What You'll Learn

To find the probability and the complement of an event

🔊 **New Vocabulary** outcome, event, theoretical probability, complement

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7.SP.5, 7.SP.7.a

✓ Check Skills You'll Need

1. **Vocabulary Review** In what three forms can you write a *rational number*?

Write each fraction as a decimal and as a percent.

2. $\frac{31}{50}$ 3. $\frac{19}{20}$

4. $\frac{11}{40}$ 5. $\frac{11}{10}$
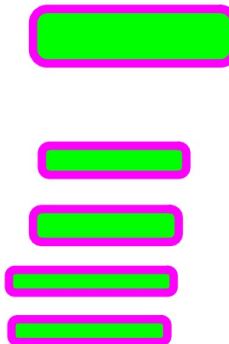
Why Learn This?

In sports, a coin toss often determines which team gets the ball first.

An **outcome** is the result of an action. For example, getting tails is a possible outcome of flipping a coin. An **event** is a collection of possible outcomes. If all the outcomes are equally likely, you can use a formula to find the theoretical probability.

Theoretical Probability

theoretical probability $= P(\text{event}) = \dfrac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}$

You can express probability as a fraction, a decimal, or a percent.

EXAMPLE **Finding Probability**

1 You select a letter at random from the letters shown. Find the probability of selecting a vowel. Express the probability as a fraction, a decimal, and a percent.

Each outcome is equally likely. The event *vowel* has 2 outcomes, A and E, out of 5 possible outcomes.

$P(\text{vowel}) = \dfrac{2}{5}$ ← number of favorable outcomes
← total number of possible outcomes

$= \dfrac{2}{5}, 0.4, \text{ or } 40\%$ ← Write as a fraction, decimal, and percent.

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1 EXAMPLE Find the probability of selecting a vowel from the letters F, G, H, and I. Express the probability as a fraction, decimal, and a percent.

The event *vowel* has one outcome, I, out of four possible outcomes.

$P(\text{vowel}) = \dfrac{1}{4}$ ⟵ number of favorable outcomes
⟵ total number of possible outcomes

$P(\text{vowel}) = \dfrac{1}{4} = 0.25 = 25\%$ ⟵ Write as a fraction, decimal, and percent.

All probabilities range from 0 to 1. The probability of rolling a 7 on a number cube is 0, so that is an *impossible* event. The probability of rolling a positive integer less than 7 is 1, so that is a *certain* event.

$$\xleftarrow{\text{less likely}} \quad \xrightarrow{\text{more likely}}$$

0	0.5	1
Impossible event		Certain event

The **complement** of an event is the collection of outcomes not contained in the event. The sum of the probabilities of an event and its complement is 1. So $P(\text{event}) + P(\text{not event}) = 1$.

EXAMPLES   **Finding Probabilities From 0 to 1**

2 **Clothes** The picture shows the jeans in Juanita's closet. She selects a pair of jeans with her eyes shut. Find $P(\text{dark color})$.

There are 8 possible outcomes. Since there are 3 black pairs and 2 blue pairs, the event *dark color* has 5 favorable outcomes.

$$P(\text{dark color}) = \frac{5}{8} \quad \begin{array}{l} \leftarrow \text{number of favorable outcomes} \\ \leftarrow \text{total number of possible outcomes} \end{array}$$

3 Refer to Juanita's closet. Find $P(\text{red})$.

The event *red* has no favorable outcome.

$$P(\text{red}) = \frac{0}{8}, \text{ or } 0 \quad \begin{array}{l} \leftarrow \text{number of favorable outcomes} \\ \leftarrow \text{total number of possible outcomes} \end{array}$$

4 Refer to Juanita's closet. Find $P(\text{not dark color})$.

$$P(\text{dark color}) + P(\text{not dark color}) = 1 \quad \leftarrow \begin{array}{l} \text{The sum of probabilities of an} \\ \text{event and its complement is 1.} \end{array}$$

$$\frac{5}{8} + P(\text{not dark color}) = 1 \quad \leftarrow \text{Substitute } \tfrac{5}{8} \text{ for } P(\text{dark color}).$$

$$\frac{5}{8} - \frac{5}{8} + P(\text{not dark color}) = 1 - \frac{5}{8} \quad \leftarrow \begin{array}{l} \text{Subtract } \tfrac{5}{8} \text{ from} \\ \text{each side.} \end{array}$$

$$P(\text{not dark color}) = \frac{3}{8} \quad \leftarrow \text{Simplify.}$$

2 EXAMPLE Jacques has 1 blue shirt, 5 white shirts, 3 green shirts, and 2 brown shirts. He selects a shirt from his closet with his eyes shut. Find each probability.

a. P(white shirt)

There are 11 possible outcomes. The event *white shirt* has 5 favorable outcomes.

P(white shirt) = $\dfrac{5}{11}$ ← number of favorable outcomes
← total number of possible outcomes

b. P(not green shirt)

There are 11 possible outcomes. The event *not green shirt* has 8 favorable outcomes.

P(not green shirt) = $\dfrac{8}{11}$ ← number of favorable outcomes
← total number of possible outcomes

c. P(blue shirt)

There are 11 possible outcomes. The event *blue shirt* has 1 favorable outcome.

P(blue shirt) = $\dfrac{1}{11}$ ← number of favorable outcomes
← total number of possible outcomes

✓ Check Your Understanding

1. **Vocabulary** Define *event* without using the word *outcome*.

2. $P(A) = \frac{1}{3}$. Write an expression for $P(\text{not } A)$. $\frac{2}{3}$

You select a marble from those shown. Match each event with its probability.

3. $P(\text{red})$ ☐   A. $\frac{5}{7}$

4. $P(\text{yellow})$ ☐   B. $\frac{2}{7}$

5. $P(\text{blue})$ ☐   C. 0

6. $P(\text{red or blue})$ ☐   D. 1

Practice 9-1

Probability

You spin a spinner numbered 1 through 10. Each outcome is equally likely. Find the probabilities below as a fraction, decimal, and percent.

1. $P(9)$

2. $P(\text{even})$

3. $P(\text{number greater than 0})$

_____   _____   _____

There are eight blue marbles, nine orange marbles, and six yellow marbles in a bag. You draw one marble at random. Find each probability.

4. $P(\text{blue marble})$ _____

5. $P(\text{yellow marble})$ _____

A box contains 12 slips of paper as shown. Each slip of paper is equally likely to be drawn. Find each probability.

red	blue	yellow	blue
yellow	red	blue	red
red	red	red	yellow

6. $P(\text{red})$

7. $P(\text{blue})$

_____   _____

8. $P(\text{red or blue})$

9. $P(\text{red or yellow})$

_____   _____

10. $P(\text{not red})$

11. $P(\text{not blue})$

_____   _____

You select a letter randomly from a bag containing the letters S, P, I, N, N, E, and R. Find the odds in favor of each outcome.

12. selecting an N

13. selecting an S

_____   _____