Syllabus

BST 426 – Linear Models
Spring, 2018

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Office Hours: By appointment
Classes: Monday / Wednesday, 11:00-12:30, SRB 1.402
Dates: January 17 – April 30

Course Description
This is a course on the theory and application of linear models, taught mainly in the framework of normal distributional assumptions. Emphasis will be placed on simple and multiple linear regression, one- and two-way analysis of variance, and analysis of covariance as illustrations of the general theory. A separate course (BST 479) covers generalized linear models, which generalize the traditional linear model to outcomes with certain non-normal distributions.

The following is a list of the major topics to be covered in the course:

- Review of necessary matrix algebra and noncentral univariate distributions
- Properties and characterizations of the multivariate normal distribution
- Linear and quadratic forms – independence and distribution theory
- Distribution theory, estimation, and hypothesis testing in full rank linear models
- Distribution theory, estimation, and hypothesis testing in non-full rank linear models
- One-way analysis of variance
- Simultaneous inference
- Simple linear regression
- Analysis of covariance
- Two-way analysis of variance
- Examination of model assumptions
- Model selection
- Random and mixed effects models (time permitting)
- Polynomial regression (time permitting)

Prerequisites
A course in mathematical statistics (STT 203 – Introduction to Mathematical Statistics) and a good working knowledge of matrix algebra (MTH 235 – Linear Algebra).

Course Aims and Objectives
The course has four major objectives:

1. To provide a detailed understanding of the distribution theory underlying the general linear model.
2. To provide a detailed understanding of procedures for statistical inference (estimation and hypothesis testing) in the context of the general linear model.
3. To illustrate the theory and application of the general linear model with commonly used techniques such as simple and multiple linear regression, one- and two-way analysis of variance, and analysis of covariance.
4. To provide an overview and understanding of additional theoretical and applied aspects of the general linear model such as simultaneous statistical inference, examination of model assumptions, and model selection.

Course Policies and Expectations
The following policies/expectations apply to this course:

*   You are expected to attend all classes. Class participation and questions are encouraged.
*   Cell phones should be turned off or set to vibrate for emergencies.
*   I do not have a fixed schedule for office hours, but I am more than happy to make appointments with students to address questions or anything else related to the class.
*   You are encouraged to discuss homework assignments with other students in the class, but you must write up the final solutions yourself. Students must work entirely independently on examinations.
*   Late homework assignments will be permitted only in case of emergency or with prior approval of the instructor.

Course Materials
The primary textbook for the class is the following:

1. Seber GAF, Lee AJ. Linear Regression Analysis, Second Edition. New York: John Wiley and Sons, 2003.

There are several other books on the subject of linear models; the following may be particularly useful:

2. Searle SR. Linear Models. New York: John Wiley and Sons, 1971.

3. Rao CR. Linear Statistical Inference and its Applications, 2nd Edition. New York: John Wiley and Sons, 1973.

4. Graybill FA. Theory and Application of the Linear Model. Pacific Grove: Wadsworth, 1976.

5. Scheffé H. The Analysis of Variance. New York: John Wiley and Sons, 1959.

6. Christensen R. Plane Answers to Complex Questions: The Theory of Linear Models, Fourth Edition. New York: Springer, 2011.

7. Miller RG Jr. Simultaneous Statistical Inference, 2nd Edition. New York: Springer-Verlag, 1981.

8. Searle SR. Matrix Algebra Useful for Statistics. New York: John Wiley and Sons, 1982.

All books will be available in Karin Gasaway's office. Material for the course will be drawn from all of these sources (and others). The first 5 of these books present the theory of the linear model from an algebraic perspective, whereas the book by Christensen emphasizes the underlying geometry (vector spaces, subspaces, orthogonality, and projections) in its presentation. In this course, the focus will be on the algebraic perspective but some of the geometrical aspects will also be introduced.

Some of the homework assignments will involve the use of SAS software. There will be in-class instruction on how to access the software and run programs to analyze data using linear models.

Assignments and Grading Procedures
The final grade will be based on weekly (approximately) homework assignments (50%), a midterm examination (20%), and a final examination (30%). In general, homework assignments will be due one week after being distributed. Graded assignments will be returned within one week.

The midterm examination will be a take-home examination distributed on Wednesday, February 28 and due on Wednesday, March 7. The date and format of the final examination will be announced at a later time.

Academic Integrity
Academic integrity is a core value of the University of Rochester. Students who violate the University of Rochester "University Policy on Academic Honesty" are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since academic dishonesty harms the individual, other students, and the integrity of the University, policies on academic dishonesty are strictly enforced. For further information on the University of Rochester Policy on Academic Honesty, please see the *Jurisdiction and Responsibility for Academic and Nonacademic Misconduct* section in the **Regulations and University Polices Concerning Graduate Studies**:
http://www.rochester.edu/GradBulletin/PDFbulletin/Regulations.pdf

Accommodations for Students with Disabilities
Students needing academic adjustments or accommodations because of a documented disability must contact the Access Services Coordinator. For information regarding access services and support at SMD, please refer to our webpage:
https://www.urmc.rochester.edu/education/graduate/current-students/disability-supports-services.aspx

Course Schedule
Classes will be held twice per week, but please note that there will be no class held on March 12 and on March 14.