Lesson 4-4

Example 1

Two number cubes are rolled. Find *P*(the sum is greater than 10 or less than 4).

Solution

List the sample space for the experiment. There are 36 possible outcomes.

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

Three outcomes have a sum greater than 10: (5, 6), (6, 5), (6, 6).

$$P(\text{greater than } 10) = \frac{3}{36}$$

Three outcomes have a sum less than 4: (1, 1), (1, 2), (2, 1).

$$P(\text{less than } 4) = \frac{3}{36}$$

Since the sum cannot be greater than 10 or less than 4 at the same time, they are mutually exclusive.

$$P(\text{greater than 10 or less than 4}) = \frac{3}{36} + \frac{3}{36} = \frac{6}{36} = \frac{1}{6}$$

Example 2

Two number cubes are rolled. Find the probability that the sum of the numbers rolled is either odd or greater than 9.

Solution

Refer to the sample space of Example 1. The events are not mutually exclusive because a sum can be both odd and greater than 9. Of the 36 possible outcomes, 18 are odd sums.

$$P(\text{odd}) = \frac{18}{36} = \frac{1}{2}$$

Sums of 10, 11, and 12 are greater than 9. There are 6 sums that are greater than 9.

$$P(\text{greater than } 9) = \frac{6}{36} = \frac{1}{6}$$

However, sums that are odd and greater than 9 have been counted twice. These are (5, 6) and (6, 5) which have a sum of 11.

$$P(\text{odd and greater than } 9) = \frac{2}{36} = \frac{1}{18}$$

Subtract the probability of the sums that have been counted twice.

$$P(\text{odd or greater than } 9) = \frac{1}{2} + \frac{1}{6} - \frac{1}{18} = \frac{9}{18} + \frac{3}{18} - \frac{1}{18} = \frac{11}{18}$$

The probability of an odd sum or a sum greater than 9 is $\frac{11}{18}$.

Example 3

GAMES A card is drawn at random from a standard deck of 52 playing cards. Find the probability that the card is black or a king.

Solution

The events are not mutually exclusive. A card can be both black and a king.
Of the 52 cards, there are 26 black cards (clubs and spades).

$$P(\text{black}) = \frac{26}{52}$$

Of the 52 cards, there are 4 kings.

$$P(\text{king}) = \frac{4}{52}$$

There are two kings that are also black, the king of clubs and the king of spades.

$$P(\text{black and king}) = \frac{2}{52}$$

$$\begin{aligned} P(\text{black or king}) &= \frac{26}{52} + \frac{4}{52} - \frac{2}{52} \\ &= \frac{28}{52} \\ &= \frac{7}{13} \end{aligned}$$