

What is the difference between disjoint and independent events?

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Disjoint and independent events are two concepts commonly used in probability theory to describe the relationship between different events. While both terms refer to events that do not overlap or affect each other, there is a subtle difference between them.

Disjoint events, also known as mutually exclusive events, are events that cannot occur at the same time. In other words, if one event happens, the other event cannot occur. For example, when tossing a coin, the outcome of getting a heads and getting a tails are disjoint events, as they cannot happen simultaneously.

On the other hand, independent events refer to events that do not affect the likelihood of each other occurring. In other words, the outcome of one event has no influence on the outcome of the other event. For example, the result of rolling a dice and flipping a coin are independent events, as the outcome of one does not affect the outcome of the other.

In summary, the main difference between disjoint and independent events lies in their relationship with each other. While disjoint events cannot occur at the same time, independent events can occur simultaneously without affecting each other's likelihood. Understanding the distinction between these two concepts is crucial in accurately calculating probabilities and making informed decisions in various areas, such as economics, finance, and statistics.

Disjoint vs. Independent Events: What's the Difference?

Two terms that students often confuse are disjoint and independent.

Here's the difference in a nutshell:

We say that two events are disjoint if they cannot occur at the same time.

We say that two events are independent if the occurrence of one event has no effect on the probability of the other event occurring.

The following examples illustrate the difference between these two terms in various scenarios.

Example 1: Flipping a Coin

Scenario 1: Suppose we flip a coin once. If we define event A as the coin landing on heads and we define event B as the coin landing on tails, then event A and event B are disjoint because the coin can't possibly land on heads *and* tails.

Scenario 2: Suppose we flip a coin twice. If we define event A as the coin landing on heads on the first flip and we define event B as the coin landing on heads on the second flip, then event A and event B are independent because the outcome of one coin flip doesn't affect the outcome of the other.

Example 2: Rolling a Dice

Scenario 1: Suppose we roll a dice once. If we let event A be the event that the dice lands on an even number and we let event B be the event that the dice lands on an odd number, then event A and event B are disjoint because the dice can't possibly land on an even number *and* an odd number at the same time.

Scenario 2: Suppose we roll a dice twice. If we define event A as the dice landing on a "5" on the first roll and we define event B as the dice landing on a "5" on the second roll, then event A and event B are independent because the outcome of one dice roll doesn't affect the outcome of the other.

Example 3: Selecting a Card

Scenario 1: Suppose we select a card from a standard 52-card deck. If we let event A be the event that the card is a Spade and we let event B be the event that the card is a Diamond, then event A and event B are disjoint because the card can't possibly be a Spade *and* a Diamond at the same time.

Scenario 2: Suppose we select a card from a standard 52-card deck twice in a row with replacement. If we define event A as the card being a Spade on the first draw and we define event B as the card being a Spade on the second draw, then event A and event B are independent because the outcome of one draw doesn't affect the outcome of the other.

Probability Notation: Disjoint vs. Independent Events

Written in probability notation, we say that events A and B are disjoint if their is zero. This can be written as:

$$P(A \cap B) = 0$$

We would define the for the events as follows:

$$A = \{2, 4, 6\} B = \{1, 3, 5\}$$

Notice that there is no overlap between the two sample spaces. Thus, events A and B are disjoint events because they both cannot occur at the same time.

Thus, we could write:

$$P(A \cap B) = 0$$

Similarly, written in probability notation, we say that events A and B are independent if the following is true:

$$P(A \cap B) = P(A) * P(B)$$

For example, suppose we roll a dice twice. Let event A be the event that the dice lands on a "5" on the first roll and let event B be the event that the dice lands on a "5" on the second roll.

If we write out all of the 36 possible ways for the dice to land, we would find that in only 1 out of the 36 scenarios the dice lands on a "5" both times. Thus, we would say $P(A \cap B) = 1/36$.

We also know that the probability of the dice landing on a "5" during the first roll is $P(A) = 1/6$.

We also know that the probability of the dice landing on a "5" during the second roll is $P(B) = 1/6$.

Thus, we could write:

$$P(A \cap B) = P(A) * P(B) \quad 1/36 = 1/6 * 1/6 \quad 1/36 = 1/36$$

Since this equation holds true, we could indeed say that event A and event B are independent in this scenario.

Additional Resources

The following tutorials offer additional information about various statistical terms: