



**Mel and Enid Zuckerman College of Public Health
University of Arizona**

**SYLLABUS
Longitudinal and Mixed Effects Models (CPH684)
Fall 2014**

Time: Monday and Wednesday (1:00pm – 2:15pm)

Location: Drachman A119

Instructor: Jin Zhou Ph. D.

Office Room: Drachman A242

Phone: 626-1393

Email: jzhou@email.arizona.edu

Office Hours: Monday and Wednesday 4pm-5pm (Appointment Needed)

Catalog Description: This course introduces basic concepts of linear algebra that are essential for understanding more advanced statistical modeling methodology. This knowledge is used to understand the General Linear Model (GLM), which includes linear regression, ANOVA, and other special applications and modern methods for the analysis of repeated measures, correlated outcomes and longitudinal data, including the unbalanced and incomplete data sets characteristic of biomedical research. Topics include an introduction to matrices for statistics, general linear models, analysis of correlated data, random effects models, and generalized linear mixed models.

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.

Course Prerequisites: CPH 576A; CPH 576B

Course Learning 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.

Program Competencies Covered:

- Analytical Skills:** Defines a problem
Determines appropriate uses and limitations of data
Understanding basic research designs used in public health
Makes relevant inferences from data
- Communication Skills:** Communicates effectively both in writing and orally (unless a handicap precludes one of those forms of communication)
Interpreting and presenting accurately and effectively demographic, statistical, and scientific information for professional and lay audiences adapting and translating public health concepts to individuals and communities
Leading and participating in groups to address specific issues, including ability to work in teams, span organizational boundaries and cross systems

Course Notes: Notes will be posted online before lecture

Required Texts/Readings:

(1) Fitzmaurice, G. M., Laird, N. M., and Ware, J. H. (2011). *Applied Longitudinal Analysis*. 2nd Ed. Wiley & Sons.

(2) "Applied Mixed Models in Medicine," Helen Brown and Robin Prescott 2nd Ed. Wiley & Sons

Course Requirements: Successful completion of all homework, examinations, and active class participation.

Grading/Student Evaluation: Homework assignments will be from the texts, and readings. The instructor will provide problems. Due dates will be given for each assignment. Late homework will not be accepted.

On both homework and examinations, partial credit will be given, so always show your work and be as neat and clear as possible. Exams and homework contribute to your final grade as follows:

Homework	30%
Midterm	40%
Final Exam	30%

Final grades are based on the following point system:

A = 90 – 100%

B = 80 – 89%
 C = 70 – 79%
 D = 60 – 69%
 E = 59% or less

Class Attendance/Participation: Attendance will not be traced, but you are responsible for everything that goes on in class, including any alteration to the syllabus. If I make an announcement in class, you are responsible for it.

All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion. Absences pre-approved by the UA Dean of Students (or Dean’s designee will be honored.)

Course Schedule:

Lec	Date	Content	Homework
1	Mon 8/25	Introduction	
2	Wed 8/27	Review linear algebra	
		Holiday	
3	Wed 9/3	Multivariate Normal Distribution and Intro to SAS	Hw1
4	Mon 9/8	Longitudinal Data - Basic Concepts	
5	Wed 9/10	Linear Regression and Analysis of Variance	HW1 Due
6	Mon 9/15	Statistical Basis of Longitudinal Analysis (Part I)	
7	Wed 9/17	Statistical Basis of Longitudinal Analysis (Part II)	HW2
8	Mon 9/22	Modeling the Mean – Analysis of Response Profiles	
9	Wed 9/24	Modeling the Mean – Adjustment for Baseline Response	HW2 Due
10	Mon 9/29	Modeling the Mean – Parametric Curves	HW3
11	Wed 10/1	Modeling the Covariance	
12	Mon 10/6	Fitting Parametric Curves and Modeling the Covariance using PROC MIXED in SAS	HW3 Due/HW4
13	Wed 10/8	Synthesis of Ideas of Analyzing longitudinal Data	
14	Mon 10/13	Introduction to Linear Mixed Effects Model: Two-Stage Random Effects Formulation	HW4 Due
15	Wed 10/15	Linear Mixed Effects Model	
16	Mon 10/20	Fitting Linear Mixed Effects Models using PROC MIXED in SAS	HW5
17	Wed 10/22	Linear Mixed Effects Model and Prediction	
18	Mon 10/27	Exam Review	HW5 Due
--	Wed 10/29	Exam Q & A	
19	Mon 11/3	Midterm Exam	
20	Wed 11/5	Assessing Model Fit	HW6
21	Mon 11/10	Aspects of Design of Longitudinal Studies	
--	Wed 11/12	Review of Logistic and Poisson Regression	HW6 due/HW7
22	Mon 11/17	Introduction to Generalized Linear Models and Extensions of Generalized Linear Models to Longitudinal Data	

23	Wed 11/19	Marginal Models and Generalized Estimating Equations (GEE)	
24	Mon 11/24	GEE using Proc Genmod	HW8
25	Wed 11/26	Generalized Linear Mixed Models and PROC NL MIXED	
26	Mon 12/1	Generalized Linear Mixed Models using PROC NL MIXED	HW8 due/Take home Exam
27	Wed 12/3	Comparison of Marginal and Mixed Effects Models; Missing Data	
28	Mon 12/8	Missing Data and Dropout	
29	Wed 12/10	Guest Lecture	Take home final due

Required Statements:

Communications: You are responsible for reading emails sent to your UA account from your professor and the announcements that are placed on the course web site. Information about readings, news events, your grades, assignments and other course related topics will be communicated to you with these electronic methods. The official policy can be found at: <http://www.registrar.arizona.edu/emailpolicy.htm>

Disability Accommodation: If you anticipate issues related to the format or requirements of this course, please meet with me. I would like us to discuss ways to ensure your full participation in the course. If you determine that formal, disability-related accommodations are necessary, it is very important that you be registered with Disability Resources (621-3268; drc.arizona.edu) and notify me of your eligibility for reasonable accommodations. We can then plan how best to coordinate your accommodations. The official policy can be found at: <http://catalog.arizona.edu/2013%2D14/policies/disability.htm>

Academic Integrity: All UA students are responsible for upholding the University of Arizona Code of Academic Integrity, available through the office of the Dean of Students and online: The official policy found at: <http://deanofstudents.arizona.edu/codeofacademicintegrity>

Classroom Behavior: (Statement of expected behavior and respectful exchange of ideas) The Dean of Students has set up expected standards for student behaviors and has defined and identified what is disruptive and threatening behavior. This information is available at: <http://deanofstudents.arizona.edu/disruptiveandthreateningstudentguidelines>

Students are expected to be familiar with the UA Policy on Disruptive and Threatening Student Behavior in an Instructional Setting found at: <http://policy.arizona.edu/disruptive-behavior-instructional> and the Policy on Threatening Behavior by Students found at: http://deanofstudents.arizona.edu/sites/deanofstudents.arizona.edu/files/Disruptive_threat_bklt_2012.pdf

Grievance Policy: Should a student feel he or she has been treated unfairly, there are a number of resources available. With few exceptions, students should first attempt to resolve difficulties informally by bringing those concerns directly to the person responsible for the action, or with the student's graduate advisor, Assistant Dean for Student and Alumni Affairs, department head, or the immediate supervisor of the person responsible

for the action. If the problem cannot be resolved informally, the student may file a formal grievance using the Graduate College Grievance Policy found at:
<http://grad.arizona.edu/academics/policies/academic-policies/grievance-policy>

Grade Appeal Policy: <http://catalog.arizona.edu/2013-14/policies/gradappeal.htm>

Syllabus Changes: Information contained in the course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate.

Plagiarism: What counts as plagiarism?

- Copying and pasting information from a web site or another source, and then revising it so that it sounds like your original idea.
- Doing an assignment/essay/take home test with a friend and then handing in separate assignments that contain the same ideas, language, phrases, etc.
- Quoting a passage without quotation marks or citations, so that it looks like your own.
- Paraphrasing a passage without citing it, so that it looks like your own.
- Hiring another person to do your work for you, or purchasing a paper through any of the on- or off-line sources.