MA4631/MA540 Fall 2018
Probability and Mathematical Statistics I

COURSE OUTLINE 8/27/18

Instructor: Balgobin Nandram; Voice: 831-5539, Fax: 831-5824, E-mail: balnan
Office: SH 002A - Office Hours: Mon 2:00-2:50; 3:00-3:50p
Class SH 203: Mon 5:30-8:20p [5:30-7:00; 7:00-7:30; 7:30-8:20p]
TA: Xiaohui Chen (xchen8)
Office: SL405; Office Hours: Mon 10:00-10:50a, Fri 10:00-10:50a.

Theme: Theory behind Statistical Inference and Modern Data Analysis
Goal: To develop skills for problem solving and logical mathematical arguments in statistical settings. The use of the theory will be emphasized.

Prerequisite: A knowledge of MA2631/3831/3832 or equivalent will make the course comfortable.

Textbook:
George Casella and Robert L. Berger (2002), *Statistical Inference*, 2nd Edition, Duxbury Press, California. The course covers Chapters 1-5. Some materials will be deleted, and additional materials will be handed out or presented.

The topics covered are

1. **Probability Theory** [3 weeks]
   (a) Probability measure (b) Axiomatic Foundations and Calculus of Probability (c) Random Variables, Distribution and Density Functions

2. **Transformations and Expectations** [2 weeks]
   (a) The Expectation Operator (b) Moment Generating functions (c) Transformations, Jacobians (one-one, many-to-one)

3. **Common Families of Distributions** [3 weeks]
   (a) Discrete Distributions (e.g., Binomial, Poisson, Hypergeometric etc.) (b) Continuous Distributions (e.g., Normal, Lognormal, Gamma, etc.) (c) Exponential Families and Location-Scale Families (d) Chebychev’s Inequality

4. **Multiple Random Variables** [3 weeks]
   (a) Marginalization, Conditioning and Independence, Bayes’ theorem, the Expectation Operator, Transformations (Jacobian), Correlation, Bayes’ theorem (b) Mixture Distributions, Hierarchical Models (c) Multivariate Distributions (Multivariate Normal and Multinomial Distributions) (d) Holder’s Inequality, Cauchy-Schwarz Inequality, Jensen’s Inequality

5. **Properties of a Random Sample** [3 weeks]
   (a) Distributions of Sums of Random Variables and Order Statistics (b) Convergence in Probability, Almost Sure Convergence, Laws of Large Numbers, Central Limit Theorems, Delta method (c) Normal Sampling ($z$, $t$, $\chi^2$, $f$ statistics) (d) Generating a Random Sample; Monte Carlo Integration
Final Grade – MA4631: A, B, C, NR; MA540: A, B, C, D, F
NR: 0-59; F: 0-50; D: 50-59; C: 60-69; B: 70-84; A: 85-100

You must participate satisfactorily in all aspects of the course.

1. Homework Assignment

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). You can seek help from the Teaching Assistant. If you are still 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. Weekly Tests

There will be weekly tests that are individual-based (not group work). This is an interactive teaching approach to Probability and Mathematical Statistics. 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. There will be one question and you will be given up to twenty-two (22) minutes (strictly not more) to do the test. These weekly tests will give you a much better understanding of the course materials and will give you a better chance to do well in the course. The good news is that there are no other lengthy tests in this 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. Please note that there will be a test on the first day of the course and you must review Sections 1.1-1.3 of the Casella and Berger text book for the test.

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NOTE: Students of MA4631 are required to do the same work as those of MA540. However, some adjustments will be made at the discretion of the instructor.

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 website, http://www.wpi.edu/offices/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 website for the procedures associated with academic dishonesty.