

PHS 651. Advanced Regression Methods for Population Health Sciences (Spring 2019)

Goals: This course provides an overview of modern statistical approaches to longitudinal and correlated data. It seeks to bridge the gap between statistical theory and real-world application by mixing methodological lectures with case studies using diverse types of data arising in health sciences research. Common topics with observational data, such as missing data and weighting techniques, will also be discussed. The main emphasis is on the practical aspects of (clustered-)data analysis.

After taking the course, students will be able to:

- Extend the knowledge of regression analysis beyond ordinary linear models
- Understand the features of correlated data and their implications in drawing inference
- Construct proper linear and generalized linear models for longitudinal and clustered data
- Understand the assumptions needed for estimation and inference
- Implement the inference procedures to solve real-world problems using statistical packages such as SAS and R
- Use diagnostic tools to assess model fit
- Interpret and present the analytic results to answer substantive questions

Prerequisites: Students are expected to have acquired basic knowledge in statistical concepts such as random variables, expectation, and variance, and to have taken a course in ordinary linear models. Prior exposure to matrix algebra and experience with statistical packages such as SAS and R will be helpful but are not required.

Time and Location: MW 2:30—3:45pm, HSLC 1220

Instructor: Lu Mao, PhD
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Readings:

- [Required] Lecture notes posted on Canvas
- [Required] Fitzmaurice, G. M., Laird, N. M., and Ware, J. H. (2012). *Applied Longitudinal Analysis*. New York: Wiley. (Book website: <https://content.sph.harvard.edu/fitzmaur/ala2e/>)
- [Optional] Verbeke, G. and Molenberghs, G. (2000). *Linear Mixed Models for Longitudinal Data*. New York: Springer.
- [Optional] Gelman, A. and Hill, J. (2007). *Data Analysis Using Regression and Multilevel/Hierarchical Models*. Cambridge: Cambridge University Press.

Course Schedule

1/23	Lecture: Reading:	Longitudinal and Clustered Data FLW, Chapter 1
1/28	Lecture: Reading:	Longitudinal Data: Basic Concepts FLW, Chapter 2, Appendix A
1/30	Lab 1:	Introduction to SAS and descriptive/graphical analysis of longitudinal data
2/4	Lecture: Reading:	Overview of Linear Models for Longitudinal Data FLW, Chapter 3
2/6	Lecture: Reading:	Estimation and Statistical Inference FLW, Chapter 4
2/11	Lecture: Reading:	Modeling the Mean: Analyzing Response Profiles FLW, Chapter 5
2/13	Lab 2:	Analyzing Response Profiles using PROC MIXED in SAS
2/18	Lecture: Reading:	Modeling the Mean: Parametric Curves FLW, Chapter 6
2/20	Lab 3:	Fitting Parametric Curves using PROC MIXED in SAS
2/25	Lecture: Reading:	Modeling the Covariance FLW, Chapter 7
2/27	Lab 4:	Fitting Covariance Pattern Models using PROC MIXED in SAS
3/4	Lecture: Reading:	Linear Mixed Effects Models FLW, Chapter 8
3/6	Lecture: Reading:	Fixed Effects versus Random Effects Models FLW, Chapter 9
3/11	Lab 5:	Fitting Linear Mixed Effects Models using PROC MIXED in SAS Fitting Linear Fixed Effects Models using PROC GLM in SAS
3/13	Lecture: Reading:	Residual Analyses and Diagnostics FLW, Chapter 10
3/25	Lecture: Reading:	Review of Generalized Linear Models FLW, Chapter 11
3/27	Lecture: Reading:	Marginal Models: Generalized Estimating Equations FLW, Chapters 12-13
4/1	Lab 6:	GEE using PROC GENMOD in SAS

4/3	Lecture: Reading:	Generalized Linear Mixed Effects Models FLW, Chapter 14
4/8	Lab 7:	Fitting Generalized Linear Mixed Models using PROC GLIMMIX in SAS
4/10	Lecture: Reading:	Contrasting Marginal and Mixed Effects Models FLW, Chapter 16
4/15	Lecture: Reading:	Missing Data and Dropout: Overview of Concepts and Methods FLW, Chapter 17
4/17	Lecture: Reading:	Missing Data and Dropout: Multiple Imputation and Weighting Methods FLW, Chapter 18
4/22	Lab 8:	Multiple Imputation using PROC MI in SAS Inverse Probability Weighted (IPW) Methods in SAS
4/24	Lecture: Reading:	Smoothing Longitudinal Data: Semiparametric Regression Models FLW, Chapter 19
4/29	Lab 9:	Fitting Smooth Curves using PROC MIXED in SAS
5/1	Lecture: Reading:	Multilevel Models FLW, Chapter 21

Office Time and Location: T&Th 2--4pm, instructor's office, or by appointment.

Homework and Exams: One homework every other week; one mid-term, and one data analysis final project.

Grading: 10% attendance; 10% in-class quizzes; 30% homework; 20% mid-term; 30% final project.