TOPIC 1: Permutations

<u>Permutations</u> – determines the number of possible arrangements in a set when the order of the arrangement matters.

<u>Factorial Notation</u>- If n is a positive integer, n! (n factorial) is a product of all positive integers less than or equal to n.

Example: 3! = (3) (2) (1) = 6

Remember: 0! = 1

Permutation Formulas:

1. The number of permutations of objects taken all at a time in n! where n is the number of objects taken.

   Formula: P(n,n)= n!

   Example: How many possible ways can we arrange 5 students in a classroom for limited face to face classes.
   Solution: n=5
   P(n,n) = n!
   = 5!
   = (5) (4) (3) (2) (1)
   = **120 possible ways**

2. **Formula: P(n,r)=**$\frac{\boldsymbol{n}!}{(\boldsymbol{n}-\boldsymbol{r})!}$ where n is the number of object and r is the total number of object taken at a time.
   Example: There are 12 volleyball varsity players in a team, but only 6 can play the game inside the court. How many possible arrangements that the coach can do so that all the players can play the game?

Solution: n=12, r=6

$$\mathbf{P(n,r)}=\frac{\boldsymbol{n}!}{(\boldsymbol{n}-\boldsymbol{r})!}$$
$$=\frac{\mathbf{12}!}{(\mathbf{12}-\mathbf{6})!}$$
$$=\frac{\mathbf{12}!}{\mathbf{6}!}$$
$$=\frac{(\mathbf{12})(\mathbf{11})(\mathbf{10})(\mathbf{9})(\mathbf{8})(\mathbf{7})\cancel{\mathbf{6}!}}{\cancel{\mathbf{6}!}}$$
$$=(\mathbf{12})(\mathbf{11})(\mathbf{10})(\mathbf{9})(\mathbf{8})(\mathbf{7})$$
=**665,280 possible ways**

3. P=$\frac{n!}{p!\ q!\ r!}$

   Example: In how many distinguishable permutations are possible with the letters of the word “MISSISSIPPI”?

   Solution: In the MISSISSIPPI, there are 4 I’s, 4 S and 2 P’s.

   n= 11, p=4, q=4 and r=2

$$P=\frac{n!}{p!\ q!\ r!}$$
$$=\frac{11!}{4!\ 4!\ 2!}$$
$$=\frac{(11)(10)(9)(\cancel{8})(7)(\cancel{6})(5)\cancel{4!}}{(\cancel{4})(\cancel{3})(\cancel{2})(1)(\cancel{2})(1)\cancel{4!}}$$
=**34,650 ways**

4. Circular Permutation: P=(n-1)!

   Example: In a classroom, the class was divided into 5 groups with 7 members in each. The groups are asked to form a circle. How many possible ways can the 7 members of the team be arranged?

   Solution: n=7

P=(n-1)!
= (7-1)!
= 6!
= (6)(5)(4)(3)(2)(1)
= **720 possible ways**