

Math 541B – Introduction to Mathematical Statistics

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The Course: Approximately the first third of the course will cover topics in “classical” mathematical statistics left over from Math 541A: hypothesis testing, confidence regions, and asymptotic theory. The remainder of the class will cover “computationally intensive” statistical methods including the bootstrap and jackknife, Monte Carlo methods, and the EM algorithm. The required prerequisite is Math 541A. Course information, assignments, solutions, and grades will be posted on Blackboard. Here is the (tentative) schedule:

Week #	Week of	Topics
1	27.Aug	Hypothesis testing, likelihood ratio tests
2	3.Sep	Neyman-Pearson lemma, Karlin-Rubin theorem, exponential families
3	10.Sep	Unbiasedness, p -values, Bayesian testing
4	17.Sep	Loss function optimality, confidence intervals (CIs), test inversion
5	24.Sep	Pivotal method, pivoting a c.d.f., Bayesian intervals
6	1.Oct	Loss-function based CIs, MT Exam 1 Wed Oct. 3 11-11:50 AM
7	8.Oct	Asymptotic theory of GLRs
8	15.Oct	the bootstrap (BS) and jackknife (JK)
9	22.Oct	consistency of JK, its variants, BS in general, relationship between BS and JK
10	29.Oct	The EM algorithm
11	5.Nov	EM algorithm
12	12.Nov	Convergence of EM algorithm, MT Exam 2 Mon Nov. 12 11-11:50 AM
13	19.Nov	Monte Carlo, rejection and importance sampling
14	26.Nov	Markov chains
15	3.Dec	The Metropolis-Hastings algorithm, MCMC
16		Final Exam Wed Dec. 12, 11-1, KAP 163

Textbook: *Statistical Inference*, 2nd edition, by Casella & Berger is the only required text, and will be our primary reference for the first portion of the class; a good supplement is *Testing Statistical Hypotheses* by Lehmann & Romano. For the rest of the class, the lectures will be the primary reference, but if you’d like a supplement the following are recommended: For asymptotic theory, *A Course in Large Sample Theory* by Ferguson; for the bootstrap and jackknife *The Jackknife and Bootstrap* by Shao & Tu and *The Jackknife, the Bootstrap and Other Resampling Plans* by Efron; for EM *The EM Algorithm and Extensions* by McLachlan & Krishnan; and for Monte Carlo methods *Monte Carlo Statistical Methods* by Robert & Casella and *Finite Markov Chains and Algorithmic Applications* by Haggstrom.

Homework: There will be about seven homework assignments. You are encouraged to work together on the assignments but each student must write up the assignment in his/her own words and show all work. The assignments are to be turned in in lecture, and no place else, on the date due. **Late policy:** Homework can be handed in during the following lecture for 25% penalty; anything after that is a zero.

Exams: There will be two in-class midterms, the first on Wednesday, Oct. 3 and the second on Monday, Nov. 12. The final exam will be Wednesday, Dec. 12, 11-1, in the lecture room. **These dates are nonnegotiable so do not take this class if you have any conflicts.**

Grades: Grades will be computed from 1/3 final exam, 1/3 homework, and 1/6 each midterm.