PSYCHOLOGY 395
ANALYSIS OF LONGITUDINAL DATA

Dewey Hall Room 238 and Room 128
Thursday 2:30pm-5:30pm
3 credits

Instructor:

Keith Burt, Ph.D.
Dewey Hall Room 340
Keith.Burt@uvm.edu
Office phone: 656-4285
Office Hours: Fridays 10:30am-11:30am and by appointment

GENERAL INFORMATION

Course Website / Contacting: http://bb.uvm.edu/. Handouts, course announcements, Web links, and other important information will be posted on the website. You should familiarize yourself with the Psyc395 Blackboard page and check it frequently for important updates. Email is the best way to reach me, and I generally respond to emails within 24-48 hours. Please use regular email rather than the Blackboard email feature.

Course Overview and Objectives

The primary aim of this course is to introduce tools for the analysis of data gathered on the same individuals over time, with a special focus on linear mixed models (LMMs). Traditional methods, such as the dependent *t*-test and repeated-measures ANOVA and MANOVA, will be discussed as special cases of LMMs. Discussions of treatment of missing data as well as some computational foundations of mixed models, such as maximum likelihood estimation and matrix algebra representations of mixed models, will be included.

Prerequisites for this course include completion of a one-year graduate-level course in multivariate statistics (e.g., PSYC340-341 or the equivalent). The lecture notes and course discussions are aimed at applied researchers with an intermediate statistical background, and for the most part lectures will emphasize conceptual and practical aspects of model-testing.

An important component of this course will be instruction in the free and open-source R software environment, especially the *nlme* package ("nonlinear and linear mixed effects") used to fit LMMs, as well as other selected packages including *ggplot2* ("grammar of graphics plotting"), which is used to create a variety of different types of graphs. Although SPSS, Excel, and other programs may be used from time to time for data manipulation and some statistical analyses, the bulk of the analytic work in this course will be conducted in R, and explicit instruction in R will be an integral part of the course. Although prior experience in R is not expected, students will be expected to make use of free online and printed resources on basic-to-intermediate R techniques to expand their comfort and familiarity with the software.

Textbook (Required)

Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis: Modeling change and event occurrence*. New York: Oxford University Press.

We will work through several sections of the textbook throughout the semester. Additional readings, both journal articles as well as chapters of other books, will be used to supplement the textbook material. These readings will generally be drawn from the "Supplemental Readings" listed at the end of this syllabus.

Advanced Reference Texts (Not required, but may be of interest)

Littell, R. C., Milliken, G. A., Stroup, W. W., Wolfinger, R. D., & Schabenberger, O. (2006). *SAS for mixed models* (2nd ed.) Cary, NC: SAS Institute.
Pinheiro, J. C., & Bates, D. M. (2004). *Mixed-effect models in S and S-PLUS*. New York: Springer.
Verbeke, G., & Molenberghs, G. (2000). *Linear mixed models for longitudinal data.* New York: Springer.

COURSE EVALUATION AND ASSIGNMENTS

Your course grade will be expressed as a percentage of 200 total possible points. This is divided into two major components, lab exercises (100 points total, 50% of final course grade) and the final project (100 points, 50% of final course grade).

Lab exercises: there will be five lab exercises to complete throughout the semester, each worth 20 points. Lab exercises will involve hands-on practice of many topics discussed and demonstrated in class, as well as conceptual and analytic questions about the different steps of analysis. Write-ups for lab exercises will typically be handed in as R code and associated output, interspersed with your commentary as well as any relevant graphs/plots.

Final project: the final project will be worth 100 points, and will represent a complete LMM analysis of a substantive research question in your designated research area. For this project, you are encouraged to use a dataset that you have access to and that is relevant to your own work; however, if you do not have access to appropriate data, a dataset will be provided for you. More information about the structure and format of the final project will be provided in class. Your final project will be evaluated based on the thoroughness and appropriateness of your analyses rather than the statistical significance of your findings.

CLASS SCHEDULE (subject to change throughout the semester, depending on topics and time)

Date	Class	Topic	Reading*	Due
9/3	1	Course introduction; matrix algebra; setting up R		
9/10	2	R basics; linear models in R; mixed model terminology; intro to graphing/plotting	"Introduction to R" (Bb), ch. 1, 2, Appendix A	
9/17	3	Linear unconditional models; restructuring data; model diagnostics	S&W, chapters 1-3	
9/24	4	(continuation)		Lab 1
10/1	5	Linear conditional models; ML estimation	S&W, chapter 4	
10/8	6	Nonlinear unconditional models	S&W, chapter 6	Lab 2
10/15	---	NO CLASS		

10/22	7	Dependent *t*-test; repeated-measures (M)ANOVA		
10/29	8	Alternative covariance structures	S&W, chapter 7	Lab 3
11/5	9	Nonlinear conditional models		
11/12	10	Dynamic covariates + missing data	S&W, chapter 5	Lab 4
11/19	11	Non-normal response models (GLMMs)		Lab 5
11/26	---	NO CLASS - Thanksgiving		
12/3	12	Summary and wrap-up		
		Final projects due Thursday, December 10		

* Other readings will be required throughout the semester; these will be made available on Blackboard, by sign-out, or will be easily obtainable through the UVM library system. See below for a supplemental readings list.

Supplemental Readings (may be added to throughout the semester)

Bauer, D.J., & Curran, P.J. (2005). Probing interactions in fixed and multilevel regression: Inferential and graphical techniques. *Multivariate Behavioral Research*, *40*, 373-400.

Bryk, A. S., & Raudenbush, S. W. (1987). Application of hierarchical linear models to assessing change. *Psychological Bulletin*, *101*, 147-158.

Long, J. D., & Pellegrini, A. D. (2003). Studying change in dominance and bullying using linear mixed models. *School Psychology Review, 32*, 401-417.

Murray-Close, D., Ostrov, J., & Crick, N. R. (2007). A short-term longitudinal study of growth of relational aggression during middle childhood: Associations with gender, friendship intimacy, and internalizing problems. *Development and Psychopathology*, *19*, 187-203.

Nagin, D. (1999). Analyzing developmental trajectories: A semi-parametric, group-based approach. *Psychological Methods*, *4*, 139-157.

Raudenbush, S. W. (2001). Comparing personal trajectories and drawing causal inferences from longitudinal data. *Annual Review of Psychology*, *52*, 501-525.

Rogosa, D. & Willett, J.B. (1985). Understanding correlates of change by modeling individual differences in growth. *Psychometrika*, *50*, 203-228.

Willett, J. B., & Sayer, A. G. (1994). Using covariance structure analysis to detect correlates and predictors of individual change over time. *Psychological Bulletin, 116*, 363-381.

Willett, J.B., Singer, J.D., & Martin, N.C. (1998). The design and analysis of longitudinal studies of development and psychopathology in context: Statistical models and methodological recommendations. *Development and Psychopathology*, *10*, 395-426.