Math 612 Mathematical Statistics

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Objectives

This course is designed for first and second year graduate students in Stochastic systems. The purpose is to learn statistical methodologies at a good mathematical level. It sounds good but the material to be covered is normally subject of a two semester sequence. The students are normally required to have Ma 611 Probability as prerequisite, therefore the focus of this class will be on the statistical concepts (Chapters 5-10 in the textbook) rather than reiterating the same ideas one can encounter in Ma611.

Course outline:

- Probability review, Ch 1, 2, 3, 4 in the textbook.
- Exponential families. Hierarchical models. Inequalities and identities, 3.4-3.6, 4.4.
- Samples and sample characteristics, Ch. 5.
- Sufficiency, ancillary, completeness. Likelihood principle Ch. 6.

- Theory of point estimation. Finding and evaluating estimators. Ch. 7.
- Theory of statistical testing. Finding and evaluating statistical tests. Ch. 8.
- Confidence intervals. Estimation and evaluation. Ch. 9.
- Asymptotic theory[1]. Ch 10.

Textbook(s):

The textbook for this class is:

- *Statistical Inference*, by George Casella and Roger L. Berger, 2^{nd} edition, Duxbury, 2002, ISBN 0-534-24312-6

Homework, Exams and Grading:

Proper assignment write-up

To understand the course material and get a good grade it is necessary (though not sufficient) to invest a substantial amount of time working on the assignments. Homework consisting of about 7-8 problems will be assigned in class and posted on the web every other week or so. They will be due on the specified due date at the specified time. *No late homework will be accepted under any circumstances.* The lowest homework grade will be dropped. I will grade two or three problems (selected by me) from each assignment which will count toward 60% of the homework grade, while casually reviewing the other problems for the remaining 40% of the homework grade.

You are encouraged to discuss homework; however, **all written homework must be written by you. Copying solutions from other students in the class, former students, tutors, or any other source is strictly forbidden**. Copying the solution of one or more problems from another source than your own brain is consider academic dishonesty/misconduct and will be dealt with according to the Stevens honor board policy.

[1] Time permitting

Your solutions must be those that you fully understand and can produce again (and solve similar problems) without help. The ideal model to follow is first to work independently, then to discuss **issues** with your fellow students, and then to prepare the final write-up.

There are three stages in the preparation of the solution to a problem in this class:

1. Outline the steps.

2. Identify the mathematical techniques necessary to carry out those steps.

3. Carry out the mathematical techniques correctly.

Comments about the first two steps. It is no surprise that in a mathematical course students spend most time on the final 3rd stage. However, the first two stages are equally important for a successful demonstration of understanding the course concepts. At the beginning of every course the problems are simple enough that the need for the first two stages seem unnecessary but by the end of the class the problems become complicated enough that this will not seem artificial (indeed it will be most helpful).

It is equally important that you do this for the test problems. During a test students have sometime difficulties carrying out all the mathematical analysis to completely solve the problem. If I can see that you know what steps you should be doing, then I can give you more credit than if you just cant carry out the steps and don't tell me anything. Thus, a clearly written plan of your solution method will help you earn a good test grade.

Comments for the third step. As a professional in a quantitative field, you will be expected to be mathematically sophisticated enough to know whether or not you are carrying out a mathematical technique correctly. I expect you to practice that sophistication in all material submitted in this course. For example, do not ever turn in a problem requiring an integration that you did not know how to do completely, so you just did it as far as you could and then wrote the answer you knew it should have, hoping the instructor or grader would not notice that the solution was not complete. Instead, find the help you need to fully carry out the solution correctly before you submit the paper, as you will do in your professional activities.

You must show all of your steps in carrying out the mathematical techniques. Explain what you are doing as if you are teaching it to someone. People who write journal articles often leave out most of the easy steps and

just show the hardest steps. That is fine for journal articles, but it is not appropriate for a classroom situation where you need to be convincing the instructor that you understand the reasons for all the steps you are doing.

Exam policy

We will have one midterm and a final exam. Both exams will be in-class, closed-book, closed-notes. You will be allowed to bring a handwritten page containing whatever you think is relevant for the exam. A summary of the distributions (pages 621-627 in your textbook) will be provided for each examination. You will have to show all the work to receive credit for the problems in the exam. The date for the midterm will be agreed on during the semester. The most weight for the final grade will be coming from the final examination.

There will be no individual make up exams. If you miss one of the exams, you may be allowed to take a *comprehensive* make up exam (location and time to be determined) at the end of the semester. To be allowed to take this make up exam you have to bring valid written documentation that explains the reason for the missed exam. The make up exam will replace at most one missing exam grade.