4. Probability

- **Certain events:** Events which are definite to happen.

  For example, the day after Saturday will be Sunday or the sun will rise from the east.

- **Impossible events:** Events which are impossible to happen.

  For example, March comes before February in a year, the apple goes up when dropped from the tree.

- **Matter of Chance:** Results of events which can not be known before they happen.

  In a cricket match, India will win or it will rain tomorrow.

- **Probability** is the measure or estimation of likelihood of happening of an event in a particular way.

- Some of the terms related to probability are:
    - **Experiment**: When an operation is planned and done under controlled conditions, it is known as an experiment. For example, tossing a coin, throwing a die etc., are all experiments.
    - **Outcomes**: Different results obtained in an experiment are known as outcomes. For example, on tossing a coin, if the result is a head, then the outcome is a head; if the result is a tail, then the outcome is a tail.
    - **Random**: An experiment is random if it is done without any conscious decision. For example, drawing a card from a well-shuffled pack of playing cards is a random experiment if it is done without seeing the card.
    - **Trial**: A trial is an action or an experiment that results in one or several outcomes. For example, if a coin is tossed five times, then each toss of the coin is called a trial.
    - **Sample space**: The set of all possible outcomes of an experiment is called the sample space. It is denoted by the letter 'S'. Sample space in the experiment of tossing a coin is {H, T}.
    - **Event**: The event of an experiment is one or more outcomes of the experiment. For example, tossing a coin and getting a head or a tail is an event.

- The outcomes of an experiment having the same chances of occurrence are known as equally-likely outcomes. For example, if we toss a coin, then the possible outcomes are head or tail, and both of them have an equal chance of occurring. So, these are equally-likely outcomes.

- When the outcomes of the experiment are equally-likely, the probability of an event is given by:

$$\frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}}$$

- Each outcome of an experiment or collection of outcomes make an event.

  For example, when a coin is tossed, the possible outcomes are head or tail.
  When two coins are tossed, the possible outcomes are:

  1. Two heads (i.e. head on both the coins)
  2. Two tails (i.e. tail on both the sides)

3. One head and one tail

Example:

What is the probability of getting one head and one tail when two coins are tossed together?

Solution:

When two coins are tossed together, the possible outcomes are:

- Head on first coin, head on second coin(H, H)

- Head on first coin, tail on second coin (H, T)

- Tail on first coin, head on second coin (T, H)

- Tail on first coin, tail on second coin (T, T)

∴ Total number of outcomes = 4

Outcomes in favour of the event are (H, T) and (T, H).

Number of favourable outcomes = 2

Therefore, probability of getting one head and one tail

$$\frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}}$$
$$= \frac{2}{4} = \frac{1}{2}$$

1. For any two events A and B of a sample space S,

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

2. For two events A and B, there may be two possibilities as follows:

(i) If A and B are mutually exclusive events then

$P(A \cup B) = P(A) + P(B)$

(ii) If A and B are mutually exclusive and exhaustive events then

$P(A) + P(B) = 1$