830:595:53435: Research Methods in the Cognitive & Behavioral Sciences
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"Lies, damn lies and ... statistics."-- Mark Twain

This course is about data and treating it with some respect. Too often without proper training a researcher will inadvertently torture, twist and violate the basic nature of the data. Data should be collected with some reverence and some expectation of what the data might show. "Data should never be collected in a vacuum nor without some consideration of its origin, frailties or likely use." --W. Gosset (inventor of the t-test).

This course will survey basic and common methods in research for the measurement, statistical analysis, and modeling of cognitive and behavioral data. Throughout the course, computer implementations particularly in ``S'' (one of the oldest statistical computer packages, originally developed in the 1970s at Bell Labs; similar to MatLab) will be illustrated side by side with the exposition of the methods and specific examples. At the end of the course, you should have familiarity with a dozen or more statistical and mathematical methods (depending on your interests and needs—we will focus on **Neuroimaging analysis methods—FSL for example**) and a conceptual basis for their use and application to your peculiar data problems. You should also have facility with the statistical package and ability to analyze and visualize data as well as form specific modeling and analysis questions about your data. We will spend roughly two weeks on each topic below, there will be readings and a specific project involving your data which will be used for a presentation at the end of the course.

I. Measurement
The nature of data, measurement scales, experimental design, scaling, critical thinking Readings in RIVAL HYPOTHESES
Psychophysics Method and Theory, Gerscheider Chapter 4.

II. Probability
Probability; random variables, conditional probabilities,
HAYS: Chapter 1;

III. Distributions
Probability density functions, distribution functions, a zoo of distributions and their connections to cognitive and behavioral data, when the normal distribution is inappropriate; the CLT
HAYS: Chapter 2; Chapter 3; Chapter 6

IV. Statistics
Means, general mean theorem, the variance, coefficient of variation, skewness, kurtosis, etc. z, t, r, F, nonparametric measures

HAYS: Chapter 4; Chapter 8

V. Estimation
Data generation model, Maximum likelihood estimation, bayes estimation
HAYS: Chapter 5;

VI. General Linear Model
The general linear model. ANOVA 1-way, 2-way, tukey, scheffe, bonferroni, planned comparisons
HAYS: Chapter 10; Chapter 11

VII. Regression
Linear, non-linear regression, non-parametric regression
HAYS: Chapter 14

VIII. Multivariate Methods (many of the topics below)
Covariance, clustering, multiple regression, PCA, Factor Analysis, MDS, Neural Networks, other methods of interest, FSL(brain imaging tutorial)

STATISTICS, William L. Hays Holt, Rinehart and Winston, Inc 1988.
This course will satisfy one of the two Research Methods courses requirements in the Psychology Graduate Program.