# Research Methods

## PSY 3307

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# Agenda

- Greek & Roman
- Variables
- Scales
- Measurement Error
- Steps in Research
- Theories
- Hypotheses
- Validity & Reliability
- Research Design
  - Correlational Designs
  - Experimental Designs
- Methods of Data Collection
- Types of Variation (Generally)
- Randomization

# Learning Greek & Roman

- Greek symbols = population
- Roman symbols = sample

$$\Sigma = Sum$$

$$\bar{x} = sample\ mean$$

$$\mu = population\ mean$$

# Learning Greek & Roman

$$s^2 = variance$$

$$s = standard\ deviation$$

$$\sigma = population\ standard\ deviation$$

$$\sigma^2 = population\ variance$$

# Learning Greek & Roman

$$N = Total\ Observations\ (Either\ Sample\ or\ Population)$$

$$f = Frequency$$

$$n = observations\ for\ categories\ in\ survey$$

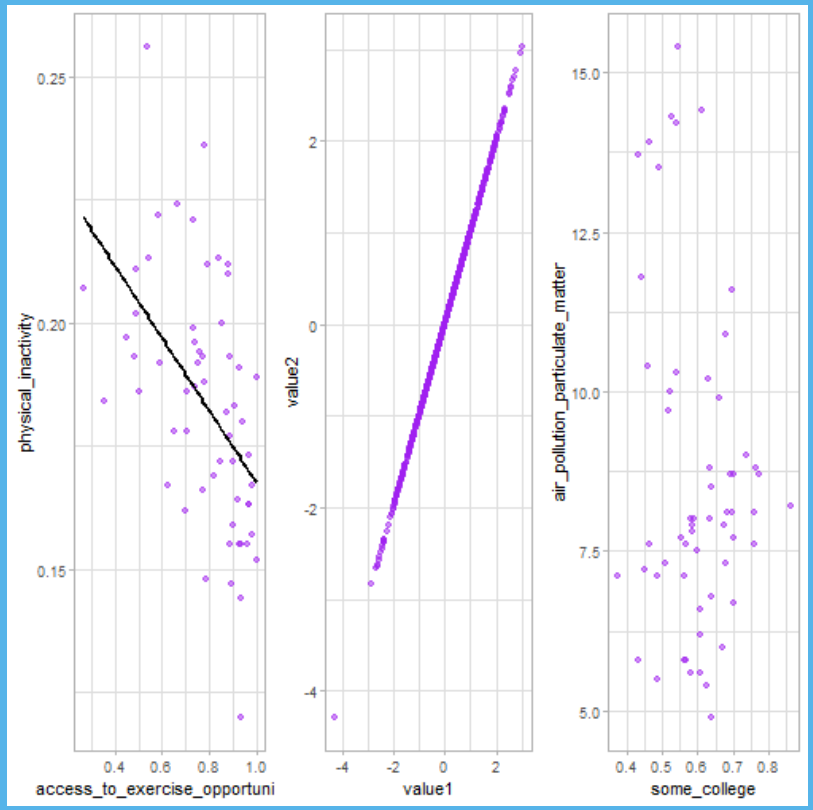
# Review

- **Variable**
  - anything that can produce different scores; scores that vary
- **Relationship**
  - the connection between two variables
- Three different types of relationships
  - **positive relationship** is when one variable increases, the second variable increases
  - **negative relationship** is when one variable increases, the second variable decreases
  - **no relationship** shows no clear connection between two variables

# Poll: Is it a Variable?

- Height
- Age
- Class Standing
- Name

# Relationships



# Descriptive & Inferential Statistics

- **Descriptive Statistics** used for organizing and summarizing your data.
- Tells the reader how the data looks.
- **Inferential Statistics** used to estimate or infer if there is a relationship in your sample data that represents the population studying
- Tells the reader if there is a relationship.

# Examples of Descriptive & Inferential Statistics

1. The average amount of physical inactivity in California counties
2. The association between parks and physical activity engaged
3. The *difference* in the number of liquor stores between San Diego and Los Angeles counties.
4. The number of males and females in PSY 3307.

# Types of Research

- **Qualitative**
  - testing theories using language
- **Quantitative**
  - testing theories with numbers

# Poll: Types of Research

- Finding the average age of students that take PSY 3307
- Conducting interviews with people on why they won't get vaccinated
- Focus groups on improving graduation rates at CPP
- Testing to see if drinking more coffee makes you better at math

# Variables

- **Independent variables** are often seen as the cause of some effect
    - Experimental designs = cause
    - Correlational designs = predictor
    - **Predictor variable** predicts an outcome; IV --> DV
- **Dependent variables** are variables that are affected by the independent variable(s)
    - Outcome based on changes from the independent variable
    - Also called **outcome variable**
- Independent variables = IV
- Dependent variables = DV
- This class, most analyses will be focused on one IV and one DV
    - More advanced statistics can have multiples of both

# Conditions

- **Conditions** are the categories of the IV to measure DV scores in an experiment
- Example: Examining test scores of students in a class. Half of the class gets a study guide while the other half is given nothing.

IV = Study guide DV = Test scores Conditions: 1 = Group receiving study guide; 2 = Group receiving nothing (control group)

- For experiments, you can say "IV had an effect on DV" or the "IV caused DV" but for correlational students that is a big NO NO. Every time JP hears/reads a correlational study that describes the effect of IV on DV he cries a little inside.

# Levels of Measurement

- What is being measured and the numbers that represent what is being measured is the **level of measurement**
- **Categorical variables**
  - entities are divided into distinct categories
  - variables that do not allow fractions
- Ex: Getting an 94.5 on a exam
- **Continuous variables**
  - a score for each person/distinct score
  - variables that can be measured with decimals
- Ex: Being a 4th year compared to a 3rd year student

# Categorical Variables

- **Binary variables**
  - there are only two categories (sex)
- **Nominal variables**
  - categorize into groups; categories are not ordered (race/ethnicity groups)
  - can be binary and nominal
- **Ordinal variables**
  - ordered categories
  - categories indicate rank order (race order)

# Continuous Variables

- **Interval variables**
  - equal intervals on the variable represent equal differences in measurement
  - zero is not an absolute zero
- **Ratio variables**
  - similar to interval
  - true zero (zero is the smallest number)

# Measurement Scale Examples

1. California Counties
2. Temperature measured in Celcius 2b. Temperature measured in Kelvin
3. Olympic Medal Winners (Gold, Silver, Bronze)
4. Money
5. Income Brackets [0-10k, 11-20k, 21-30k, ...]
6. Miles per hour (mpg)
7. 10 most common baby names
8. Grades (A, B, C, D, F)
9. Grades (100-95, 94-90, 89-85, 84-80, ...)
10. Grades (100-0%)

# Measurement Error

- **Measurement error** is the discrepancy between the actual value you're trying to measure and the value you obtained
- A participant's ID states a weight of 130lbs
- Their actual weight is 134lbs
- There is a measurement error of 4lbs
- To assess measurement error, we rely on validity and reliability

# Steps of Conducting Statistics Within the Research Process

- Initial observation(s)
- Theory creation
- Generate hypothesis
  - identify variables of interest
- Generate predictions
- Collect data
- Analyze data
- Interpret data

# Initial Observation

- Something in the real world
  - JP Example: What causes Type-2 diabetes in the United States?
  - **Research Question** is a question about a concept you are interested in answering
- read other research
  - helps you get a better idea of what the field is focusing on
  - `psycnet`, `pubmed` (medical), `google scholar`

# Theory & Hypotheses

- A **theory** is a general principle or set of principles that explain findings about a topic to then move forward with new hypotheses to be created
- A **hypothesis** is a prediction from a theory
    - plural term is **hypotheses**
- **Falsification** refers to the act of disproving a theory or hypothesis

# Theory & Hypothesis Examples

- The Immigrant Paradox
  - Those that immigrate into the United States are healthier than assimilated individuals
- Theory: Immigrants are healthier because those that immigrate are healthy enough to immigrate
- Hypothesis: Those immigrating are younger than assimilated individuals
  - Immigrants' age is related to how healthy they are
- Possible explanation: Immigrants may look healthier in certain behaviors (healthier eating), but may be unhealthier in other aspects (mental health, physical activity)

# Another Example

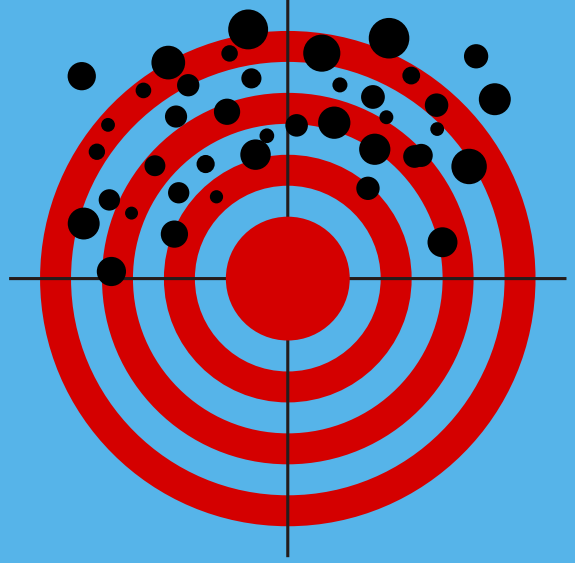
- Example:
  - IV: Race/Ethnicity
  - DV: Depression
- Racial/ethnic groups will vary in depression levels (two-tailed hypothesis)
- White participants will have higher depression than Latinx/a/o participants (one-tailed hypothesis)

# Try It Out Yourself

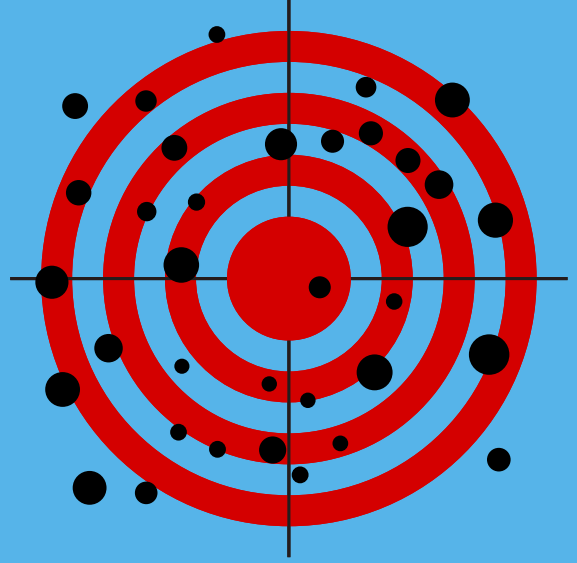
- Example:
  - IV: Age Groups (Baby, Minor, Young Adult, Adult, Older Adult)
  - DV: Amount of naps in a day
- Hypothesis:

# Validity & Reliability

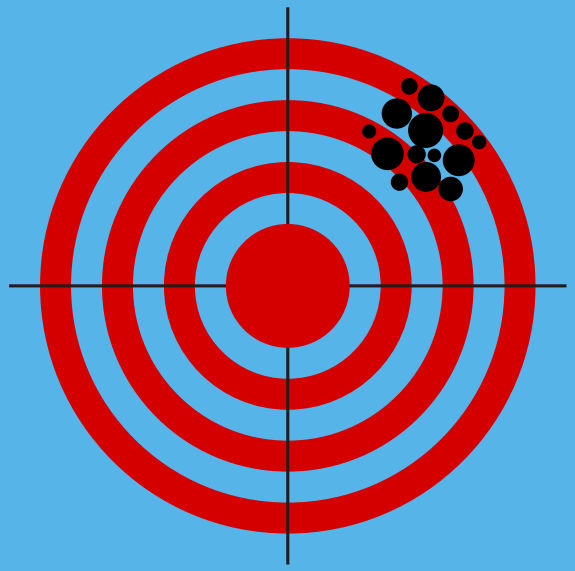
- if an instrument is measured how it is supposed to be than it is **valid** or shows **validity**
- if a measure is consistent then it is deemed **reliable** or shows **reliability**



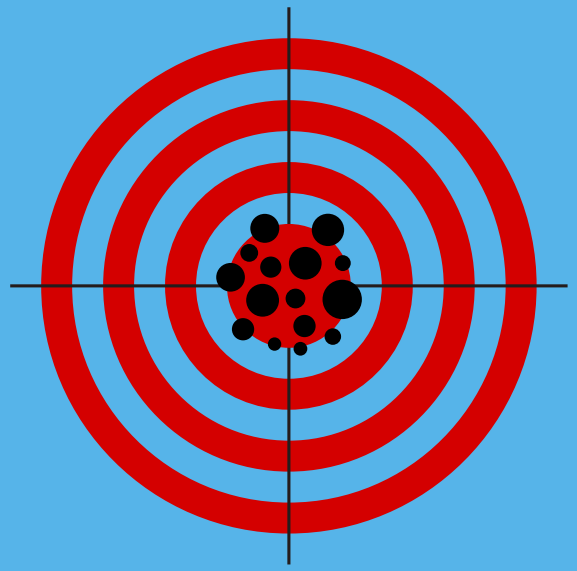
Unreliable & Unvalid



Unreliable, But Valid



Reliable, Not Valid



Both Reliable & Valid

# Validity & Reliability

- **criterion validity** is when your instrument should measure what it is supposed to while agreeing with a "gold standard" objective measure
    - Self-reported stress compared to measuring stress physiologically
- **concurrent validity** is assessing your measure is valid by comparing it to another measure
    - Waist Circumference compared to Body Mass Index (weight/height [kg/m^2])
    - type of criterion validity
- **preditive validity** is when you are measuring observations at a later point
    - much more complex validity to achieve
    - better measure of criterion validity

# Validity & Reliability

- **content validity** is examining to see whether your instrument measures the full range of a construct
- Depression
    - not eating
    - not sleeping
    - sleeping too much
    - eating too much
    - sadness
    - lack of energy

# Validity & Reliability

- two main measures of reliability
- **Test-retest reliability**
  - testing participants with the same measure twice
  - in theory, they should score the same
- **Internal reliability/consistency** or **Cronbach's alpha**
  - assesses the consistency the findings from each item

$$\alpha = Cronbach's\ Alpha$$

# Designs

- **Design** is how a study is organized
- Experimental (manipulate your independent variable to see what effect it has on the dependent variable)
    - True Experiment
    - Quasi Experiment
    - Natural Experiment
- Correlational (don't manipulate anything; just look at the relationship between two variables)
    - Correlation
    - Regression

# Correlational Designs

- measured either through:
    - **cross-sectional** where measures and other data are gathered at one time point
    - **longitudinal** gathered data over several time points with the same participants or with different cohorts of participants
- issue of **tertium quid**, or the issue of a third (or fourth) variable that may be present that may actually be impacting the relationship/association you were originally interested in
- Example: school --> stress
    - burnout (**confounding variable**) is an example of a extraneous variable that is affecting the main relationship

# Experimental Designs

- true experiments imply causality; x (IV) causes y (DV)
    - IV is manipulated
    - participants are randomly selected and randomly put into groups
- there are conditions in the IV that are compared when testing for the DV
    - mindfulness -- > attention
    - meditation --> attention
    - control --> attention

# Methods of Data Collection

- Types of collecting data
- **between-subjects**
  - different groups get different conditions/manipulations
- **within-subjects** or **repeated measures**
  - every participant gets each condition
  - multiple time points and gets the same condition each time

# Types of Variation

- **Unsystematic Variation**
  - variation in scores based on unknown factors/reasons
  - participant with a headache may not perform similarly to peers or other time points
- **Systematic Variation**
  - differences in performance in conditions or time points based on experimental manipulation
  - one condition being encouraging words prior to taking an exam compared to a control

# Randomization

- **randomization** is the act of separating groups in an objective way
  - it eliminates most other sources of systematic variation
  - creates a strong experiment

# Randomization with Within-Subjects Designs

- systematic variation is often seen through **practice effects** and **boredom effects**
- practice effects are when participants perform differently because they remember aspects of the experiment from the previous time point
    - taking an exam when it is the same exact exam
- boredom effects are when participants are too tired or bored from the first time point
    - an exam is long
- while impossible to completely remove, **counterbalancing** can reduce these effects
    - randomly having participants take condition 1 before condition 2 or vice versa

# Randomization with Between-Subjects Designs

- best option is to simply randomly put participants in the conditions/groups