

Basics of Probability

Probability refers to the extent of occurrence of events. When an event occurs like throwing a ball, picking a card from deck, etc., then there must be some probability associated with that event.

In terms of mathematics, probability refers to the ratio of wanted outcomes to the total number of possible outcomes. There are three approaches to the theory of probability, namely:

1. Empirical Approach
2. Classical Approach

In this approach,

As the name suggests the classical approach to defining probability is the oldest approach. It states that if there are n exhaustive, mutually exclusive and equally likely cases out of which m cases are favourable to the happening of event A ,

Then the probabilities of event A is defined as given by the following probability function:

Formula

$$P(A) = \frac{\text{Number of favourable cases}}{\text{Total number of equally likely cases}}$$

Thus to calculate the probability we need information on number of favourable cases and total number of equally likely cases. This can be explained using following example.

Example:

Problem Statement: A coin is tossed. What is the probability of getting a head?

Solution:

Total number of equally likely outcomes (n) = 2 (i.e. head or tail)

Number of outcomes favourable to head (m) = 1

$$P(\text{head}) = \frac{1}{2}$$

3. Axiomatic Approach

In this approach, we represent the probability in terms of sample space (S) and other terms.

Basic Terminologies:

- **Random Event** :- If the repetition of an experiment occurs several times under similar conditions, if it does not produce the same outcome every time but the outcome in a trial is one of the several possible outcomes, then such an experiment is called random event or a probabilistic event.
- **Elementary Event** – The elementary event refers to the outcome of each random event performed. Whenever the random event is performed, each associated outcome is known as elementary event.
- **Sample Space** – Sample Space refers to the set of all possible outcomes of a random event. Example, when a coin is tossed, the possible outcomes are head and tail.
- **Event** – An event refers to the subset of the sample space associated with a random event.

- **Occurrence of an Event** – An event associated with a random event is said to occur if any one of the elementary event belonging to it is an outcome.
- **Sure Event** – An event associated with a random event is said to be sure event if it always occurs whenever the random event is performed.
- **Impossible Event** – An event associated with a random event is said to be impossible event if it never occurs whenever the random event is performed.
- **Compound Event** – An event associated with a random event is said to be compound event if it is the disjoint union of two or more elementary events.
- **Mutually Exclusive Events** – Two or more events associated with a random event are said to be mutually exclusive events if any one of the event occurs, it prevents the occurrence of all other events. This means that no two or more events can occur simultaneously at the same time.
- **Exhaustive Events** – Two or more events associated with a random event are said to be exhaustive events if their union is the sample space.

Probability of an Event – If there are total p possible outcomes associated with a random experiment and q of them are favourable outcomes to the event A , then the probability of event A is denoted by $P(A)$ and is given by

$$P(A) = \frac{q}{p}$$

The probability of non occurrence of event A , i.e, $P(A') = 1 - P(A)$

Note –

- If the value of $P(A) = 1$, then event A is called sure event .
- If the value of $P(A) = 0$, then event A is called impossible event.
- Also, $P(A) + P(A') = 1$

MISCELLANEOUS QUESTIONS ON PROBABILITY FROM NCERT

1. A box contains 10 red marbles, 20 blue marbles and 30 green marbles. 5 marbles are drawn from the box, what is the probability that

(i) all will be blue? (ii) at least one will be green?

2. 4 cards are drawn from a well – shuffled deck of 52 cards. What is the probability of obtaining 3 diamonds and one spade?

3. A die has two faces each with number '1', three faces each with number '2' and one face with number '3'. If die is rolled once, determine

(i) $P(2)$ (ii) $P(1 \text{ or } 3)$ (iii) $P(\text{not } 3)$

4. In a certain lottery 10,000 tickets are sold and ten equal prizes are awarded. What is the probability of not getting a prize if you buy (a) one ticket (b) two tickets (c) 10 tickets.

5. Out of 100 students, two sections of 40 and 60 are formed. If you and your friend are among the 100 students, what is the probability that

(a) you both enter the same section?

(b) you both enter the different sections?

6. Three letters are dictated to three persons and an envelope is addressed to each of them, the letters are inserted into the envelopes at random so that each envelope contains exactly one letter. Find the probability that at least one letter is in its proper envelope.

7. From the employees of a company, 5 persons are selected to represent them in the managing committee of the company. Particulars of five persons are as follows:

S. No.	Name	Sex	Age in years
1.	Harish	M	30
2.	Rohan	M	33
3.	Sheetal	F	46
4.	Ali	F	28
5.	Salim	M	41

A person is selected at random from this group to act as a spokesperson. What is the probability that the spokesperson will be either male or over 35 years?

8. If 4-digit numbers greater than 5,000 are randomly formed from the digits 0, 1, 3, 5, and 7, what is the probability of forming a number divisible by 5 when:

(i) the digits are repeated? (ii) the repetition of digits is not allowed?

9. The number lock of a suitcase has 4 wheels, each labelled with ten digits i.e., from 0 to 9. The lock opens with a sequence of four digits with no repeats. What is the probability of a person getting the right sequence to open the suitcase?