

Statistics and Data Analysis

Unit 03 – Lecture 01: Population, Sample, Sampling, Estimation and Confidence Intervals

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

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Learning Outcomes

- Differentiate population parameters and sample statistics

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- Differentiate population parameters and sample statistics
- Explain sampling bias vs random error
- Describe common sampling methods (SRS, stratified, cluster)
- Compute and interpret a basic confidence interval for a mean

Sampling: Key Points

- Population vs sample

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- Population vs sample
- Bias vs random error

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- Population vs sample
- Bias vs random error
- Representative sampling matters

Confidence Intervals: Key Points

- Interpretation: long-run coverage

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- Width depends on n and variability

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- Interpretation: long-run coverage
- Width depends on n and variability
- CIs support decision-making with uncertainty

Confidence Intervals: Key Formula

$$\bar{x} \pm t_{\alpha/2, n-1} \frac{s}{\sqrt{n}}$$

Exercise 1: Parameter vs Statistic

Give one example of a parameter and one of a statistic.

Solution 1

- Parameter: population mean
- Statistic: sample mean

Exercise 2: CI Interpretation

In one sentence, what does a 95% CI mean (correctly)?

Solution 2

- About 95% of such intervals contain the true mean in repeated sampling.

Exercise 3: Bias Scenario

Why does convenience sampling create bias?

Solution 3

- Because some groups are over/under-represented systematically.

Mini Demo (Python)

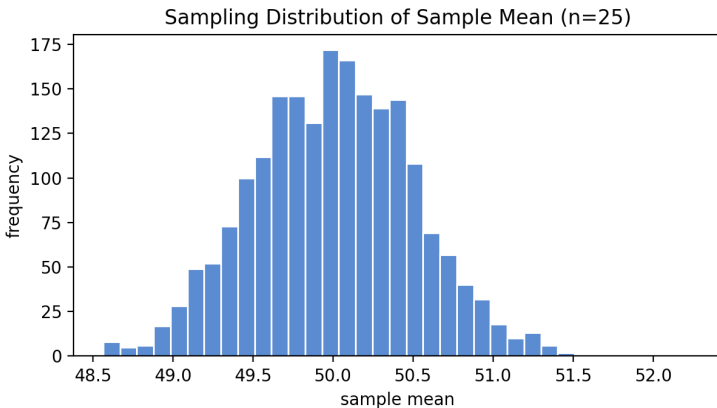
Run from the lecture folder:

```
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

If your CI is too wide, what two actions reduce its width (without cheating)?