Jumping into Statistics: Introduction to Study Design and Statistical Analysis for Medical Research Using JMP Pro Statistical Software

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Meet the Instructors

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Course Objectives

- Review fundamentals of study design and research methodology

- Understand how to choose best statistical test for your research question

- Practice basic statistical analysis use JMP Pro Software

Course Topics

- Asking a Good Research Question

- Life Cycle of Research and Scientific Method

- Study Design

- Data types and Database Construction

- Descriptive Statistics

- Data Visualization

- Population and Sample, Probability, Statistical Inference

- How to Chose Correct Statistical Method and Run Some Analyses
  - T-tests, ANOVA, Non-Parametric
  - Chi-square, odds ratio, relative risk
  - Regression and Correlation
  - Survival Analysis
  - Test Diagnostics (e.g. sensitivity, specificity, etc.)

- Comparing Statistical Modeling and Machine Learning

Study Design: Sample Size and Power Calculations

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What is statistical power?

- Ability of a study to detect differences or effects if they exist.

- What influences power?
  - Effect size (e.g. differences, correlation)
  - Sample Variation (e.g. SD)
  - Sample size

  - In study planning, we aim to determine sample size needed in order adequately power a study

Understanding Errors

Your Statistical Decision	True state of null hypothesis	
	H_0 True (example: the drug doesn't work)	H_0 False (example: the drug works)
Reject H_0 (ex: you conclude that the drug works)	*Type I error (α)* *False positive* Incorrectly rejecting null	*Correct*
Do not reject H_0 (ex: you conclude that there is insufficient evidence that the drug works)	*Correct*	*Type II Error (β)* *False Negative* Incorrectly accepting null

For most research, $α$ is set to **0.05**…i.e. willing to accept, at most, a **5%** chance of obtaining a false positive

That's why we look for **p < 0.05** in statistical testing

Determining statistical power

- Power = 1 – beta (Type II error rate)
  - Probability of rejecting null when it is actually false
    - i.e. statistically significant result when an effect exists
  - Typical Threshold = 80%

  - Note: Type I and Type II error are inversely related

Determining statistical power

- What information do we need for sample size determination?
  - **Power threshold (80%)**
  - **Smallest effect size of interest**
    - Mean difference
    - Proportion difference/Event rate difference
    - Correlation
    - Odds Ratio
  - **Type I error (alpha = 0.05)**
  - **Variability**
    - SD
    - Baseline proportions, event rates in controls

  - Best if these values are informed by previous work!

Power Programs

- JMP Pro (but it is limited)

- G*Power
  - More options (correlations, regression, odds ratio, repeated measures)
  - https://www.psychologie.hhu.de/arbeitsgruppen/allgemeine-psychologie-und-arbeitspsychologie/gpower.html

- GLIMMPSE
  - Mixed Models
  - https://glimmpse.samplesizeshop.org/

- Power and Sample Size
  - http://powerandsamplesize.com/

- Open Epi
  - Note: has not been updated in a while, but links and programs still work
  - https://www.openepi.com/Menu/OE_Menu.htm

- For more complex designs, should seek consult from a statistician

Demo!

Questions?

JMP Pro!

https://software.ufl.edu/