BMA 590 / ST 590: Statistical Modeling in Ecology • Spring 2019
TuTh 10:15 – 11:30 • 102 David Clark Labs
Course homepage: www.stat.ncsu.edu/people/gross/courses/ST590/
Moodle (for gradebook only): wolfware.ncsu.edu

Instructor: Kevin Gross (kevin_gross@ncsu.edu), 251 David Clark Labs
Office Hours: Tuesday 2:00 – 4:00 (tentative).

Course texts:

1. *Ecological Models and Data in R*, by Benjamin M. Bolker. 2008. Required. (BB)
2. *Mixed Effects Models and Extensions in Ecology with R*, by A. F. Zuur et al. Springer, 2009. Available as an e-book from NCSU libraries. (Z09)

Pre-requisites: Students are expected to be familiar with derivatives and integrals (one semester of calculus is sufficient). Other prerequisites include elementary matrix algebra, basic probability (up to distribution functions for discrete and continuous random variables), and basic statistics (such as one might obtain in ST 511).

Course learning objectives:

1. Students will identify salient features of ecological data that represent unique analytical challenges.

2. Students will learn mathematical relationships among contemporary statistical methods for non-normal and / or correlated data.

3. Students will learn how to apply contemporary statistical methods for non-normal and / or correlated data, with an emphasis on writing code for contemporary statistical software.

4. Students will learn how to critically assess statistical models in the published scientific literature, and identify how those models are used to advance scientific research.

5. Students will learn how to characterize inferences from statistical models succinctly and efficiently.

6. Students will gain proficiency in R.

Anticipated coverage:

Topic	Major book section(s)	Approximate timing
Likelihood (from a frequentist perspective)	BB Ch. 6 – 8	weeks 1 – 3
The bootstrap	--	week 3
Smooth regression	Z09 Ch. 3	week 4
Mixed-effects models	Z09 Ch. 4 – 5	weeks 5 – 6
Data in space and time	Z09 Ch. 6 – 7	weeks 7 – 8
Generalized linear and generalized additive models	Z09 Ch. 9 – 11	weeks 9 – 10
GEEs, GLMMs	Z09 Ch. 12 – 13	weeks 11 – 12
Bayesian basics	BB Ch. 6 – 8	weeks 13 – 15

Computing: I will provide instruction in R, but you may use another computing language or package if you wish. For assignments that involve computing, you will need to turn in both your code and some output.

There is no computer lab associated with this course. However, computing is an essential component of contemporary statistical analysis. I anticipate class sessions in which students work on their own computers.

Assignments: Consult the home page or assignment calendar for assignments and due dates. You are allowed to consult with others when completing assignments, but each person must submit their own work.

Lateness Policy: Please make every effort to turn in homework on time. Late homework will be accepted, but will incur a 25% penalty for each school day that the assignment is late. That is, if a homework is worth 12 points and is due on Thursday, then it will receive a 3 point lateness penalty if submitted Friday, a 6 point lateness penalty if submitted the following Monday, and a 9 point lateness penalty if submitted the following Tuesday. No homework will be accepted more than three school days following the due date without the instructor's explicit permission.

Grading: Final grades will be based on assignments (80%) and class attendance and participation (20%).

BMA / ST 590 -- Statistical Modeling in Ecology

Spring 2019

Instructor: Kevin Gross (email)
Office Hours (251 David Clark Labs): Tuesday 2:00 - 4:00

TA: Rui Zhu (email)
Office Hours (1101 SAS Hall): Friday 9:00 -- 11:00

Syllabus
Schedule
Assignments
Data sets

Schedule:

Class no.	Date	Topic	Lecture materials	Reading	Additional resources
1	Tu Jan 8	Course introduction. Likelihood basics.	overheads	BB 6.0 - 6.2.1.1 (Poisson dist'n: BB 4.5.1.2)	
2	Th Jan 10	Likelihood in two dimensions. Bias.		BB 6.2.1.2, 5.3.0, 6.3.1.1	
3	Tu Jan 15	Likelihood-based confidence intervals.		BB 6.4.1, 6.5	
4	Th Jan 17	Likelihood-based model comparison		BB 6.6.0 - 6.6.2, 6.6.5 - 6.7	
5	Tu Jan 22	Numerical optimization		BB 7.0 - 7.2, 7.4	
6	Th Jan 24	Confidence intervals for functions of parameters		BB 7.5.0 - 7.5.2	
7	Tu Jan 29				
8	Th Jan 31				
9	Tu Feb 5				
10	Th Feb 7				
11	Tu Feb 12				
12	Th Feb 14				
13	Tu Feb 19				
14	Th Feb 21				
15	Tu Feb 26				
16	Th Feb 28				
17	Tu Mar 5				
18	Th Mar 7				
	Tu Mar 12	**SPRING BREAK**			
	Th Mar 14	**SPRING BREAK**			
19	Tu Mar 19				
20	Th Mar 21				
21	Tu Mar 26				
22	Th Mar 28				
23	Tu Apr 2				
24	Th Apr 4				
25	Tu Apr 9				
26	Th Apr 11				
27	Tu Apr 16				
28	Th Apr 18				
29	Tu Apr 23				
30	Th Apr 25				

Assignments:

Additional Resources:

- R Resources
  - Torfs & Brauer's (very) brief introduction to R (recommended if you are new to R)
  - Quick-R
  - CRAN, the comprehensive R archive network
  - RStudio
  - Cookbook for R
  - DataCamp on-line instruction in R and data science
  - Swirl (an R tutorial, in R)
  - Google's R Style Guide (advanced)
  - Some R books:
    - A Beginner's Guide To R (Zuur, Ieno and Meesters, Springer, 2009) (introductory)
    - Introductory Statistics with R (2e, Dalgaard, Springer, 2008) (introductory)
    - Advanced R (Wickham, Chapman & Hall, 2014) (advanced)
- Wiki, website for Bolker book
- Website for Zuur et al. (2009) book

Data sets:
Horse kick data