SYRACUSE UNIVERSITY
MAT 653, STATISTICAL COMPUTING
FALL 2012 SYLLABUS

Instructor: Thomas John, Ph.D.
Carnegie 219A, 443-1587(office), 443-3849(message/math-dept), thjohn@syr.edu
Class: Tue & Thu 2:00PM - 3:20PM in Carnegie 311 (Carnegie 100 is the computer cluster that we will use as needed. Carnegie 311 will be the regular meeting room. The days that we will meet in the cluster will be announced in lecture ahead of time.)
Office Hours*(tentative)*: Tue & Thu 9:30-10:30 AM, and by appointment

Text:
Required Reading: *Statistical Computing with R*, by Maria L. Rizzo, ISBN: 9781584885450.
Secondary Reading: *Computational Statistics Handbook with MATLAB*, 2nd Ed, by Wendy L. Martinez & Angel R. Martinez, ISBN: 9781584885665.

Course Description:
(per course catalogue: Simulation and Monte Carlo techniques appropriate where statistical theory does not yet provide a solution. Design and analysis of experiments under nonstandard conditions.)

The overall goal will be to introduce statistical computing topics and the associated implementation via R. We will cover chapters 1-3, 5-6, 9-10 of "Statistical Computing with R", and chapters 10-11 of "Computational Statistics Handbook with MATLAB". If time allows, we will cover a few additional topics (such as the EM Algorithm, Principal Component Analysis, Spline Regression Models, etc). See the end of the syllabus for the listing of key topics.

Prerequisite: MAT 521.

Grading: Grades for the course will be based on the total number of points accumulated on two exams, a number of small assignments/projects, and attendance/participation. The exams will count 20% each, assignments/projects will count 40%, and the attendance/participation 20% toward your grade. The dates for the exams will be announced as the semester progresses.

Attendance: You are expected to attend every class. If you miss a class, it is your responsibility to obtain a copy of the lecture notes for that class from another student. You are also responsible for any announcements about changes to the course schedule, the exam schedule, or the course requirements that were made during that class.

Academic Integrity: The Syracuse University Academic Integrity Policy holds students accountable for the integrity of the work they submit. Students should be familiar with the Policy and know that it is their responsibility to learn about instructor and general academic expectations with regard to proper citation of sources in written work. The policy also governs the integrity of work submitted in exams and assignments as well as the veracity of signatures on attendance sheets and other verifications of participation in class activities. Serious sanctions can result from academic dishonesty of any sort. For more information and the complete policy, see http://academicintegrity.syr.edu.

Learning Goals and Expectations: Students are expected to use/understand probability & statistics related mathematical notations & concepts, master the basic notions of statistical computing, select/apply appropriate computational methods for non-standard statistical problems, and acquire the skills necessary for the applications of these topics.

Disabilities: If you believe that you need accommodations for a disability, please contact the Office of Disability Services (ODS), http://disabilityservices.syr.edu, located in Room 309 of 804 University Avenue, or call (315) 443-4498 for an appointment to discuss your needs and the process for requesting accommodations. ODS is responsible for coordinating disability-related accommodations and will issue students with documented disabilities Accommodation Authorization Letters, as appropriate. Since accommodations may require early planning and generally are not provided retroactively, please contact ODS as soon as possible. You are also welcome to contact me privately to discuss your academic needs although I cannot arrange for disability-related accommodations. Making arrangements with ODS takes time. Do not wait until just before the first test.

Key Course Topics:

- Methods for Generating Random Variables
  - The Inverse Transform Method
  - The Acceptance-Rejection Method
  - Transformation Methods
- Monte Carlo Integration and Variance Reduction
  - Monte Carlo Integration
  - Variance Reduction, Importance Sampling, & Stratified Sampling
- Monte Carlo Methods in Inference
  - Monte Carlo Methods for Estimation
  - Monte Carlo Methods for Hypothesis Tests
- Markov Chain Monte Carlo Methods
  - The Metropolis-Hastings Algorithm
  - The Gibbs Sampler
  - Monitoring Convergence
- Probability Density Estimation
  - Univariate Density Estimation
  - Kernel Density Estimation
- Supervised Learning *(from secondary reading)*
  - Classification Trees
- Unsupervised Learning *(from secondary reading)*
  - Hierarchical Clustering
  - K-Means Clustering
- Numerical Methods in R *(if time allows; from main text)*
  - Maximum Likelihood Problems
  - The EM Algorithm
  - Linear Programming-The Simplex Method
- Finding Structure *(if time allows; from secondary reading)*
  - Principal Component Analysis
- Parametric Models *(if time allows; from secondary reading)*
  - Spline Regression Models
  - Logistic Regression
  - Generalized Linear Models