Permutations and Combinations: Takeaways

Concepts

- If we have an experiment E_1 (like flipping a coin) with **a** outcomes, followed by an experiment E_2 (like rolling a die) with **b** outcomes, then the total number of outcomes for the composite experiment E_1E_2 can be found by multiplying **a** with **b** (this is known as the **rule of product**):

$$\text{Number of outcomes} = a \times b$$

- If we have an experiment E_1 with **a** outcomes, followed by an experiment E_2 with **b** outcomes, followed by an experiment E_n with **z** outcomes, the total number of outcomes for the composite experiment $E_1E_2 \ldots E_n$ can be found by multiplying their individual outcomes:

$$\text{Number of outcomes} = a \times b \times \ldots \times z$$

- There are two kinds of arrangements:
  - Arrangements where the order matters, which we call **permutations**.
  - Arrangements where the order doesn't matter, which we call **combinations**.
- To find the number of permutations when we're sampling with replacement, we can use the formula:

$$Permutation = n!$$

- To find the number of permutations when we're sampling without replacement and taking only **k** objects from a group of **n** objects, we can use the formula:

$$_nP_k = \frac{n!}{(n-k)!}$$

- To find the number of combinations when we're sampling without replacement and taking only **k** objects from a group of **n** objects, we can use the formula:

\begin{equation} _nC_k = {n \choose k} = \frac{n!}{k!(n-k)!} \end{equation}

Resources

- A tutorial on calculating combinations when sampling with replacement, which we haven't covered in this mission
- An easy-to-digest introduction to permutations and combinations