MA4632/MA541 Spring 2020

Probability and Mathematical Statistics II

COURSE OUTLINE **1/16/20**

Instructor: Balgobin Nandram; Voice: 831-5539, F: 831-5824; Email: balnan@wpi.edu; Web: http://www.wpi.edu/~ balnan

Office: SH 002A; Office Hours: Thu 2-4; other times by appointment

Class SH203: Thu 5:30-6:55; 7:00-7:25; 7:30-8:20.

Theme: Theory behind Applied Statistics

Goal: To understand how to construct tests and estimators, and why certain tests and estimators are most preferred in Applied Statistics.

Strict Pre-requisite: MA4631/MA540 (Probability and Mathematical Statistics I) or equivalent. If you do not have the necessary background, it will be difficult for you to follow the course materials, and therefore it is advisable for you not take the course.

TEXT BOOK

George Casella and Robert L. Berger (2002), **Statistical Inference**, 2^{nd} Edition, Duxbury Press, California. **The course covers Chapters 6-10.** If it becomes necessary, additional materials will be handed out. You must have a copy of the text book in all classes. You will be told what sections you need to read for the next class. One of the roles of the professor is to make it is easier for you to read the text book.

COURSE MATERIALS

1. **Introduction and Preliminaries - Review** [1 week]
   (a) Sampling from a normal distribution and a uniform distribution; (b) Location-scale families and exponential families; (c) Basic results, order statistics, asymptotics (see below).

2. **Principles of Data Reduction** [3 weeks]
   (a) Sufficient statistics, factorization theorem, minimal sufficiency, ancillary statistic, sufficiency principle; (b) Completeness, Basu's theorem; (c) Likelihood function, likelihood principle; (d) Equivariance principle.

3. **Point Estimation** [$3\frac{1}{2}$ weeks]
   (a) Methods of construction; (b) Maximum likelihood estimation (MLE), Bayes estimators; (c) Evaluation of estimators: Cramér-Rao lower bound, Rao-Blackwellization - Sufficiency, unbiasedness and completeness, mean-squared error, equivariant estimators; (d) Computation using EM algorithm.

4. **Hypothesis Testing** [3 weeks]
   (a) Methods for test construction, likelihood ratio tests, Bayesian tests; (b) Evaluation of tests, error probabilities, power function; (c) Neyman-Pearson Lemma, MP and UMP tests.

5. **Interval Estimation** [$1\frac{1}{2}$ weeks]
   (a) Methods of construction, inversion, pivotal quantities, Bayesian intervals; (b) Evaluation of intervals, coverage, unbiased, UMA; (c) Maximum likelihood intervals.

6. **Asymptotic Evaluations** [2 weeks]
   (a) Point estimation; (b) Robustness; (c) Hypothesis testing; (d) Interval Estimation.

COURSE ACTIVITIES

1. **Homework Assignments**

   There will be one assignment of a few problems every two-three weeks. You are required to write your own solutions; but you can discuss the solutions with your classmates. Many problems will not be taken from the text book and would be assigned by the Instructor. It is important that you put in a great effort to solve the homework problems; they are more extensive than the tests (see below). If you are getting difficulties to solve the homework problems, it is time for you to see the Instructor. A good understanding of these homework problems will help you to show a good performance at the tests (see below).

   You must not copy the solution of a homework problem from somewhere else; you must provide your own solution. You must spend time reading and studying the prescribed text book. Specifically, copying of materials from the internet and other sources is strictly prohibited. If you do these things, it will be a concern for academic dishonesty (see below).

   Answers to the problems will be handed out after you have turned in your own. Key points will be discussed; you may be asked to discuss the solution of an important homework problem on the chalk board.

2. **Bi-weekly Tests**

   There will be bi-weekly tests that are individual-based (not group work). Students are required to have a deep understanding of the materials covered up the previous week. The current homework assignment is pertinent to today's test. This is an interactive teaching approach to Mathematical Statistics. There will be one question and you will be given up to twenty-five (25) minutes (**strictly not more)** to do the test. These bi-weekly tests are a part of the interactive teaching of mathematical statistics, will give you a much better understanding of the course materials and a better chance to do well in the course. Please note that there are no make-up tests. I understand that it is possible for you to miss a test, so only an optimal number of tests (to be decided by the instructor), will be counted towards your final grade.

3. **Final Exam**

   This is one-hour test and it will be based on all important topics covered in the course. This is a test designed to give students some practice on other important tests. Consequently, this is the only test that is not an open book or open note test.

WEIGHTS FOR COURSE ACTIVITIES

Homework assignments	25
Bi-Weekly tests	50
Final Exam	25
	100

You must participate satisfactorily in all three aspects of the course. Specifically, to earn a grade of C (or better) you must get a C (or better) on all three course activities.

FINAL GRADE

MA4632–A, B, C, NR; **MA541**–A, B, C, D, F
NR: 0-59; F: 0-50; D: 50-59; C: 60-69; B: 70-84; A: 85-100

At his discretion, the professor would make appropriate adjustments to accommodate students of MA4632.

DISABILITY

If you need course adaptations or accommodations because of a disability, or if you have medical information to share with me, please make an appointment with me as soon as possible; see my office hours on the first page of this document. If you have not already done so, students with disabilities, who believe that they may need accommodations in this class, are encouraged to contact the Disability Service Office (DSO) as soon as possible to ensure that such accommodations are implemented in a timely fashion. The DSO is located in the Student Development and Counseling Center, the phone number is 508-831-4908 and e-mail is DSO@WPI.EDU.

ACADEMIC DISHONESTY

The web site, http://www.wpi.edu/Pubs/Policies/Honesty, states "Any act that interferes with the process of evaluation by misrepresentation of the relation between the work being evaluated (or the resulting evaluation) and the student's actual state of knowledge is an act of academic dishonesty." See the web site for the procedures associated with academic dishonesty.

Good Luck !!!