Statistics and Data Analysis
Unit 03 – Lecture 07 Notes

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Topic

Interpret published hypothesis testing results; emphasize CI, effect size, and pitfalls.

Learning Outcomes

- Interpret p-values and confidence intervals correctly
- Compute a simple effect size from summary statistics
- Identify common red flags (only p-values, many tests, no effect size)
- Write a cautious conclusion in plain language
- Avoid correlation-causation confusion

Detailed Notes

These notes are designed to be read alongside the slides. They expand each slide bullet into plain-language explanations, small worked examples, and common pitfalls. When a formula appears, emphasize (1) what each symbol means, (2) the assumptions needed to use it, and (3) how to interpret the final number in the problem context.

Reading Results

- Check n, center, spread
- Prefer CI + effect size
- Ask: what does it mean in the real world?

Pitfalls

- Multiple comparisons
- Selective reporting (p-hacking)
- Over-claiming causation

Exercises (with Solutions)

Exercise 1: Interpret CI

95% CI for (new-old) is (1.2, 3.8). What does it suggest?

Solution

- Likely positive effect (CI above 0).
- Magnitude between 1.2 and 3.8 units.

Exercise 2: Compute d

A: n=20 mean=72 SD=10; B: n=20 mean=68 SD=10. Compute Cohen's d.

Solution

- Pooled SD=10
- d=(72-68)/10=0.4

Exercise 3: Cautious conclusion

p-value=0.03 but effect size is tiny. What should you conclude?

Solution

- Evidence of difference, but small magnitude.
- May not justify action without cost/benefit.

Exit Question

What is one red flag when a paper reports only p-values and no effect sizes?

Demo (Python)

Run from the lecture folder:

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

Output files:

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

References

- Montgomery, D. C., & Runger, G. C. *Applied Statistics and Probability for Engineers*, Wiley.
- Devore, J. L. *Probability and Statistics for Engineering and the Sciences*, Cengage.
- McKinney, W. *Python for Data Analysis*, O'Reilly.