EnM 503

Probability, Random Variables and Stochastic Processes

Primary Objective

The primary objective of this course is to alleviate the burden on students who have difficulty in leaving their business activities on a regular basis to attend formal classes. The class will meet on three occasions: the first day, for a short time, to introduce the class to one another and to encourage the formation of study groups, and on two other occasion for taking the two term exams. The course is presented almost entirely on the Intranet at web site [www.seas.upenn.edu/~enm503/index.html](http://www.seas.upenn.edu/~enm503/index.html). The material presented in the course is designed to provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in engineering and applied science. The course is intended for graduate students in SEAS who have had the equivalent of the undergraduate mathematics courses: Math 140, 141, and 240. Students with a firm foundation in probability theory are encouraged to take EnM 603.

Text and References:

Homework will be assigned from the following text:

Title: A First Course in Probability, 6th Edition  
Author: Sheldon Ross  
Publisher: Prentice Hall Publishing Company  
Year: 2002

Course Syllabus:

Topics:
1. Foundations of Probability Theory  
2. Counting Principles  
3. Random Variables  
4. Distribution and Density Functions  
5. Functions and Sequences of Random Variables  
6. Expectation  
7. Characteristic Functions and Moment Generating Functions  
8. Ordered Statistics  
9. Elements of Random (Stochastic) Processes  
10. Limit Theorems
Course Outline

I Concepts of Probability

1. The Vocabulary of Probability Theory
2. Events and Probability
3. Sample Spaces
4. Algebra of Sets

II Combinatorial Analysis

1. Principles of Counting
2. Permutations and Combinations
3. Multi-nomial Coefficients

III Probability Theory

1. Sample Spaces
2. Axioms of Probability
3. Compound Events
4. Conditional Probability
5. Total Probability
6. Baye's Theorem

IV Independent Events and Sample Spaces

1. Concept of Independence
2. Reliability of Systems
3. Repeated Trials
4. Difference Equations

V Random Variables

1. Definition and Concept of Random Variables
   a Continuous Random Variables
   b Discrete Random Variables
2. Probability Distribution Functions
   a. Continuous Random Variables
   b. Discrete Random Variables

3. Probability Density Functions

4. Probability Mass Functions

5. Conditional Probability Density and Distribution Functions

6. Conditional Probability Mass Functions

7. Joint Probability Density and Distribution Functions
   VI. Functions of Random Variables

1. Distribution Method
2. Density Transformation Method
3. Jacobian Transformation Method
4. Conditional Distribution Method

VII Expectation

1. Definitions
2. Mean, Variance
3. Covariance and Correlation Coefficient
4. Conditional Expectation

VII Characteristic and Moment Generating Functions

VIII Ordered Statistics

IX Random Processes

1. Bernoulli Process

2. Binomial Process a Geometric Distribution b DeMoivre'- LaPlace Theorem , Gaussian Process , Poisson Processess, Gamma and Exponential Processes

X Limit Theorems

1. Markov's Inequality
2. Chebychev's Inequality
3. Weak and Strong Law of Numbers
4. Central Limit Theorem
Grading Policy

Homework - 20%
Exams
   Exam 1 - 40%
   Exam 2 - 40%

Examination Schedule

   Exam #1 (Chapters 1,2,3 and 4) June 12, 2003
   Exam #2 (Chapters 5, 6, 7 and 8) Jun 26, 2003