8-6
Day 2

Permutations—A permutation of n different elements is an ordering where order DOES matter…ABD and BAD are different.

# of permutations on n elements
n! different ways they can be ordered

# of permutations of n elements taken r at a time

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

Ex 1) Eight horses are running a race. How many ways can the horses place out of 8 with no ties?

$8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$

$8! = 40{,}320$

Ex 2) Eight horses are running a race. In how many ways can these horses come in first, second, and third?

$8 \cdot 7 \cdot 6 = 336$

25) In how many distinguishable ways can the letters in BANANA be written?

$n = 6$ → total letters

$$\frac{n!}{} = \frac{6!}{3! \cdot 2!} = \frac{6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{3 \cdot 2 \cdot 1 \cdot 2 \cdot 1} = \frac{120}{2} = 60$$

Distinguishable Permutations

Suppose a set of n objects has n_1 of one kind of object and n_2 of a second kind, n_3 of a third kind, and so on….with $n = n_1 + n_2 + n_3 + \ldots + n_k$. The **distinguishable** permutations of the n objects is

$$\frac{n!}{n_1!n_2!n_3! \ldots n_k!}$$

Combinations—order is NOT important and ABC and CBA are considered the same.

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

Ex 3) In how many different ways can three letters be chosen from the letters A, B, C, D, and E? Order is not important.

$_5C_3 = 10$ ways

Ex 4) A standard poker hand consists of 5 cards dealt from a deck of 52. How many different poker hands are possible?

$_{52}C_5 = 2,598,960$

Ex 5) Reed is forming a 12-member synchro swim team from 10 girls and 15 boys. The team must consist of five girls and seven boys. How many different 12-member teams are possible?

Girls Boys

$_{10}C_5 \cdot {}_{15}C_7 =$

$252 \cdot 6435 = 1,621,620$