

Psychology 310P
Course Information Sheet

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Teaching Assistant:	TBA
Course Meeting Times:	MWF 11:10-12:25 One of these meetings will frequently involve lab exercises in statistical computing.
Instructor Website:	http://www.statpower.net
Textbook:	Glass & Hopkins, <i>Statistical Methods in Education and Psychology</i> , 3 rd edition ISBN: 0205142125
Grading:	Course grades will be scaled. Midterm 1- 20%. Midterm 2 - 20% Final Exam - 30% Lab Assignments, homework, class participation - 30%.

Outline of Statistical Topics

Topics for review and diagnostic test (covers preparatory handouts and Glass and Hopkins, Chapters 1–6)

The laws of linear transformation

Subscript and summation notation

Shape -- Tabulating and depicting data.

Frequency distributions and their properties

Cumulative Frequency

Relative Frequency

Cumulative Relative Frequency

“Axioms of Relative Frequency”

Skewness

Kurtosis

Percentiles

Central Tendency

The Mean

Estimating the mean from a grouped frequency distribution

Computing the mean for pooled groups

The Median

Variability

The Range

The Semi-Interquartile Range

The Variance and Standard Deviation

Computational formulas and their derivation

The normal distribution.

The standard score

Interval probability estimates with the normal curve

The bivariate normal distribution

Measures of relationship.

The linear transform

Definition

Effect on measures of central tendency

Effect on measures of variability

Covariance and Correlation

Effect of linear transforms on the covariance.

The product moment correlation coefficient.

Definition

Effect of linear transforms.

Computational formulas.

Linear regression

General Algebraic Setup for Regression

- Linear regression
 - Computational formulas
 - The “least squares” criterion
 - Solving for the optimal least squares regression coefficients
 - Using linear regression
 - Description
 - Prediction

- Correlational Fallacies
 - Inferring causality
 - Confusing Perfect Correlation with Equivalence
 - Problems with mixed distributions
 - Problems with skewed marginals
 - Restriction of range
 - Shrinkage

The laws of linear combination

- Mean of a linear combination
- Variance and covariance of linear combinations of variates
- A simple heuristic algorithm and its derivation

- The algebra of variances and covariances
 - Deriving some classic results
 - Orthogonality in Regression
 - The “Rich get Richer” phenomenon

- Some Relationships between Geometry and Statistics
 - Vectorial representation of numerical lists
 - The geometry of variance and correlation
 - Seeing a classic result through geometry

Conditional Distribution Theory

- Some basic definitions
 - Bivariate distributions
 - Marginal distributions
 - Conditional distribution

- Bivariate normal distribution

- Some simple consequences
 - Regression toward the mean
 - Conditional distribution calculations

Inferential Statistics.

Probability theory

- Set theory
 - Basic Definitions
 - Set

- Subset
- Proper subset
- Null set
- Universal set
- Operations
 - Union
 - Intersection
 - Complement
- Key Definitions
 - Mutually Exclusive Sets
 - Exhaustive Sets
 - Set Partition
- Basic Theorems in Set Theory
- Probabilistic experiments and sample spaces
- Simple (elementary) and compound events
- Probability axioms
- Three basic theorems of probability theory
- Conditional probability and independence
 - A classic paradox
 - Bayes's Theorem
- Counting rules and combinatorics
 - The General Path Rule
 - Permutations
 - Permutations with selection
 - Combinations
- Random variables and probability distributions
- The binomial distribution
- Expected value and variance of a random variable
 - Effect of a linear transform.
- Covariance and correlation for random variables.
 - Linear combination rules revisited
- The normal approximation to the binomial

Basic theoretical aspects of statistical estimation

- Unbiasedness
- Efficiency
- Consistency

Standard confidence interval estimation logic

- Inverting probability statements
- The critical distance approach – “Taking a stroll with Mr. Mu”

Hypothesis testing logic

- Partitioning the parameter space
- Partitioning the sample space
- Test statistics
- Power and error rates
- Factors influencing power

Tests on means -- a general approach

- When population variances are known
 - 1-sample, 2-sample, and k-sample tests on independent samples

Dependent sample procedures
Extensions for general asymptotic Z-statistics
The central limit theorem

When population variances are unknown, independent samples

Student's t -distribution
Assumptions for the t -test
Robustness
1-Sample t
2-Sample t
 k -Sample t

When population variances are unknown, dependent samples

Repeated measures
Matched samples
2-Sample, matched sample t -test
Generalized Matched Sample t
Assumptions

Confidence intervals on linear combinations of means

Independent Samples
Dependent Samples

Additional Theoretical distributions for use in statistical inference

The Chi-square distribution.
The F distribution.
Noncentral Chi-Square and F distributions

Tests on variances

1-sample
2-sample independent

Tests on proportions

1 and 2-sample independent and dependent procedures.

Tests on correlations

Classical asymptotic theory -- The Pearson-Filon equations.
The Fisher (and related) normalizing transforms.
Independent and dependent sample tests on 1 or two correlations.
Generalized procedures for comparing elements of a correlation matrix.
Robustness problems in correlational significance tests.

The analysis of variance – 1-Factor Fixed and Random Effects.

The models and their underlying statistical assumptions.
The meaning of "effect" in the analysis of variance.
Computational procedures.
Robustness properties of ANOVA.
Multiple comparison procedures.
Error rates (experimentwise, per experiment, per comparison) and the problems of multiple testing.
Planned orthogonal contrasts.
The Scheffe test.
The Tukey test.

Noncentrality Interval Estimation – Confidence Intervals on Effect Size

The analysis of variance – 2-factor fixed, random, and mixed model