Class Meetings: MW 11:00-12:20, DBH 1429
Instructor: Yaming Yu, yamingy@uci.edu
Office Hours: W 2:00-4:00 DBH 2228, or by appointment

Objectives: In-depth exposure to modern computational methods useful in applied statistics; specific topics include optimization, quadrature, Monte Carlo methods, and numerical linear algebra.

Prerequisites: Some background in probability and statistical inference equivalent to two quarters of upper division or graduate coursework. (Possible UCI sequences include Econ 220A-B, Psych 203A-B, Math 201A-B, Math 131A-B-C, Stat 120A-C, Stat 225). Prior experience programming in R or matlab is helpful.

Recommended Texts:

Course Requirements: There will be bi-weekly assignments in addition to a final project. The grade is determined as follows:

- Homeworks 40%, Final Project 50%, Class Participation 10%.

Homeworks and projects should be written up independently. UCI policy on academic honesty will be strictly enforced.

Tentative Outline of Topics:
1. Optimization Methods: Discussion of numerical computation; univariate optimization (search methods, Newton’s method); multivariate optimization; scoring; Guass-Seidel algorithm; EM algorithm for missing data problems.
3. Numerical Linear Algebra and Linear Regression: condition number; Cholesky, QR, singular value decompositions.
4. Numerical Integration: Basic quadrature; importance sampling; variance reduction techniques.
5. Monte Carlo simulation: Random number generation including uniform distributions and other distributions; general simulation methods including inverse cdf and rejection.
6. Simulation via Markov Chains: Metropolis-Hastings; Gibbs sampler; efficiency of Markov chain algorithms; assessing convergence; rates of convergence; improving convergence.
7. Additional Topics (time permitting): advanced Markov chain Monte Carlo including reversible jump MCMC, auxiliary variables, simulated annealing, and perfect simulation; bridge sampling; bootstrap methods, Bayes factor and Bayesian model selection.

Computing:
- Homework and class projects will require computing with a statistical package such as R. This package is freely available: URL: www.r-project.org.