = \frac{1}{2}$

21. a prime number

(2, 3, 5, 7, 11)

$P(\text{prime}) = \frac{5}{12}$

22. a number greater than 3

(4, 5, 6, 7, 8, 9, 10, 11, 12)

$P(>3) = \frac{9}{12} = \frac{3}{4}$

23. a number less than 8

(1, 2, 3, 4, 5, 6, 7)

$P(<8) = \frac{7}{12}$

24. a factor of 8

(1, 2, 4, 8)

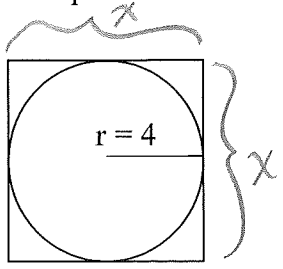
$P(\text{factor of 8}) = \frac{4}{12} = \frac{1}{3}$

25. a multiple of 3

(3, 6, 9, 12)

$P(\text{multiple of 3}) = \frac{4}{12} = \frac{1}{3}$

26. What is the probability that a randomly thrown dart that hits the square board will land in the circular region?



$\text{Area(circle)} = \pi r^2 = \pi(4)^2 = 16\pi$

$\text{Area(square)} = x^2 = 8^2 = 64$

$P(\text{lands in circle}) = \frac{\text{Area of circle}}{\text{total area}}$

$= \frac{16\pi}{64} \approx 0.785 \rightarrow 78.5\%$