Simple Sample Spaces...Tree Diagrams

- **Outcome** — a particular result of an experiment
- **Sample Points** — individual outcomes of the sample space.
- **Event** — any subset of the sample space.

**Sample Space:**
The set of all possible outcomes. Outcomes cannot overlap. All outcomes must be represented. Can find by:
1. A List
2. A Tree Diagram
3. Lattice Grid

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**Example**

- List the sample space for drawing one card from a deck of cards.

- **Answer.** 52 Outcomes

<table>
<thead>
<tr>
<th>Clubs</th>
<th>Diamonds</th>
<th>Hearts</th>
<th>Spades</th>
</tr>
</thead>
<tbody>
<tr>
<td>2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A</td>
<td>2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A</td>
<td>2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A</td>
<td>2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A</td>
</tr>
</tbody>
</table>

**Example...**

- Find the sample space for rolling 2 dice.

<table>
<thead>
<tr>
<th>Die 1</th>
<th>Die 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 1</td>
<td>1, 2</td>
</tr>
<tr>
<td>2, 1</td>
<td>2, 2</td>
</tr>
<tr>
<td>3, 1</td>
<td>3, 2</td>
</tr>
<tr>
<td>4, 1</td>
<td>4, 2</td>
</tr>
<tr>
<td>5, 1</td>
<td>5, 2</td>
</tr>
<tr>
<td>6, 1</td>
<td>6, 2</td>
</tr>
</tbody>
</table>

**Example.....**

- Find the sample space for the gender of children if a family has 3 children.

- See if you can list all of the possibilities.

**Answer.....**

BBB, BBG, BGB, GBB, GGG, GGB, GBG, BGG

8 Outcomes
Tree Diagrams……

- Tree Diagram – a device used to list all possibilities in a systematic way.
- Each branch lists the choices.
- Let’s do a tree diagram of the previous example with the gender of 3 children. Remember, we had 8 outcomes.

Example……

- Display the sample space using a tree diagram if a coin is tossed and a die is rolled.

You Try……

- Draw a tree diagram if you toss one coin and spin a 4 section spinner.
Example……

- A lunch menu has a choice of the following (one from each category)
  - Meat: Hamburger, Hot Dog, Chicken
  - Starch: French Fries, Baked Potato
  - Drink: Coke, Tea
- List all of the possible combinations.

Answer……12 Outcomes

Example……

- Sue and Tom play in a tournament. The 1st person to win 2 out of 3 games is the winner. Find all the possible outcomes.

Answer……6 Outcomes

Independent Event……

- Two events A and B are independent events if the fact that A occurs does NOT affect the probability of B occurring.
- Example:
  - a. Roll a die and get a 6; then roll a 2nd die and get a 3.
  - b. Draw a queen from a deck of cards, replace it and draw another queen.
Identify the following as independent or dependent events……

1. Being a female and having brown hair  [1. Independent]
2. Completing the homework and getting a 100 for a HW grade  [2. Dependent]

Multiplication Rule……

When 2 events are independent, multiply the # of possibilities in each category to get the total # of possibilities.

Example……

Find the number of items in the sample space of a license plate containing 3 letters and 3 numbers (digits) that can be repeated.

Answer……

$$26 \cdot 26 \cdot 26 \cdot 10 \cdot 10 \cdot 10 = 17,576,000$$

Example……

Find the number of items in the sample space of a license plate containing 3 letters and 3 numbers (digits) that can NOT be repeated.

Answer…..

$$26 \cdot 25 \cdot 24 \cdot 10 \cdot 9 \cdot 8 = 11232000$$
Example……
- How many ways can a nurse visit 4 places.

Answer……24

\[ 4 \cdot 3 \cdot 2 \cdot 1 = 24 \]

Example……
- Find the number of items in the sample space of a 5 digit I.D. tag if the numbers
  a. Can be repeated
  b. Can NOT be repeated.

Can Be Repeated:
\[ 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 = 100000 \]

Can NOT be repeated:
\[ 10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 = 30240 \]

Answer……
- Can NOT be repeated:

Example……
- How many ways can someone read 5 books?
Example......

- How many outcomes are in the sample space if a person selects 3 items from a jar with 6 items

- A. With Replacement
- B. Without Replacement

Answer......

- With Replacement:
  \[ 6 \cdot 6 \cdot 6 = 216 \]

- Without Replacement:
  \[ 6 \cdot 5 \cdot 4 = 120 \]