r-combination of n-elements set is Permutation without regards of order!

$$\rightarrow \quad P(n,r) = C(n,r) \cdot \underbrace{r!}_{\text{number of same set, different order}}$$

$$\rightarrow \quad \boxed{C(n,r) = \frac{n!}{(n-r)!\, r!}} = \binom{n}{r}$$

Ex: How many 3-person comittee from 4 people:

$$C(4,3) = \frac{4!}{1! \cdot 3!} = 4$$

Ex: How many permutations of MISSISSIPPI ?

Sol:

1. 11 places for 1 M : $\binom{11}{1} = 11$
2. 10 places for 4 S : $\binom{10}{4} = 210$
3. 6 places for 4 I : $\binom{6}{4} = 15$
4. 2 places for 2 P : $\binom{2}{2} = 1$

$$\rightarrow \quad P = 11 \cdot 210 \cdot 15 \cdot 1 = 3300$$

Theorem: Suppose a collection of n objects

n_1 of type 1 are indistinguishable

n_2 ____ 2 ____

...

n_k ____ k ____

and $n_1 + n_2 + \dots + n_k = n$.

→ The number of distinguishable permutation :

$$\frac{n!}{n_1!\, n_2! \cdots n_k!} = \binom{n}{n_1}\binom{n-n_1}{n_2}\binom{n-n_1-n_2}{n_3}\cdots$$