Math4392: Advanced Linear Models

Spring 2019

Instructor:	Dr. Nan LIN
	Office: Room 205, Cupples I
	Email: nlin@wustl.edu
Time and location:	11am-12pm (MWF), Cupples I Room 115
Office hours:	1-2pm Monday
TA information:	TBA

General information

Textbook: *Generalized, Linear, and Mixed Models*, by Charles E. McCulloch, Shayle R. Searle, John M. Neuhaus. Wiley, 2008. ISBN: 0470073713

Reference book*: *Extending the Linear Model with R*, by Julian J. Faraway. Chapman & Hall/CRC, 2005. ISBN: 158488424X

Class webpage: All homework assignments, handouts, and other information will be available on Canvas (`https://mycanvas.wustl.edu/`). Students should check the class webpage frequently for updates.

*: *ebook available through the university library*

Course Description

This is an advanced course on generalized linear models, linear mixed-effect models and generalized linear mixed-effect models. This course teaches the statistical theory and practice of the aforementioned models, including maximum likelihood estimation, restricted maximum likelihood estimation, generalized estimating equation and so on. The theory will be approached mainly from the frequentist perspective and data analysis using R will be demonstrated. The coverage of this class includes Chapters 1-9 in the Textbook and Chapters 1-10 of the Reference book.

Prerequisite

- **Math and statistics**: Math309 (or 429), Math439 and Math493 (Math494 is strongly preferred). More specifically, this class assumes familiarity with the following topics:
  - Calculus
  - Matrix algebra, such as vectors, matrices, matrix inverse, determinants, linear transformation
  - Multivariate normal distribution
  - Joint, conditional, marginal distributions
  - Change-of-variable formula
  - Estimation
  - Bias, variance, covariance
  - Hypothesis testing

- **Programming**: Familiarity with R is required. If students do not know R but are familiar with languages such as Matlab, Stata and Python, you should be able to learn the basics of R by studying the online book "An Introduction to R" at `http://cran.r-project.org/doc/contrib/Lam-IntroductionToR_LHL.pdf` on Chapters 1-5, Chapter 7 (7.1-7.3) and Chapter 8 (8.1-8.3). Another useful online book on R is "simpleR - Using R for Introductory Statistics" at `http://cran.r-project.org/doc/contrib/Verzani-SimpleR.pdf`.

Computing

Students are **required** to use R to complete all assignments when needed. R is a free software that can be downloaded from http://cran.r-project.org/. It works under major operating systems, including Windows, Linux and Mac OS. An add-on package called '`faraway`' needs to be installed to run the sample programs in the Reference book.

For SAS users: SAS is also a great tool for the analyses in this class. However, for easy access and uniformity, the open-source free R is chosen as the only software for this class.

Homework

Homework will be assigned approximately every other week. Students will have one week to finish and turn in the homework. The grader will grade homework and assign a score for each homework set. Late homework submitted **within 2 days of due date will receive 25% penalty** for each day late. Any homework late by more than 2 days will not be graded and receive zero point.

Examinations

There will be one midterm exam and one **cumulative** final exam. The midterm exam will be held in the regular class time. Both exams will be closed book and closed notes. No "cheat sheet" is allowed. Students can bring a calculator to the exams, but sharing calculators is not allowed.

Make-up exams will **NOT** be given under any circumstances. If verifiable documentation is given for a legitimate absence, then your final exam grade will be reweighted. If a student misses the midterm exam, her/his final will count 50% of the final grade, instead of the usual 30%. However, no reweighting will be given if the final exam is missed, and a course grade of 'Incomplete' will be given.

Exam time and location:

- Midterm: 11am-12pm, Friday March 8, in class
- Final: 10:30am-12:30pm, May 7, at Room 115, Cupples I

Remark: Students who take this class as the math Ph.D. qualifying exam subject will receive three hour final exam, and the decision on your qualifying exam is solely based on your performance on the final exam.

Grading

Grades will be based on the homework sets (50%), the midterm (20%), and the final exam (30%). Cr means D or better if you elect "Credit/No Credit." The final letter grade is given according to the following scale.

$[95, 100]$	$A+$	$[83, 85)$	$B+$	$[65, 75)$	C
$[87, 95)$	A	$[77, 83)$	B	$[60, 65)$	D
$[85, 87)$	$A-$	$[75, 77)$	$B-$	< 60	Fail

Learning Tips

1. Try to show up in all the lectures. Make good notes.
2. Ask questions in class. Your questions may be others' as well. No questions are too elementary, and all deserve to be answered.
3. Discuss with your classmates about your questions. It is perfectly acceptable to work together on homework assignments.
4. Finish homework in time.

Class Policies

1. No auditing is allowed. Students must formally register for this class.
2. Late homework: Late homework submitted **within 2 days of due date will receive 25% penalty** for each day late. Any homework late by more than 2 days will not be graded and receive zero point.
3. Exam conflicts: Prior permission and arrangement only.
4. Collaboration: I encourage discussion of homework in broad, conceptual terms where one student is trying to educate another without giving away the answer, but **all work turned in must be your own**. For example, each student must write his/her own programs in entirety.
5. Academic Integrity: All students are expected to adhere to the university's academic integrity policy. Any student who is found to have cheated on an assignment or exam will receive a zero score for that work, regardless of the extent of the offense.