PERMUTATIONS

Permutations are an off shoot of the Fundamental Counting Principle and specifically count the number of ways a certain task can be arranged or ordered.

Formally, an order of arrangements of *r* objects, without repetition, selected from *n* distinct objects is called a permutation of *n* objects taken *r* at a time, given by the equation:

$$_nP_r = \frac{n!}{(n-r)!}$$

The factorial symbol is the exclamation point, generally given as:

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

Again, it's important to note that when you need to count the number of ways you can arrange items where order is important, then a permutation can be used to count.

Concept Example:

The following problem introduces the concept reviewed within this module. Use this content as a primer for the subsequent material.

In a track meet, 15 men competed in time trials for 5 slots in the final. How many different ways could the top 5 slots be arranged if the order in which the men finished mattered.

Solution:

The first thing that must be done is to quickly recognize that this is a problem dealing with permutations. Recall that when you need to count the number of ways you can arrange items where order is important, then a permutation can be used to count.

The general equation for a permutation is:

$$_nP_r = \frac{n!}{(n-r)!}$$

So defining n and r, we find that:

n=15, which is the number of total items, or athletes in this case
r=5, which represents the number of open spots available

Plugging these values in to the equation:

$$_{15}P_5 = \frac{15!}{(15-5)!} = \frac{15!}{10!}$$
$$= \frac{15(14)\cdots(11)(10)(9)\cdots(2)(1)}{(10)(9)\cdots(2)(1)} = 360{,}360$$

There are 360,360 ways that 15 athletes can be arranged, without repetition, in 5 spot for the final.