

The **probability** of an event is a number that tells you how likely it is that the event will occur. Sometimes probabilities are expressed as fractions, sometimes as decimals, and sometimes as percents.

For example, if you were to ask someone what the probability is of flipping a coin and getting tails, they will probably tell you “one-half”, or “.5”, or “50%.” Why? Because there are two sides on the coin, and one of them represents tails. This suggests that we can find a probability by making a fraction as described below:

<p>Theoretical probability</p> $P(\text{event}) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}}$
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The list of everything that can happen in a probability situation is called the **sample space**. When we flip a coin, we can get either heads (H) or tails (T), so the sample space is H, T.

The probability of an event must be a number between 0 and 1. An event with probability 0 would be called “impossible.” An event with probability 1 would be called “certain.”

Example 1 Finding a Sample Space

Give the sample space for each situation:

- a. Roll a die
- b. Flip a coin twice
- c. Flip a coin and roll a die
- d. Roll two dice and add them.
- e. You can buy a laptop in two colors, silver or black. It comes set up three different ways: for gaming, work, or video processing.

Example 2 Finding a Theoretical Probability

Suppose you roll a die (a cube with numbers 1 – 6 on its faces). What is the probability of ...

- a. Rolling a 3?
- b. Rolling an even number?
- c. Rolling a 7?
- d. Rolling a number less than 10?

Example 3 Finding a Theoretical Probability

Suppose you spin a spinner that has 10 evenly-sized spaces on it, with numbers 1-10. What is ...

- a. $P(5 \text{ or } 7)$
- b. $P(\text{not } 5 \text{ or } 7)$
- c. $P(\text{less than } 6)$
- d. $P(\text{greater than } 4)$
- e. $P(\text{multiple of } 3)$
- f. $P(\text{prime number})$

Example 4 Finding a Theoretical Probability

Suppose you choose a marble at random from a bag containing 2 red marbles, 4 green marbles, and 6 blue marbles. What is the probability of choosing each item listed below? Be sure to use good notation!

- a. red
- b. not red
- c. green
- d. not green
- e. blue
- f. not blue

Example 5 Finding a Theoretical Probability

One hundred fifty randomly-selected students were asked to name their favorite subject at school. The results are shown in the table. Find the probability that a randomly selected student prefers the indicated subject. Give your answer as a reduced fraction.

- a. Math
- b. English
- c. Art
- e. Foreign Language

Subject	Number of Responses
English	50
History	30
Math	40
Foreign Language	18
Art	12

Example 6 Probability Word Problems

There are 480 freshmen at your school. The leadership class wants to know how many freshmen to expect at the dance on Friday. They survey 50 randomly selected freshmen and find that 36 plan to go to the dance. How many freshmen should they expect at the dance?

Practice for 12-7: Theoretical and Experimental Probability

You spin a spinner that has 15 equal-sized sections numbered 1 to 15. Find the theoretical probability of landing on the given section(s) of the spinner.

1. $P(15)$

2. $P(\text{odd number})$

3. $P(\text{even number})$

4. $P(\text{not } 5)$

5. $P(\text{less than } 5)$

6. $P(\text{greater than } 8)$

7. $P(\text{multiple of } 5)$

8. $P(\text{less than } 16)$

9. $P(\text{prime number})$

10. You roll a number cube. What is the probability that you will roll a number less than 5?

11. The probability that a spinner will land on a red section is $\frac{1}{6}$. What is the probability that the spinner will not land on a red section?

You choose a marble at random from a bag containing 2 red marbles, 4 green marbles, and 3 blue marbles. Find the probability of choosing.

12. red

13. blue

14. not green

15. not red

16. green

17. not blue

18. You roll a number cube. What is the probability that you will roll an even number?

Why? EXPLAIN!

One hundred twenty randomly selected students at Roosevelt High School were asked to name their favorite sport. The results are shown in the table. Find the experimental probability that a student selected at random makes the given response.

19. $P(\text{basketball})$

20. $P(\text{soccer})$

21. $P(\text{baseball})$

22. $P(\text{football})$

Sport	Number of Responses
Basketball	30
Baseball	22
Football	34
Soccer	20
Other	14

23. A meteorologist says that the probability of rain today is 35%. What is the probability that it will not rain?

24. Hank usually makes 11 out of every 20 of his free throws. What is the probability that he will miss his next free throw?

25. There are 250 freshmen at Central High School. You survey 50 randomly selected freshmen and find that 35 plan to go to the school party on Friday. How many freshmen are likely to be at the party?

26. The Widget Company randomly selects its widgets and checks for defects. If 5 of the 300 selected widgets are defective, how many defective widgets would you expect in the 1500 widgets manufactured today?