

What is a sample space and what are some examples?

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A sample space refers to the set of all possible outcomes of an experiment or event. It is denoted by the symbol "S" and is an important concept in probability theory. The sample space includes all outcomes, whether they are favorable or unfavorable, and is used to determine the likelihood of a particular event occurring.

For example, if we toss a coin, the sample space would consist of two possible outcomes - heads or tails. Similarly, when rolling a dice, the sample space would consist of six possible outcomes - numbers 1 to 6. In more complex experiments, the sample space may consist of a combination of outcomes, such as when drawing cards from a deck or flipping multiple coins. The sample space is a fundamental concept in probability and is essential in making predictions and decisions based on the likelihood of certain outcomes.

What is a Sample Space? Definition & Examples

The sample space of an experiment is the set of all possible outcomes of the experiment.

For example, suppose we roll a dice one time. The sample space of possible outcomes includes:

Sample space = 1, 2, 3, 4, 5, 6

Using notation, we write the symbol for sample space as a cursive S and the outcomes in brackets as follows:

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

Examples of Sample Spaces

Here are a few more examples of sample spaces:

Example 1: Coin Toss

Suppose we toss a coin one time. If we let H = the coin lands on heads and T = the coin lands on tails, then the sample space for this coin toss is:

$$S = \{H, T\}$$

Example 2: Marbles in a Bag

Suppose we randomly select one marble from a bag that contains three marbles: a red marble, a green marble, and a blue marble. If we let R = red, G = green, and B = blue, then the sample space is:

$$S = \{R, G, B\}$$

Example 3: Coin Toss & Dice Roll

Suppose we toss a coin and roll a dice at the same time. If we let $H1$ represent the result of a "Head" and a "1" then the sample space for the results is:

$$S = \{H1, H2, H3, H4, H5, H6, T1, T2, T3, T4, T5, T6\}$$

The Fundamental Counting Principle

This principle states that if event A has n distinct outcomes and event B has m distinct outcomes, then the total number of potential outcomes can be calculated as:

$$\text{Total outcomes} = m * n$$

Example 1: Coin Toss & Dice Roll

For example, if we toss a coin and roll a dice at the same time, then the total number of outcomes in the sample space can be calculated as:

Total outcomes = (2 ways a coin can land) * (6 ways a dice can land) = 12 possible outcomes.

We wrote out these 12 outcomes in the previous example:

$$S = \{H1, H2, H3, H4, H5, H6, T1, T2, T3, T4, T5, T6\}$$

Example 2: Counting Outfit Combinations

This principle can also be used to calculate the total outcomes in a sample space for more than two events.

For example, suppose a random drawer contains 3

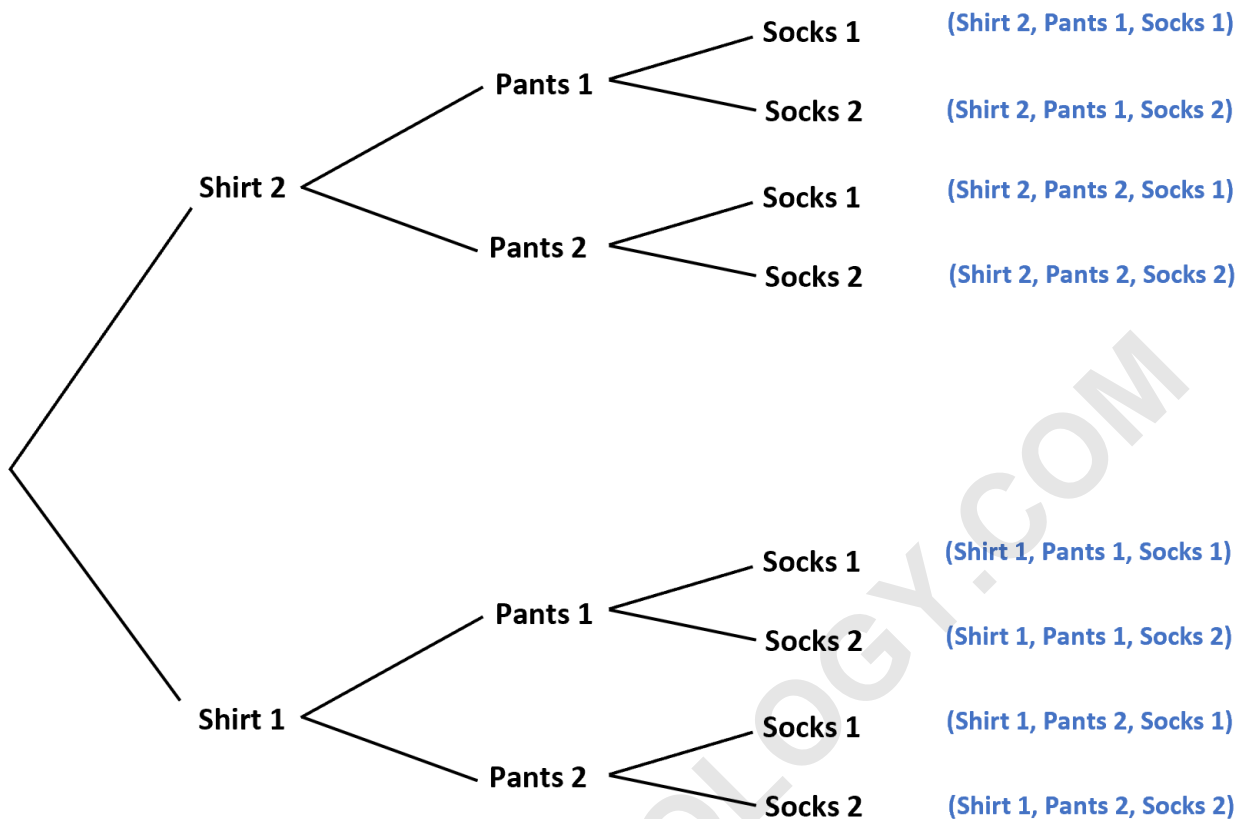
different shirts, 4 different pants, and 2 different socks. If we randomly select one article of clothing each without looking, the total number of possible outfits would be calculated as:

Total outfits = $3 * 4 * 2 = 24$ possible outfits

Visualizing Sample Spaces with Tree Diagrams

When the number of outcomes in a sample space is large, it can be helpful to construct a tree diagram to visualize the different combinations of outcomes.

For example, suppose a closet contains 2 different shirts, 2 different pants, and 2 different socks. If we randomly select one article of clothing each without looking, the total number of possible outfits could be visualized as:



This diagram helps us visualize the eight different potential outcomes in the sample space.

We can also use the fundamental counting principle to confirm that there should be eight different outcomes:

Total outcomes = 2 shirts * 2 pants * 2 socks = 8 possible outfits

Calculating Probabilities of Outcomes in Sample Spaces

Once we have identified the sample space of some experiment, we can calculate the probability of some

event A occurring by using the following formula:

$$P(A) = (\text{Sample Space of } A) / (\text{Total Sample Space})$$

For example, suppose we roll a dice one time. The sample space can be written as:

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

If we define event A as the dice landing on the number "2", then the sample space of event A can be written as:

$$S = \{2\}$$

Thus, the probability of event A occurring can be calculated as:

$$P(A) = 1/6$$

If we define event A as the dice landing on an even number, then the sample space of event A can be written as:

$$S = \{2, 4, 6\}$$

Thus, the probability of event A occurring can be calculated as:

$$P(A) = 3/6$$

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