

# Statistics and Data Analysis

## Unit 03 – Lecture 05: ANOVA (One-Way) and Post-hoc Intuition

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<https://github.com/tali7c/Statistics-and-Data-Analysis>

# Quick Links

Overview

ANOVA Concept

Assumptions

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Summary

# Agenda

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- 2 ANOVA Concept
- 3 Assumptions
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- 5 Demo
- 6 Summary

# Learning Outcomes

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- Describe between-group vs within-group variation
- Interpret F statistic at a high level
- State main assumptions of one-way ANOVA
- Explain what a post-hoc test is



# ANOVA Concept: Key Points

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- Avoids inflating Type I error vs many t-tests
- If significant, follow with post-hoc

# ANOVA Concept: Key Formula

$$F = \frac{\text{between-group variation}}{\text{within-group variation}}$$

# Assumptions: Key Points

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- Independent observations
- Rough normality within groups (or robust with  $n$ )
- Similar variances across groups

# Exercise 1: Write $H_0$

Compare 3 group means. What is  $H_0$ ?



# Solution 1

■  $H_0: \mu_1 = \mu_2 = \mu_3$

## Exercise 2: Within variance

If within-group variance increases, what happens to  $F$  (all else equal)?

## Solution 2

- F tends to decrease; harder to detect differences.

## Exercise 3: Next step

ANOVA p-value is 0.01 at  $\alpha=0.05$ . What next?

## Solution 3

- Reject  $H_0$ .
- Run post-hoc to find which pairs differ.

# Mini Demo (Python)

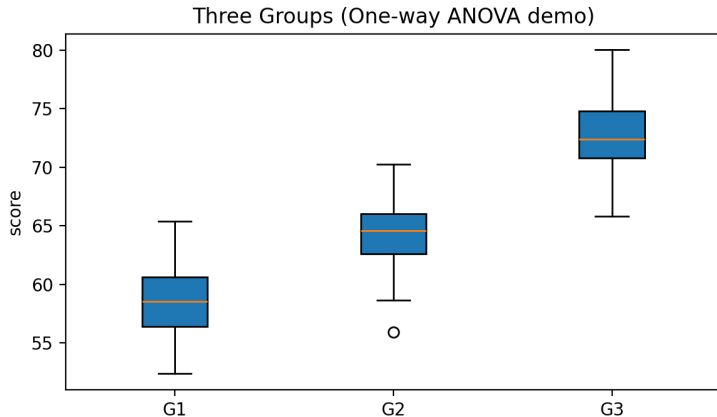
Run from the lecture folder:

```
python demo/demo.py
```

Outputs:

- images/demo.png
- data/results.txt

# Demo Output (Example)



# Summary

- Key definitions and the main formula.



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- Key definitions and the main formula.
- How to interpret results in context.
- How the demo connects to the theory.

# Exit Question

Why are several pairwise t-tests not equivalent to one ANOVA?