

Statistics and Data Analysis

Unit 03 – Lecture 02: Hypothesis Testing (t-test): Concepts and Setup

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

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Learning Outcomes

- Define null and alternative hypotheses clearly

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- Compute a one-sample t statistic (given summary)

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Learning Outcomes

- Define null and alternative hypotheses clearly
- Compute a one-sample t statistic (given summary)
- Explain p-value and significance level alpha
- Distinguish one-tailed vs two-tailed tests
- State key assumptions behind the t-test

t-test Basics: Key Points

- H₀/H₁ setup

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- H₀/H₁ setup
- Test statistic measures how far the sample is from H₀
- Assumptions: independence, outliers, normality/CLT

t-test Basics: Key Formula

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}, \quad df = n - 1$$

p-values: Key Points

- p-value = probability of data (or more extreme) assuming H0

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- p-value = probability of data (or more extreme) assuming H₀
- Small p-value → evidence against H₀

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- p-value = probability of data (or more extreme) assuming H₀
- Small p-value → evidence against H₀
- p-value is not effect size

Exercise 1: Write hypotheses

Claim: mean score is 60. Write H₀ and H₁ for a two-sided test.

Solution 1

- H₀: $\mu = 60$
- H₁: $\mu \neq 60$

Exercise 2: Compute t

Given $n=25$, $x\bar{=}53$, $s=10$, test $H_0: \mu=50$. Compute t.

Solution 2

- $SE = 10/\sqrt{25} = 2$
- $t = (53-50)/2 = 1.5$
- $df = 24$

Exercise 3: Tail choice

You want to show a new method increases mean score. One-tailed or two-tailed?

Solution 3

- One-tailed (right): $H_1: \mu > \mu_0$

Mini Demo (Python)

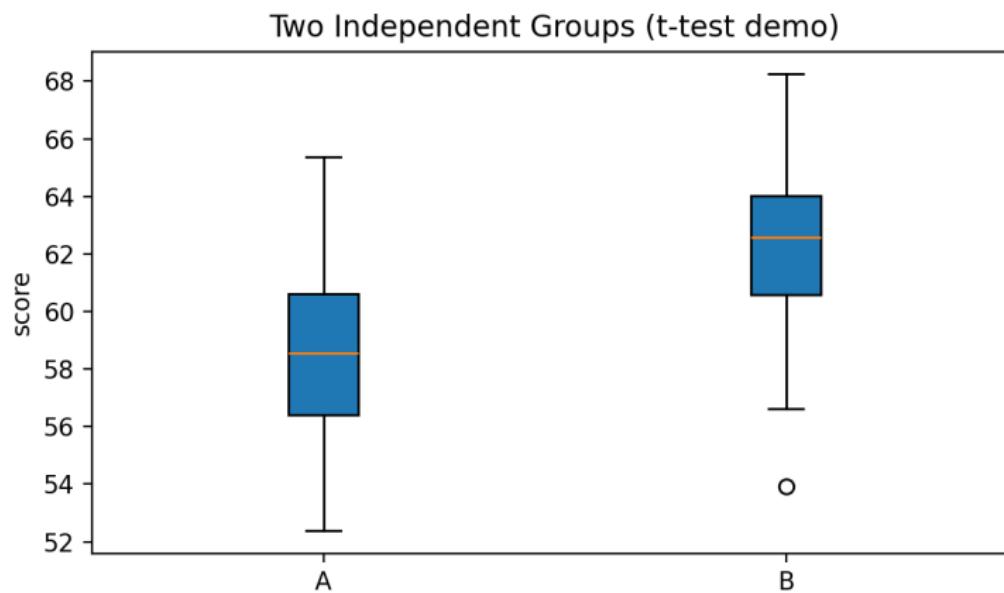
Run from the lecture folder:

```
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.

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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 can a very small p-value still be unimportant in practice?