Table of Contents

# 2.7 Sampling Distributions & Counting

## Sampling distributions

The **sampling distribution** of a statistic is the probability distribution of that statistic across many random samples from the same population. For example, the sampling distribution of the sample mean approaches normality as sample size increases (Central Limit Theorem). Sampling distributions allow us to compute standard errors and conduct inference.

## Counting techniques

Counting principles are fundamental to probability calculations when enumerating sample spaces.

* **Fundamental counting principle** – If there are m ways to perform one task and n ways to perform another, there are m × n ways to perform both.
* **Permutation** – An ordered arrangement of items. The number of ways to arrange k items chosen from n is P(n,k) = n!/(n-k)!.
* **Combination** – An unordered selection of items. The number of ways to choose k items from n without regard to order is C(n,k) = n!/[k!(n-k)!].

## Example

* **Sampling distribution** – Consider repeatedly sampling 30 students’ heights and computing the mean each time. The distribution of these sample means will be approximately normal.
* **Counting** – The number of ways to choose 3 committee members from 10 candidates is C(10,3) = 120; the number of ways to arrange 3 of the 10 candidates in order is P(10,3) = 720.

## Summary

Sampling distributions underpin inferential statistics by describing how sample statistics vary across samples. Counting techniques provide tools to enumerate possible outcomes and compute probabilities.

## Reflection questions

1. Why is the sampling distribution of the mean important in statistics?
2. Differentiate between permutations and combinations with examples.
3. How does the fundamental counting principle simplify probability calculations?

## References