The Ohio State University College of Public Health

Models for Continuous and Discrete Longitudinal Data
PUBHBIO 8230: 3 credit hours – Spring, 2017

Instructor: Abigail B. Shoben, Ph.D.
Email: shoben.1@osu.edu
Office: 249 Cunz Hall
Phone: 614-247-8092

Lectures: W/F 9:35am–10:55am, University Hall 028

Office Hours: W/F 11:00am–12:00pm, or by appointment

Course Description: This course will focus on classical and modern approaches to analyze continuous and discrete longitudinal data. Topics include exploratory analysis of correlated data, random effect and growth curve models, likelihood derivations for random effects models, serial correlation, measurement error, Generalized Estimating Equations (GEE), analysis of discrete longitudinal data, estimation with missing data and methods for multivariate longitudinal data.

Prerequisites: STAT 6802 (622) and STAT 6950 (645), or permission of the instructor.

Exclusions: Not open to students with credit for STAT 7470 (726)

Required Text: *Applied Longitudinal Analysis*, 2nd edition, by Fitzmaurice, Laird, & Ware (2011)

Reference Texts: All available as electronic resources through the OSU library:

1. Diggle, Heagerty, Liang & Zeger. (2013). *Analysis of Longitudinal Data.*
2. Fitzmaurice, Davidian, Verbeke, & Molenberghs (eds). (2008). *Longitudinal Data Analysis.*
3. Hedeker & Gibbons. (2006). *Longitudinal data analysis.*
4. Verbeke & Molenberghs. (2009). *Models for Discrete Longitudinal Data.*
5. Verbeke & Molenberghs. (2009), *Linear Mixed Models for Longitudinal Data.*

Class Format: In class lecture and class discussion.

Course Notes: Posted on Carmen prior to each lecture. Materials have been adapted from notes created by Garrett Fitzmaurice, Marie Davidian, and Julian Wolfson.

Carmen: There is a Carmen site for this course: `http://carmen.osu.edu`
Lecture notes, homework assignments and datasets, and answer keys to homework and exams will be posted to Carmen.

Learning Objectives

Upon successful completion of the course, students will be able to:

1. Identify situations in practice where intra-subject/cluster correlations are present for the outcome variable and understand why methods such as linear regression are not adequate for these situations.
2. Construct meaningful and informative graphs that explore the mean and correlation structures of the data.
3. Apply linear mixed effects models or marginal models to analyze outcome data on a continuous scale, including building a model and checking various assumptions.
4. Apply generalized linear mixed models or marginal models to analyze data with categorical or counted responses, including building a model and checking various assumptions.
5. Demonstrate derivations and computational methods for estimating the regression parameters and performing hypothesis tests.
6. Describe the relationship between mixed effects models and marginal models and the strengths and drawbacks of each.
7. Apply appropriate methods to explore the missing data process and obtain consistent estimators and valid inference in the presence of common types of missing data.

Interdisciplinary PhD Program in Biostatistics Competencies

1. Understands the theoretical foundations of statistical methods.
2. Critique general scientific research articles and assess the appropriateness of the statistical applications and methodology involved.
3. Communicate the results of statistical analyses to statistical and non-statistical audiences.

Disability Statement

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. You are also welcome to register with Student Life Disability Services to establish reasonable accommodations. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; `slds.osu.edu`; 098 Baker Hall, 113 W. 12th Avenue.

Mental Health Services

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a students ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Lifes Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614– 292–5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614–292–5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1– 800–273–TALK or at `suicidepreventionlifeline.org`.

Academic Integrity

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University, the College of Public Health, and the Committee on Academic Misconduct (COAM) expect that all students have read and understood the University's *Code of Student Conduct* and the College's *Student Handbook*, and that all students will complete all academic and scholarly assignments with fairness and honesty. The *Code of Student Conduct* and other information on academic integrity and academic misconduct can be found at the COAM web pages (`http://oaa.osu.edu/coam.html`). Students must recognize that failure to follow the rules and guidelines established in the University's *Code of Student Conduct*, the *Student Handbook*, and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the University, or subvert the educational process." Examples of

academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the *Code of Student Conduct* and the *Student Handbook* is never considered an "excuse" for academic misconduct, so I recommend that you review the *Code of Student Conduct* and the *Student Handbook*, specifically, the sections dealing with academic misconduct.

If I suspect a student of academic misconduct in this course, I am obligated by University Rules to report these suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the Universitys *Code of Student Conduct* (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the University.

If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Course Outline: *Subject to change*

Date	Topics	Readings	Activity
1/11	Introduction, historical overview	Ch 1-3	lecture
1/13	Modeling the mean	Ch 5,6	lecture
1/18	Modeling the covariance	Ch 7	lecture
1/20	Descriptive statistics - utility & intuition	n/a	lecture
1/25	Answering scientific questions – outcome measures	TBA	discussion
1/27	Linear mixed models (1)	Ch 8	lecture
2/1	Linear mixed models (2)	Ch 9	lecture
2/3	Linear mixed models (3)	Ch 10	lecture
2/8	Linear mixed models – theory & application	TBA	discussion
2/10	Review generalized linear models, interactions	Ch 11	lecture
2/17	GEE (1)	Ch 12, 13	lecture
2/22	GEE (2)	Ch 13	lecture
2/24	GEE – theory & applications	TBA	discssion
3/1	GLMM introduction	Ch14	lecture
3/3	Fitting GLMMs, tricks & pitfalls	Ch 15	lecture
3/8	Marginal vs̀conditional models	Ch 16	lecture
3/10	Targets of inference	TBA	discussion
3/22	Putting it all together – case studies	n/a	lecture
3/24	In-class Exam		
3/29	Effective communication & simulation study design	n/a	lecture
3/31	Survey of missing data methods	Ch 17,18	lecture
4/5	No class - project meetings		
4/7	Missing data in practice	TBA	discussion
4/12	Sample size consideration	Ch 20	lecture
4/14	Case study – accelerated designs	TBA	discussion
4/19	Final project presentations	n/a	discussion
4/21	Final project presentations	n/a	discussion

Tentative HW due dates: 1/27, 2/15, 2/22, 3/3, 3/22

Software Notes:

R (`http://www.r-project.org/`)

For the purpose of in-class illustration and to get the best computing support from the TA and the instructor, you are highly encouraged to use R for this course. Limited support may be available if you would prefer to use SAS or Stata based on previous experience. R, Stata, and SAS are all available free of charge on the PCs in the Cunz Hall computer labs. R is available as a free download and student licenses are available for SAS and Stata home use (info available at `http://ocio.osu.edu/software/`).

Grading:

Final class grade will be determined as follows:

25%	Homework
30%	In-Class Exam
10%	Class Participation
35%	Final Project & Presentation

Any questions regarding the grading should be addressed **within one week** of the return of the homework or exam. As a general policy, when requested, the regrading will apply to the whole exam or the homework, not just to the specific part which the student thinks there might be a mistake.

Grading Scale:*

94–100	A	87–89	B+	77–79	C+	67–69	D+	$\leq$59	E
90–93	A-	84–86	B	74–76	C	60–66	D		
		80–83	B-	70–73	C-				

**The instructor reserves the right to adjust the grading scale if it appears necessary due to overall class performance. These adjustments will only raise a student's grade, not lower it.*

Midterm Exam:

There will one midterm exam; in class, closed book.
Students who miss taking the exam will be penalized fully in the absence of a documented excuse. Students with a problem taking a midterm exam at the scheduled time must contact the instructor immediately upon discovery of the problem.

Final Project:

The final project will consist of an oral presentation and a written summary. The written summary will be due the date of the final exam (April 26) and oral presentations will take place at the end of the semester. The project will be a simulation project to answer an interesting question in the field of longitudinal data analysis. Students will work **independently** on a topic chosen in consultation with the instructor. Students are encouraged to choose a topic that is relevant to their current or future research interests. More details and a list of possible topics will be provided later in the course.

Class Participation:

As noted on the schedule, several classes are designated as student led discussions of topics in longitudinal data analysis. On these days, all students are expected to have read the assignment prior to class and be prepared to participate. One student, the **presenter**, will begin class with a 20-25 minute review of the concepts presented. Two other students, **discussion leaders**, will be responsible for facilitating discussion and should have several questions prepared in advance of the class.

The class has an expectation of regular attendance and participation on discussion days. Students who anticipate more than sporadic absence (>10% of class days) should discuss their situation with the instructor as soon as possible).

Homework:

Homework will include both written exercises and computer analyses. There will be approximately 5 homework assignments. Students are permitted and encouraged to work together on homework, but submitted assignments must be written independently.

For homework in which R (or another statistical program) is needed, unedited output is unacceptable for answering the questions. Students should give a clear statement of the answer from the output, either in words or a table, as appropriate. Additionally, students should turn their code that generated the output used to answer the question. This requirement is most easily satisfied with an appendix to the homework answers containing the code needed for each question.

Clear and effective communication is crucial in statistical practice. This rule is applied to both homework and exams. It is the student's responsibility to make sure that all answers are justified in enough detail for the grader to understand. Points will be deducted for answers that are not well-justified.

Online Submission:

Students are required to turn homework assignments and the final written project **electronically** via Carmen by the dates/times listed on the course website for each assignment. In order to facilitate grading, **assignments must be submitted as either Microsoft Word documents or as PDF files.** Using Latex or similar program to write up assignments is encouraged, but not required. It is the student's responsibility to ensure that any hand-written problems that are scanned for submission as PDFs are clearly legible.

Disclaimer:

This syllabus should be taken as a fairly reliable guide for the course content. However, you cannot claim any rights from it and in particular I reserve the right to change due dates or the methods of assessment. Official announcements will **always** be those posted on the course website (Carmen).