Chapter 12
Probability

12.1 Sample Spaces and Probability

12.2 Independent and Dependent Events

12.3 Two-Way Tables and Probability

12.4 Probability of Disjoint and Overlapping Events

12.5 Permutations and Combinations

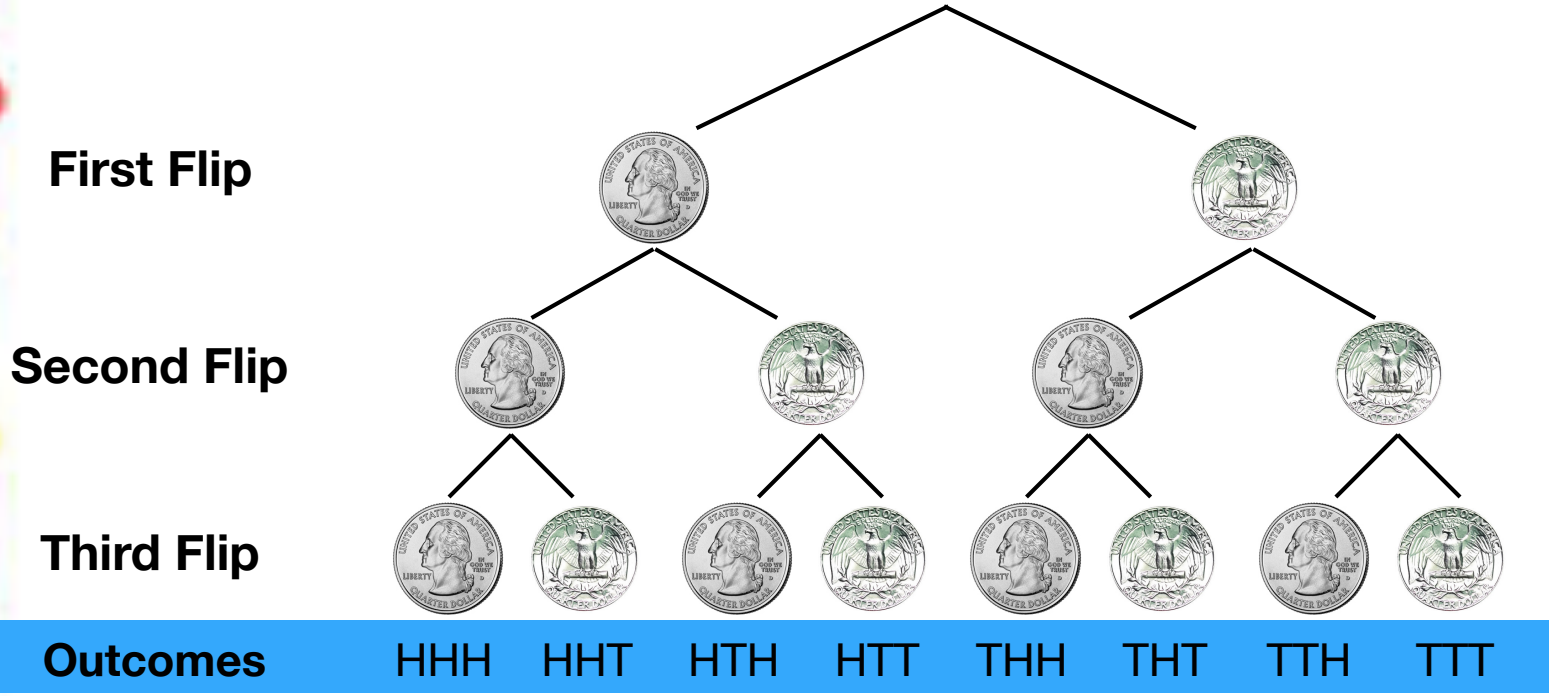
12.6 Binomial Distributions

12.5 Permutations and Combinations

Fundamental Counting Principal

- **Definition** - A way to determine the number of outcomes in your sample space.

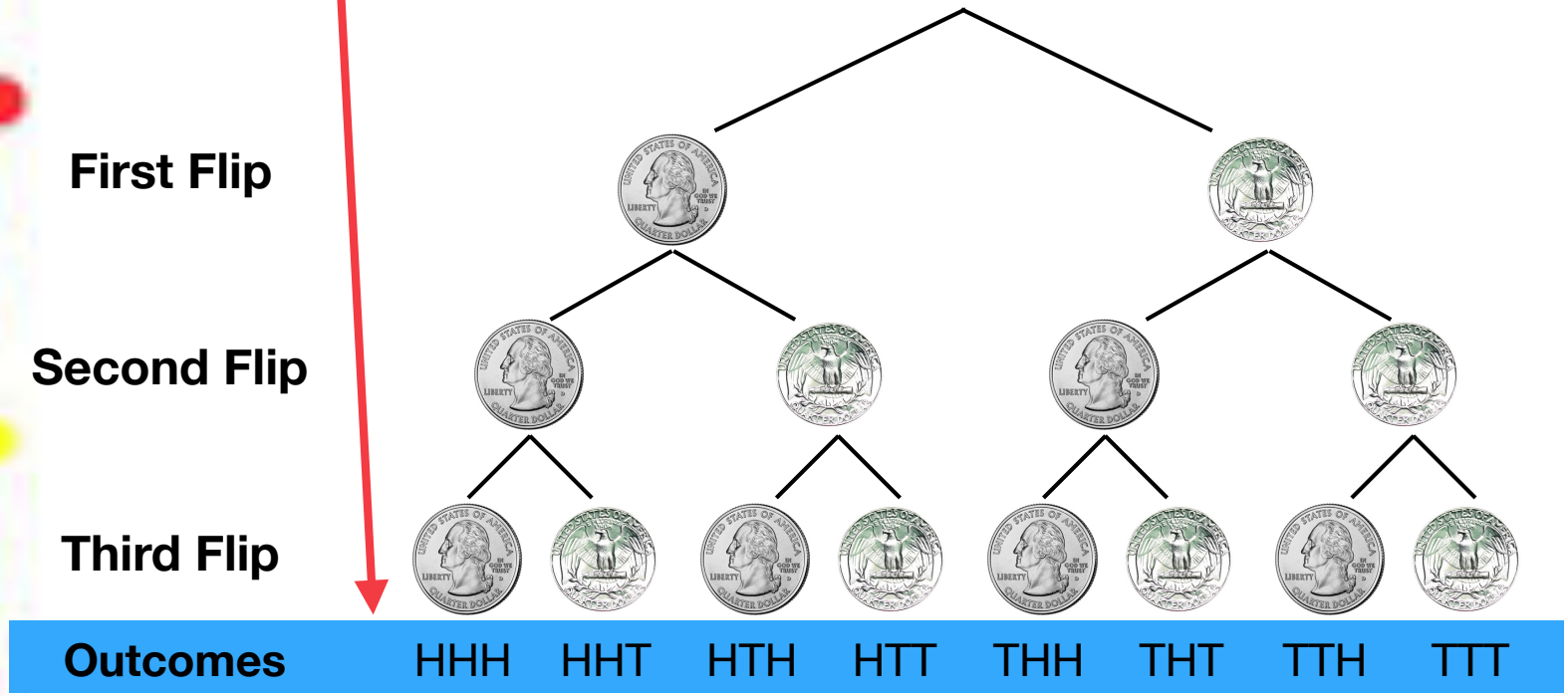
Tree Example: Flipping a quarter three times.



12.5 Permutations and Combinations

Permutations

- **Definition** - An arrangement of objects in which order is important.



12.5 Permutations and Combinations

Permutations

- **Definition** - An arrangement of objects in which order is important.

Example 1: The permutations of the letters in the word JULY.

$$\text{Number of Permutations} = (\text{Choices for 1st letter})(\text{Choices for 2nd letter})(\text{Choices for 3rd letter})(\text{Choices for 4th letter})$$

$$= (4)(3)(2)(1)$$

$$= 24$$

12.5 Permutations and Combinations

Permutations

- **Definition** - An arrangement of objects in which order is important.

Example 2: The permutations of 2 of the letters in the word JULY.

$$\text{Number of Permutations} = (\text{Choices for 1st letter})(\text{Choices for 2nd letter})$$

$$= (4)(3)$$

$$= 12$$

12.5 Permutations and Combinations

Factorial

- **Definition** - The product of the integers from 1 to n. (Only positive integers)

$$n! = n \cdot (n-1) \cdot (n-2) \cdot \ldots \cdot 3 \cdot 2 \cdot 1$$

Special case: $0! = 1$

Example: $4! = 4 \cdot 3 \cdot 2 \cdot 1 = 24$

12.5 Permutations and Combinations

Permutations Formulas

1. The number of permutations of n objects is given by:

$$_nP_n = n!$$

Example 1: The permutations of the letters in the word JULY.

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2. The number of permutations of n objects taken r at a time, where $r \leq n$, is given by:

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

Example 2: The permutations of 2 of the letters in the word JULY.

12.5 Permutations and Combinations

Calculating Permutations

Example: Ten horses are running in a race. In how many ways can the horses finish first, second, and third? (Assume no ties.)

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

12.5 Permutations and Combinations

Calculating Permutations

Problem 1: There are 12 school floats in a parade. In how many ways can the floats be ordered in the parade?

Problem 2: The floats will be judged and the 1st, 2nd, 3rd, and 4th place finishers will be given prizes. How many ways can the floats place?

Problem 3: Suppose your float represents the math club and your friend's float represents the swim club. What is the probability that your float will take 1st place in the parade and your friend's float takes 2nd?

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

12.5 Permutations and Combinations

Combinations

- **Definition** - An arrangement of objects in which order is NOT important.

Example 1: The combinations of 2 letters in the word JULY.

Example 2: The combinations of all the letters in the word JULY.

12.5 Permutations and Combinations

Combinations Formula

The number of combinations of n objects taken r at a time, where $r \leq n$, is given by:

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

Example 1: The combinations of 2 letters in the word JULY.

Example 2: The combinations of all the letters in the word JULY.

12.5 Permutations and Combinations

Calculating Combinations

Example: You order a sandwich at a restaurant. You can choose 2 side dishes from a list of 8. How many combinations of side dishes are possible?

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