PS 211: Introduction to Experimental Design

Fall 2025 · Section C1

Discussion 8: Understanding Mean Differences & Poster Methods (Part 1)

Outline for Today

- **Attendance:** please sign your name at the front within the first 2 minutes.
- **Lecture 10 Review:** paired-samples *t*-tests and the logic of mean differences
  - Clarify what a *mean difference* really represents.
- **Submit your Introduction** within the first 30 minutes
  - You've had two weeks to work on this, so it should be complete or nearly complete.
  - Post a Google Doc link with your introduction and references in **Slack** so I can review it.
  - Use the past discussion slides as a checklist to make sure it's polished.
- **Worksheet Practice:** interpreting *t*-values and confidence intervals
- **Poster Work:** begin drafting the *Methods* section of your project

Recap – What's a Mean Difference?

- Each participant has **two related scores** (e.g., before vs after).
- Subtract one from the other → each person's **difference score D**.
- The **mean difference M_D** is the *average of all those D scores*.
- If there's truly no effect, we expect that average difference ≈ 0.
- The t-test asks: *Is our observed M_D large enough that random noise alone probably wouldn't create it?*

The Standard Error (SE)

- SE tells us how much sample means (or mean differences) typically vary across random samples.
- Formula for paired t: SE = s (sample standard deviation) / √n
- s describes variability within one sample, while SE describes variability between possible samples
- Smaller SE → more precise estimate → larger t (if difference stays constant).
- When SE is big, even a 1-point mean difference may be *statistically weak*; when SE is small, that same difference may be *statistically strong*.

The Logic of the t Statistic

- t = (M_D - 0) / SE_D
- Numerator = observed difference
- Denominator = expected variation if H0 true
- Big t → unlikely under H0 → reject H0
- Small t → plausible under H0 → fail to reject
- The sign (+ or –) only shows direction, not magnitude of evidence.

Interpreting Confidence Intervals

- 95 % CI = M_D ± (t_crit × SE_D)
- Shows plausible range for the *true* mean difference in the population.
- If 0 is inside the interval → we can't rule out no difference.
- If 0 is outside the interval → difference is statistically significant.
- CI width shrinks as sample size increases or variability decreases.

Common Misunderstandings

- “Mean difference” ≠ “difference of means” – we only have one group’s change scores here.
- A non-significant t doesn’t mean *no effect* – it means we lack enough evidence.
- Larger n reduces SE but doesn’t change the raw difference itself.
- Reporting both t and Cohen’s d helps show *strength* vs *certainty* of the effect.

Quick Practice

Scenario 1:
Five students report hours of sleep before and after midterms:
6.0, 6.5, 5.5, 7.0, 6.0 → 7.0, 7.0, 6.0, 7.5, 6.5

1. Compute each difference (after – before).

2. Find the mean difference and estimate SE (s / √n).

3. If t_crit = ±2.776 and your t = 1.8, do we reject H0?

4. Interpret in plain English.

Transition to Poster Methods Section

- The Methods section explains *how you would test* your hypothesis.
- Include:
  1. Participants – who and how many?
  2. Design – within- or between-subjects? (you can now define this clearly!)
  3. Procedure – what participants do, what you measure.
  4. Dependent variable – how is it quantified and analyzed?
  5. Independent variable - how will you manipulate this?
- Begin a short outline today and raise your hand when you're ready for feedback

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- **Worksheet Practice:**
- **Poster Work:** begin drafting the *Methods* section of your project