STAT301: Simulation and Computation Techniques Using S-Plus
May Intercession, 2004
Time: 10:00-11:40, Monday, May 17 – Friday, May 21
and Monday, May 25 – Friday, May 28.
Location: MDLBH 7
Instructor: Athanasios Christou Micheas
Office: 134G Middlebush Building
Office Hours: 12:00-1:00, after class (all week)
(Also by appointment)
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course web site:
http://www.stat.missouri.edu/~amicheas/stat301/stat301.html

Prerequisites: Stat305.

Text:

1) Krause and Olson, Statistics and Computing: The basics of S and S-Plus
2) Sheldon Ross: Simulation, 3rd Edition

Students with disabilities: If you have special needs as addressed by the Americans with Disabilities Act (ADA) and need assistance, please notify the Office of Disability Services, A038 Brady Commons, 882-4696 or the course instructor immediately. Reasonable efforts will be made to accommodate your special needs.

Course Requirements: Regular homework assignments.

Homework: Homework assignments will be made and collected every two days. You may work together on these assignments, but you must formulate and write your own solutions. No credit will be given for answers without supporting work.

• All homework is due at the beginning of class.
• Late homework will not be accepted, except for acts of God, e.g. medical emergencies or death in the family.
• Annotate your output (either with a word processor or by hand) so that we may determine that you have accomplished the goals of the assignment.

Objectives of the course:

The course illustrates simulation and computation techniques using S-PLUS.

In the last two decades there has been an explosion in the statistics literature regarding computation-simulation methods. As technology advanced, researchers were able to visualize what theory was suggesting, about Markov chains, Markov Random fields and in general Bayesian computation. There is a great demand in highly efficient algorithms that would generate random vectors from any distribution we might fit to the data for example, or compute characteristics of a posterior distribution thus aiding the researcher in performing a Bayesian analysis. For instance, calculation of the normalizing constant in closed form, has always been a hard (if not impossible) problem for Bayesians before computers came along. After the mid 80’s, when computing resources were advancing, the illustration of Simulated
Annealing and Gibbs Sampling to image restoration, by Geman and Geman (1984), opened up a new area in Bayesian statistics, and computational statistics in general.

In this course, we begin from the very basic notion of a (pseudo) random number, and continue to discuss different methods for generating discrete and continuous random variables (or vectors). Several classic Monte Carlo methodologies are studied and some applications of the Bootstrap method. The later part of the course is devoted to Markov Chain Monte Carlo algorithms, their theory and their application using S-Plus as the primary programming language.

Topics to be covered:

- (Pseudo) Random Number Generation
- Monte-Carlo Methods: Numerical Approximation of Integrals, Computation of means, probabilities, and powers of statistical tests
- Bootstrap Techniques
- Computing Roots of equations using the Newton-Raphson Algorithm
- Markov Chain Monte Carlo Techniques: Metropolis-Hastings, Gibbs Sampler, Simulated Annealing

IMPORTANT

- Students need to obtain an account (pawprint) with the MU server, bengal.missouri.edu.
- The statistics department has a site license for PC S-PLUS, and it is available for free to students. Details to come. There is a public domain version of S-PLUS called R that is gaining widespread popularity. The R package can be downloaded from http://www.r-project.org.
- For an available list of computing sites offered on campus, please go to http://iat/services.missouri.edu/computing-sites. There should be PC versions of S-Plus installed on the machines of these labs. You'll need your pawprint again to login.