

STOR 590, FALL 2020
ADVANCED LINEAR MODELS
Instructor: Richard L. Smith

Time of Class: This course is on Mondays, Wednesdays and Fridays, 1:20-2:10 pm. The first class is on Monday, August 10, and the last class is on Monday, November 16. There will be no class on Monday September 7 (Labor Day) or on Monday October 12 (University Day). Final exams are scheduled to take place during November 18-24, but no specific times have been announced as of yet. In any case, my intention is to use a take-home exam (further details below), but that may be changed if I get different instructions from the Registrar's office or the STOR department.

Location: This will be an online class. All class sessions will take place by zoom. Further information about accessing zoom will be give in class or by emails to students.

Instructor: Richard L. Smith, Hanes 303. rls "at" email "dot" unc "dot" edu

Office hours (tentative): Tuesdays (online only) 11:00-12:30; Wednesdays (online only) 9:30-11:00; Wednesdays 4:00-5:00 pm (in person). These office hours may be changed after consultation with the two classes I am teaching this semester; updates will be posted here and announced directly to the class. Instructions for joining an online office hours will be posted on the course sakai page after the course begins. In addition, since there is a half hour gap between this class and the next one, I expect to be able to remain online for at least 10-15 minutes after each class to answer in-person students' questions.

Instructional Assistant and Grader: Jiaying Li, jyjingli "at" live "dot" unc "dot" edu

Prerequisites: STOR 435, STOR 455.

Class Policies.

Although the class was originally designated "Hyflex," it is now an online-only class. All classes will be recorded in real time via zoom and students are expected to attend at the announced time of the class. However, the classes will be recorded, with recordings posted after the class, and I understand there is a small number of students for whom synchronous attendance in class would create a hardship because of time zone differences. For those students, and anyone else for whom synchronous attendance is not possible, you are expected to view the video as soon as possible after class and in any case before the next class. The schedule for assignments and exams will be the same for all students. There will be both in-person and remote office hours, and I may create some additional office hours intended specifically for students in Asian time zones. Full details of the university's policies for the fall semester have been posted at <https://carolinatogether.unc.edu/in-the-classroom/> and these policies will be in force for the resolution of any disputes that arise during the class. I will be keeping track of attendance for administrative purposes, and students who do not attend regularly may receive a warning.

Class Policies

The main thing to emphasize is that regular attendance is still expected whether synchronous or asynchronous. In addition, I would like to remind everyone of a few “dos and don'ts” about zoom meetings: see <http://rls.sites.oasis.unc.edu/ZoomMeetingCodeOfConduct.pdf>. If you have questions about the arrangements for the course, please email the instructor.

Assignments and Exams

The grading of the course will be split among homeworks (25%), midterm exam (35%) and final exam (40%). Homeworks will be given at roughly two-week intervals and will mostly consist of numerical exercises to be completed in R or RStudio. They will be announced on the course sakai page and are to be handed in via the Assignments tab on sakai.

The midterm is planned to be a take-home exam and will also consist primarily of numerical exercises to be conducted in R or RStudio. *Very tentatively*, the exam will be posted online at 6:00 pm Sunday, September 27 and due (via sakai) at 6:00 pm Monday, September 28 (in which case, the September 28 class will be cancelled). However, this will only be finalized after the class begins; let me know if you have a specific conflict with those dates.

Tentatively again, the final exam will be handled the same way, as a take-home with a 24-hour window for completion. The schedule for this will be discussed with the class after the full exam schedule is posted.

You are reminded that the university Honor Code is in effect for this course. For homework assignments, you are allowed to discuss the problems among yourselves, but the work you hand in must be your own; direct copying is not permitted. For exams, whether in-class or take-home, you are expected to work the problems entirely by yourselves and consultation of any kind is forbidden, unless it is with me or the Instructional Assistant.

Course Materials and Topics

Required Text: Extending the Linear Model with R: Generalized Linear, Mixed Effects and Nonparametric Regression Models, Second Edition by Julian J. Faraway, Published 2016, Chapman and Hall/CRC Press.

<https://www.crcpress.com/Extending-the-Linear-Model-with-R-Generalized-Linear-Mixed-Effects-and/Faraway/p/book/9781498720960>

Copies will be available in the Student Stores: you are welcome to obtain your own copy from other courses if you like, but please make sure to get *Second Edition*.

Course Outline:

This course covers topics in linear models going beyond the material in STOR 455. The primary foci will be (a) Generalized Linear Models; (b) Random Effects; (c) Bayesian Statistics; (d) Nonparametric Methods (kernels, splines and related techniques). The course will be heavily computational, using the R statistical package (or RStudio), emphasizing the analysis of large datasets. However, you should expect to see some theoretical derivations as well where these are necessary to motivate the computational procedures; there will be no formal theorem/proof style mathematics. The material is distinct from that in STOR 556, which covers time series analysis; students who took STOR 556 in Fall 2019 are welcome to take STOR 590 as well, but STOR 556 is not a prerequisite for STOR 590. Students who took STOR 556 in Spring 2019 (or STOR 590 in Spring 2020) are not eligible to take STOR 590 in Fall 2020.

Course webpage:

<http://rls.sites.oasis.unc.edu/s590-2020/s590.html>

This is primarily just to publicly advertise the course; the majority of course materials will be placed on the course sakai page and accessible only to registered students.

List of Course Topics

The course is still evolving (including the time it was taught as STOR 556, this is the third time it has been taught) so the following is tentative; I may add or delete topics as I go. Chapter numbers are as in Faraway; however I plan to bring forward the material in Chapter 8 as this gives the general principles used in each of Chapters 2-7.

1. Quick review of linear models and logistic regression (assumed to have been covered in STOR 455).
2. Binary response models (Chapter 2).
3. Generalized linear models: general theory and methods (Chapter 8).
4. Binomial and proportion models (Chapter 3).
5. Count regression (Chapter 5).
6. Contingency tables: two-way, three-way, matched pairs, ordinal variables (Chapter 6 – omit correspondence analysis).
7. Other GLMs: gamma, inverse gaussian, joint modeling of mean and dispersion, quasi-likelihood (omit Tweedie GLM).
8. Random effects: basic concepts, estimation and inference, prediction, diagnostics (first half of Chapter 10).
9. Examples of random effect models: block designs, split plots, nested effects, crossed effects, multilevel models (second half of Chapter 10).
10. Repeated measures (Chapter 11).
11. Bayesian methods (Chapter 12).
12. Generalized linear mixed models (Chapter 13).
13. Introduction to nonparametric regression (Chapter 14).