Fall 2008
ST725: Advanced Theory of Statistics (Estimation Theory and Hypothesis Testing)

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Meets: To be determined. This is listed on the books for MWF at 11 a.m. but the course will be run more as a reading than lecture course. There will be a single meeting a week of approximately an hour and half (to be arranged). We’ll meet as scheduled on Wed. Sept. 3 for our initial meeting.

Grading: There will be no in-class exams. Course grade is based on homework and probably a take-home exam (or two?)

We’ll use the text pretty regularly for reading and some problems. The book is challenging. In a number of places we will supplement the text with journal articles and material from other texts (that will be made available).

Prerequisites: Stat608, Stat605 (Advanced Probability) and ST705 or permission of instructor.

[Those having ST608 and 705 but not having ST605 (which in turn requires M623: Real Analysis) but still wanting a more advanced look at statistical theory than occurs in ST607-608,706 could register to audit or take the course pass/fail.

Description: This course treats the advanced theory of statistics, going into a more advanced treatment of number of topics first seen in ST607-608 plus coverage of some new material. Topics include statistical models; point estimation, hypothesis testing and confidence intervals from a relative frequentist, decision theoretic and Bayesian point of view; consideration of finite sample and asymptotic techniques in a variety of parametric and non-parametric models, with more of an emphasis on commonly used approximate/asymptotic methods. “Application of the theory to single and multi-sample problems, linear and generalized linear models and the analysis of categorical data. Cover also includes the use of estimating equations and “computational” topics; e.g. EM algorithm and (time permitted) the basic theory of the Bootstrap.

Tentative Outline (Topics and reading will be refined as we move along).
The sections refer to Shao’s book. As noted above, we will be reading other journal articles and materials from other books to supplement Shao.

- Probability Theory (Ch. 1). Assumed as part of background (i.e, ST605). You should give this a quick read for review You can skip sections 1.4.4 and 1.5.6. We’ll use parts
of this material more than others in the course. Some gets used very little. So, don’t get bogged down in details and proofs. At this point just focus on a quick review of basic definitions and results.

- Fundamentals of Statistical Inference (Ch. 2) Read all of chapter 2. All the concepts here have been covered in ST607-608, so some sections can be read as review (although the treatment here is a bit more advanced). Emphasis here is on the sections on exponential and location-scale families, sufficiency, statistical decision theory and asymptotic criteria.

- ”Unbiased” Estimation (Ch. 3).
  - UMVUE’s and the information inequality (Section 3.1, but not 3.1.4)
  - Asymptotically unbiased estimators (3.5.1, 3.5.2)

- Estimation in Parametric Models. (Ch. 4)
  - Bayes Estimators (and relationship to Decision Theory): Sections 4.1.1 - 4.1.3 , 4.3.1-4.3.2
  - Maximum Likelihood (including related computational issues) Sections 4.4
  - Asymptotic Efficiency: 4.5.1, 4.5.2
  - Estimation and asymptotic properties in linear and generalized linear models. (3.3, some parts of chapter 4).

- Testing and confidence sets in parametric models.
  Some parts of Chapters 6 and 7.

- Estimation in Nonparametric Models (Selected sections from Ch. 5.)
  - Nonparameter estimation of the CDF, density and percentiles
  - M estimators
  - Generalized Estimating Equations
  - Variance estimation including the bootstrap.

- Nonparametric tests and intervals.