

# 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?

$$8 \cdot 10 \cdot 6 = \underline{480}$$

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  $\rightarrow$  !

$\hookrightarrow$  multiply by all whole #s below the #

$$\hookrightarrow 0! = 1$$

$$\underline{\text{EX}} \rightarrow 6! = 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 720$$

$$\underline{\text{EX}} \rightarrow 4! = 4 \cdot 3 \cdot 2 \cdot 1 = 24$$

- Permutations  $\rightarrow$  # of possibilities where order DOES matter

$${}_n P_r = \frac{n!}{(n-r)!} \quad (n \text{ items chosen } r \text{ at a time})$$

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

$${}_{12} P_3 = \frac{12!}{9!} = \frac{12 \cdot 11 \cdot 10 \cdot \cancel{9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}}{\cancel{9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}} = 12 \cdot 11 \cdot 10 = \underline{1320}$$

$$\frac{12}{1^{\text{st}}} \cdot \frac{11}{2^{\text{nd}}} \cdot \frac{10}{3^{\text{rd}}}$$

5 ppl  
P, VP, VP  
5 · 4

- Combinations  $\rightarrow$  # of possibilities where order DOES NOT matter

$${}^n C_r = \frac{n!}{r!(n-r)!} \quad (n \text{ items chosen } r \text{ at a time})$$

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

$${}^5 C_3 = \frac{5!}{3!2!} = \frac{5 \cdot 4 \cdot \cancel{3 \cdot 2 \cdot 1}}{(\cancel{3 \cdot 2 \cdot 1})(2 \cdot 1)} = \frac{20}{2} = \underline{10}$$

Susie Ted Jo Tom Tim  
5 4 3 — —  
Ted Jo Susie Jo Ted Susie  
Susie Jo Ted Jo Susie Ted  
Ted Susie Jo

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

$${}^{10} C_7 = \frac{10!}{7!3!} = \frac{10 \cdot 9 \cdot 8}{3 \cdot 2 \cdot 1} = \frac{720}{6} = \underline{120}$$

HW: p. 841 → 10-24 (omit 20)

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