We've already discussed random experiments with multiple stages. In such experiments, each stage has it's own sample space, or set possible outcomes.

The next question is: Does it matter what order the stages happen? This where the idea of permutations and combinations comes in. For both, we are talking about taking n things r at a time. What this means is that our sample size is n, and we are going to have r stages.

Example: We have a standard deck of 52 cards, and we are going to draw 5 cards from the deck. In this case, n is 52 and r is 5. Note that r is never larger than n.

Permutations

Order **does** matter!

In horse racing, "win" is 1st place, "place" is 2nd place, and "show" is 3rd place. So, if you bet on a particular horse to win, and he only shows, it matters to you because you won't win as much money. The same is true of any other type of race – including elections. It matters if a person is elected as President or Vice President. Each stage has an identified position of importance.

123 is different from 132 is different from 312 is different from …

Formula: $\frac{n!}{(n-r)!}$

Combinations

Order **does not** matter!

If you order a double-scoop ice cream cone, does it matter whether the chocolate is on the top or on the bottom? For most people, the answer is "no".

123 is the same as 132 is the same as 312 is the same as…

Formula: $\frac{n!}{(n-r)!\,r!}$

What is a factorial?

Factorial means you multiply together all positive integers less than or equal to the number you are taking the factorial of.

Example:

5! = 5 x 4 x 3 x 2 x 1