

Biostatistics 537: Longitudinal Data Analysis - Fall 2009

Room 132 SPHPI	Tuesday & Thursday 10-11:45 am
Donald Hedeker hedeker@uic.edu	Office hours: Tue & Thu 1:00-2:00 pm (or by appt.) SPHPI 955; (312) 996-4896
Text:	Hedeker & Gibbons (2006) Longitudinal Data Analysis
Notes & handouts:	http://www.uic.edu/classes/bstt/bstt513
Computer programs:	PROC GLM, MIXED, GENMOD, NLMIXED, IML in SAS
Homework:	6 problem sets (72% of grade). Turn in at class. Computer output must be edited, only relevant portions submitted with original written discussion.
Exam:	Final Exam - take home (28% of grade - comprehensive)
Auditing:	Must fill out Visitor's Permit. Admissions and Records in Students Services Building (Harrison & Racine) Forms can be processed from 2nd to 10th day of the semester
Drop dates:	9/4/09 (without W) and 10/2/09 (with W)

Prerequisites STAT 411 and BSTT 504, or consent of the instructor. For consent, students must have thorough knowledge of multiple regression and ANOVA modeling, and some knowledge of matrix algebra, maximum likelihood estimation, logistic regression, and SAS.

Learning Objectives In this course, students will learn about statistical techniques for analyzing longitudinal, or repeated measures, data. The course will focus primarily on application of the various statistical models covered, with direct application illustrated using standard statistical software. Thus, students who complete the course will learn how to analyze longitudinal data and interpret the results from such analysis.

Topics Addressed The course will also cover the underlying statistical theory of models for longitudinal data analysis, including derivation and estimation of model parameters. Some of the models and topics for longitudinal data analysis that will be covered include the following:

- Univariate and multivariate analysis of variance for repeated measures
- Random or mixed-effects models (aka HLM or multilevel models)
- Covariance pattern models
- Generalized estimating equations (GEE) models
- Mixed-effects logistic regression models
- Missing data in longitudinal studies

Student Responsibilities and Resources

Academic Integrity Statement Academic dishonesty is an offense against the University and I am obligated to report any incident to the Associate Dean for Academic Affairs. Academic dishonesty includes (but is not limited to): cheating or assisting someone else in academic dishonesty, plagiarism, unauthorized possession of class materials (e.g., tests, reserve materials), and unauthorized changing of one's grade. Students are encouraged to consult their instructor on rules for proper citation, or website sources such as

<http://www.library.uiuc.edu/learn/handouts/researchprocess.html#citing%20sources>

Two excellent sources which define plagiarism and how to avoid it may be found at:

<http://www.indiana.edu/~wts/pamphlets/plagiarism.shtml>

<http://owl.english.purdue.edu/owl/resource/589/01/>

Students are also strongly encouraged to review UIC's Guidelines on Academic Integrity at

http://www.vcsa.uic.edu/MainSite/departments/dean_of_students/Our+Services/Student+Judicial+Affairs.htm

and the School of Public Health's Student Honor Code at

http://www.uic.edu/sph/shandbook_sphpolicies.htm#honorcode

Disability Statement If you need accommodations because of a disability and are registered with the Office of Disability Services at UIC, if you have emergency medical information to share with me, or if you need special arrangements in case the building must be evacuated, please inform me immediately. Please see me privately after class, at my office, or email me.

Mutual Tolerance and Respect Public health deals with controversial issues from multiple perspectives and consideration of these issues may cause disagreements among us or may evoke strong personal feelings, depending on our individual experience, histories, identities and world-views. Therefore, in all of our interactions and communications, it is important that we strive to have mutual respect and tolerance for one another and for any course guests and members of the community with whom we come into contact.

Approximate Schedule

<i>week</i>	<i>date</i>	<i>topic</i>
1	8/25	Introduction
	8/27	Univariate (randomized block) ANOVA
2	9/1	Univariate (split plots) ANOVA, Sphericity assumption
	9/3	MANOVA growth curve analysis - one group
3	9/8	MANOVA growth curve analysis - multiple groups
	9/10	Mixed-effects regression models (MRM) introduction
4	9/15	MRM with grouping variable; multilevel representation
	9/17	MRM trend analysis; Empirical Bayes estimates
5	9/22	MRM with time-varying covariates
	9/24	MRM with orthogonal polynomials
6	9/29	MRM estimation
	10/1	MRM estimation - ML and REML; Wald and LR tests
7	10/6	Covariance pattern models: introduction
	10/8	Covariance pattern models: estimation
8	10/13	MRM with autocorrelated errors
	10/15	Selection of variance-covariance structure
9	10/20	MRM for dichotomous responses
	10/22	MRM for dichotomous responses
10	10/27	MRM for dichotomous responses: example
	10/29	MRM for dichotomous responses: estimation
11	11/3	Generalized Estimating Equations (GEE) models: introduction
	11/5	GEE models for dichotomous responses
12	11/10	Comparison of GEE and MRM for dichotomous responses
	11/12	MRM for ordinal responses
13	11/17	MRM for nominal responses
	11/19	Missing data in longitudinal studies
14	11/24	Pattern mixture and selection modeling of missing data
	11/26	Thanksgiving (no class)
15	12/1	Sample size calculation for longitudinal studies
	12/3	catch-up and review
16	12/8	Final exam is due

Some texts and collections:

- Brown H. & Prescott R. (1999). *Applied Mixed Models in Medicine*. New York: Wiley.
- Collins L. & Sayer A.G. (Eds.) (2001). *New Methods for the Analysis of Change*. Washington, DC: APA Press.
- Davis C.S. (2002). *Statistical Methods for the Analysis of Repeated Measurements*. New York: Springer.
- Demidenko E. (2004). *Mixed Models: Theory and Applications*. New York: Wiley.
- Diggle P.J., Heagerty, P., Liang K.-Y., & Zeger, S.L. (2002). *Analysis of Longitudinal Data, 2nd edition*. New York: Oxford University Press.
- Fahrmeir L. & Tutz G. (1994). *Multivariate Statistical Modelling Based on Generalized Linear Models*. New York: Springer-Verlag.
- Fitzmaurice G.M., Laird, N.M. & Ware J. H. (2004). *Applied Longitudinal Analysis*. New York: Wiley.
- Frees E. W. (2004). *Longitudinal and Panel Data: Analysis and Applications in the Social Sciences*. New York: Cambridge University Press.
- Goldstein H. (2003). *Multilevel Statistical Models, 3rd edition*. London: Edward Arnold.
- Hand D. & Crowder M. (1996). *Practical Longitudinal Analysis*. New York: Chapman and Hall.
- Hardin J. W. & Hilbe J. M. (2002). *Generalized Estimating Equations*. New York: Chapman and Hall/CRC.
- Hsiao C. (2003). *Analysis of Panel Data, 2nd edition*. Cambridge: Cambridge University Press.
- Hox J. (2002). *Multilevel Analysis Techniques and Applications*. Erlbaum: Mahwah, New Jersey.
- Jones B. & Kenward M.G. (2003). *Design and Analysis of Cross-Over Trials*. New York: Chapman and Hall/CRC.
- Jones R.H. (1993). *Longitudinal Data with Serial Correlation: A State-Space Approach*. New York: Chapman and Hall.
- Longford N. (1993). *Random Coefficient Models*. New York: Oxford University Press.
- Lindsey J.K. (1999). *Models for Repeated Measurements, second edition*. New York: Oxford University Press.
- McCulloch C.E. & Searle S.R. (2001). *Generalized, Linear, and Mixed Models*. New York: Wiley.
- Molenberghs G. & Verbeke G. (2005). *Models for Discrete Longitudinal Data*. New York: Springer-Verlag.
- Moskowitz D.S. & Hershberger S.L. (Eds.) (2002). *Modeling Intraindividual Variability with Repeated Measures Data*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Pinheiro J.C. & Bates D.M. (2000). *Mixed-Effects Models in S and S-PLUS*. New York: Springer-Verlag.
- Raudenbush S. W. & Bryk A. S. (2002). *Hierarchical Linear Models, 2nd edition*. Thousand Oaks, CA: Sage.
- Singer J.D. & Willett J.B. (2003). *Applied Longitudinal Data Analysis*. New York: Oxford University Press.
- Skrondal A. & Rabe-Hesketh S. (2004). *Generalized Latent Variable Modeling*. New York: Chapman & Hall.
- Snijders T. & Bosker R. (1999). *Multilevel Analysis*. Thousand Oaks, CA: Sage.
- Twisk J.W.R. (2003). *Applied Longitudinal Data Analysis for Epidemiology*. New York: Cambridge University Press.
- Verbeke G. & Molenberghs G. (2000). *Linear Mixed Models for Longitudinal Data*. New York: Springer-Verlag.