Permutations/Combinations

- Fundamental Counting Principle (FCP) → Event A occurs a ways & Event B occurs b ways, then total # of outcomes is $a \cdot b$

EX → Mr. Higgins has 8 dress shirts, 10 ties, & 6 pairs of dress pants. How many outfits can be made?

$$8 \cdot 10 \cdot 6 = 480$$

EX → Sandwich shop offers 3 types of bread, 5 meats, 5 cheeses, 7 sauces, & 6 toppings. How many sandwiches can be made if 1 of each category must be chosen?

$$3 \cdot 5 \cdot 5 \cdot 7 \cdot 6 = \underline{3150}$$

- Factorial → !
  - ↳ multiply by all whole #s below the #
  - ↳ $0! = 1$

EX → $6! = 6\cdot5\cdot4\cdot3\cdot2\cdot1 = 720$

- Permutations → # of possibilities where order DOES matter

$${}_nP_r = \frac{n!}{(n-r)!}$$ (n items chosen r at a time)

EX → 12 people are in a race. How many ways can people finish 1st, 2nd, 3rd?

$${}_{12}P_3 = \frac{12!}{(12-3)!} = \frac{12!}{9!} = \frac{12\cdot11\cdot10\cdot\cancel{9}\cdot\cancel{8}\cdot\cancel{7}\cdot\cancel{6}\cdot\cancel{5}\cdot\cancel{4}\cdot\cancel{3}\cdot\cancel{2}\cdot\cancel{1}}{\cancel{9}\cdot\cancel{8}\cdot\cancel{7}\cdot\cancel{6}\cdot\cancel{5}\cdot\cancel{4}\cdot\cancel{3}\cdot\cancel{2}\cdot\cancel{1}} = 12\cdot11\cdot10 = 1320$$

$$\underset{1st}{\underline{12}} \cdot \underset{2nd}{\underline{11}} \cdot \underset{3rd}{\underline{10}} = 1320$$

- Combinations → # of possibilities where order **DOES NOT** matter

$$ {}_{n}C_{r} = \frac{n!}{r!\,(n-r)!} $$

(n items chosen r at a time)

EX → 5 people are eligible for a 3-person committee. How many ways can the committee be chosen?

$$ {}_{5}C_{3} = \frac{5!}{3!\,(5-3)!} = \frac{5\cdot 4\cdot \cancel{3\cdot 2\cdot 1}}{(\cancel{3\cdot 2\cdot 1})(2\cdot 1)} = \frac{20}{2} = 10 $$

EX → 10 movies to be picked from. 7 movies will be seen. How many possibilities are available for movie marathon?

$$ {}_{10}C_{7} = \frac{10!}{7!\,(10-7)!} = \frac{10\cdot 9\cdot 8\cdot \cancel{7\cdot 6\cdot 5\cdot 4\cdot 3\cdot 2\cdot 1}}{(\cancel{7\cdot 6\cdot 5\cdot 4\cdot 3\cdot 2\cdot 1})(3\cdot 2\cdot 1)} = \frac{720}{6} = 120 $$

HW: p. 841 → 10 - 28 even