11.5 Counting Principles

Addition Principle

m ways to do A, n ways to do B, cannot do both at the same time. Then there are m + n ways to choose one of the actions.

E.g. 3 desktops, 2 laptops ⇒ 5 options

Multiplication Principle

m ways to do A. n ways to do B.

Then there are m × n ways to do both.

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E.g. 3 different shirts, 4 different pants.

How many possible outfits to choose from? 12

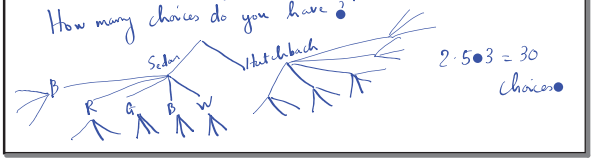
E.g. Buy new car

2 body styles: sedan, hatchback

5 colors: B, R, G, B, W

3 models: GL (Standard), SS (Sport), SL (Luxury)

How many choices do you have?



2 · 5 · 3 = 30 choices

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Remark: Independent and Dependent.

MP. It only works when all choices are independent of one another.

If one choice affects another choice, then a single result is not correct.

E.g. You can only choose R for hatchback

15 + 3 = 18

Combinations and Permutations

When order doesn't matter ⇒ combination

When order does matter ⇒ permutation.

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Permutations: 2 types of permutation.

- Repetition is allowed.
- Repetition is not allowed

Permutation with repetition.

E.g. choices of 3-symbol code for a safe. Each symbol could be a letter, or a digit from 0 to 9. How many possible ways are there to form those codes.

36 × 36 × 36

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Formula (permutation with repetition)

If n is the # of things to choose from and we choose r of them (Repetition is allowed, order matters), then there are

$$n^r$$ choices

Permutation w/o repetition.

E.g. At a swimming competition, 9 swimmers compete.

How many ways can all 9 swimmers line up for a picture?

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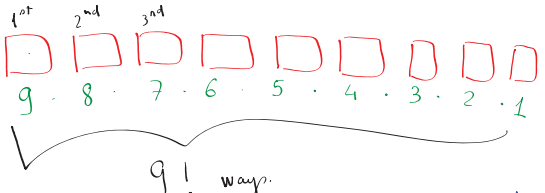

9! ways.

How many ways can they place first, second, & third?

$$\frac{9 \cdot 8 \cdot 7 \cdot 6!}{6!} = \frac{9!}{6!}$$

Formula: n is the # of things to choose from and we choose r of them (repetition is not allowed, order matters)

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