

# Probability and Mathematical Statistics I

## COURSE OUTLINE

8/23/12

**Instructor:** Balgobin Nandram; Voice: 831-5539, Fax: 831-5824, E-mail: balnan

**Office:** SH 103 - Office Hours: Tue, Thu 9:00-9:50a, 4:30-4:50p

**Class SH 306:** Tue, Thu, 3:00-4:20p

**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**, 2<sup>nd</sup> 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** [ $2\frac{1}{2}$  weeks]
  - (a) Probability measure (b) Axiomatic Foundations and Calculus of Probability (c) Random Variables, Distribution and Density Functions
2. **Transformations and Expectations** [ $2\frac{1}{2}$  weeks]
  - (a) The Expectation Operator (b) Moment Generating functions (c) Transformations, Jacobians (one-one, many-to-one)
3. **Common Families of Distributions** [2 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, the Expectation Operator, Transformations (Jacobian), Correlation (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** [4 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 (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 Assignments**

There will be one assignment (3-5 problems) every two weeks; the homework report is due the following week. Some problems will be taken from the text book and some will be assigned by the instructor. The homework activity is a good way to encourage team work. For this purpose, you will form teams of 3-4 students, and each team is required to turn in one homework report. **Answers copied from somewhere else (e.g., a web site) will be graded zero.** Answers to the problems will be handed out after you have turned in your own. Key points will be discussed. **Your homework report will not be accepted after the required due date.**

2. **Quizzes**

There will be at most one in-class quiz each week. Each quiz will last **at most** ten (10) minutes, and it will be based on very simple mathematical calculations or arguments. Quizzes are not team work; they are used to assess individual students' performance.

3. **In-Class Tests**

There will be two in-class tests. They will be based on all materials covered so far with emphasis on the most recent ones. Each test will last not more than 90 minutes. In-class tests are not team work; they are used to assess an individual student's performance. Note that because each meeting of the course is only 80 minutes' duration, you would need to make arrangements to stay an extra 10 minutes on the day a test is given.

Homework Assignments	20	
Quizzes	30	Lecture
Test 1	25	Thursday, October 11, 2012
Test 2	25	Thursday, December 13, 2012
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	100	
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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.