**EPsy 8282 – Statistical Analysis of Longitudinal Data I**
N647 Elliott Hall, T,R 9:45 AM–11:00 AM
Spring 2012

**Instructor**
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## COURSE DESCRIPTION

The objective of this course is to equip you with modern tools to analyze longitudinal data. Throughout the course you will work labs to provide you with the information for performing data analysis. You are encouraged to form groups of no larger than three to work on the labs.

An alternative title for this course is *Longitudinal Data Analysis using R*. R is a freely-distributed statistics computer program that will be used for the labs, class notes, and class demonstrations. Since this course is designed for applied researchers, it is important you become well-acquainted with at least one statistics program so that ideas from the class can become more fixed in your mind through actual data analysis. I have chosen R because (1) it is free and cross-platform (Windows, Mac, Linux), (2) it is syntax- based so analyses are reproducible, (3) it has a graphics package (**ggplot2**) that is very useful in graphing longitudinal data, and (4) it has an analysis package (**lme4**) and function (`lmer()`) that are easy to use and offer up-to-date methods for the analysis of longitudinal data. I assume you have never used nor heard of R, so the first portion of the lectures and the first lab concentrates on fundamentals of the program.

This course differs from similarly titled courses offered in biostatistics and statistics departments in that (1) we focus on longitudinal analysis in the context of the behavioral sciences, (2) the mathematics are less rigorous, and (3) the emphasis is on application with the use of the **ggplot2** package for graphics and the `lmer()` function in the **lme4** package for data analysis. The required labs are designed for applied researchers with an intermediate knowledge of statistics.

## PREREQUISITES

The required prerequisite for this course is a year-long Ph.D.-level statistics sequence in the social sciences or equivalent. In the Department of Educational Psychology, this is *EPsy 8261, Probability and Inference*, and *EPsy 8262, Regression and the General Linear Model*. It is expected the student has familiarity with multiple regression including dummy coding of predictors. A primer of dummy coding in multiple regression can be found at several sites on the Internet. Additional background in matrix algebra and cross-sectional HLM is also helpful but not required.

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## COURSE TEXTBOOK & READINGS

- Fitzmaurice, G. M., Laird, N. M., & Ware, J. H. (2004). *Applied longitudinal analysis*. New York: Wiley. (Required)
- Long, J. D. (2011). Longitudinal data analysis for the behavioral sciences using R. Thousand Oaks, CA: Sage. (Suggested)
- Teetor, P. (2011). *R Cookbook*. Sebastopol, CA: O'Reilly. (Optional for R)

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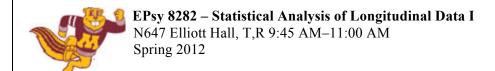
You also may want to get *RStudio™*. *RStudio* is a new integrated development environment (IDE) for R. *RStudio* combines an intuitive user interface with powerful coding tools to help you get the most out of R. *RStudio Desktop* is free and can be downloaded at http://www.rstudio.org/download/

## COURSE REQUIREMENTS

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 lab will be assigned a grade and this grade will be applied to the individuals within the group.

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).

There will be five labs to be worked using R. The labs will be posted on the course website (see below) and the due dates announced in class. The lab topics are (1) Introduction and data restructuring with R, (2) Graphing longitudinal data with ggplot() in the **ggplot2** package, (3) Analysis with lmer() and the **lme4** package, (4) LMER analysis with static predictors, and (5) Modeling nonlinear trajectories.

## COURSE TOPIC OUTLINE

Below is a table of course topics with corresponding chapters of the book (Fitzmaurice, Laird, & Ware, 2004).

| Session | Topic | Chapter |
|---------|-------|---------|
| 1 | Overview of longitudinal analysis | Chapter 1 |
| 2 | An introduction to R | Supplementary Reading |
| 3 | Data structures and longitudinal analysis | Chapter 2 |
| 4 | Graphing longitudinal data with ggplot2 | Supplementary Reading |
| 5 | Introduction to LMER | Chapter 3 |
| 6 | Overview of Maximum Likelihood Estimation | Chapter 4 |
| 7 | Inference with LMER | Chapter 5 |
| 8 | Building models: Selecting predictors and effects | |
| 9 | Modeling nonlinear change | Chapter 6 |
| 10 | Extending LMER | Chapter 7, 8, 9 |
| 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/~zief0002/8282.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

The final grade will be determined by a combination of lab grades. For individuals in groups, the assignment will be at the group level, i.e., all individuals in the group will receive the same grade. See below for students not taking the course for a letter grade.

Grades will be assigned by the following standards:

| 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 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.


**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.

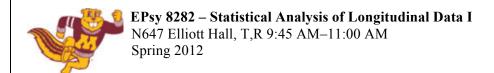*Psychological Foundations of Education Program Mission Statement*
To apply and generate knowledge of psychological processes and methodological procedures involved in learning and teaching for the betterment and improvement of humans in a wide range of situations.

*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 *Quantitative Methods in Education Program, Education Sciences Building 250, 612-624-0042.*

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