

MATH 542L: ANALYSIS OF VARIANCE AND REGRESSION

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TEACHING ASSISTANT: TBA

CLASSROOM: KAP 113, TIME: MWF 9 – 9:50AM

OFFICE HOURS: MONDAY 1-2.30PM, WEDNESDAY 1.30-3PM, OR BY APPOINTMENT.

General Information:

This course is an introduction to two of the most widely-used statistical tools: regression and analysis of variance. We will cover their theory and see some applications to real data sets, but most of the applications and data analysis will be through data analysis assignments and class projects.

Prerequisites:

Working knowledge (advanced undergraduate level) of Linear Algebra, Probability Theory, and Mathematical Statistics.

(Approximate) list of covered topics:

- random vectors and their characteristics;
- the multivariate normal distribution;
- quadratic forms (QFs), their distribution and properties;
- moment generating functions;
- the linear regression model;
- estimation of regression coefficients & maximum likelihood estimation
- estimation with linear constraints;
- orthogonal design matrices;
- generalized least squares;
- hypothesis testing in regression: the F -test and goodness of fit testing;
- confidence intervals in regression: Student's t , Bonferroni, maximum modulus t , Scheffe's S -Method;
- prediction intervals;
- polynomial regression;
- ANOVA: one-way layout, two-way layout, random effects models, and invariance; analysis of covariance.
- regularization methods including ridge regression and the LASSO;
- multiple testing and the False Discovery Rate (if time permits).

Lecture notes:

Lecture notes will be posted on Blackboard. These are *not* comprehensive lecture notes but just a summary of some portions of the material. For example, many (but not necessarily all) of the main theorems we'll discuss are stated in the notes but their proofs are not. I strongly recommend that you take your own notes during lectures.

Grading:

Course grades will be based on

- (20%) Homework assignments; most problems will be assigned from the textbook. There will also be data assignments; you can use your favorite software, including R, Matlab, and Python.

Important note: assignments should be turned in at the beginning of the lecture on the due date – no credit will be given for assignments turned in any other way unless specified otherwise. If you can not attend the lecture, please contact me in advance and explain the reason.

- (2 × 25%) Two midterm exams that will take place during the lectures on Wednesday, February 14, and Friday, April 6 (possibly Monday, April 9).
- (30%) Final exam (comprehensive) that will take place on Friday, May 4 at 8am in our usual classroom (note that the final exam dates are assigned by the university and can not be changed).
- Please see the registration calendar for additional information, including the last day to drop the course: <https://classes.usc.edu/term-20181/calendar/>.

Books and useful references:

Linear Regression Analysis, 2nd edition, by Seber & Lee will be our main reference; homework problems will be assigned out of it. Two good supplementary books are *Introduction to Linear Regression Analysis* by Montgomery et al., and *Applied Regression Analysis* by Draper & Smith. A good resource for R examples is *Handbook of Statistical Analyses in R* by Everitt & Hothorn.

Students Requiring Special Accommodation:

Any student requesting academic accommodations based on special needs is required to register with DSP each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to the instructor as early in the semester as possible. DSP is located in GFS 120 and is open 8:30 a.m. till 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Academic Integrity:

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. The Student Guidebook contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: <http://www.usc.edu/dept/publications/SCAMPUS/gov/>. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: <http://www.usc.edu/student-affairs/SJACS/>.