STA355H1: Theory of Statistical Practice- Fall 2014

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Lectures: Mondays 2:10-4pm in SS1087, and Wednesdays 2:10-3pm in SS2118

Office hours: Wednesdays 10:30-11:30am in SS6025, or by appointment

Course web page: Available through https://portal.utoronto.ca

Course Goal

The main goal of this course is to provide students with the necessary tools of mathematical statistics necessary to be a good applied statistician. The focus of the course will be on the theory behind statistical methodology (from exploratory data analysis to formal statistical inference) and there will be a substantial data analytic component.

Textbook and readings

Required: *Statistical Models* by A.C. Davison (Cambridge University Press)
We will not make extensive use of this book although it will serve as a valuable reference in subsequent courses. The textbook will be supplemented with a number of required readings in the form of handouts and possibly journal articles, which will be posted on Blackboard.

Other recommended references:

- *Stat Labs: Mathematical Statistics Through Applications* by D. Nolan and T. Speed (Springer)
- *Statistical Inference, 2nd edition* by G. Casella and R. Berger (Duxbury)
- *Mathematical Statistics and Data Analysis, 3rd edition* by J. Rice (Duxbury)

Computing

To recognize the role of computing in mathematical statistics as well as to emphasize the connections between applied and mathematical statistics, we will use R extensively in this course both for data analysis as well as for carrying out simple Monte Carlo experiments. R is free software and can be downloaded (for Windows, Mac, and Linux operating systems) from http://cran.r-project.org. Documentation for R can also be found at www.r-project.org and this site also lists some books related to R. A useful book that gives a good introduction to R programming is

A First Course in Statistical Programming with R by Braun and Murdoch (Cambridge University Press).

Evaluation

The course grade will be based on four homework assignments (7.5% each for a total of 30%), a midterm exam (25%), and a final exam (45%).

- Homework assignments will involve both mathematical exercises as well as some computing using R. Two assignments will be handed in before the midterm and two after.
- The midterm exam is tentatively scheduled for **Monday, October 27, 2014** from **2:10-4pm.** There is no make-up test. If the test is missed for a valid reason and proper documentation is received within a week of the test, the test's weight will be shifted to the final exam.
- The final exam will be held during the December exam period. After October 10, 2014 the details will be posted at the Faculty of Arts and Science website at http://www.artsci.utoronto.ca/current/exams/.

Academic Integrity Policy

Students should familiarize themselves with the University's policies on academic integrity, which can be found at www.artsci.utoronto.ca/osai/students.

Accessibility Needs

The University of Toronto is committed to accessibility. If you require accommodations for a disability, or have any accessibility concerns a bout the course, the classrooms, or course materials, please contact Accessibility Services as soon as possible: disability.services@utoronto.ca or http://studentlife.utoronto.ca/accessibility.

Syllabus

The following topics will be covered in the course:

Short probability review

Random variables, probability distributions and expected values, convergence in distribution and in probability, related theorems (CLT, WLLN etc.), distribution theory for normal samples.

Statistical models

Sampling variation and uncertainty in estimation, order statistics, spacings, standard errors, jackknife estimates of bias and variance, density estimation, introduction to goodness-of-fit.

Point and interval estimation

Substitution principle, likelihood estimation, more on standard errors and their estimation, introduction to Bayesian estimation, confidence intervals, pivots (exact and approximate), credible intervals, bias/variance tradeoffs (in density estimation and non-parametric regression), robustness.

Hypothesis Testing

Elements of hypothesis testing, Neyman-Pearson Lemma and its consequences, p-values (and their behaviour under the null and alternative hypotheses), goodness-of-fit testing, multiple tests.