

Looking Ahead

Sample Spaces and Events

Objective: To specify the sample space and events for a random experiment.

Vocabulary

Probability The branch of mathematics that deals with the possibility, or likelihood, that an event will happen.

Random experiment An activity repeated under essentially the same conditions where the outcome of the activity can't be predicted.

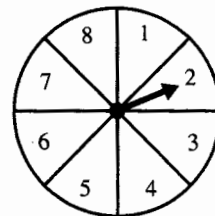
Sample space of an experiment The set of all possible outcomes of a random experiment.

Event Any subset of the sample set of an experiment.

Simple event An event involving a single member of the sample space.

Example 1 For the experiment of spinning the pointer of the spinner below, give:

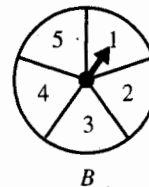
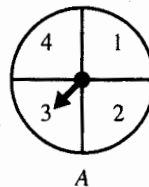
- the sample space for the experiment.
- the event that an odd number results.
- the event that a number less than 4 results.



- Solution**
- $\{1, 2, 3, 4, 5, 6, 7, 8\}$
 - $\{1, 3, 5, 7\}$
 - $\{1, 2, 3\}$

Example 2 Two spinners are divided as shown at the right. For this experiment, give:

- the sample space for the experiment.
- the event that the sum of the numbers on the two spinners equals 5.
- the event that the sum of the numbers on the two spinners is more than 5.



Solution A simple event can be represented by an ordered pair (A, B) , where A is the number from spinner A and B is the number from spinner B .

- $\{(1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (3, 1), (3, 2), (3, 3), (3, 4), (3, 5), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5)\}$
- $\{(1, 4), (2, 3), (3, 2), (4, 1)\}$
- $\{(1, 5), (2, 4), (2, 5), (3, 3), (3, 4), (3, 5), (4, 2), (4, 3), (4, 4), (4, 5)\}$

Sample Spaces and Events (continued)

For the experiments described in Exercises 1–5, first give the sample space and then give each event.

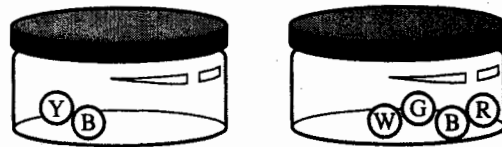
1. Each of the letters P, Q, R, S, T, U, V, W, and X is written on a card. The cards are shuffled, and then one card is drawn at random.

- The letter is a vowel.
- The letter is not a vowel.
- The letter is W or X.



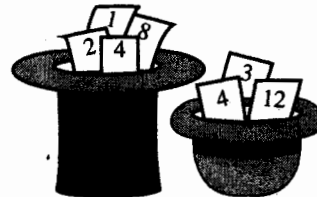
2. A glass jar contains a yellow marble and a blue marble. A second jar contains a white, a green, a blue, and a red marble. One marble is taken at random from each jar.

- One marble is red.
- At least one marble is blue.
- Neither marble is green.



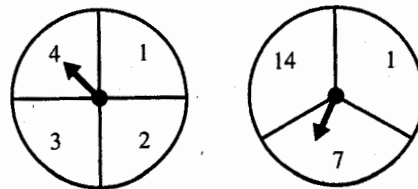
3. A hat contains cards numbered 1, 2, 4, and 8. A second hat contains cards numbered 3, 4, and 12. One card is drawn at random from each hat.

- Both numbers are the same.
- Both numbers are factors of 6.
- The sum of the numbers is less than 7.
- The sum of the numbers is greater than 12.



4. A spinner is divided into four equal sections numbered 1, 2, 3, and 4. A second spinner is divided into three equal sections numbered 1, 7, and 14. The pointer on each spinner is spun.

- Both numbers are even.
- Exactly one number is even.
- The sum of the numbers is between 8 and 18.
- The product of the numbers is greater than 15.



5. Refer to the two-spinner experiment in Example 2. The ordered pair (a, b) represents a simple event.

- $a + b > 6$
- $a < b$
- $a + b$ is a multiple of 4.
- $a \cdot b = a + b$
- $a + b = 7$
- $a + b$ is an even number.

Probability

Objective: To find the probability that an event will occur.

Vocabulary

Probability of an event The ratio of the number of outcomes favoring the event to the total number of possible outcomes. For example, in the case of a tossed coin, the probability of $\{H\}$, written $P(H)$, is $\frac{1}{2}$ and the probability of $\{T\}$, written $P(T)$, is also $\frac{1}{2}$.

The probability of an impossible event is 0.

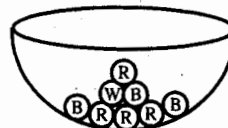
The probability of an event that is certain is 1.

For any probability P , $0 \leq P \leq 1$.

Example

A glass bowl contains 4 red marbles, 3 blue marbles, and 1 white marble. A marble is drawn at random from the bowl. Find the probability of each event.

- Event A : The marble drawn is red.
- Event B : The marble drawn is either red or blue.
- Event C : The marble drawn is not red.
- Event D : The marble drawn is green.



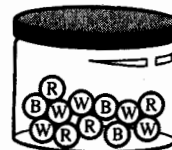
Solution

The sample space is {red 1, red 2, red 3, red 4, blue 1, blue 2, blue 3, white}.

- Since there are 4 red marbles, Event A has 4 equally likely outcomes.
So $P(A) = \frac{4}{8} = \frac{1}{2}$.
- Since there are 4 red marbles and 3 blue marbles, Event B has 7 equally likely outcomes. So $P(B) = \frac{7}{8}$.
- If a marble is not red, then it must either be blue or white. Since there are 3 blue marbles and 1 white marble, Event C has 4 equally likely outcomes. So $P(C) = \frac{4}{8} = \frac{1}{2}$.
- Since there aren't any green marbles, $P(D)$ is an impossible event, so $P(D) = 0$.

Solve.

- A jar contains 4 red marbles, 5 white marbles, and 3 blue marbles. A marble is drawn at random from the jar. Find the probability of each event.
 - The marble is red.
 - The marble is either red or white.
 - The marble is either red, white, or blue.

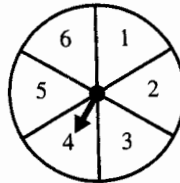


- The marble is white.
- The marble is black.

Probability (continued)

Solve.

2. One card is drawn at random from a standard deck of 13 hearts, 13 diamonds, 13 clubs, and 13 spades. Find the probability of the event that the card is:
- an ace.
 - a black 2.
 - a spade.
 - the jack of diamonds.
 - a 2 or 3.
 - an ace, king, or queen.
3. A letter is drawn at random from the word Q U A R T E R. Find the probability of the event that the letter is:
- a vowel.
 - a consonant.
 - a T.
 - an R.
4. A cube whose sides are numbered 1, 2, 3, 4, 5, and 6 is rolled. Find the probability of the event that the number on the cube is:
- a 4.
 - a 3 or 6.
 - greater than 2.
 - greater than 1 but less than 4.
5. A spinner has six equal sections numbered 1, 2, 3, 4, 5, and 6. The pointer on the spinner is spun. Find the probability of each event.
- The pointer stops on an odd number.
 - The pointer stops on a number less than 4.
 - The pointer stops on a multiple of 2.
 - The pointer stops on a perfect square.



6. A penny, a nickel, and a quarter are tossed. Find the probability of the event that the coins show:
- 3 tails.
 - exactly 2 tails.
 - at least 2 tails.
 - one or two tails.
7. A spinner is divided into four equal sections numbered 1, 2, 3, and 4. A second spinner is divided into three equal sections numbered 2, 4, and 8. Each pointer is spun. Find the probability of each event.
- $P(1, 8)$
 - $P(4, \text{not } 4)$
 - $P(4, 8)$
 - $P(\text{even number, even number})$
 - $P(\text{sum is } 6)$
 - $P(\text{sum is more than } 7)$

