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Complete MATH

IIT-JEE · CBSE eBOOKS

CLASS 11&12th

CLASS 11th

Probability

01. Some Definitions

Elementary Event *If a random experiment is performed, then each of its outcomes is known as an elementary event.*

Sample Space *The set of all possible outcomes of a random experiment is called the sample space associated with it and it is generally denoted by S.*

In other words, the set of all elementary events associated to a random experiment is called its sample space.

Remark 1 *Elementary events associated to a random experiment are also known as indecomposable events.*

Occurrence Of An Event *An event A associated to a random experiment is said to occur if any one of the elementary events associated to it is an outcome.*

Thus, if an elementary event E is an outcome of a random experiment and A is an event such that $E \in A$, then we say that the event A has occurred.

Negation of An Event *Corresponding to every event A associated with a random experiment we define an event "not A" which occurs when and only when A does not occur.*

It follows from this that the event A occurs iff $\overline{A}$ does not occur.

Favourable Elementary Events *Let S be the sample space associated with a random experiment and A be an event associated to the experiment. Then elementary events belonging to A are known as favourable elementary events to the event A.*

Probability

Definition *If there are n elementary events associated with a random experiment and m of them are favourable to an event A, then the probability of happening or occurrence of A is denoted by P (A) and is defined as the ratio* $\frac{m}{n}$

Thus, $P(A) = \frac{m}{n}$

Clearly, $0 \leq m \leq n$

$\therefore \quad 0 \leq \frac{m}{n} \leq 1 \Rightarrow 0 \leq P(A) \leq 1$

If $P(A) = 1$, then A *is called certain event and* A *is called an impossible event, if* $P(A) = 0$.

The number of elementary event which will ensure the non occurrence of A i.e. which ensure the occurrence of A is $(n - m)$. Therefore,

$$P(\overline{A}) = \frac{n-m}{n}$$

$$\Rightarrow \quad P(\overline{A}) = 1 - \frac{n-m}{n} \Rightarrow P(\overline{A}) = 1 - P(A) \Rightarrow P(A) + P(\overline{A}) = 1$$

The odds in favour of occurrence of the event A are defined by $m : (n - m)$ i.e.; $P(A) : P(\overline{A})$.

Types of Events

a. **Certain (Or Sure) Event** *An event associated with a random experiment is called a certain event if it always occurs whenever the experiment is performed.*
The sample space associated with a random experiment defines a certain event.

b. **Impossible Event** *An event associated with a random experiment is called an impossible event if it never occur whenever the experiment is performed.*
The event represented by φ is an impossible event.

c. **Compound Event** *An event associated with a random experiment is a compound event, if it is the disjoint union of two or more elementary events.*

Remark *If there are n elementary events associated to a random experiment, then the sample space associated to it has n elements and so there are 2^n subsets of it. Out of these 2^n subsets there are n single element subsets. These single element subsets define n elementary events and the remaining $2^n - (n + 1)$ subsets (excluding null set) define compound events. Some of these compound events can be described in words whereas for others there may not be general description.*

d. **Mutually Exclusive Events** *Two or more events associated to a random experiment are said to be mutually exclusive or incompitable events if the occurrence of any one of them prevents the occurrence all other i.e. if no two or more of them can occur simultaneously in the same trial.*
Clearly, elementary events associated with a random experiment are always mutually exclusive.

e. **Exhaustive Events** *Two or more events associated with a random experiment are exhaustive if their union is the sample space i.e. events A_1, A_2, ..., A_n associated with a random experiment with sample space S are exhaustive if $A_1 \cup A_2 \cup \ldots \cup A_n = S$.*
All elementary events associated to a random experiment form a system of mutually exclusive and exhaustive events.

f. **Mutually Exclusive and Exhaustive System of Events** *Let S be the sample space associated with a random experiment. A set of events A_1, A_2, ..., A_n is said to form a set of mutually exclusive and exhaustive system of events if*
(i) $A_1 \cup A_2 \cup \ldots \cup A_n = S$ *i.e. events* $A_1 \cup A_2 \cup \ldots \cup A_n$ *from an exhaustive set of events.*
(ii) $A_i \cap A_j = \varphi$ *for* $i \neq j$ *i.e. events* A_1, A_2, ..., A_n *are mutually exclusive.*

Thus, if two events A and B are mutually exclusive, then

$$P(A \cap B) = 0$$

Similarly, if A, B and C are mutually exclusive events, then $P(A \cap B \cap C) = 0$.

NOTE ☞ *The events which are not mutually exclusive are known as compatible events.*