Recognize Independent and Dependent Events

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10.7 Recognize Independent and Dependent Events

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[Figure 1]

Do you know the difference between a dependent event and an independent event? If someone runs a 5 minute mile and someone else runs a 10 minute mile are these two events dependent on each other?

In this concept, you will learn to recognize independent events and dependent events.

Independent and Dependent Events

When you work with probability, you can think about different events and how these events impact each other. Let's look at an example.

[Figure 2]

Suppose there are two events:

Event A: Toss 5 on the number cube

Event B: Spin blue on the spinner

The probability of each of these events by itself is easy enough to compute. In general:

$$P(\text{event}) = \frac{\#\text{ of favorable outcomes}}{\text{total }\#\text{ of outcomes}}$$

If this is the case, then you can write the following ratios for rolling a 5 and spinning blue.

$$\begin{aligned} P(5) &= \frac{\#\text{ of favorable outcomes}}{\text{total }\#\text{ of outcomes}} \\ P(5) &= \frac{1}{6} \\ P(\text{blue}) &= \frac{\#\text{ of favorable outcomes}}{\text{total }\#\text{ of outcomes}} \\ P(\text{blue}) &= \frac{1}{4} \end{aligned}$$

These two events were performed with a spinner and a number cube. Does event A affect the probability of event B in any way? That is, does the number cube landing on 5 affect where the arrow lands in the spinner? If not, then the two events are said to be independent events.

If the outcome of one event has no effect on the outcome of a second event, then the two events are **independent events.**

Events A and B above are independent events. No matter how the number cube turns up, its outcome does not affect the outcome of spinning the spinner.

Now let's think about a different kind of example, one where the outcome of one event does impact the outcome of another event.

A bag has 3 red marbles, 4 blue marbles, and 3 green marbles. Irene pulls 1 green marble out of the bag. Does this change the probability that the next marble Irene pulls out of the bag will be green?

First, find the number of favorable outcomes and the total number of outcomes for the first pick from the bag.

$$\begin{aligned} \#\text{ of favorable outcomes} &= \#\text{ of green marbles} \\ &= 3 \\ \text{total }\#\text{ of outcomes} &= \#\text{ of marbles} \\ &= 3\text{ red} + 4\text{ blue} + 3\text{ green} \\ &= 10 \end{aligned}$$

Next, find the probability of choosing a green marble.

$$\begin{aligned} P(\text{green}) &= \frac{\#\text{ of favorable outcomes}}{\text{total }\#\text{ of outcomes}} \\ P(\text{green}) &= \frac{3}{10} \end{aligned}$$

Then, for the second marble, there are now only 9 marbles left in the bag and only 2 of them are green. So the probability of pulling out a green marble for the second marble is now:

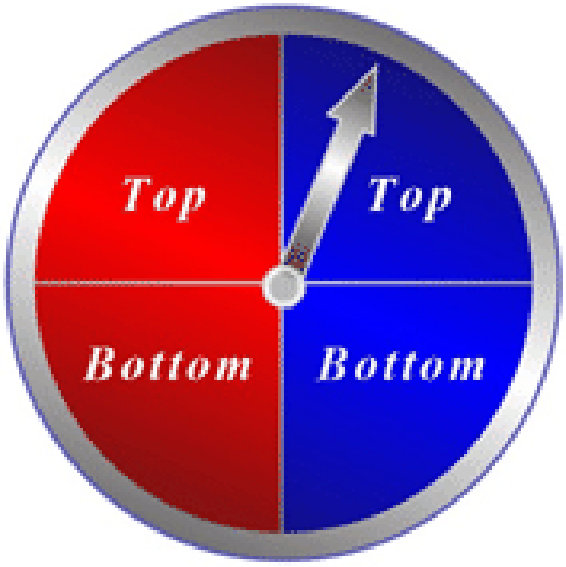
$$\begin{aligned} P(\text{green}) &= \frac{\#\text{ of favorable outcomes}}{\text{total }\#\text{ of outcomes}} \\ P(\text{green}) &= \frac{2}{9} \end{aligned}$$

Clearly, the first event affected the outcome of the second event in this situation. So the two events are NOT independent. In other words, they are dependent events.

If the outcome of one event has an effect on the outcome of a second event, then the two events are **dependent events.**

Sometimes, you have mutually exclusive events and you have events that overlap and are not mutually exclusive. Two events A and B that cannot occur at the same time are **mutually exclusive events**. **Mutually inclusive events** can occur at the same time.

Events $R(\text{red})$ and event $T(\text{top})$ are overlapping events or mutually exclusive events because both events share one outcome $(\text{red} - \text{top})$.



[Figure 3]

To calculate the probability of overlapping events, list the sample space and find the favorable events.

$$\begin{array}{ll} \textbf{red} - \textbf{top} & \text{blue} - \text{top} \\ \text{red} - \text{bottom} & \text{blue} - \text{bottom} \end{array}$$

The probability of red-top is:

$$\begin{aligned} P(\text{red} - \text{top}) &= \frac{\text{\# of favorable outcomes}}{\text{total \# of outcomes}} \\ P(\text{red} - \text{top}) &= \frac{1}{4} \end{aligned}$$

Examples

Example 1

Earlier, you were given a problem about the race and the two runners. Two runners are in a race. The first runner runs a 5 minute mile and the second runner runs a 10 minute mile.

The events are independent. The speed of one runner does not impact the speed of another runner.

For a single toss of a number cube, what is the probability of event $E(\textbf{even})$ and event $S(4)$ both occurring?

First, identify the overlapping outcomes of both events.

$$\begin{aligned} E(\text{even}) &= 2, 4, 6 \\ S(4) &= 4 \end{aligned}$$

Next, find the total number of outcomes.

$$\begin{aligned} \text{Total outcomes} &= 1, 2, 3, 4, 5, 6 \\ &= 6 \text{ total outcomes} \end{aligned}$$

Then, find the probability of the overlapping events.

$$\begin{aligned} P(4) &= \frac{\text{\# of favorable outcomes}}{\text{total \# of outcomes}} \\ P(4) &= \frac{1}{6} \end{aligned}$$

Identify whether the following events are independent or dependent.

Example 2

Rolling a 1 and then rolling a 6 on a number cube.

The answer is these events are independent events because the rolling of a one does not affect the second roll and getting a six.

Example 3

A bag has a red and two blue marbles.

First, one blue marble is drawn and then replaced.

Then, a red one is drawn.

Are these two events dependent or independent?

The answer is these events are independent events because the blue marble was replaced; it does not affect the outcome of drawing of red.

Example 4

A box contains 5 white and 6 red marbles. What is the probability of successfully drawing, in order, a red marble and then a white marble?

The answer is these events are dependent events because the red marble was not replaced; the number of total outcomes will decrease from 11 to 10 when choosing the white marble.

Review

Write whether events A and B are dependent or independent.

1. A : Doug flips a coin. B : Marlene chooses a card out of a deck.

2. A : In a bag with 5 white marbles and 5 black marbles, Sanjay pulls out a white marble. B : Without returning the marble to the bag, Sanjay pulls out a second marble.

3. A : Eddie chooses the color blue for his new bike. B : Eddie chooses lasagne from the dinner menu.

4. A : The probability that it will rain tomorrow. B : The probability that the Red Wings hockey team will win their game tomorrow.

5. A : The probability that it will rain tomorrow. B: The probability that the baseball team will have a rain delay.

6. A : From a deck of cards, the probability of one player drawing a heart from the deck. B : On the next player's turn, the probability of drawing another heart.

7. A : The probability of a spinner landing on blue 6 times in a row. B : The probability of the spinner landing on blue on the next spin.

8. A : The probability of flipping a coin and having it come up heads. B : The probability of flipping it again and having it come up heads.

9. A : The probability that it will snow tomorrow. B : The probability of having a snow day from school.

10. A : The probability that it will be 90 degrees. B : The probability of enjoying a hot day at the beach.

11. A : The probability that it will rain tomorrow. B : The probability of getting an A on a math test.

12. A: The probability that the Rockies will be in the playoffs. B : The probability that the Rockies will win the World Series.

13. A : The probability that tomorrow will be sunny. B : The probability that tomorrow will be a full moon.

14. A : The probability that tomorrow will be sunny. B : The probability that tomorrow will be cloudy.

15. A : The probability that it will be cold today. B : The probability that it will be a full moon tomorrow.

Review (Answers)

To see the review answers, return to the Table of Contents and select ‘Other Versions’ or ‘Resources’.

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