Probability - 2

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1 Probability - A Theoretical Approach

In part 1, we looked into the experimental approach to probability, which is based on the results of actual experiments.
This experimental interpretation of probability can be applied, when it is possible to repeat an experiment a large number of times. The requirement of repeating an experiment has some limitations, as it may be very expensive or unfeasible in many situations. For example, launching a satellite in space and computing the probability of failure during launch.
In such experiments, the repetition can be avoided by calculating the theoretical probability instead. The theoretical probability of an event E is defined as :

$$\text{P(E)} = \frac{\text{Number of outcomes consistent with E}}{\text{Number of all possible outcomes of the experiment}}$$

It is important to **note** here that when dealing with theoretical probability, we do make certain assumptions and ignore certain possibilities.
For example, when tossing a coin, we assume that it is an unbiased fair coin that is not tampered with and is equally likely to land on head or tail. We also dismiss the negligible possibility of the coin somehow landing on its edge, which may happen, for example, if the coin falls in the sand.

2 Coin Toss Example

Let us understand the concept of theoretical probability through the coin toss example.
The possible outcomes of the coin toss experiment are two - Head and Tail. Now, let E be the event "getting a head". What would be $P(E)$?
The number of of outcomes consistent with E is 1 (getting a head), and we already know that there are 2 possible outcomes (assuming a fair coin and ignoring the edge case). Therefore :

$$\text{P(E)} = \frac{\text{Number of outcomes consistent with E}}{\text{Number of all possible outcomes of the experiment}} = \frac{1}{2}$$

Note : An event consisting of only one outcome of an experiment is called an elementary event. In the above example, E is an elementary event.
Also, the **sum of probabilities of all elementary events is 1**.
(This is natural because each elementary event would cover one possible outcome of the experiment. And when you sum them up, you get all possible outcomes of the experiment, which is same as the denominator in the formula for theoretical probability above. Hence proved.)

3 Dice Throw Example

4 References

1. Class 10 - Chapter 15 : Probability.
   NCERT Mathematics Textbook, Version 2020-21.
   As per Indian National Curriculum Framework 2005.