Lesson 2: Factorial Notation and Permutations

GOAL:

- Represent the number of arrangements of n objects taken n at a time, using factorial notation.
- Determine the number of permutations of n objects taken n at a time.
- Determine the number of permutations of n objects taken r at a time.

An arrangement of a set of objects is called a **permutation**.

In a permutation, the order of the arrangement matters, like a combination to a lock or a pin number on a bank card.

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

Example 1

In how many ways can the letters in the word AMIGOS be re-arranged (or 'permuted')? Use the fundamental counting principle to determine your answer.

6 choices (letters)

$6 \times 5 \times 4 \times 3 \times 2 \times 1 = 720$ ways to arrange the letters AMIGOS

$6! = 6 \times 5 \times 4 \times 3 \times 2 \times 1$

$n!$

(n factorial

Fortunately, there is a more efficient way to enter this multiplication into a calculator. It's called Factorial Notation. In mathematics, the **factorial** of a non-negative integer n, denoted by $n!$ is the product of all positive integers less than or equal to n.

Using factorial notation, the product $6 \times 5 \times 4 \times 3 \times 2 \times 1$ can be represented by 6! (read as "six factorial"). Use the factorial key on your calculator to verify that $6! = 720$.

Note: on the graphing calculator, the factorial symbol can be accessed by pressing the MATH button and then using the cursor to select PRB; the factorial symbol is option 4.

In general, for any whole number n:

$$n! = n \times (n-1) \times (n-2) \times (n-3) \ldots \ldots 4 \times 3 \times 2 \times 1$$