PS 211: Introduction to Experimental Design

Fall 2025 · Section C1

Discussion 2: Summaries of Lectures 1–3

Outline for Today

- Attendance
- Recap of Lectures 1–3
- Worksheet and icebreakers
- Discussion poster project

Lecture 1: Course Overview

- Introductions (Kate & Juneau)
- Logistics: lectures, discussions, Slack
- No textbook → we use R & RStudio
- Course goals: describe variables, samples, hypothesis testing, R analysis, interpretation, communication, limits of statistics
- Grading: exams (70%), homework (10%), data write-up (10%), discussion (10%)

Lecture 1: Science & Statistics

- **Data** = values that convey information
  - E.g., numbers, words, observations
  - Used for calculation, reasoning, discussion, decision-making
- **"Statistics"** can mean data, summaries of data, or methods for analysis
- Statistics are used constantly in daily life: medicine, finance, policy, news, science
- Goals of science: describe phenomena, predict relationships, and explain these relationships
- Scientific method: observe, review literature, hypothesis, design, collect/analyze data, conclude & communicate
- Publication process: peer review, revision, publication

Lecture 2: Variables & Research

- **Continuous**: any value, can have fractions (height, weight)
- **Discrete**: specific values only (number of pets)
- **Nominal**: categories (names only)
- **Ordinal**: rankings, ordered but no fractions
- **Interval**: equal intervals, no true zero (temperature °F)
- **Ratio**: equal intervals, true zero (reaction time = 0)

Lecture 2: Research Methods

- Non-experimental: naturalistic, case study, surveys
- Experimental: manipulation of IV(s), measure effect on DV(s)
- IV = manipulated variable, levels = values it takes
- DV = outcome variable
- Variables must be defined (easy: age; harder: happiness?)
  - Abstract, hard-to-define variables can be carefully defined **operationally**
  - Operational definitions specify the observations or procedures used to measure/manipulate a variable
- Variables can have levels
  - Discrete example = type of pet could be dog, cat, hamset
  - Continuous example = reaction time could range from 0 to infinity

Lecture 2: Correlation vs Experiment

- **Correlational studies**: variables observed as they naturally occur, cannot show causality
- **Confound** = variable that varies with IV and affects DV, making it hard to isolate the causal effect of IV on DV
- **Experiments**: random assignment helps reduce confounds and allows causal inference
- **Reliability**: consistency of a measure
- **Validity**: accuracy of a measure
- **Between-Subjects** participants experience only one level of the IV
- **Within-Subjects** participants experience all levels of the IV

Lecture 3: Descriptive vs Inferential

- **Descriptive stats**: summarize and organize data
- **Inferential stats**: use sample data to make inferences about a population
- Raw data = original numbers, hard to interpret alone
- Frequency distributions help visualize data: tables, grouped tables, histograms
- There are many correct ways to present data
  - But our goal is to choose the **most useful** ways!

Lecture 3: Visualizing Data

- **Frequency table**: list values + counts
- **Grouped frequency table**: intervals (bins) for ranges
- **Histogram**: graph of grouped frequency table; bars touch, continuous variables only
- **Distribution** = how values are spread or clustered
- **Normal distribution**: symmetric, bell-shaped
- **Skew**:
  - Positive skew → tail right, floor effect
  - Negative skew → tail left, ceiling effect
- Bar graphs = categorical data

Worksheet for Today

1. Introduction: In groups of 3-4, share your **name** and one example of a **variable** you've noticed in daily life (e.g., coffee cups per day, hours of sleep). Say whether it's **discrete** or **continuous**.

2. Come up with two examples of **ordinal variables** that could show up in a BU student survey.
   a. For one of them, explain why it is ordinal and not interval.

3. Methods: As a group, come up with an **operational definition** for a tricky variable (e.g., "happiness," "stress," "study effort").

4. Studies: BU finds that students who sleep more have higher GPAs.
   a. Is this correlational or experimental?
   b. What would a confound be?
   c. How could you redesign this as a true experiment?

5. Visualization: Sketch a **positively skewed** and a **negatively skewed** histogram of exam scores.
   a. How does the shape differ between the two?
   b. In what situation might you prefer a **bar graph** instead of a histogram?

6. Wrap-up: What is the most useful concept from lecture so far? The easiest? The most challenging?

Discussion poster project

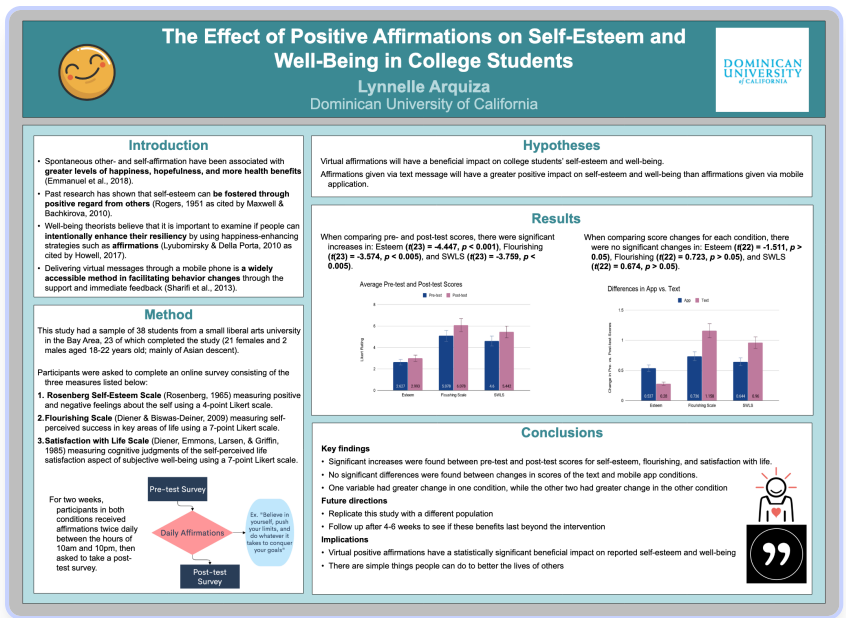
- In small groups, you will come up with a research hypothesis, conduct a literature review, and write hypothetical methods, results, and discussion sections to be presented on a poster at the end of the semester.
- **Next week**, we will form groups of 3-4 and brainstorm research ideas
- Attend discussion! $\longrightarrow$ much easier to coordinate
  - Goal is no work outside of discussion section

Checklist – what should my poster have?

- Introduction
  - Current literature
  - Research question
  - Hypothesis
- Methods
  - Participants
  - Independent variable
  - Dependent variable
  - Analysis
- Results
  - Descriptive statistics
  - Inferential statistics
- Figures (1-2)
- Conclusion
- Limitations
- References (choose a citation style)

Design your figures and posters to be easily understood!

Good: https://scholar.dominican.edu/ug-student-posters/101/



Not so good: https://colinpurrington.com/2012/02/example-of-bad-scientific-poster/

Outline for future weeks

- Discussion 3: Form groups and brainstorm research ideas
- Discussion 4: Research poster topics and form hypotheses
- Discussion 5: Refine topic and compile references
- Discussion 6-7: Introduction section
- Discussion 8-9: Methods section
- Discussion 10-11: Analysis plan and limitations section
- Discussion 12: Finalize poster
- Discussion 13: Group poster presentations!