COUNTING + PERMUTATIONS

- "Outcomes" are the results of a particular event. These are sometimes "choices."
- We can use systematic listing, two-way table, or tree diagram.

"Sample space" is a list of all possible outcomes.

By what is the sample space of flipping a coin and rolling a die?

<table>
<thead>
<tr>
<th>Systematic Listing</th>
<th>Two-Way Table</th>
<th>Tree Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>H1</td>
<td>HKE</td>
</tr>
<tr>
<td>H2</td>
<td>H2 H3</td>
<td>2</td>
</tr>
<tr>
<td>H3</td>
<td>H4 H5 H6</td>
<td>3</td>
</tr>
<tr>
<td>H4</td>
<td>T1</td>
<td>4</td>
</tr>
<tr>
<td>H5</td>
<td>T2 T3</td>
<td>5</td>
</tr>
<tr>
<td>H6</td>
<td>T4 T5 T6</td>
<td>6</td>
</tr>
<tr>
<td>T1</td>
<td>T1 T2 T3 T4</td>
<td></td>
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<tr>
<td>T2</td>
<td>T1 T2 T3 T4</td>
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<td>T3</td>
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<tr>
<td>T6</td>
<td>T1 T2 T3 T4</td>
<td></td>
</tr>
</tbody>
</table>
FUNDAMENTAL PRINCIPLE OF COUNTING

IF ONE EVENT HAS \( m \) POSSIBLE OUTCOMES AND
A SECOND EVENT HAS \( n \) POSSIBLE OUTCOMES, THEN
THE TOTAL NUMBER OF POSSIBLE OUTCOMES IS \( m \times n \)

YOU CAN BE ASKED TO STATE THIS. YOU
EITHER HAVE TO LEARN IT OFF OR BE ABLE
TO EXPLAIN IT IN YOUR OWN WAY/WORDS.

ii. TO CALCULATE THE NUMBER OF OUTCOMES
OF 2 OR MORE EVENTS, WE MULTIPLY
THE NUMBER OF OUTCOMES OF EACH EVENT
TOGETHER...

E.g., IN A RESTAURANT, THERE ARE 3 STARTERS
4 MAINS
2 DESSERTS.

THE NUMBER OF DIFFERENT MEALS THAT CAN
BE ORDERED IS:

\[
\text{STARTERS} \times \text{MAINs} \times \text{DESSERTs} = 24.
\]
Eq 1) How many ways can the letters of the word "MATHS" be arranged?

Answer:
There are 5 letters

\[
\begin{array}{ccccc}
1^\text{st} & 2^\text{nd} & 3^\text{rd} & 4^\text{th} & 5^\text{th} \\
5 & 4 & 3 & 2 & 1 \\
\end{array}
\]

= 5! = 120

Eq 2) How many ways can the same letters be arranged if the arrangements must begin with "H"?

Put this in first... there is only one way that the 1st box can be filled...

Then, once the H is taken, there are only 4 letters left to choose from, so...(and so on...)

\[
\begin{array}{ccccc}
1^\text{st} & 2^\text{nd} & 3^\text{rd} & 4^\text{th} & 5^\text{th} \\
1 & 4 & 3 & 2 & 1 \\
\end{array}
\]

= 24
PERMUTATIONS — THIS IS THE SAME AS ARRANGEMENTS, except we don’t have to use all the letters/things being arranged.

Example: Six greyhounds (A, B, C, D, E, F) enter a race. How many different ways can the first 3 places be filled?

\[
\begin{array}{c}
1^\text{st} \\
2^\text{nd} \\
3^\text{rd}
\end{array}
\begin{array}{c}
6 \\
5 \\
4
\end{array} = 120
\]

Note: There is a way to do this on your calculator, it is called \( nPr \).

The example above would be \( 6P3 = 120 \).

You don’t have to use this method to solve this type of problem.