Overview

- **Research Design**
  - What drives your research design?
  - The battle between Qualitative and Quantitative is over
  - Think before you leap
  - What SHOULD drive your research design.

- **Advanced Statistical Techniques**
  - Why a t-test just doesn’t cut it anymore
  - Regression Models and SEM

- **Statistical Decisions**
  - What drives your analysis choices?
  - What SHOULD drive your analysis choices.
Why Continued Education

- Due to lack of research and statistical knowledge/education researchers naively:
  - use incorrect statistical methods
  - misinterpret statistical results
  - use unsound research designs
  - can’t recognize other poor research

- Techniques change and adapt with increased technology and complexity of the research

- Grant and Publication Reviewers are more educated and looking for these techniques
Qualitative Strategies

- **Ethnographies**
  - intact cultural group in a natural setting

- **Grounded Theory**
  - constant comparison of data to refine theory

- **Case Studies**
  - study an individual, event, or activity

- **Phenomenological Research**
  - identify with participants to develop patterns

- **Narrative Research**
  - provide stories about their lives
Quantitative Research

- **Descriptive or Non-Experiments**
  - Case Studies, Content Analysis, Survey Research, Naturally Occurring Designs, Field Studies

- **Quasi-Experiment Designs**
  - Nonequivalent Groups, Interrupted Time Series, Correlational

- **Experiments**
  - Between Subjects, Within Subjects, Mixed Models
Describe the state of nature at a point in time.

Map out a situation or set of events in order to describe what is happening behaviorally.

Does not directly concern itself with causal explanations, except perhaps speculatively.

Answer who, what, when, where, how.
Identify causes

“X is responsible for Y”

Four Critical Elements
  › Random selection of Ss
  › Random assignment of Ss to treatments
  › Experimenter manipulation of treatments
  › Experimenter control
Experimental Examples

- Simplest of the experimental designs
  - Two Group Design
  - Multiple Group Posttest Design
  - Multiple Group Pretest Posttest Design
  - Ex Post Facto Design
  - Multiple Group Time Series Design

- Factorial Designs

- Soloman Four Group Design

- Multivariate Designs
Quasi Experimental Design

- “Resembling”
- Fails to allocate the treatments at random

Common Types
  > Nonequivalent Groups Designs
  > Interrupted Time Series Designs
  > Correlational Designs
What drives your research design?
The battle between Qualitative and Quantitative is over.
Mixed Model Procedures

- **Sequential**
  - expand the findings of one method with another method

- **Concurrent**
  - converge both to provide a comprehensive analysis of the research problem

- **Transformative**
  - use theory as perspective changes within a design that contains both qualitative and quantitative
Research Design

- Research design defines the statistical analysis you use through your
  - Within and Between Subjects Designs
  - Measures of Interest
  - Sample Size
Research Design

- **Between Subjects**
  - Ss exposed to one treatment group each
  - Free of carry over effects
  - Less control over subject variables
    - randomization
    - matching
    - selection of homogeneous subject population

- **Within Subjects (Repeated Measures)**
  - Each Ss receives all treatments in turn
  - Control for subject variables (individual differences)
  - Reduces number of subjects needed
  - Before and After Design
    - possibility of carry over effects
    - counter-balancing

- **Mixed Models**

- **Factorial Designs**
  - All possible combinations of levels of the variables are included in the experimental design.
  - Main Effects and Interactions
What SHOULD drive your research design.

- Research goals, objectives
- Prior Research
- Quality research questions and hypotheses
- Validity and Reliability
- Resources
- Feasibility
Validity

- Appropriateness or meaningfulness
- Measures what it is designed to measure
- Internal and External
  - Instrument Reactivity
  - Unreliability of instruments
  - Invalidity of Instruments
  - Instrument change over time
  - Differential subject loss
  - Bias in Assignment of Subjects to Treatment
  - Hawthorne Effects
  - Non-representative samples
Reliability

- Consistency or stability of a measuring device
- Calibration
- Measurement error
- Can be increased by multiple measurements or multiple measures
  - Test-Retest
  - Equivalent Forms
Your research design drives the inferences and conclusions you can draw from your data and analyses.

Pitfalls to Avoid

- Assuming the only possible reason for change is the intervention
- Experimenter/Interviewer Bias
- Choosing the wrong groups to compare
- Claiming that results from a small scale study also apply to a wide group
There are three kinds of lies: lies, damned lies, and statistics.

-Benjamin Disraeli
Why are statistics so important?

- Crucial to the understanding of underlying scientific phenomena and to advancing knowledge and practice.
- Statistics give more accurate information than your own experience.
Types of Statistics

- Descriptive vs. Inferential
- Parametric vs. Nonparametric
- Univariate, Bivariate, and Multivariate
Univariate Analyses

- Correlations
- Regressions
- T-tests
- Analysis of Variance (ANOVA)
- Analysis of Covariance (ANCOVA)
Multivariate Analyses

- Multiple Regression
- MANOVA
- Cluster Analysis
- Discriminant Analysis
- Factor Analysis
- Multidimensional Scaling
- Principle Components Analysis
Meta-Analysis

- Examination of past research
- Does effect, association, or difference, really exist?
- Need at least 2 studies....
Most of what we study is much more complicated than a simple $X$ is different than $Y$ relationship.

With the complexity of human research, relationships between variables often consist of multiple confounding variables that should be taken into account.
Why are advanced statistics important?

- Complex research questions and methodologies require complex statistics.
- Journals and Grant Funders are expecting more complex research.
- We need complexity to build on the available knowledge in our fields.
Advanced Analyses

- Multiple Regression
  - Linear, Logistic, Negative Binomial, etc
  - Hierarchical, Stepwise, Forward/Backward, Weighted

- Path Analysis
  - Moderation, Mediation

- Structural Equation Models

- Partial Least Squares Models

- Multi-Level Models
What drives your analysis choices?
What SHOULD drive your statistical decisions.

- Variable types
- Sample size
- Distribution of the data
- Participant demographics
- Research question
- Relationships among key variables
- Assumptions Testing
Types of Variables

- Quantitative vs. Qualitative
- Independent vs. Dependent

- Continuous
  - Ratio, Interval

- Categorical/Nominal
  - Binary, Dichotomous

- Ordinal
Distribution of Data

- Measures of Central Tendency
  - Mean – the average
    - outlier sensitive
  - Median – central value of a set of ranked values; 50th percentile; not influenced by outliers
  - Mode – most frequent value; not influenced by outliers

- Measures of Dispersion - Statistics that show the amount of variation or spread in the scores, or values of, a variable.
  - Variance
  - Standard Deviation
  - Standard Error
Normal Distribution
Skewed Distribution

(+) Positively Skewed Distribution

(-) Negatively Skewed Distribution
Kurtosis

General Forms of Kurtosis

(+) Leptokurtic
(0) Mesokurtic (Normal)
(-) Platykurtic
Bimodal Distribution
Using Statistical Decision Trees
What is the effect of breast feeding on child’s BMI?

IV = ?

DV = ?
What is the effect of breast feeding on child’s BMI?

IV = Breast Milk vs. Formula

DV = BMI
Study Example

- What is the effect of breast feeding on child’s BMI?

- IV = ?

- DV = ?

- Measure when they leave the hospital, 2 months later, 1 year later, and at 5 years
What is the effect of breast feeding on child’s BMI?

IV = Breast Milk vs. Formula

DV = BMI

Measure when they leave the hospital, 2 months later, 1 year later, and at 5 years
Statistics are no substitute for judgment.

-Henry Clay