

PSYCHOLOGY 6600: RESEARCH DESIGN AND ANALYSIS I
syllabus
Summer 2008

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e-mail	<i>thayne@cpd2.usu.edu</i> (please include “Psych 6600” in the subject line)
phone	Daytime phone: 435-797-2042
required texts	Cohen, B. H. (2001). <i>Explaining Psychological Statistics, 2nd ed.</i> New York: John Wiley & Sons. Green, S. B. & Salkind, N. J. (2005). <i>Using SPSS for Windows and Macintosh: Analyzing and Understanding Data, 4th ed.</i> Prentice Hall.
lecture sessions	Tuesday and Thursday 4:00 – 6:30 pm, EDUC 131
office hours	Wednesday 4:00 – 5:30 pm or by appointment. CPD room 180 or 181 (lab)

purpose

This course is intended to extend the student’s facility with the basic statistical analysis procedures that underlie currently accepted research practice in the social sciences. Primary emphasis will be placed on the analysis of data and interpretation of statistical outcomes, particularly output from SPSS statistical analysis software. See the last page for specific content objectives.

The development of statistical analysis software, while alleviating much of the tedium associated with statistical practice and allowing increasingly sophisticated analyses, has also increased the risk of “garbage-in, garbage-out,” so we will be careful to distinguish between *statistical models, procedures* for testing those models, and specific procedural implementations in SPSS.

contacting the instructor

Students are encouraged to contact me by email or phone. Here are some suggestions for making sure that you can reach me:

- **when emailing**, please include “Psych 6600” in the subject line of your email – this is quite important as it will ensure that your email is filtered into the proper inbox folder on my computer and not deleted as SPAM, which will help me to answer your question promptly.

prerequisites & pretest

This is a graduate-level course in applied statistics. Although the course covers the same basic models and procedures dealt with in introductory classes, it does so in much greater detail. For this reason, the student must already have at least a definitional understanding of all procedures covered in this class. To ensure that each student has the necessary background knowledge, students may not take this course without earning a passing score on the WebCT-administered Pretest. A description of the Educ/Psych 6600 Pretest policy may be retrieved from the CEHS website at <http://www.cehs.usu.edu/ors/6600.htm>.

assignments & grading

Your final grade will be based on

1. Homework approximately 2/3 of grade
2. 3 Exams approximately 1/3 of grade

1. homework sets from cohen text (*due one week after lecture on each chapter*).

chapter 1 p. 11: 1, 2, 3, 5, 7, 8 p. 18: 1, 7 p. 20: 2, 3	chapter 5 p. 135: 1, 2, 3, 5, 6 p. 148: 1, 2, 3, 4 p. 154: 1	chapter 9 p. 265: 3, 4, 5, 7 p. 276: 5, 6, 8	chapter 12 p. 352: 1, 2, 5, 7 p. 371: 3, 5, 6 p. 382: 3, 4, 5	chapter 15 p. 497: 1, 2, 9, 10 p. 515: 1, 4 (not d), 7
chapter 2 p. 31: 2, 5, 6	chapter 6 p. 166: 1, 2, 3, 5, 7 p. 176: 1, 3, 4, 7, 9	chapter 10 p. 296: 2, 3, 7, 8 p. 306: 1, 2, 5 p. 313: 1, 2	chapter 13 p. 397: 1, 2, 3 p. 414: 3, 7, 8	chapter 16 p. 538: 2, 4 p. 555: 2, 3 (just eta squared)
chapter 3 p. 64: 6, 9 p. 73: 1, 3	chapter 7 p. 198: 1, 2, 3 p. 213: 1, 3, 9	chapter 11 p. 325: 2, 3	chapter 14 p. 440 : 1, 2, 3, 7 p. 461: 2, 4, 6 (not b)	chapter 19 p. 685: 2, 4, 6 p. 692: 1, 2, 5, 7
chapter 4 p. 102: 2, 3, 4, 5, 7, 8 p. 112: 1, 3, 5, 7 p. 120: 1, 3, 4	chapter 8 p. 232: 2, 4, 6, 8 p. 240: 1, 3, 5, 9			chapter 20 p. 707: 3, 5 p. 716: 1, 3, 5, 10 p. 725: 1, 2, 5

2. Homework for SPSS lessons (Green and Salkind) may be assigned at the end of class (due the following week).

3. exams

In-class exams will consist of definitions, multiple choice and computations. Examinations will cover all the material discussed in class *and* in the readings. Exams will strongly emphasize material covered since the last exam; however, review questions may be included.

	date	cohen chapters
test 1	26 June	1-8
test 2	10 July	9-12, 19-20
test 3	29 July	13-16

course calendar

date	topic	Cohen chapters	spss lessons	test
6/10	Basic concepts	1-2	1-11	
6/12	Means, variances and Z-scores	3-4	12-18	
6/17	Hypothesis testing and one-sample t-test	5-6	19-22	
6/19	Two-sample t-test	7	24	
6/24	Statistical power and effect size	8		
6/26	Review-- Test 1			Test 1
7/1	Correlation and regression	9-10	31, 33	
7/3	Matched t-test and categorical procedures	11; 19-20	23, 39-41	
7/8	Simple ANOVA	12	25	
7/10	Multiple comparisons	13	25	Test 2
7/15	Two-way ANOVA	14	26	
7/17	Repeated measures ANOVA	15	29	
7/22	Mixed ANOVA designs	16	30	
7/24	No class Pioneer Day			
7/29	Review			Test 3
8/01	Test 3 due			

miscellany

access to spss software

SPSS is required for this course. Microsoft Excel simply does not have the needed functionality and is not an acceptable substitute. The YETC computer lab in the Education Building has SPSS installed on many of its computers. SPSS is also installed on the following campus computer labs: Ag-Science, Sci-Tech Library, and Family Life (see <http://www.sls.usu.edu/> for maps and locations).

Six- and twelve-month licenses for the SPSS Graduate Pack are available from e-academy.com, <http://estore.e-academy.com>. Note that the "Graduate Pack" (not the "Career Starter") is required for this course and would probably be required for thesis/dissertation work.

changes in assignments and schedule

The instructor reserves the right to make changes to this syllabus at any time. Changes will be announced in class.

students needing assistance with the english language

Several assignments in this course require English composition. If you feel you need assistance, please visit the USU Writing Center. They have tutors available to help. Ray B. West Building, Room 104, 797-2712, <http://writingcenter.usu.edu>.

academic integrity – "the honor system"

"Each student has the right and duty to pursue his or her academic experience free of dishonesty. The Honor System is designed to establish the higher level of conduct expected and required of all Utah State University students.

The Honor Pledge: To enhance the learning environment at Utah State University and to develop student academic integrity, each student agrees to the following Honor Pledge: 'I pledge, on my honor, to conduct myself with the foremost level of academic integrity.' A student who lives by the Honor Pledge is a student who does more than not cheat, falsify, or plagiarize. A student who lives by the Honor Pledge:

- Espouses academic integrity as an underlying and essential principle of the Utah State University community;
- Understands that each act of academic dishonesty devalues every degree that is awarded by this institution; and
- Is a welcomed and valued member of Utah State University."

plagiarism

"Plagiarism includes knowingly 'representing, by paraphrase or direct quotation, the published or unpublished work of another person as one's own in any academic exercise or activity without full and clear acknowledgment. It also includes the unacknowledged used of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.' The penalties for plagiarism are severe. They include warning or reprimand, grade

adjustment, probation, suspension, expulsion, withholding of transcripts, denial or revocation of degrees, and referral to psychological counseling.”

students with disabilities

“Reasonable accommodation will be provided for all persons with disabilities in order to ensure equal participation within the program. If a student has a disability that will likely require some accommodation by the instructor, the student must contact the instructor and document the disability through the Disability Resource Center (797-2444), preferably during the first week of the course. Any request for special consideration relating to attendance, pedagogy, taking of examinations, etc., must be discussed with and approved by the instructor. In cooperation with the Disability Resource Center, course materials can

be provided in alternative format, large print, audio, diskette, or Braille.”

withdrawal policy and "i" grade policy

“Students are required to complete all courses for which they are registered by the end of the semester. In some cases, a student may be unable to complete all of the coursework because of extenuating circumstances, but not due to poor performance or to retain financial aid. The term ‘extenuating’ circumstances includes: (1) incapacitating illness which prevents a student from attending classes for a minimum period of two weeks, (2) a death in the immediate family, (3) financial responsibilities requiring a student to alter a work schedule to secure employment, (4) change in work schedule as required by an employer, or (5) other emergencies deemed appropriate by the instructor.”

course learning objectives

1. Basic Framework for Conducting Statistical Analysis

- A. Describe the role of systematic research in improving educational and psychological practice
- B. State how interpretation of statistics depends on design and measurement
- C. Understand the role of randomness in research design and statistical analysis as well as its strengths and limitations
- D. Demonstrate ability to graphically represent data and interpret descriptive statistics
- E. Define statistical power as function of N , α , and effect size
- F. Describe effect sizes as a general concept—measures of magnitude independent of sample size and scale of measurement
- G. Calculate, describe, and interpret measures of effect size and conduct power analysis
- H. Explain statistical significance testing and types of errors in hypotheses testing
- I. Interpret results of statistical significance testing and measures of effect size

2. Fundamental Concepts in Statistical Analysis

- A. Differentiate between:
 - 1) Samples and populations
 - 2) Statistics and parameters
 - 3) Constant and variance
 - 4) Continuous and categorical data
 - 5) Descriptive and inferential statistics
- B. Understand the scales (levels) of measurement in scientific research and the appropriate statistical method to use for each scale
- C. Appropriately generate the following data visualization aides:
 - 1) Frequency distribution
 - 2) Histogram/Stem-and-leaf display
 - 3) Bar charts (including clustered and stacked)
 - 4) Line plots
 - 5) Scatter-plots
- D. Identify the properties of a “normal” distribution and know how to:
 - 1) Qualitatively evaluate normality
 - 2) Use the probability tables of the standard normal distribution
- E. Explain what is meant by independence of observations in statistical analysis
- F. Explain what is meant by homogeneity of variance in statistical analysis
- G. Understand the properties of a sampling distribution and its relation to:
 - 1) Hypothesis testing
 - 2) Test statistics and critical values
 - 3) Type I versus Type II errors
 - 4) One versus two-tailed tests
 - 5) Rejecting the null hypothesis
- H. Learn the role of probability in making statistical inferences

- I. Calculate, describe, and interpret measures of effect size and conduct power analyses
- J. Express results of statistical analyses as both:
 - 1) Estimates with confidence intervals
 - 2) Results of hypothesis tests

3. Competence in Applications of Descriptive Statistics

- A. Calculate and differentiate between measures of central tendency (e.g., mean, trimmed mean, median, mode) and understand the advantages and disadvantages of each
- B. Calculate and differentiate between measures of dispersion (e.g., range, interquartile range, variance, standard deviation, coefficient of variation) and understand the advantages and disadvantages of each

4. Competence in Applications of Inferential Statistics

- A. Select, conduct, and interpret tests of statistical significance
- B. Understand and describe the assumptions of tests of statistical significance
- C. z - and t -tests
 - 1) Define and understand: sampling distribution of the mean, sampling distribution of the difference between means, standard error, central limit theorem
 - 2) Understand the differences between the z - and t -distributions
 - 3) Decide which means hypothesis test to use when the population standard error is known or unknown
 - 4) Decide when to use an independent-samples versus a paired-samples t -test
 - 5) Determine the relationship between the 1-sample t -test and the paired-samples t -test
 - 6) Compute and interpret the measures of effect size from t -tests
 - a. Cohen’s d
 - b. Squared point-biserial correlation coefficient (r^2_{pb})
 - 7) Compute confidence intervals and interpret their meaning in relation to tests of hypotheses
 - 8) Make statements regarding clinical/educational significance
- D. Correlation
 - 1) Define: bivariate frequency distribution, coefficient of determination, covariance, linear relationship, curvilinear relationship, direct and inverse relationships
 - 2) Compute the covariance
 - 3) Compute the Pearson product-moment correlation (r) from the covariance
 - 4) Understand the concepts of valence, magnitude, and linearity in relation to r
 - 5) Use statistical software to construct a scatterplot and interpret it with respect to the following: approximate correlation, linearity, homogeneity of variance, outliers
 - 6) Identify the assumptions underlying the use of Pearson r to describe a relationship and describe how r can be affected by violations of these assumptions
 - 7) Describe the appropriateness of using the Pearson product moment correlation to summarize the relation between

- two variables and ways that the correlation coefficient may be misleading in a particular dataset
- 8) Interpret r^2 as an effect size
 - 9) Read a matrix of correlation coefficients
 - 10) Know under what circumstances to apply alternative correlational techniques (e.g., r_{pb} , phi, Cramer's v , η^2 , Spearman's ρ)
 - 11) Explain the difference between correlation and cause and effect
- E. Simple linear regression
- 1) Define: bivariate normal distribution, coefficient of determination, error of estimate, residual
 - 2) Explain the relationship between correlation and prediction
 - 3) Explain the assumptions underlying the use of r for prediction, and examine data for evidence as to whether they are met
 - 4) Know the equation for a straight line and how to compute the slope and the intercept given two linearly-related continuous variables
 - 5) Use the appropriate equation to predict a score on one variable when the score on another, the correlation between the two variables, and other relevant information, are known
 - 6) Understand the relationship between the slope and r
 - 7) Compute and interpret the standard error of estimate and understand how it varies with r
- F. 1-Way analysis of variance (ANOVA or AOV)
- 1) Define: Rationale for ANOVA, independent and dependent variables, F -distribution, within- and between-group sums of squares, total sum of squares, between- and within-group mean square, F -ratio/ F -test, degrees of freedom, standard errors, error term, η^2 and Ω^2 (as measures of effect size), *post-hoc* and *a priori* pairwise and/or complex comparisons, levels of an independent variable, general linear model
 - 2) Use statistical software to compute the aforementioned statistics, create appropriate graphs, and explain/interpret results
 - 3) Describe the assumptions commonly presumed to underlie the use of analysis of variance and the likely effects of violating them
 - 4) Explain what is meant by partitioning the sum of squares
 - 5) Identify the two components of the total sum of squares in a one-factor experiment
 - 6) Explain the relationship between the t - and the F -ratio
 - 7) Discuss the advantages and disadvantages of using *a priori* and *post-hoc* comparisons
- G. Factorial Analysis of Variance (ANOVA)
- 1) Define: Factorial design, factor level, treatment, classification, grouping variable, main effect, interaction, simple effect, between-subject factor, within-subject factor, 2-Way ANOVA, 3-Way ANOVA, repeated-measures design, mixed design ANOVA
- 2) Describe ANOVA as a special case of the general linear model (GLM)
 - 3) Know the statistical assumptions underlying factorial ANOVA
 - 4) Explain how sum of squared deviations, degrees of freedom, and mean squares are computed for each factor
 - 5) Select the appropriate error terms for forming F -ratios
 - 6) Given the sums of squares and degrees of freedom, compute and interpret F -ratios
 - 7) Compute and interpret partial η^2 and other measures of effect size
 - 8) Distinguish between random and fixed factors
 - 9) Identify when repeated measures ANOVA should be used
 - 10) Create and interpret figures representing ordinal and disordinal interactions
 - 11) Interpret significant interactions in terms of:
 - a. Expectations based on marginal means
 - b. Figural representations of means
 - c. Anticipated differences between pairs of means
 - 12) Correctly conduct and interpret *a priori* planned comparisons and *post-hoc* tests
 - 13) Learn how to use SPSS to carry out factorial ANOVA
- H. Data analysis for nominal and ordinal data
- 1) Define: Chi-square (χ^2) distribution, assumptions for chi-square tests, chi-square goodness of fit (GOF) test, chi-square test of independence, observed frequency, expected frequency, contingency tables, contingency coefficient, Phi, Cramer's V , Fisher's exact test, McNemar Test, odds ratio, Kappa
 - 2) Apply chi-square, including: the selection of the appropriate formula, computation, interpretation of statistical significance and effect size, and conclusions, for the following situations: testing for goodness of fit, testing for independence with a 2 x 2 or larger table, testing the significance of difference between proportions for independent or correlated samples
 - 3) Discuss the relationship between the χ^2 , z , t , and F distributions
 - 4) Interpret chi-square results in relation to degree of association
5. **Competency in Use of Statistical Software (e.g., SPSS)**
- A. Fundamentals of data management and manipulation
 - 1) Assigning variable definitions and variable types
 - 2) Importing/exporting data
 - 3) Recoding and computing new variables
 - 4) Sorting, transposing, and ranking data
 - B. Computation of appropriate statistical procedures
 - C. Interpretation of output from statistical procedures
6. **Develop Skills in Reporting of Statistical Results in APA Style**
- A. Master the basics of APA style for the communicating results of statistical analyses
 - B. Learn how to create tables and figures in APA style