Course Syllabus for STAT 675

March 2022

Description: **Statistical Computing** (3 units) – Techniques of advanced computational statistics. Numerical optimization and integration pertinent for statistical calculations; simulation and Monte Carlo methods including Markov chain Monte Carlo (McMC); bootstrapping; smoothing/density estimation; and other modern topics.

Prerequisite(s): STAT 566/MATH 566, or equivalent, and knowledge of a computer programming language such as R, FORTRAN, C/C++, or Python.

Purpose of Course: To acquaint advanced graduate students in statistics, biostatistics, mathematics, and related fields with the modern methodologies and issues associated with computational statistics.

Current Textbook: Rizzo, M. L. (2019). *Statistical Computing with R*, second edition. Boca Raton, FL: Chapman & Hall/CRC Press.

Topics:	**Book Sections**	**Time**
Review of R Review of the **R** computing environment; workspaces; data entry; calculation; graphics	1	1 week
Numerical Methods Root finding; numerical integration	13.1–13.3	1 week
Optimization Numerical maximization/minimization; EM (Expectation-Maximization) algorithm	14.1–14.2, 14.4–14.5	1 week
Pseudo-Random Numbers Random number generation: Inverse-transform; acceptance-rejection; transformations; multivariate probability calculations	3.1–3.6	4 weeks
Monte Carlo Integration Simulation and Monte Carlo integration; variance reduction; antithetic variables/control variates; importance sampling; stratified sampling	6.1–6.7	2.5 weeks
Bootstrap & Jackknife Resampling Bootstrapping; jackknife resampling; percentile confidence intervals	8.1–8.5	2 weeks
Markov chain Monte Carlo (MCMC) Markov chains; Metropolis-Hastings algorithm; Gibbs sampling; convergence	2.8, 11.1–11.4	2 weeks
Density Estimation Univariate density estimation; kernel smoothing	12.1–12.3	1 week
		14+ weeks