

# Permutations and Combinations: Takeaways



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## 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**):

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

- 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  $E_1E_2 \dots E_n$  can be found by multiplying their individual outcomes:

$$\text{Number of outcomes} = a \cdot b \cdot \dots \cdot z$$

- 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 without replacement, we can use the formula:

$$\text{Permutation} = n!$$

- 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:

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

## Resources

- [A tutorial on calculating combinations when sampling with replacement](#), which we haven't covered in this lesson
- [An easy-to-digest introduction to permutations and combinations](#)