PROBABILITY

(**Probability** is the extent to which something is likely to happen)

1. <u>Experimental (or) Empirical Probability</u>:

A probability that is based on the outcome of an actual experiment and adequate recording of the happening of an event**.**

[say, E = event and P = Probability, then P(E) = Probability of an event E]

$$P(E) = \frac{Number\ of\ trials\ in\ which\ the\ event\ happened}{Total\ number\ of\ trials}$$

2. <u>Theoretical (or) Classical Probability</u>:

A probability that is based on the assumption about the occurrence of an event (E) rather than the outcome of an actual experiment.

$$P(E) = \frac{Number\ of\ favourable\ outcomes}{Total\ possible\ outcomes}$$

3. <u>Equally Likely Outcomes</u>:

Outcomes of an event are said to be 'equally likely' when they have the same chance of occurring. It happens in case of an unbiased and a fair event.

Example:

<u>Event</u>- Throwing a die (An unbiased and a fair event)

<u>Outcomes</u>- 1, 2, 3, 4, 5 and 6. (All are equally likely to occur)

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4. ELEMENTARY EVENT:

An event having only a single outcome at a time.

Example:

Event- Tossing a coin (An unbiased and a fair event)

Outcomes- Either a Head (H) or a tail (T). (Equally likely to occur)

5. SUM OF PROBABILITIES RULE:

The sum of probabilities of all the elementary events of an experiment is **one**.

Example 1:

Event- Throwing a die (An unbiased and a fair event)

Outcomes- 1, 2, 3, 4, 5 and 6. (All are equally likely to occur)

∴ **P (1) + P (2) + P (3) + P (4) + P (5) + P (6) = 1**

Example 2:

Event- Tossing a coin (An unbiased and a fair event)

Outcomes- Head (H) and tail (T). (Equally likely to occur)

∴ **P (H) + P (T) = 1**

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6. COMPLEMENTARY EVENT:

Complementary events are those events where the probability of one event excludes the happening of the other event.

In general, it is true that for an event E, there also exists the **complement** of the event E ($\overline{E}$ **or not E**). We also say that E and $\overline{E}$ are **complementary** events.

$$\therefore \mathbf{P}(\overline{E}) = 1 - \mathbf{P}(\mathbf{E}) \quad \rightarrow \quad \mathbf{P}(\overline{E}) + \mathbf{P}(\mathbf{E}) = 1$$

Example:

*Event (E) – getting a head (**H**) after tossing a coin.*

Complement event ($\overline{E}$) – **not getting a head (H)** or **getting a tail (T)**

7. IMPOSSIBLE EVENT:

An event that has no chance of occurring. Probability of such an event that is *impossible* to occur is **zero**.

$$\therefore \mathbf{P}\text{ (impossible event)} = 0$$

Example:

Event- getting a seven in a single throw of a die.

$$\therefore \mathbf{P}\text{ (getting a 7)} = \frac{0}{6} = 0$$

Note: There are only six possible outcomes in a single throw of a die (*1, 2, 3, 4, 5 and 6*). Since no face of the die is marked 7, so there is no outcome favorable to 7. In other words, getting a 7 in a single throw of a die, is *impossible*.

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8. <u>SURE EVENT</u>:

An event that has 100% probability of occurring. Probability of such an event that is *sure/certain* to occur is **one**.

$$\therefore \textbf{P (sure event)} = \textbf{1}$$

<u>Example</u>:

<u>Event</u>- getting a number less than seven in a single throw of a die.

$$\therefore \textbf{P (getting a number less than 7)} = \frac{\textbf{6}}{\textbf{6}} = \textbf{1}$$

<u>Note</u>: Since every face of a die is marked with a number less than 7 (*1, 2, 3, 4, 5 and 6*), it is *sure* that we will always get a number less than 7 when it is thrown once. So the number of favourable outcomes is same as the number of all possible outcomes, which is 6.

9. The probability of an event E is a number P(E) such that

$$0 \leq P(E) \leq 1$$