PROBABILITY

1. **Coin**: On tossing a coin there are two possibilities either head may come up or tail may come up.
2. **Die**: A die is a well balanced cube with its six faces marked with numbers (dots) from 1 to 6, one number on the one face. The plural of die is dice.
3. **Cards**: A pack of cards consists of four suits i.e.., Spades, Hearts, Diamonds and Clubs. Each suit consists of 13 cards, nine cards numbered $2, 3, 4, \ldots\ldots$, 10 and an Ace, a King, a Queen and a Jack or Knave. Colour of Spades and Clubs is black and that of Hearts and Diamonds is red. Ace, King, Queen and Jack cards are called Face cards.
4. **Random Experiments:** An experiment, whose outcomes cannot be predicted in advance is called a Random experiment. For example, on tossing a coin, we cannot predict whether head will come up or tail will come up.
5. **Event** : Every subset of a sample space is called an Event.

6. **Types of Events:**

   - **Simple Event**: Single element of the sample space is called a Simple event. It is denoted by S.
   - **Compound Event**: Compound event is the joint occurrence of two or more events.
   - **Sure Event**: In a sure event, a set of all the favorable outcomes is the sample event itself. Its probability is always 1.
   - **Impossible Event**: If E is an impossible event, then $S \cap E = \phi$ and the probability of impossible event is 0.
   - **Equally Likely Events**: Two events are said to be equally likely, if none of them is expected to occur in preference to the other. For example, if we toss a coin, each outcome head or tail is equally likely to occur.

- **Mutually Exclusive Event**: Two events E_1 and E_2 are said to be mutually exclusive if $E_1 \cup E_2 = \phi$. On tossing a coin two events are possible, (i) coming up a head excludes coming of a tail, (ii) coming up a tail excludes coming of a head. Coming of a head andcoming of a tail are mutually exclusive events.
- **Independent Events**: Occurrence of one event does not depend on the occurrence of other. For example, on tossing two coins simultaneously occurrence of one toss does not depend upon the occurrence of the second one.
- **Exhaustive Events**: Exhaustive events consist of all possible outcomes.
- **Complement of an Event**: The complement of an event E with respect to the sample space S is the set of all elements of S, which are not in E. The compliment of E is denoted by E' or $\overline{E}$

$E \cap E' = \phi$ Or $E \cup \overline{E} = \phi$

And $P\left(\overline{E}\right) = 1 - P(E)$

Probability of an Event: $P(A) = \frac{Number\ of\ outcomes\ favorable to A}{Total\ number\ of\ possible\ outcomes}$

$$\text{Probability of an event } P(A) = \frac{n(A)}{n(S)},$$

where n(A) = number of elements in the set A, n(S) = number of elements in the set S.

Probability: Number P (ωi) associated with sample point ωi such that

(i) $0 \leq P(\omega_i) \leq 1$

(ii) $\sum P(\omega_i) \text{for all } \omega_i \in S = 1$

(iii) $P(A) = \sum P(\omega_i)$ for all $\omega_{i\in} A.$

Odds: If an event E occurs in the m ways and does not occur in n ways, then

(i) odds in the favour of the events = $\frac{m}{n}$

(ii) odds against the event = $\frac{n}{m}$

(iii) P (E) = $\frac{m}{m+n}$

Addition law of probability:

- If A and B are any two events associated with an experiment, then

  P(A or B) = P(A) + P(B) – P(A and B)

equivalently, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
And $P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(A \cap C) - P(B \cap C) + P(A \cap B \cap C)$

Multiplication law of probability:

$P(A \cap B) = P(A) \times P(B)$

Combination: Number of combinations of n things taken r at a time is denoted by ${}^{n}C_{r}$

$${}^{n}C_{r} = {}^{n}C_{n-r}$$

- If A and B are mutually exclusive, then P(A or B) = P(A) + P(B)