- If certain objects are to be arranged in such a way that the order of objects is not important, then the concept of combinations is used.
- The number of combinations of n things taken r ($0 \le r \le n$) at a time is given by $^nC_r = n!/r!(n-r)!$
- The relationship between combinations and permutations is $^nC_r = {^nP_r}/r!$
- The number of ways of selecting r objects from n different objects subject to certain condition like:
  1. k particular objects are always included = $^{n-k}C_{r-k}$
  2. k particular objects are never included = $^{n-k}C_r$
- The number of arrangement of n distinct objects taken r at a time so that k particular objects are
  1. Always included = $^{n-k}C_{r-k}.r!$,
  2. Never included = $^{n-k}C_r.r!$.
- In order to compute the combination of n distinct items taken r at a time wherein, the chances of occurrence of any item are not fixed and may be one, twice, thrice, …. up to r times is given by $^{n+r-1}C_r$
- If there are m men and n women (m > n) and they have to be seated or accommodated in a row in such a way that no two women sit together then total no. of such arrangements

  = $^{m+1}C_n.\ m!$ This is also termed as the Gap Method.

- If there is a problem that requires n number of persons to be accommodated in such a way that a fixed number say 'p' are always together, then that particular set of p persons should be treated as one person. Hence, the total number of people in such a case becomes (n-m+1). Therefore, the total number of possible arrangements is (n-m+1)! m! This is also termed as the String Method.
- Let there be n types of objects with each type containing at least r objects. Then the number of ways of arranging r objects in a row is n^r.
- The number of selections from n different objects, taking at least one= $\mathbf{^nC_1 + {^nC_2} + {^nC_3} + ... + {^nC_n} = 2^n - 1.}$
- Total number of selections of zero or more objects from n identical objects is n+1.
- **Selection when both identical and distinct objects are present:**
- The number of selections, taking at least one out of $a_1 + a_2 + a_3 + ... a_n + k$ objects, where a_1 are alike (of one kind), a_2 are alike (of second kind) and so on ... a_n are alike (of nth kind), and k are distinct

  = $\{[(a_1 + 1)(a_2 + 1)(a_3 + 1) ... (a_n + 1)]2^k\} - 1$.

- Combination of n different things taken some or all of n things at a time is given by $2^n - 1$.
- Combination of n things taken some or all at a time when p of the things are alike of one kind, q of the things are alike and of another kind and r of the things are alike of a third kind

$= [(p + 1) (q + 1)(r + 1)....] – 1$

- Combination of selecting s_1 things from a set of n_1 objects and s_2 things from a set of n_2 objects where combination of s_1 things and s_2 things are independent is given by $^{n_1}C_{s1} \times {}^{n_2}C_{s2}$
- **Some results related to ^nC_r**
  1. $^nC_r = {}^nC_{n-r}$
  2. If $^nC_r = {}^nC_k$, then r = k or n-r = k
  3. $^nC_r + {}^nC_{r-1} = {}^{n+1}C_r$
  4. $^nC_r = n/r \; {}^{n-1}C_{r-1}$
  5. $^nC_r/{}^nC_{r-1} = (n-r+1)/ r$
  6. If n is even ^nC_r is greatest for r = n/2
  7. If n is odd, is greatest for r = (n-1) /2, (n+1)/2