

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>

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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

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

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- Independent observations

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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)

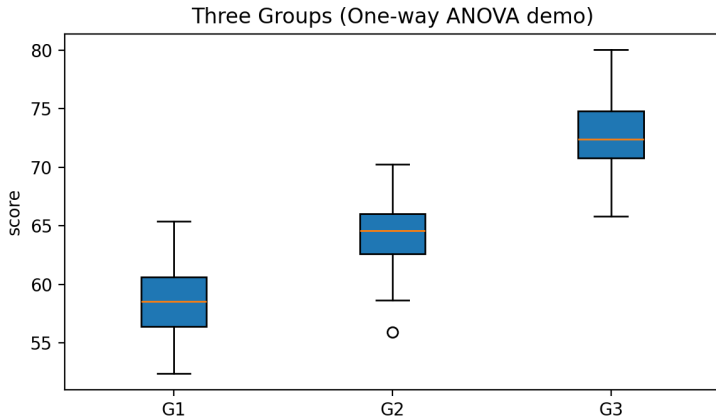
Run from the lecture folder:

```
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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- 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?