Probability - 1

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1 Probability - An Experimental Approach

We get glimpses of uncertainty in our daily lives. Come to think of it, any game has an element of uncertainty in it. In Tennis for instance, where you cannot be sure of the other player's moves, or a team sport like Football with multiple variables.
Similarly, There is always an element of uncertainty when tossing a coin or throwing a dice. We can utilize the coin-toss game as an experiment, and observe its outcomes. We will try to measure the chance of occurrence of a particular outcome in our experiment, numerically.

1.1 Coin Toss Experiment

Our **Experiment** in this case is tossing of a coin, where we toss a coin and observe its **outcome**.
Each toss of a coin in this case is called a **trial**. A trial is an action which results in one or several outcomes.
Further, an **event** is the collection of one or more outcomes of that particular experiment. For instance, in our coin toss experiment, "getting a tail" is an event with outcome "tail" or while throwing a dice, the event "getting an even number" is an event consisting of outcomes 2, 4 and 6.

1.2 Definition

Based on what we observe as the outcomes of our trials, we find the **experimental** or **empirical probability**. The experimental probability of an event E happening is given by :
$$P(E) = \frac{\text{Number of trials in which E happened}}{\text{Total number of trials}}$$
So, the experimental probability is based on the number of trials undertaken, and the number of times the event you are looking for, comes up.

2 Examples

2.1

A coin is tossed 1000 times, and the following outcomes are observed :
Head : 455 times, Tail: 545 times.

Compute the probability for both events "getting a head" and "getting a tail".

Solution :

Let us call the event of getting a head as H and that of getting a tail as T. Then as per the definition of experimental probability :

$$P(H) = \frac{455}{1000} = 0.455$$

Similarly, the probability of getting a tail will be :

$$P(T) = \frac{545}{1000} = 0.545$$

2.2

Two coins were simultaneously tossed 500 times and the following events were recorded based on the outcomes observed :

Two Heads (Head-Head) = 105

One Head (Head-Tail or Tail-Head) = 275

No Head (Tail-Tail) = 120

Find the probability of occurrence of each of these events.

Solution :

Denoting the events of getting two heads, one head and no head as HH, H and T respectively, we can calculate the experimental probability as follows :

$$P(HH) = \frac{105}{500} = 0.21$$

$$P(H) = \frac{275}{500} = 0.55$$

$$P(T) = \frac{120}{500} = 0.24$$

Note : The probability of an event always lies between 0 and 1, that is :

$$\mathbf{0 \leq P(E) \leq 1}$$

This is natural, because in the formula for experimental probability, you can observe that the denominator is always going to be greater than or equal to the numerator.

3   References

1. Class 9 - Chapter 15 : Probability.
   NCERT Mathematics Textbook, Version 2020-21.
   As per Indian National Curriculum Framework 2005.