

BIO 226: APPLIED LONGITUDINAL ANALYSIS

COURSE SYLLABUS

Spring 2015

Instructor: Dr. Brent Coull
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Office hours: Tuesdays, 3:30-4:30pm (or by appointment)

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Office hours: Starts 2/4/15
Monday, Tuesday, Wednesday 12:30-1:30pm
Location: SPH2-438B (Biostatistics Library Conference Room)

Course Description:

This course covers modern methods for the analysis of repeated measures, correlated outcomes, and longitudinal data, including the unbalanced and incomplete data that are characteristic of biomedical research. Topics include an introduction to the analysis of longitudinal data, the analysis of response profiles, fitting parametric curves, covariance pattern models, random effects and growth curve models, generalized linear models for longitudinal data including generalized estimating equations (GEE), and generalized linear mixed models (GLMMs). We also discuss connections with multilevel modeling.

Class presentations and homework assignments will focus on data analysis in SAS using PROC GLM, PROC MIXED, PROC GENMOD, and PROC NLMIXED.

Prerequisites: BIO 210, BIO 211, BIO 213 or BIO 232 (or signature of instructor)

Meeting Times: Tuesdays and Thursdays, 1:30-3:20

Room: HSPH Kresge Building, Room G1

Format: Lectures with periodic labs to demonstrate and explore statistical methods and SAS programming. Lectures will be videotaped and posted on the course website within a day or two after class.

Course Objectives:

At the completion of the course, you will be able to:

- 1) Describe the statistical methods utilized to analyze longitudinal data in a variety of settings and with a variety of types of outcome variables.
- 2) Analyze a scientific problem that requires repeated measurements, identify an appropriate design, and identify the statistical methods required to analyze the data.
- 3) Utilize SAS procedures GLM, MIXED, GENMOD and NLMIXED to perform longitudinal analyses of data generated from randomized and observational studies with repeated measures designs.
- 4) Apply modern methods for the analysis of longitudinal data to a range of settings encountered in biomedical and public health research
- 5) Interpret and communicate the clinical/scientific meaning of the results of your longitudinal analysis.

Text: Fitzmaurice, G. M., Laird, N. M., and Ware, J. H. (2011). *Applied Longitudinal Analysis*. 2nd Ed. Wiley & Sons. [Very highly recommended—the course follows the text closely]

Lecture slides and handouts will be available for download on the course website.

Requirements: Homework assignments, and two exams.

Grading: Students will be evaluated based on their performance on the homework assignments (40%) and exams (30% each).

Homework assignments are due on the date and time stated on the assignments. No credit will be given for late homeworks unless the student has made prior arrangements by email with the Instructor.

Course Home Page: Accessed through the HSPH Course Gateway. Access is open to registered students and others with a Harvard ID.

Registration: All attendees of classes should register for credit for ordinal or P/F grade, or as an auditor. However, auditing is discouraged—please speak to the instructor if you plan to audit the course. Postdoctoral fellows and other members of the Harvard community may attend but please obtain the Instructor's permission to do so (and obtain access to the course home page).

Classroom Protocol: Students may sometimes be called out of class for professional or personal reasons. Please keep this to a minimum, sit near the door when you may be called out, and step out quietly when you are called. Cell phones and beepers may be left on in class only if they are set on vibration mode.

Emailing TAs: If you have a question about course material, please use the “Questions for TAs” tab on the course webpage. This will enable other students to benefit from the Q&A.

COURSE OUTLINE: Spring 1

NB: Dates and topics are provisional and may be adjusted.

Part I: LINEAR REGRESSION, ANALYSIS OF VARIANCE AND INTRODUCTION TO LONGITUDINAL DATA

Tues. 1/27	School Closed
Thurs. 1/29	Lecture: Introduction Reading: FLW, Chapter 1 Lecture: Review of Linear Regression and One-Way ANOVA Reading: Review notes on regression models from pre-requisite; FLW, Appendix A and Appendix B
Tues. 2/3	Lab 1: SAS Review (targeted for students with no or little prior SAS experience) (Homework assignment 1 available)
Thurs. 2/5	Lecture: Longitudinal Data – Basic Concepts Reading: FLW, Chapter 2

Part II: LINEAR MODELS FOR LONGITUDINAL DATA

Tues. 2/10	School closed
Thurs. 2/12	Lecture: Statistical Basis of Longitudinal Analysis (Part 1) Reading: FLW, Chapter 3 (Homework assignment 1 due)
Tues. 2/17	Lecture: Statistical Basis of Longitudinal Analysis (Part 2) Reading: FLW, Chapter 4
Thurs 2/19	Lab 2: Introduction to PROC MIXED (Homework assignment 2 available)
Tues. 2/24	Lecture: Modelling the Mean – Analysis of Response Profiles Reading: FLW, Chapter 5 (Sections 5.1-5.4, 5.8-5.9)
Thurs. 2/26	Lecture: Modelling the Mean – Adjustment for Baseline Response Reading: FLW, Chapter 5 (Sections 5.5-5.7) (Homework assignment 2 due).
Tues. 3/3	Lab 3: Analysis of Response Profiles using PROC MIXED in SAS (Homework assignment 3 available).
Thurs. 3/5	Lecture: Modelling the Mean – Parametric Curves Reading: FLW, Chapter 7
Tues. 3/10	Lecture: Modelling the Covariance Reading: FLW, Chapter 7 (Homework assignment 3 due).
Thurs. 3/12	Lab 4: Fitting Parametric Curves and Modelling the Covariance Synthesis for Analyzing Longitudinal Data using PROC MIXED in SAS (Homework assignment 4 available).

Tues. 3/17

NO CLASS: SPRING RECESS

Thurs. 3/19

NO CLASS: SPRING RECESS

COURSE OUTLINE: Spring 2

NB: Topics are provisional and may be adjusted.

Part II (continued): LINEAR MODELS FOR LONGITUDINAL DATA

Tues. 3/24	Introduction to Linear Mixed Effects Model: Two-Stage Random Effects Formulation Lecture: Linear Mixed Effects Model Reading: FLW, Chapter 8 (Sections 8.1-8.4)
Thurs. 3/26	Lab 5: Fitting Linear Mixed Effects Models using PROC MIXED in SAS (Homework assignment 4 due) (Homework assignment 5 available)
Tues. 3/31	Lecture: Linear Mixed Effects Model and Prediction Reading: FLW, Chapter 8 (Sections 8.5-8.9)
Thurs. 4/2	Lab 6: Exam Review (Homework assignment 5 due)
Tues. 4/7	Mid-term Exam
Thurs. 4/9	Lecture: Assessing Model fit: Empirical Covariance Estimation and Regression Diagnostics Reading: FLW, Chapter 10 (Homework assignment 6 available)
Tues. 4/14	Lecture: Aspects of Design of Longitudinal Studies Reading: FLW, Chapter 20 (Sections 20.1-20.3) and Chapter 9 (9.5-9.6)

Part III: GENERALIZED LINEAR MODELS FOR LONGITUDINAL DATA

Thurs. 4/16	Lecture: Modern Uses of Mixed Models (Homework assignment 6 due)
Tues. 4/21	Lecture: Logistic and Poisson Regression; Introduction to Generalized Linear Models and Extensions of Generalized Linear Models to Longitudinal Data Reading: FLW, Chapter 11 (Sections 11.2, 11.6-11.7); Chapter 12 (Section 12.1) (Homework assignment 7 available --- this reviews logistic and Poisson regression and will not be graded; solution will be provided for self-review)
Thurs. 4/23	Lecture: Marginal Models and Generalized Estimating Equations Reading: FLW, Chapter 12 (Sections 12.2-12.3); Chapter 13 (Sections 13.1-13.2, 13.4, 13.6)
Tues. 4/28	Lab 7: GEE using PROC GENMOD (Homework assignment 8 available)
Thurs. 4/30	Lecture: Generalized Linear Mixed Models Reading: FLW, Chapter 14
Tues. 5/5	Lab 8: Generalized Linear Mixed Models using PROC NLMIXED (Homework assignment 8 due) (Take-home exam available)
Thurs. 5/7	Lecture: Comparison of Marginal and Mixed Effects Models Reading: FLW, Chapter 16

Tues. 5/12

Lecture: Missing Data and Dropout

Reading: FLW, Chapter 17

Thurs. 5/14

Lecture: Multilevel Models

Reading: FLW, Chapter 22 (Sections 22.1-22.3; 22.5)
(Take-home exam due)