



EPsy 8252 – Methods in Data Analysis for Educational Research II

120 Burton Hall, T, R 11:15 AM–12:30 PM

Spring 2012

Instructor

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COURSE DESCRIPTION

Methods in Data Analysis for Educational Research II is the second course of a two-semester sequence for students in education. *Methods in Data Analysis for Educational Research I* or comparable coursework is a prerequisite for enrolling in *Methods in Data Analysis for Educational Research II*. The two-semester sequence provides in-depth coverage of widely used statistical methods and models and prepares students for advanced statistical coursework such as

- EPsy 8266 – *Statistical Analysis Using Structural Equation Methods*,
- EPsy 8267 – *Applied Multivariate Analysis*,
- EPsy 8268 – *Hierarchical Linear Modeling in Educational Research*,
- EPsy 8282 – *Statistical Analysis of Longitudinal Data*, and/or
- EPsy 8290 – *Item Response Theory*.

Methods in Data Analysis for Educational Research II provides rigorous coverage of statistical methods including linear and generalized linear multiple regression models, qualitative predictors, mixed-effects models, parameter estimation, hypothesis testing, and their application to cross-sectional and repeated measures educational data.

Prerequisites include a sound conceptual understanding of the topics of **Design** (role of research questions, research design including sampling and instrumentation, data analysis, and causal inferences in educational research), **Foundational Topics in Data Analysis** (probability distributions, expected value, variances, covariances, correlations, simple data transformations, central limit theorem, parameters, estimators—least squares, maximum likelihood, sampling distributions, empirical vs. theoretical distributions, statistical null and alternative hypotheses, Type I and Type II errors, power, effect sizes, confidence intervals), **Bivariate Correlation/Simple Regression** (estimation, model checking, hypothesis testing, matrix approach), and **Multiple Linear Regression** (multiple regression for continuous outcomes including polynomials, matrix approach, model fitting and OLS estimation, partial correlations and partial slopes, prediction, coefficient of determination (R^2) and associated confidence interval, standardization, hypothesis testing, model comparison, variable selection and model specification, model checking, interpretation, coding categorical predictors including fixed effects single factor ANOVA, cross-validation, a priori power/sample size calculations).

Furthermore, some knowledge of appropriate data analytic procedures and proper interpretation of results related to these topics is also necessary. Students who are not well versed in these prerequisites are strongly advised to not enroll in Data Analysis II.



COURSE TEXTBOOK & READINGS

The following textbook is required for the course.

- Fox, J. (2008). *Applied regression analysis and generalized linear models* (2nd ed.). Thousand Oaks, CA: Sage.

The following are a list of books/materials/websites that may be useful in further complementing your learning in this course.

- Fox, J. (2009). *A mathematical primer for social statistics*. Thousand Oaks, CA: Sage.
- Fox, J., & Weisberg, S. (2011). *An R companion to applied regression* (2nd ed.). Thousand Oaks, CA: Sage.
- Gelman, A., & Hill, J. (2007). *Data analysis using regression and multilevel/hierarchical models*. New York: Cambridge University Press.
- Sheather, S. J. (2009). *A modern approach to regression with R*. New York: Springer.
- Teetor, P. (2011). *R cookbook*. Sebastopol, CA: O'Reilly.

Lastly, there are several articles that you will need to read during the semester (TBA on the course website). These can be obtained through the *Journals* link on the University of Minnesota Libraries website (<http://www.lib.umn.edu/>). In order to access the full text of the articles, you may need to log in using your University x500 username and password.

COURSE REQUIREMENTS

Discussions/Participation: Students will read all the journal articles and be expected to discuss these articles in class. *Active participation in the course is required by all students.* Active participation includes, but is not limited to, being engaged during the class, asking questions, providing additional insight and material, responding to other students and the instructor, and always being open and inquisitive. This will be worth 5% of your course grade.

Homework Assignments: Students will be expected to develop proficiency in writing coherent summaries and interpretations of data analyzed by the methods introduced in the course. The homework assignments include problems that will help students learn the course material and software through reflection and practice. Several assignments will require students analyze parts of the Early Childhood Longitudinal Study (ECLS) data managed by the National Center for Education Statistics (see <http://nces.ed.gov/ecls/>). Details of this dataset appear in the homework.

Submitted homework assignments must be typed--handwritten assignments will ordinarily receive no credit. Homework assignments that are submitted via e-mail without prior instructor approval will receive no credit. If approval is granted to turn in an assignment via e-mail the *only acceptable format is a PDF file*.

To foster cooperation and collaboration, you are permitted to form groups of no larger than three to work on the labs. For all work handed in, list the names of the group members in alphabetical order. Each assignment will be assigned a grade and this grade will be applied to the individuals within the group.



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You do not need to join a group to be successful in this course. Please choose your work group partners carefully as *I am not willing to manage intragroup conflicts or assign varying grades within a group*. If you are taking the course as S/N I strongly discourage you from joining a group unless the others members are S/N as well. If you are auditing the course I forbid you from joining a group unless you band together with other auditors (auditors hand in no work).

Homework will make up 60% of your course grade. Each assignment will make up an equal proportion of this part of the grade.

End of Course Project: This project will be a comprehensive application of an advanced data analysis. More information will be provided later in the semester. This project will make up 35% of your course grade.

STATISTICAL COMPUTING

Statistical computing is an integral part of statistical work and subsequently EPsy 8252. To support your learning in this area, this course will emphasize the use of R. R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS (<http://www.r-project.org>). It is assumed that everyone enrolled in the course is comfortable using a computer to perform basic statistical analysis (although it is not assumed that you have used R).

While some R syntax and programming is taught during class time, there is also a fair amount that you may need to learn on your own outside of class. There are several resources to help you learn how to program on your own at your own pace:

Tutorials and documentation can be found on the Web (especially through the [Contributed Documentation](#) link on the R homepage). While students have found many useful materials online you should at least obtain (and read) the document called [simpleR](#).

EPsy 8252 is technologically intensive, both during instruction and assignments. Due to the variation in computer systems and the difficulty in assessing problems via email, the instructor and TA may not be able to assist in trouble shooting all problems you may have. In these cases contact the university [Academic and Distributed Computing Services](#) (ADCS) or your systems administrator (if you have one).

DOWNLOADING AND INSTALLING SOFTWARE

The first course requirement is that you download and install the free R software. In order to download and install R your computer must be connected to the Internet. The latest version of R can be obtained from the *R Project for Statistical Computing* at <http://www.r-project.org/>

After navigating to the website click on CRAN under Download, Packages on the left-hand side of the welcome screen. You must choose a server in your country of origin, called a CRAN mirror. After doing so, select the appropriate operating system for your computer–Linux, MacOS, or Windows. For Linux and MacOS, follow the directions at the top of the download page. For Windows, download the base package and install it like any other executable file. On Windows machines you might need to have “administrator” privileges to successfully install and use the program.



You also may want to get *RStudio*™. *RStudio* is a new integrated development environment (IDE) for R. *RStudio* combines an intuitive user interface with powerful coding tools to help you get the most out of R. *RStudio Desktop* is free and can be downloaded at <http://www.rstudio.org/download/>

COURSE TOPIC OUTLINE

Below is a table of course topics with corresponding chapters of the required book.

| | Topic | Chapter |
|----|--|-----------------------------|
| 1 | An Introduction to R | |
| 2 | Review of Multiple Regression | Fox (5-7, 8.1, 9) |
| 3 | Regression with Multiple Categorical Predictors | Fox (8.2, 8.3) |
| 4 | Regression Diagnostics: Checking the Validity of the Model | Fox (11, 12, 13) |
| 5 | Remedies for Regression Problems | Fox (4, 12.2.2, 12.5, 13.2) |
| 6 | Overview of Maximum Likelihood Estimation | Fox (12.5) |
| 7 | Regression with Random Effects | TBA |
| 8 | Regression with Mixed Effects | TBA |
| 9 | Repeated Measures | TBA |
| 10 | Regression with Categorical Response Data | Fox (14) |
| 11 | Additional topics (if time permits) | |

TECHNOLOGY

The course uses technology on a regular basis during both instruction and assessments (e.g., homework assignments, exams, etc.). *Student difficulty with obtaining or operating the various software programs and technologies—including printer trouble—will not be acceptable as an excuse for late work.* Due to the variation in computer types and systems, the instructor or TA may not be able to assist in trouble shooting all problems you may have.

Course Website: Most of the homework assignments, data files, etc. are available on the course website (<http://www.tc.umn.edu/~zief0002/8252.htm>). The website works best with a recent version of *Mozilla Firefox*, *Google Chrome*, or *Safari*.



Mac Users: If you are using a Mac and seem to have problems downloading files, *hold the option-key* while clicking on the link. This should download the file to your desktop. You then need to erase the .txt suffix that is appended to the end of the file. For example, a comma separated value (CSV) file should have the suffix .csv, and not .csv.txt. If all else fails, the materials can be downloaded and printed in the *Educational Psychology Computer Lab* (see section below).

Email: Email is the primary source of communication among instructors, TAs and students for this course. As such, you will be expected to check your email frequently (i.e., at least once per day). As per the University policy, “students are responsible for all information sent to them via their University assigned email account. If a student chooses to forward their University email account, he or she is responsible for all information, including attachments, sent to any other email account.”

EVALUATION OF STUDENT PERFORMANCE

Grades will be based on the end-of-course project (35%), discussion/participation (5%) and homework (60%). Students who wish to receive a Satisfactory (S) must obtain the total points required for a C– grade; anything less will be graded as N (Unsatisfactory).

| Percentage Cutoff | Grade | Percentage Cutoff | Grade | Percentage Cutoff | Grade |
|-------------------|-------|-------------------|-------|-------------------|-------|
| 92.5% | A | 80.5% | B- | 59.5% | D |
| 89.5% | A- | 76.5% | C+ | Below 59.5% | F |
| 86.5% | B+ | 72.5% | C | | |
| 82.5% | B | 69.5% | C- | | |

The letter grade at the right of the table reflects the following descriptions of performance:

- *A*: achievement that is outstanding relative to the level necessary to meet course requirements.
- *B*: achievement that is significantly above the level necessary to meet course requirements.
- *C*: achievement that meets the course requirements in every respect.
- *D*: achievement that is worthy of credit even though it fails to meet fully the course requirements.
- *F*: Represents failure (or no credit) and signifies that the work was either (1) completed but at a level of achievement that is not worthy of credit or (2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an Incomplete (see below). Academic dishonesty in any portion of the academic work for a course shall be grounds for awarding a grade of *F* or *N* for the entire course.

Shortly after the course, you may access your grades on-line at www.onestop.umn.edu, or by calling the Gopher Student Line at 612-624-5200. Labs will be handed back in class or during office hours. Uncollected labs and final projects will be retained for one semester after the course and then discarded.

MISCELLANY REGARDING STUDENT PERFORMANCE

Satisfactory/not satisfactory (S/NS) grading and incompletes: Quoting from the university grading policy, “achievement required for an *S* is at the discretion of the instructor.” Because this is a Ph.D. level course, the minimum criterion for an *S* in this course will be the equivalent of a letter grade of *B–* (not *C–* as in many



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undergraduate courses), which translates into a minimum of 78%. If you are part of a group that receives a letter grade, then the above criteria will be used to assign an *S* or *N*.

Due to possibly differing motivation levels, it is recommended that students taking the course as S/N not be part of a group whose other members are taking the course for a letter grade. S/N people should band together.

People officially auditing the course are not allowed to join work groups or hand in any work. Unofficial audits (just “hanging out”) are also not allowed.

Incompletes for this course will be given on a case-by-case basis. The most valid reason for an incomplete is an unforeseen event that gravely interferes with a student’s ability to perform at an adequate level. Incompletes will not be given for unqualified poor performance.

You are expected to hand in all work on the dates to be determined in the course. If illness or other legitimate scenario prevents the timely handing in of work, you must inform me of this fact during office hours or via email. I reserve the right to judge what constitutes a “legitimate scenario” and I may impose a penalty for late work.

STUDENT RESOURCES

Educational Psychology Computer Lab: The Peik Hall Computer Labs (Peik Hall 325 and Peik Hall 355) will have some open times during the week. These times will be posted on the respective doors. All the machines in the computer lab of Peik Hall 325 and 355 have the course software installed on them. Other computer labs on campus *do not* necessarily have this software installed on them.

Technology Support: The University Academic and Distributing Computing Services (ADCS) offers and supports a wide range of information technology-related services, functions, and processes through their website (<http://www1.umn.edu/adcs/help>). While most support is free to the University community, selected services or extensive consulting may be offered on a fee basis.

Writing Support: The University Center for Writing provides free writing instruction for all University of Minnesota students at all stages of the writing process. For more information, or to set up an appointment, visit their website (<http://writing.umn.edu>).

MISSION STATEMENTS

Quantitative Methods in Education (QME)

The Quantitative Methods in Education (QME) track offers educational opportunities in both quantitative and qualitative methods with a broad array of introductory and advanced coursework. Students who choose QME as their track within educational psychology may specialize in any of four areas: *measurement, evaluation, statistics, and statistics education*. The goal of QME is to provide students with broad but rigorous methodological skills so that they may conduct research on methodologies, may help to train others in methodology, or will have the skills necessary to conduct research in related fields.



Psychological Foundations of Education Program Mission Statement

To apply and generate knowledge of psychological processes and methodological procedures involved in learning and teaching for the betterment and improvement of humans in a wide range of situations.

Department of Educational Psychology Mission Statement

Educational psychology involves the study of cognitive, emotional, and social learning processes that underlie education and human development across the lifespan. Research in educational psychology advances scientific knowledge of those processes and their application in diverse educational and community settings. The department provides training in the psychological foundations of education, research methods, and the practice and science of counseling psychology, school psychology, and special education. Faculty and students provide leadership and consultation to the state, the nation, and the international community in each area of educational psychology. The department's scholarship and teaching enhance professional practice in schools and universities, community mental health agencies, business and industrial organizations, early childhood programs, and government agencies. *Adopted by the Dept. of Educational Psychology faculty October 27, 2004.*

College of Education & Human Development Mission Statement

The new College of Education and Human Development is a world leader in discovering, creating, sharing, and applying principles and practices of multiculturalism and multidisciplinary scholarship to advance teaching and learning and to enhance the psychological, physical, and social development of children, youth, and adults across the lifespan in families, organizations, and communities.

UNIVERSITY OF MINNESOTA POLICIES AND PROCEDURES

Diversity: It is the University Policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities that may affect their ability to participate in course activities or to meet course requirements. Students with disabilities are encouraged to contact me when possible to discuss their individual needs for accommodations.

University Grading Standards

A achievement that is outstanding relative to the level necessary to meet course requirements.

B achievement that is significantly above the level necessary to meet course requirements.

C achievement that meets the course requirements in every respect.

D achievement that is worthy of credit even though it fails to meet fully the course requirements.

S achievement that is satisfactory, which is equivalent to a B- or better.

F (or N) Represents failure (or no credit) and signifies that the work was either completed but at a level of achievement that is not worthy of credit, or was not completed and there was no agreement between the instructor and the student that the student would be awarded an I.

I (Incomplete) Assigned at the discretion of the instructor when, due to extraordinary circumstances, e.g., hospitalization, a student is prevented from completing the work of the course on time. *Requires a written agreement between instructor and student.*



Scholastic Misconduct: Academic integrity is essential to a positive teaching and learning environment. All students enrolled in University courses are expected to complete coursework responsibilities with fairness and honesty. Failure to do so by seeking unfair advantage over others or misrepresenting someone else's work as your own, can result in disciplinary action. The University Student Conduct Code defines scholastic dishonesty as follows:

***Scholastic Dishonesty.** Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic grades, honors, awards, or professional endorsement; or altering, forging, or misusing a University academic record; or fabricating or falsifying of data, research procedures, or data analysis.*

Within this course, a student responsibility for scholastic dishonesty can be assigned a penalty up to and including "F" or "N" for the course. If you have any questions regarding the expectations for a specific assignment or exam, ask.

Credits and Workload Expectations: Generally, when a one-credit course is taken, an average of three hours of learning effort per week (over a full semester) is necessary to achieve an average grade. A student taking a three-credit course that meets for three hours a week should expect to spend an additional six hours a week on coursework.

Additional Statements: This publication/material is available in alternative formats upon request. Please contact *Psychological Foundations Program, Education Sciences Building 250, 612-624-0042*.

The University of Minnesota is an equal opportunity employer and educator.