Introduction and Principles of Quantitative Research

EDUC 641: Intro

TBD

Roadmap

Research is a partnership of questions and data		What types of data are collected?	
		Categorical data	**Continuous data**
What kinds of questions can be asked of those data?	Questions that require us to describe single features of the participants	• How many members of class have black hair? • What proportion of the class attends full-time?	• How tall are class members, on average • How many hours per week do class members report studying, on average?
	Questions that require us to examine relationships between features of participants	• Are male-identifying students more likely to study part-time? • Are PrevSci PhD students more likely to be female-identifying?	• Do people who say they study for more hours also think they'll finish their doctorate earlier? • Are computer-literate students less anxious about statistics?

Features of scientific research

1. Data-based

2. Systematic

4. Defined sample and population

4. Contextualized

5. Reliabile and valid

6. Disprovable

7. Peer-reviewed

Three facets to research

Design

- Where will you conduct research?
- Population of interest?
- Sample?
- Variables to examine?

Analysis

- How will you process the data?
- How will you display results?
- How will you communicate findings?

Measurement

- How will you collect data?
- Who will be observer?
- How will measurement be valid?

Goals of EDUC sequence

- Develop the basic quantitative skills necessary to be a research scientist
    - Not all the skills you will need (and not the only courses you should take)
    - Foundations of statistics, methods and data science
- Contextualize those skills
    - "Building a toolbox, not a cookbook"

Kinds of statistics

Often conceived of as...

Either descriptive or inferential

Either exploratory or confirmatory

In fact, on a continuum

Research design and statistics

This sequence focuses on statistics, but research design is AS (MORE?) important

It can be tempting to use statistical techniques to fix poor research design

- "You can't fix by analysis what you bungled by design" -Light, Singer & Willett. (1990). *By Design*
- Make sure you have mastered content from EDUC 612, particularly concepts of:
  - measurement, internal and external validity
- Strongly encourage you to consider courses in advanced research design (EDUC 646, EDLD 650, EDLD 679)

Types of data

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How we collect and quantify the data informs the kind of analysis we will conduct.

Levels/scales of measurement

What is measurement? assigning numbers based on a set of rules

Levels of measurement: how categories/numbers are defined

Each type of measurement has a set of properties which determines the appropriate analysis.

Four levels/scales of measurement

1. Nominal
2. Ordinal
3. Interval
4. Ratio

Nominal scale

No hierarchy among levels of a variable

Levels are unordered, representing labels

A variable defining whether someone is an omnivore, vegetarian, vegan or fruititarian is on a nominal sclae

Most demographic variables are nominal:

- Hair color
- Race
- Ethnicity
- Gender

Ordinal scale

Levels are logically ordered; a higher level indicates "more"

Distances between levels are not necessarily equal

Level 1 < Level 2 < Level 3 < ... (monotonicity)

Examples:

- Grades (A - F letter grades)
- Competition (1st place, 2nd place, 3rd place)
- Likert scale (on a scale of 1 to 10 with 1 being *very unhappy* and ten being *very happy*, how happy are you today?)

Interval scale

Represents *quantity* and has *equal units*

Ordinal scale + equal measurement units

There is no absolute zero

Examples:

- The Fahrenheit temperature scale
  - The difference between 20 F and 30 F is the same as the difference between 60 F and 70 F
  - 0 does not represent "no temperature"
  - There is no concept of dividing or multiplying values on the scale. There are no ratios. We can't describe 50 F as half as hot as 100 F or twice as hot as 25 F

Ratio scale

Interval scale + True zero point

True zero means a point where the thing being measured does not exist

Examples:

- Height
- Mass
- Distance
- Length of a piece of wood
- Test score (?)

Levels of measurement

	Indicates difference	Indicates direction of difference	Indicates amount of difference	Has absolute zero
Nominal	X			
Ordinal	X	X		
Interval	X	X	X	
Ratio	X	X	X	X

Categorical variable

- Nominal and ordinal measures
- Use labels to describe

Continuous variable

- Interval and ration measures
- Data with arithmetic properties

Synthesis and wrap-up