Quantitative Methods in Educational Research II
FS05-CEP-933-001

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Location	224 Erickson Hall
Times	M W 10:20am - 11:40am

Required Text

Ott, R. L. and Longnecker, M. (2001). *An Introduction to Statistical Methods and Data Analysis*. Pacific Grove, CA: Duxbury. (5th Edition) ISBN:0534251226; Please note Errata.

Suggested Text

The following texts/references contains alternative treatments of the topics covered by the Ott & Longnecker text, and could be consulted with profit.

- Kirk, R. E. (1995). *Experimental Design: Procedures for the Behavioral Sciences*, 3rd ed. Pacific Grove, CA: Brooks/Cole.
- Lewis-Beck, S. (1980). *Applied-regression: An Introduction*. Beverly Hills: Sage.
- Weisberg, S. (2005). *Applied Linear Regression, 3rd ed.* New York: John Wiley.

Course Description

This course introduces students to techniques of data analysis and statistical inference commonly employed in educational, sociological, and psychological research. Students will encounter many worked examples drawn from the text. Assignments are structured around the NELS88 and High School & Beyond databases. These databases contains extensive measurements of students' beliefs, aspirations, attitudes, health behaviors, and background, as well as related information from teachers, parents, and schools. The major topics are univariate and multiple regression and one- and two-factor analysis of variance with multiple comparisons and interactions. SPSS will be used, along with some SAS when necessary. We also give an introductory treatment of common instances of dependent observations in research on functional enterprises such as businesses, hospitals, and schools. Knowledge of basic algebra is required, as is adequate understanding of the fundamental principles of descriptive statistics and hypothesis testing (as covered, for example, in CEP 932 or its equivalent). Knowledge of calculus is not required.

Course Objectives

By the end of the course the student should have acquired the ability to:

1. recognize continuous and discrete (or categorical) variables and choose appropriate statistical procedures accordingly;
2. describe the relationship between predictor variables and a continuous outcome variable;
3. find point estimates and confidence intervals, and perform hypothesis tests for regression coefficients;
4. formulate multiple regression models appropriate for various research problems and interpret computer output relevant to those models;
5. delineate assumptions of linear statistical models and examine data to evaluate conformity to those

assumptions;
6. appreciate why experiments may be helpful, when appropriate;
7. formulate analysis-of-variance models, estimate their parameters, and test hypotheses about those parameters;
8. design tests of specific a priori and post hoc contrasts in the context of analysis of variance models;
9. recognize similarities and differences between regression and analysis-of-variance models;
10. identify and control sources of error through experimental design and statistical adjustment;
11. identify observations which may be dependent, and explain the limitations of ordinary techniques for these data;
12. write coherent summaries and interpretations of data analyzed by the above procedures.

Tentative Schedule

Date	Day	Topics	Assignments
8/29	1	Introductions: Course Description, Content, Logistics	
8/31	2	Review: Characteristics of Distributions and Calculation of a *t*-test. Differences in means between two groups, within group variances; sample sizes; sample versus population.	Chapter 6
9/5		**Labor Day Holiday**	
9/7	3	Summation Notation and T-test in Context: Formulas; pooled standard deviation Conceptual introduction to regression: Straight line relationship between two continuous variables; Correlations; Slope and intercept.	Chapter 11: 531-534
9/12	4	Estimating Regression Coefficients: Standard error for regression; Use in constructing t-test, Covariance and correlation.	Chapter 11: 540-545
9/14	5	Assessing Fit & Inference for Regression Coefficients: T-test, estimate/(standard error), inference to a population from sample	Chapter 11: 557-561
9/19	6	Assessing Fit & Inference for Regression Coefficients: Review, Checking assumptions (Regression Analysis with SPSS)	Chapter 11: 576-582 **Assignment 1 Due**
9/21	7	Experimental designs: Motivation for using Multiple Regression (MR): Randomization: Design vs. Statistical Control	Chapter 2: 27-35
9/26	8	Conceptual introduction to multiple regression: Variance accounted for in the outcome	Chapter 12: 617-645

9/28	9	Building MRs: Inference for MRs: Indicators of model fit: coefficients; p-values; R^2; t-tests; F-tests; change in mean square error (MSE or F^2). Interpreting MRs: Forecasting	Chapter 12: 646-657
10/3	10	Interactions in MRs: Effects coding; multiplying to create new variables; interactions including continuous variables.	Chapter 12: 622-623; 670-674
10/5	11	MR Modeling I: Collinearilty, Variable selection, Leverage, Influence	Chapter 13
10/10	12	MR Modeling II: An extended example	**Assignment 2 Due**
10/12	13	Review of Multiple Regression	
10/17	**14**	**Mid-term (short take-home test)**	
10/19	15	Analysis of Experiments: Introduction to ANOVA	Chapter 14: 829-845
10/24	16	Controlling Variation via Design: Sample Size, Power	Chapter 14: 845-848
10/26	17	Comparing More than Two Populations: Some Tools for Inference	Supplemental
10/31	18	Multi-factor experiments: Standard Designs	Chapter 15
11/2	19	Constructing and Testing Linear Combinations of Effects: Contrasts, Adjusting Type I error for multiple comparisons	Chapter 15 **Assignment 3 Due**
11/'7	20	Analysis of Covariance (ANCOVA): controlling for the pre-test, interactions with a pre-test, difference scores	Chapter 16
11/9	21	Analysis of Covariance (ANCOVA): Further examples	Chapter 16
11/14	22	ANOVA for some Fixed-Effects, Random-Effects, & Mixed-Effects Model I	Chapter 17
11/16	23	ANOVA for some Fixed-Effects, Random-Effects, & Mixed-Effects Model II	Chapter 17
11/21	24	Dependence among Observations I: Split-plots, Repeated measures designs	Chapter 18: 1025- 1040 **Assignment 4 Due**
11/23	25	Crossover Designs, Unbalanced Designs	Chapter 18: 1040-1044 Chapter 19

11/28	26	Dependence among Observations II: Hierarchical Linear Models (HLMs)	Supplemental
11/30	27	The HLM as a Mixed-Effects Model for Unbalanced Data	Supplemental
12/5	28	Review of Course: The General Linear Model	
12/7	29	Review of Course: Additional Examples	
12/12		**Exam Week: 12/12-12/16**	

Course Requirements

CEP 932, or an equivalent with the consent of the instructor.

Grading Policy

Read the following very, very carefully:

Your grade, scored from 0 to 100, will be based on the performance of 4 homework assignments, a take-home mid-term exam, and a final, according to the following weights:

Item	%
Homework 1	15
Homework 1	15
Homework 1	15
Homework 1	15
Mid-term	20
Final	20

I encourage you to work on your assignments in groups of 2 or 3. Be sure to participate as an independent contributor, rather than a "sleeping partner" (business term).

Print and submit your homework on time. Chronically late assignments or take-home exam will diminish their collective weight (60% for assignments and 15% for the mid-term) to be determined **at the discretion of the instructor** (we really do not want that).

The mid-term, which draws upon critical content covered through Class 13 (see Schedule), is a take-home that you can really get done in class and so it should not take more than 1 hour. The final covers materials from Class 15 through Class 25.

Letter grades are based on the following conversion from its original score.

Score	Grade
67-73	2.5

74-83	3.0
84-93	3.5
94-100	4.0

How to do well:

1. Allow at least 10 hours per assignment (more likely 15)
2. Organize before you compute
3. Follow examples in handouts
4. Study with others
5. Come to class!
6. Be punctual -- this class can bury you if you get too far behind
7. Be thorough -- respond to all parts of the questions
8. Ask questions in class and come to office hours, attend labs, and review sessions
9. IMPORTANT! Write clearly, be concise, and neat (print work, interspersed with hand-written equations, hand-sketched graphs, etc., is probably best.)

Attendance Policy

The TA will take attendance before each lecture. Punctuality is also a matter of courtesy. Send the TA a note if you know you are going to be absent, or be late.

Academic Integrity

The student, by taking the course, pledges adherence to the basic norms of academic honesty and integrity.

Teaching Assistant

Adam E. Wyse
Room/Hours TBD

Laboratory

Wednesdays (tentative)
Room/Hours TBD