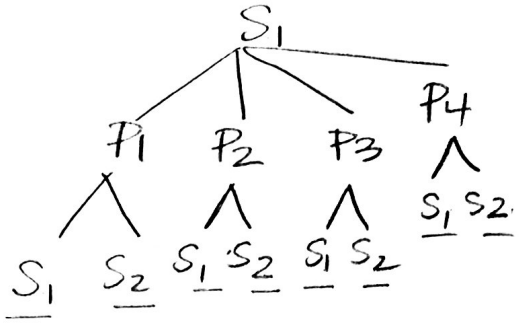
AFM Notes, Unit 1 - Probability
1-1 FPC and Permutations

Name Brooks
Date 1-30 Period 2

The Fundamental Principle of Counting

How many different outfits could you put together using two sweaters, four pairs of pants, and two pairs of shoes?

$\underset{SW}{2} \cdot \underset{P}{4} \cdot \underset{Sh}{2} = 16$



The **Fundamental Principle of Counting** says: Suppose there are "a" ways of choosing one item, and "b" ways of choosing a second item, and "c" ways of choosing a third item, and so on. Then the total number of possible outcomes is a · b · c.

The probability of an event is: P(Event) = $\frac{\#\text{ of ways event can happen}}{\text{total \# of possible outcomes}}$

Ex 1) Suppose a license plate can have any three letters (26) followed by any four digits. (10) 0-9

a) How many different license plates are possible?

$\underset{L}{26} \cdot \underset{L}{26} \cdot \underset{L}{26} \cdot \underset{D}{10} \cdot \underset{D}{10} \cdot \underset{D}{10} \cdot \underset{D}{10} = 26^3 \cdot 10^4 =$ 175,760,000

b) How many license plates are possible that have no repeated letters or digits?

$\underset{L}{26} \cdot \underset{L}{25} \cdot \underset{L}{24} \cdot \underset{D}{10} \cdot \underset{D}{9} \cdot \underset{D}{8} \cdot \underset{D}{7} =$ 78,624,000

c) What is the **probability** that a randomly selected license plate has no repeated letters or digits?

$P(\text{plate w/no repitition}) = \frac{78,624,000}{175,760,000} = 0.447 = 44.7\%$

Permutations

Ex. 2) I have five books I want to arrange (in a particular order) on a shelf.

a) How many different ways can I arrange them?

$5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 120$ $\quad {}_5P_5$

b) What if I only want to arrange 3 of my 5 books on a shelf? How many ways can I do this?

$5 \cdot 4 \cdot 3 = 60$ $\quad {}_5P_3$

Whenever you want to know how many ways there are of arranging (in order) some number of items, that's called a Permutation.

With Permutations
ORDER
MATTERS

P (n, r) — n: # of items; r: # of spots to fill

Math → PROB → #2 $\quad {}_nP_r$

Ex 3: Seven flute players are performing in an ensemble.

a) The names of all seven players are listed in the program in random order. How many different ways could the players' names be listed (i.e., **arranged**) in the program?

$7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 5040$ $\quad {}_7P_7$

b) How many different ways could the players' names be listed in alphabetical order by last name?

1 way

c) If the players' names are listed in the program in random order, what is the **probability** that the names happen to be in alphabetical order?

$$P(\text{names in alpha order}) = \frac{1}{5040} = 1.98 \times 10^{-4} = 0.000198 = 0.0198\%$$

d) After the performance, the players are backstage. There is a bench with only room for four to sit. How many possible **arrangements** are there for four of the seven players to sit on the bench?

$7 \cdot 6 \cdot 5 \cdot 4 = 840$ $\quad {}_7P_4$