STAT 31080
NUMERICAL ANALYSIS IN STATISTICS AND APPLIED MATHEMATICS

Syllabus, Winter 2017

This is a beginning graduate course on selected numerical methods used in modern statistics and applied mathematics. Topics include fundamentals of ODEs and PDEs, quadratures, and Monte Carlo methods. Methods of analysis are introduced including error measures and different notions of numerical convergence. Newton's method, convex optimization and elements of nonconvex optimization are covered, together with implementations in selected selected software packages. The course will discuss codes and case studies for each topic area.

Schedule

LECTURES Mondays and Wednesdays 1:00-2:20 pm Jones 226

Contact Information

Instructors:

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Prerequisites

Prerequisites are Stat 24300 or other background in linear algebra, with permission of the instructors.

Course Structure

The course will have a standard lecture format, and will have four written assignments and a course project. Assignments will have a mix of analysis and simulation. The project requires analysis of a data set and computational problem to be chosen by the student. Students may work in groups of size two on the projects. The projects will be presented during the last week of the course.

Course Calendar

The course calendar and other materials will be posted on the course Piazza website, `https://piazza.com/uchicago/winter2017/stat31080/home`

The schedule of topics and assignments follows.

Week	Date	Topic	Assignments
1	January 2	—	
	January 4 VKL	overview	
2	January 9 L	convex analysis	
	January 11 L	convex optimization, conic programming	assn 1 out
3	January 16	—	
	January 18 L	codes and case studies	
4	January 23 VK	quadrature	
	January 25 VK	ODE, PDE	assn 1 due, assn 2 out
5	January 30 VK	codes	
	February 1 VK	case studies	
6	February 6 L	gradient and Newton methods	
	February 8 L	nonsmooth optimization; Laplacian systems	assn 2 due, assn 3 out
7	February 13 L	codes	
	February 15 L	case studies	
8	February 20 VK	Monte Carlo; measures of error	
	February 22 VK	stochastic differential equations	assn 3 due, assn 4 out
9	February 27 VK	codes	
	March 1 VK	case studies	
10	March 8	project presentations	
	March 10		assn 4 due; projects due

Background Materials

The course will not follow a textbook. The following books and papers may be relevant to some of the course material:

- Golub, Gene and van Loan, Charles, *Matrix Computations*, Johns Hopkins University Press, 2013.
- Boyd, Stephen and Vandenberghe, Lieven, *Convex Optimization*, Cambridge University Press, 2004.
- R. Koenker and I. Mizera, "Convex optimization in R," *Journal of Statistical Software*, Vol 60(5), 2014.
- Liu, Jun S. *Monte Carlo Strategies in Scientific Computing*, Springer, 2001.
- Nesterov, Yuri, *Introductory Lectures on Convex Optimization: A Basic Course*, Springer, 2004.
- Iserles, Arieh. *A First Course in the Numerical Analysis of Differential Equations*, Cambridge Texts in Applied Mathematics, 1996.
- Greenbaum, Anne and Timothy P. Chartier. *Numerical Methods: Design, Analysis, and Computer Implementation of Algorithms*, Princeton University Press, 2012.