Section 9.1: Basic Combinatorics

* **Fundamental Counting Principle**: Figures out the number of outcomes in a probability problem given an event.
  * If there are x number of outcomes in event A & y number of outcomes in event B, then there are $x \cdot y$ outcomes when event A & B are combine.

ex: Making a pizza:

3 types of crust
2 types of cheese
5 choices of toppings

$3 \cdot 2 \cdot 5 = 30$ different types of pizzas can be made.

ex: Getting dressed:

1 Pair of shoes
3 Pairs of pants
6 shirts.

$1 \cdot 3 \cdot 6 = 18$ different outfits

* **Permutations**: ORDER IS IMPORTANT! Placing elements in a set in order.

ex: # of WAYS "SKYLINE" can be arranged.

$\underset{\uparrow}{7} \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 7!$

7 choices

$= 5040$ "words"

*Not all will make words!

ex: # of ways 10 runners can place 1st, 2nd, & 3rd.

$\underset{\uparrow}{10}_{1^{st}} \cdot \underset{\uparrow}{9}_{2^{nd}} \cdot \underset{\uparrow}{8}_{3^{rd}} = 720$ ways

10 choices, 9 choices, 8 choices

ex: # of ways MISSISSIPPI can be arranged.

4-I's
4-S's
2-P's
1-M

$\frac{11!}{4!\,4!\,2!\,1!} = 34{,}650$

**must ÷ by the # of repeats

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

n: # of objects, r: # at a time

10 runners → 1st, 2nd, 3rd

$_{10}P_3 = 720$

* Combinations: THINK GROUPS!

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

(n: # of objects; r: # taken at a time)

ex: Teacher sends 5 kids (group) to the library out of 30 kids.

$_{30}C_5$ → [30] [MATH] [PROB] [3:nCr] [5]

= 142,506 different groups

* Must be able to distinguish between Permutations & Combinations.

ex: Choosing to cook 3 potatoes (group!) out of a bag of 15.

$_{15}C_3 = 455$

ex: You need a new password that consists of 3 letters (capitalization is unimportant) and 3 numbers (0-9). How many passwords can be made if:

a) # & letters can not repeat.: $\frac{26}{L} \cdot \frac{25}{L} \cdot \frac{24}{L} \cdot \frac{10}{\#} \cdot \frac{9}{\#} \cdot \frac{8}{\#}$

= 11,232,000 (Lots Less!)

b) # and letters can repeat.

$\frac{26}{L} \cdot \frac{26}{L} \cdot \frac{26}{L} \cdot \frac{10}{\#} \cdot \frac{10}{\#} \cdot \frac{10}{\#} = 17,576,000$