Math 1313  Section 5.3

Section 5.3 Generalized Multiplication Principle

Suppose a task $T_1$ can be performed in $N_1$ ways, a task $T_2$ can be performed in $N_2$ ways,..., and finally a task $T_n$ can be performed in $N_n$ ways. Then the number of ways of performing the tasks $T_1, T_2, \ldots, T_n$ in succession is given by the product $N_1 \cdot N_2 \ldots N_n$.

Example 1: A coin is tossed 3 times, and the sequence of heads and tails is recorded.

a. Determine the number of outcomes of this activity.

\[ 2 \cdot 2 \cdot 2 = 2^3 = 8 \]  2 tosses

b. List the outcomes of this experiment by first drawing a tree diagram.

Example 2: The Burger Bar offers the following items on its menu:

<table>
<thead>
<tr>
<th>Burger</th>
<th>Sides</th>
<th>Beverages</th>
<th>Desserts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Meat</td>
<td>Fries</td>
<td>Tea</td>
<td>Cheesecake</td>
</tr>
<tr>
<td>Double Meat</td>
<td>Onion Rings</td>
<td>Coffee</td>
<td>Brownie</td>
</tr>
<tr>
<td></td>
<td>Fruit Bowl</td>
<td>Soda</td>
<td>Cookie</td>
</tr>
<tr>
<td></td>
<td>Cheddar Peppers</td>
<td>Ice Cream Cone</td>
<td></td>
</tr>
</tbody>
</table>

If a customer chooses 1 item from each category, how many meals can be made? List 1 meal possible.

2 \cdot 4 \cdot 3 \cdot 4 = 96

Single Meat, Onion Rings, Tea, Cookie
Example 3: An identification number for employees at a certain company contains six digits. How many ID numbers are possible if repetition is allowed?

\[
\begin{array}{cccccc}
10 & 10 & 10 & 10 & 10 & 10 \\
0-9 & 0-9 & 0-9 & 0-9 & 0-9 & 0-9 \\
\end{array}
= 10^6
= 1,000,000
\]

Example 4: A license plate consists of 2 letters followed by 4 digits. How many license plates are possible if the first letter can't be O, the first digit can't be 0 and no repetitions are allowed?

\[
\begin{array}{cccc}
25 & 25 & 9 & 9 \\
\text{Not} & \text{can not} & \text{can not} & \text{can not} \\
\text{an} & \text{be a} & 1-9 & 1-9 \\
\text{O'} & \text{repeat} & \text{only} & \text{repeat} \\
\end{array}
= 2,835,000
\]

Example 5: In the original plan for area codes in 1945, the first digit could be any number from 2 through 9, the second digit was either 0 or 1, and the third digit could be any number except 0. With this plan, how many different area codes were possible?

\[
\begin{array}{c}
8 \\
2-9 \\
\end{array}
\begin{array}{c}
2 \\
0 or 1 \\
\end{array}
\begin{array}{c}
9 \\
1-9 \\
\end{array}
= 144
\]

Example 6: Six performers are to present their comedy acts on a weekend evening at a comedy club. One of the performers insists on being the last stand-up comic of the evening. If this performer’s request is granted, how many different ways are there to schedule the appearances?

\[
\begin{array}{c}
5 \\
\end{array}
\begin{array}{c}
4 \\
\end{array}
\begin{array}{c}
3 \\
\end{array}
\begin{array}{c}
2 \\
\end{array}
\begin{array}{c}
1 \\
\text{Granted} \\
\text{Request} \\
\end{array}
= 120
\]

Example 7: The call letters for radio station begin with K or W, followed by 3 additional letters. How many sets of call letters having 4 letters are possible? Repetition is allowed.

\[
\begin{array}{c}
2 \\
\text{K or W} \\
\end{array}
\begin{array}{c}
26 \\
26 \\
26 \\
\end{array}
= 35,152
\]