STT 461 Computations in Probability and Statistics

Meets: MW 5:30-6:50, C310 Wells Hall (sometimes in Lab B100A)

Instructor: Professor Raoul LePage,
A428 Wells Hall, entropy@msu.edu, 353-3984

Office Hours: MW, 4:50-5:30 (classroom); Tu, 1:30-2:30 A428 WH

Textbook: Instructor's notes will be posted on HYPERLINK "http://www.stt.msu.edu/~rdl" www.stt.msu.edu/~rdl click on STT461 Spring 2005.

Prerequisites: CPS 131 or CPS 230; MTH 314, STT 441. No previous familiarities with software or statistical ideas will be assumed beyond the prerequisites.

About the subject: Computational statistics is rapidly penetrating all areas of statistical applications and is intimately associated with the development of most advances in statistics today. As you read through the topics below you can begin to see the outlines of an emerging approach to statistics that substitutes general purpose computer intensive methods (Monte Carlo) for many of the specialized formulas and tables of other approaches.

Topics:

Monte Carlo. It is about solving problems with the aid of random samples on computers.
Accuracy of statistical computation. Can a program be trusted?
Statistical Computation tools at the desktop. Some accurate tools for doing statistics at the desktop.
Simulation of random samples having prescribed distributions. This is a common ingredient of most Monte Carlo operations.
Importance Sampling. Weighting enables one type of random sampling to

perform the work of another.

Bootstrap methods. Almost an "automatic statistician's table," Bootstrap can deal with the problem of estimating the distribution of some statistic, as would be needed for a confidence interval. When applicable it eliminates the need to invoke specialized formulas or tables.

Bayesian Method. Can one likewise produce "reasonable" estimators by fairly automatic means? That is one of the things Bayes method gives us.

Markov Chain Monte Carlo (MCMC). This method reduces Bayes calculations to tabulations of Monte Carlo output.

Data Imputation. Sometimes we have missing data. What to do? Sampling from the Bayes distribution of missing data is one approach. It likewise reduces analyses with missing data to tabulations of Monte Carlo output.

Bayes with preliminary data. Bayes method requires a "prior" probability distribution to "get going." The problem of choosing a prior has been the subject of a lot of study but remains complicated in spite of that. One approach uses a portion of the data to construct a prior in a fairly simple way, after which Bayes method is applied to the rest of the data.

Approximate Bayes. By modifying the Markov Chain Monte Carlo we can simplify Bayes analysis, getting approximate Bayes analysis.

Meta statistics. Sometimes we have several statistical studies of the same type or even varying types. How can we combine them to reach overall conclusions?

EM algorithm. Alternates expectation with maximization for such purposes as calculating the maximum likelihood estimator.

Inverse Methods. Bayes method is an example of a linear inverse method. It means that you are essentially solving simultaneous linear equations. There are general Monte Carlo methods for doing that.

Adjustments to the Course Plan: This syllabus is subject to minor adjustments depending upon unforeseen circumstances. In particular there are a number of techniques that are worthy of our study but have not been mentioned above. You will be kept fully informed.

No makeup exams or assignments will be given. With prior approval points may be shifted to a future assignment or exam.

Grading: The following scale is intended as a guide. It may be revised in the case of unforeseen circumstances. You will be kept informed of any changes.

Exam 1 = 15 questions   **Exam 2** = 15 questions
Exam 3 = 15 questions   **Final Exam** = 25 questions
Homework = 80 questions   **Total** = 150.

130+   = 4.0
122 to 130- = 3.5
115 to 122- = 3.0
107 to 115- = 2.5
100 to 107- = 2.0
 97 to 100- = 1.5
 90 to 97- = 1.0

Policy on work sharing. I encourage students to interact and will allow consulting between students prior to submission of homework but not exams. All parties must jointly submit a signed statement outlining the exchange. In such cases points may be shifted from one student to another, but usually in minor degree if the exchange is mild.

Homework. Each week there will be a homework assignment due two weeks later.

Key dates:
    January 10, Monday, first class, late enrollment fee begins.
    January 14, Friday, last day from CR/NCR/visitor; end open adds.
    January 17, Monday, Martin Luther King Day, class will not meet.
    January 24, Wednesday, Exam 1
    February 4, Friday, end of tuition refund period.
    February 21, Wednesday, Exam 2
    March 3, mid-semester, last day to withdraw or drop course with NG

reported; last day to drop class using enrollment system ('til 6 p.m.)

March 7 through 11, Spring break no class.

April 1, last day to withdraw.

Monday, March 28, Exam 3

April 27, Wednesday, last STT 461 class.

May 2, Monday, 8 p.m., Final Exam