An Introduction to Probability

by Sophia

WHAT'S COVERED

This lesson introduces probability. The first objective is to understand the difference between experimental and theoretical probability. Secondly, you will come to understand the basic probability associated with the outcomes of experiments. This lesson covers:

1. Theoretical and Experimental Probability
2. Experimental Probability

1. Theoretical and Experimental Probability

There exist two types of probability, theoretical and experimental. Theoretical probability focuses on forecasting how probable it is for an event to happen based on perfect probabilities. The goal of experimental probability is to describe how probable it is that an event will occur based on experiments that were done. You will focus mainly on experimental probability.

THINK ABOUT IT

Why would experimental probability have advantages over theoretical probability?

While theoretical probability can sometimes tell you mathematically what the probability of an outcome is, actually conducting trials of experiments provides you with a realistic sense of what these probabilities actually are.

We use experimental probability to determine the probability that an outcome of a specific event will occur, when we may not know the probabilities associated with such outcomes. We use theoretical probability when the likelihoods of all possible outcomes are already known.

2. Experimental Probability

People conduct experiments to find out more about the possible probabilities that exist for specific outcomes. Experiments conducted to establish the distribution of outcomes are referred to as probability experiments.

These events are referred to as a group of outcomes of an experiment on which the experimenter may be focused.

IN CONTEXT

Probability experiments are experiments such as surveying people about their soda brand preferences, or testing whether a basketball player is more likely to make a second free throw after making the first one. Considering if a test group has certain side effects related to a new prescription drug is also a probability experiment.

In a soda brand survey, the outcomes might be Brand A, Brand B, or No Preference. An event would be the response that interests a person conducting the survey. So, if the experimenters were conducting market research on the characteristics of people interested in Brand A, then they would focus on the Brand A outcome as an event, as opposed to the other outcomes.

In the free throw experiment, the outcomes would be to make the shot or miss the shot. An event would be related to whichever of those outcomes the experimenter is interested in answering—say, making the shot depending on whether or not they made the first one. Consider the **probability of an outcome** as the proportion that the outcome occurs in the probability experiment when considering all of the possible outcomes. Such a probability of an event is called Event A, and the probability of A is equal to P(A).

FORMULA TO KNOW

Probability of A

$$P(A) = \frac{number\ of\ outcomes\ in\ A}{total\ number\ of\ outcomes}$$

If you were interested in learning more about the probability of a specific event taking place, you would look for something called favorable outcomes. These outcomes are those in which all outcomes related to an event, which is being called Event A, actually do occur.

Suppose you were playing a board game that involves rolling two six-sided dice to determine how many spaces you need to move. If you need to move eight spaces, these combinations will yield that outcome:

- 2 and 6
- 3 and 5
- 4 and 4
- 5 and 3
- 6 and 2

These are favorable outcomes. It is important to realize that such outcomes aren't necessarily good, just that they are the outcomes that you are interested in. In the case of playing a board game, you would not be interested in the outcomes of rolling two dice that yield seven spaces if you happen to need eight spaces to achieve a specific goal.

When every one of the outcomes of an experiment is equally likely to occur, the probability of a given Event A is equal to the number of favorable outcomes divided by the total number of possible outcomes. Consider a coin toss. There are two possible outcomes, heads and tails. Both have an equal probability of occurring. In this case, the probability of a coin landing heads up is equal to 1 divided by the total number of outcomes, or 2.

Possible outcomes that an experimenter considers are based on the observed outcomes that occur as the experiment is conducted. In such an experiment, favorable outcomes are the outcomes that are related to the particular outcome that you are most interested in discovering more about. This course only focuses on the types of experiments in which the outcomes are equally likely to occur.

Consider a random experiment in which the experimenter has someone take 1 of 20 small pieces of paper out of a hat, each with a number written on them from 1 to 20. Since the person choosing the piece of paper cannot see which number is written on it, you are assuming that the numbers are being picked randomly. The person has an equal chance of picking any one of the 20 pieces.

Such an experiment is designed to see if one numbered piece of paper happens to be chosen more often than the others. There are 20 possible outcomes in this experiment, with each having a 1 in 20 probability of occurring. If the event you choose to focus on in this instance was all even numbers, you would consider choosing an even number to be the favorable outcome, and it would have a probability of 10 in 20.

Suppose a researcher is interested in the game “rock, paper, scissors.” If a group of people are playing the game, and a random selection of them are chosen, you would expect that the possible outcomes of an individual’s choices are rock, paper, or scissors. Theoretically, we might expect each outcome to occur with equal probability. That is, each occurs 1/3 of the time.

Perhaps the researcher is curious as to whether or not that is actually the case. In the instance of this experiment, if you are interested in how often a person chooses paper, the probability of that occurring is equal to this one favorable outcome divided by all three outcomes. Another way to show this is 1/3, or 1 out of 3.

TERM TO KNOW

Probability of an Outcome

Proportion that the outcome occurs in an experiment when considering all possible outcomes.

SUMMARY

In this lesson, you learned how to understand the difference between a **theoretical and experimental probability**. You also learned about the basics of probability and outcomes of experiments. We also went through a few examples to illustrate that point.

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TERMS TO KNOW

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