# Permutation And Combination

## Fundamental Principle of Counting

For several mutually independent events $P_1, P_2, P_3, \ldots, P_n$ which can occur in $n(P_1), n(P_2), n(P_3), \ldots, n(P_n)$ ways.

## Addition Rule

The no.of ways in which either $P_1$ or $P_2$ or $P_3$ or......or $P_n$ occurs is

$$n(E) = n(P_1) + n(P_2) + n(P_3) + \ldots\ldots + n(P_n)$$

## Product Rule

The no.of ways in which $P_1$ and $P_2$ and $P_3$ and ....and $P_n$ occur is

$$n(E) = n(P_1) \times n(P_2) \times n(P_3) \times \ldots \times n(P_n).$$

## Factorial Notation

It is denoted by n! and defined as

$$n! = n \times (n-1) \times (n-2) \times \ldots \times 3 \times 2 \times 1$$

where n is a natural number

We also define 0!=1

## Permutation

It is an arrangement, in a defined order, of objects taken some or all at a time.

## Permutation when all objects are distinct

Premutation of n different objects taken r at a time , where $0 \leq r \leq n$ , without repetition is , ${}^nP_r = \dfrac{n!}{(n-r)!}$

and with repetition of objects is $n^r$.

## Permutation when all objects are not distinct

Permutation of n objects where

$P_1$ objects are of one kind,

$P_2$ objects are of second kind,

.

.

$P_k$ objects are of $k^{th}$ kind and the rest if any , are of different kind is

$$= \frac{n!}{P_1!P_2!\ldots P_k!}$$

## Properties of ${}^nP_r$

1. ${}^nP_n = n!$
2. ${}^nP_1 = n$
3. ${}^nP_0 = 1$
4. ${}^nP_{n-1} = n!$

## Combination

1. It is selection of r objects from n objects where order of selection does not matter.Here , $0 \leq r \leq n$.
2. It is denoted as (n , r) or ${}^nC_r$, calculated as

$${}^nC_r = \frac{n!}{r!\,(n-r)!}$$

$${}^nC_r = \frac{{}^nP_r}{r!}$$

## Properties of ${}^nC_r$

1. ${}^nC_0 = {}^nC_n = 1$
2. ${}^nC_r = {}^nC_{n-r}$
3. If ${}^nC_r = {}^nC_p$ then either $r = p$ or $r + p = n$
4. ${}^nC_1 = n$