# SOMS 662 Statistical Computing

**Fall 2004 Syllabus**

**Tuesday 5:00-7:40pm Glocker Hall 133**

**Instructor: Russell Zaretzki** 328 SMC
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**Prerequisites**

Experience with Matlab or another programming language such as SPLUS, R, Gauss, C, Fortran etc. Knowledge of statistics and probability at the level of **SOMS 563-564**.

**Office Hours**

TBD or by appointment.

**Course Description**

This course will focus on core computational techniques which are useful for statistical research and advanced applications. The focus will not be on in depth study of basic algorithms of computer science and numerical analysis. Instead we will be interested in developing skills and knowledge useful in the development of modern statistical procedures.

Topics include a brief overview of traditional numerical analysis techniques. A discussion of optimization and root finding methods useful for estimation. A discussion of Numerical and Monte Carlo integration which is useful for statistical inference. The EM algorithm and the Bootstrap will also be covered.

Algorithms for data mining such as CART/recursive partitioning will not be covered in this course. There will be some discussion of symbolic computing using Maple and Mathematica.

**Texts**

Monahan, JF (2001). *Numerical Methods of Statistics.* Cambridge.
This is the basic textbook for the course. Below we give an outline with sections covered.

Williams, D (2001). *Weighing the Odds.* Cambridge.
A nice optional reference on mathematical statistics and probability at an intermediate level. Discussions of theory and algorithms.

Davison, AC (2003). *Statistical Models.* Cambridge
Another optional text. Contains intermediate discussion of mathematical statistics and many statistical models which are commonly used.

An extensive bibliography of useful references will be given on the course web page.

**Grading**
Grades will be based on homework assignments which will be assigned approximately every two weeks. Because this is a practical course, assignments will contain both theoretical exercises along with programming. Answers to specific questions and summary of program results and performance should be well organized and clearly presented. Program code must be well documented and included in an appendix. A final exam may be given depending on departmental policy.

**Programming Languages**
Matlab will be used for class examples and discussion. If access to Matlab is not available, other programming language will be acceptable for assignments. Please discuss with the instructor if you have any questions.

**Participation**
You are strongly encouraged to participate in class discussions. Please ask questions when you have them. This is the first time that I am teaching such a course and I will need feedback to understand which elements of the presentation are unclear. Personal experiences and interests related with this material are also appreciated.

**Course Outline (Very Tentative)**

**Aug 24.** Syllabus, Introduction to Statistical Computing, Computer Arithmetic Sections 2.1, 2.4-2.7.

**Aug 31.** Computer Arithmetic cont. Matrices and Linear Equations 3.1 - 3.7. Hw 1. assigned.

**Sep 7.** More Matrix Decompositions. Chapter 4 and 5.

**Sep 14.** Introduction to Optimization. Chapter 8. Hw 2. assigned.

**Sep 21.** Maximum Likelihood and Nonlinear Least Squares Chapter 9.

**Sep 28.** Optimization Continued. Hw 3 assigned.

**Oct 5.** Integration with Symbolic Computing Systems.

**Oct 12.** Introduction to Numerical Integration. Hw 4 assigned. assigned.

**Oct 19.** Numerical Integration and Monte Carlo Methods.

**Oct 26.** Discrete and Continuous Random Variable Generation. Hw 5 assigned.

**Nov 2.** Continuous Random Variable Generation Continued.

**Nov 9.** Variance Reduction Techniques. Hw 6 assigned.

**Nov 16.** Markov Chain Monte Carlo methods.

**Nov 23.** MCMC and the EM algorithm or class cancelled!

**Nov 30.** The Bootstrap.