ORIE 6700 Course Information (Fall 2015)

Class Times:

Lectures: MWF, 1:25–2:15, Hollister Hall 320
Section: Th, 2:55–4:25, Phillips Hall 213

Instructor: Yudong Chen (yudong.chen at cornell dot edu, Rhodes 223)

TA: Chek Hin (Michael) Choi (cc2373)

Exam Times:

Prelim: Oct. 15 (Thursday), 7:30-9:30pm, Phillips 403.
Final: Dec 10 (Thursday), 9:00-11:30am, Hollister 312.
Please contact Prof. Chen if you have an existing conflict with the exam times.

Syllabus:

The course is about how to think rationally about the scientific extraction of information from data. This is a “theory” course, but mathematical formulations will be motivated by applications.

• Basic concepts and models: exponential families, location/scale families, mixture models, order statistics, sufficient statistics, completeness.
• Statistical decision theory: risk, optimality, admissibility, Bayesian framework.
• Hypothesis testing: most powerful tests, Neyman-Pearson and Karlin-Rubin, z/t-tests, Bayesian hypothesis testing.
• Interval estimation: duality with testing, Bayesian credible intervals, p-values.
• Computational statistics: Expectation-Maximization (EM), gradient descent, Markov chain Monte Carlo, Gibbs Sampler, model checking.
• Modern high dimensional statistics: sparse regression, compressed sensing and Lasso, concentration inequalities, non-asymptotic analysis, selected topics.

**Prerequisites:**

• Multivariate calculus including $\varepsilon$-$\delta$ proofs as taught in advanced calculus or mathematical analysis courses, such as Math 4130 at Cornell.

• Linear algebra and matrices (eigenvalues/vectors, SVD)

• One semester of undergraduate probability, including:
  
  o Probabilities, random variables and vectors, probability mass functions and probability density functions. Cumulative distribution functions. Joint probability mass/density functions, independence
  
  o Expected values, moments, moment generating functions, (co)variance
  
  o Modes of convergence (in distribution, in probability, and almost surely)
  
  o The law of large numbers and the central limit theorem
  
  o Basic distributions (normal, uniform, exponential, gamma, beta, chi-square, $t$, $F$, binomial, Poisson, geometric, hypergeometric, negative binomial).

Probability prerequisites can mostly be found in Casella and Berger: Sections 1.1-6, 2.1-3, 3.1-3 & 3.6.1, 4.1-3, 4.5-4.6, 5.1-5. You should read these sections carefully in the first week of class. They may give a more formal treatment of these topics than you have seen before. For a more basic reference, may also wish to consult the textbook, “A First Course in Probability,” by Sheldon Ross, although you are required to understand the material at the level of Casella and Berger.

**Textbooks:**


The last three are not required, but just for your interest and additional reading.
**Office Hours (tentative):**

Yudong Chen: Monday 11:30-12:30, Rhodes 223, or by appointment.
Michael Choi (TA): Tuesday 11:30am - 12:30pm, Rhodes 420

**Web site:**

Log in to http://blackboard.cornell.edu to access course material. You should be automatically given access to the course Blackboard site when you enroll in the course; all course communication is via Blackboard.

**Homework:**

Homework assignments will be posted weekly on Wednesday, and are due the following Wednesday by noon to the course dropbox on the 2nd floor of Rhodes Hall. The first homework will be assigned Sept. 2. The 2 lowest HW grades are dropped before averaging to get the composite grade. No HWs accepted late or to any other location.

You may discuss problems if you find this educational but solutions must be written up individually. Copying is a violation of the honor code.

**Academic Integrity:**

Each student in this course is expected to abide by the Cornell University Code of Academic Integrity. Any work submitted by a student in this course for academic credit will be the student’s own work. See above for the policy regarding homework. The Code is available at:

http://cuinfo.cornell.edu/Academic/AIC.html.

**Grading:**

Grades will be according to: Homework: 20%, Midterm: 30%, Final: 50%.