Chapter 11: Probability

*** This Entire Worksheet was Covered in Class Tues. 11/10/09 ***
Introduction & Section 11.1 "FCP"

Probability Theory: mathematics of uncertainty and risk

"What is the likelihood an event will occur?"

History: games of chance (tossing bones), ~ 40,000 years ago; dice have been found in ancient Greek and Egyptian tombs; oldest dice found 3,000 BC; modern dice (top + bottom sum = 7) since 1400 BC.

Girolamo Cardano (1501 - 1576): wrote the first theoretical study of probabilities and gambling, Books on Games of Chance (1545), as a gambler's manual.
<table>
<thead>
<tr>
<th>Real birth of probability: 17th century</th>
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<tbody>
<tr>
<td><strong>Blaise Pascal</strong> (1623 -1662) and <strong>Pierre de Fermat</strong> (1601 -1665) developed 1st theory of probability in 1654.</td>
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<td><strong>Jacob Bernouli</strong> (1654 - 1705): founder of probability theory, wrote <em>Art of Guessing</em> (1713) which focused on gambling, but suggested applications in government, economics, law, and genetics. He fused pure math with empirical methods used in statistical experiments. Bernouli's theorem is called the &quot;law of large numbers&quot;.</td>
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<td><strong>Pierre Simon de Laplace</strong> (1749 - 1827): &quot;Father of Probability Theory&quot;, 1st applied probability theory to non-gambling matters in 1812. He showed its usefulness in interpreting scientific data.</td>
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**Section 11.1: The Fundamental Counting Principle**

(Objective 1)

**Counting Methods:** determine the number of possible outcomes in a given situation.

- **FCP**
- Tree Diagrams
- Factorials
- Product Tables
- Permutations
- Combinations

**Fundamental Counting Principle**

If the 1\textsuperscript{st} task has M options and 2\textsuperscript{nd} task has N options, then the sequence of tasks has M\(\times\)N options.

\[
4 \times \frac{5}{\text{Shirts}} \times \frac{8}{\text{Pants}} = 160
\]

ex. Find the number of possible ways to print a flyer if there are 3 options for the paper color (yellow, red, green) and 2 options for the font (bold, italic).

\[
\frac{3}{\text{P}} \times \frac{2}{\text{F}} = 6
\]

A **tree diagram** lists the outcomes. FCP just tells the number of possible outcomes.
ex. At Slim Pickins Restaurant, the light lunch special consists of a choice of one of 3 salads and one of 5 types of fruit. In how many ways can a person order a light lunch special?

**EASY!**

ex. At Untrust Bank, each employee has a 3-digit PIN for a xerox card. How many codes are possible?

\[
\frac{10 \times 10 \times 10}{1^{st} \quad 2^{nd} \quad 3^{rd}} = 1000
\]

What if the 1^{st} digit cannot be 0 or 1?

\[
\frac{8 \times 10 \times 10}{1^{st} \quad 2^{nd} \quad 3^{rd}} = 800
\]
ex. How many 3-digit numbers are in our counting system?
\[ \frac{9}{1^{st}} \times \frac{10}{2^{nd}} \times \frac{10}{3^{rd}} = 900 \]

ex. License plates in a particular state display 3 letters followed by 2 numbers. How many different license plates can be manufactured for this state?
\[ \frac{26}{L_1} \times \frac{26}{L_2} \times \frac{26}{L_3} \times \frac{10}{n_1} \times \frac{10}{n_2} = 26^3 \times 100 = 1,757,600 \]

Hw. #14: A car model comes in 9 colors, with or without air conditioning, with or without sun roof, with or without automatic transmission, and with or without antilock brakes. In how many ways can the car be ordered with regard to these options?
\[ \frac{9}{C} \times \frac{2}{ac} \times \frac{2}{sr} \times \frac{2}{t} \times \frac{2}{b} = 144 \]
Hw. #17: In the original plan for area codes in 1945, the 1st digit could be any number from 2 through 9, the 2nd digit was either 0 or 1, and the 3rd digit could be any number except 0. With this plan, how many different area codes are possible?

\[
\frac{8}{1^{\text{st}}} \times \frac{2}{2^{\text{nd}}} \times \frac{9}{3^{\text{rd}}} = 144
\]

Text ex. 6: Telephone numbers in the U.S. begin with three-digit area codes followed by seven-digit local telephone numbers. Area codes and local phone numbers cannot begin with 0 or 1. How many different telephone numbers are possible?

\[
\frac{8 \cdot 10 \cdot 10 - 8 \cdot 10 \cdot 10 - 10 \cdot 10 \cdot 10}{10 \cdot 10 \cdot 10} = \frac{6,400,000,000}{100,000} = 64,000,000
\]

See text ex. 1 - 6.