11th Standard - Mathematics

Probability

Random Experiment

An experiment whose outcomes cannot be predicted or determined in advance is called a random experiment.

Outcome

A possible result of a random experiment is called its outcome.

Sample Space

A sample space is the set of all possible outcomes of an experiment.

Events

An event is a subset of a sample space associated with a random experiment.

Types of Events

Impossible and sure events: The empty set Φ and the sample space S describes events. Intact Φ is called the impossible event and S i.e. whole sample space is called sure event.

Simple or elementary event: Each outcome of a random experiment is called an elementary event.

Compound events: If an event has more than one outcome is called compound events.

Complementary events: Given an event A, the complement of A is the event consisting of all sample space outcomes that do not correspond to the occurrence of A.

Mutually Exclusive Events

Two events A and B of a sample space S are mutually exclusive if the occurrence of any one of them excludes the occurrence of the other event. Hence, the two events A and B cannot occur simultaneously and thus $P(A \cap B) = 0$.

Exhaustive Events

If $E_1, E_2, \ldots, E_n$ are n events of a sample space S and if $E_1 \cup E_2 \cup E_3 \cup \ldots \cup E_n = S$, then $E_1, E_2, \ldots E_3$ are called exhaustive events.

Mutually Exclusive and Exhaustive Events

If $E_1, E_2, \ldots E_n$ are n events of a sample space S and if

$E_i \cap E_j = \Phi$ for every $i \neq j$ i.e. E_i and E_j are pairwise disjoint and $E_1 \cup E_2 \cup E_3 \cup \ldots \cup E_n = S$, then the events

$E_1, E_2, \ldots, E_n$ are called mutually exclusive and exhaustive events.

Probability Function

Let $S = (w_1, w_2, \ldots w_n)$ be the sample space associated with a random experiment. Then, a function p which assigns every event $A \subset S$ to a unique non-negative real number $P(A)$ is called the probability function.

It follows the axioms hold

- $0 \leq P(w_i) \leq 1$ for each $W_i \in S$
- $P(S) = 1$ i.e. $P(w_1) + P(w_2) + P(w_3) + \ldots + P(w_n) = 1$
- $P(A) = \Sigma P(w_i)$ for any event A containing elementary event w_i.

Probability of an Event

If there are n elementary events associated with a random experiment and m of them are favorable to an event A, then the probability of occurrence of A is defined as

$$P(A) = \frac{m}{n} = \frac{\text{Favourable number of outcomes}}{\text{Total number of outcomes}}$$

The odd in favour of occurrence of the event A are defined by m : (n – m).

The odd against the occurrence of A are defined by n – m : m.

The probability of non-occurrence of A is given by $P(\bar{A}) = 1 - P(A)$.

Addition Rule of Probabilities

If A and B are two events associated with a random experiment, then

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

Similarly, for three events A, B, and C, we have

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

Note: If A andB are mutually exclusive events, then

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