Instructor: Dr. Anuj Srivastava (Room OSB 106D, 644-8832)
anuj@stat.fsu.edu
Office hours: Tuesday and Thursday 10:00 – 11:00am or by appointment.

Location: Room 110 OSB, Tue-Thu 2:00 – 3:15pm

Class Website: http://stat.fsu.edu/~anuj/classes/5106-f-06.php

Course Objective:

To gain an understanding of the techniques and ideas used in implementing mathematical/statistical formulations on computers, with a focus on common statistical approaches. Students will also obtain practice in using Matlab.

Prerequisites: Probability theory (discrete and continuous random variables), linear algebra, advanced calculus, and some programming background.

Reference Texts: There is no specific textbook required for this class. Instead it may be useful to purchase Matlab software (student version, approx $100.00 in bookstore). I will use material from these books to prepare class notes.

4. Random Number Generation and Monte Carlo Methods by James Gentle (Springer Verlag, 98).

Topics Covered:

1. Linear Methods for Regression Analysis: Floating point arithmetic and error analysis, multiple regression analysis, orthogonalization by Householder transformations; singular value decomposition (SVD); linear dimension-reduction, principal component analysis (PCA); PCA and linear regression.


3. Elementary Pattern Recognition:
   a. Clustering: distances, data normalization, hierarchical clustering, partitional clustering, k-means clustering. Fisher’s discriminant analysis (FDA), PCA versus FDA.
   b. Classification: Bayesian classification, minimax criterion, k-nearest neighbor classification; Kernel trick, support vector machines, choice of kernels; boosting, Adaboost.
4. **Simulation of Random Variables**: pseudorandom number generators, modular arithmetic, combination generators, discrete and continuous random variables; inverse transform method, acceptance-rejection method, mixture methods.

5. **Monte-Carlo methods for Integration**:
   a. General MC formulation: sample mean and variance
   b. Importance sampling (ex: Cauchy), optimal choice of sampling density
   c. Variance reduction techniques: antithetic variables, control variates, variance reduction by conditioning, importance sampling by twisted simulations.


7. **Special Topics**:

**Tentative Schedule**: Linear Methods (2 weeks), Nonlinear Methods (2 weeks), Pattern Recognition (2 weeks), Simulation of Variables (2 weeks), Monte-Carlo Methods (2 weeks), Dynamic Programming (2 weeks), Special Topics (2 weeks).


**Grading Policy**: Grades will be calculated using the weights: 40% homework, 25% mid-term, 25% final and 5% class participation and 5% in-class quizzes. Both the mid-term and the final will be take-home projects. You will be asked to write a report on the project. These projects are graded for both the solutions and the quality of presentations. Project reports are graded much more strictly compared to the homework. (Final grading will be relative)

**Homework**: It will be assigned every Thursday (on the class website) and will be due the next Thursday in class. Late assignments will not be accepted. Please write clear and detailed answers to the homework problems. If a problem involves writing a program, submit a printout of the code with the solution. It is important to provide illustrative outputs of your programs to accompany the homework solutions. For instance, the graphs should be labeled and placed close to the associated written part. Points are allocated to the level of presentation.

You are allowed to discuss homework problems with other students in the class but you have to prepare and present your own solutions.

There will be separate assignments for undergraduates and graduates.

**Attendance Policy**: It is strictly required to attend all the lectures. It is the student’s responsibility to make up for the material covered in the class during his/her absence.

**Academic Honor System**: 
“The Academic Honor System of The Florida State University is based on the premise that each student has the responsibility to: 1) Uphold the highest standards of academic integrity in the student’s work, 2) Refuse to tolerate violations of academic integrity in the academic community, and 3) Foster a high sense of integrity and social responsibility on the part of University community.”

Please note that violations of this Academic Honor System will not be tolerated in this class. Specifically, incidents of plagiarism of any type or referring to any unauthorized material during examinations will be rigorously pursued by this instructor. Before submitting any work for this class, please read the “Academic Honor System” in its entirety (as found in the FSU General Bulletin and in the FSU Student Handbook) and ask the instructor to clarify any of its expectations that you do not understand.

Students with disabilities needing academic accommodation should: (1) register with and provide documentation to the Student Disability Resource Center; (2) bring a letter to the instructor indicating the need for accommodation and what type. This should be done during the first week of class.