ISyE 6650A,Q Probabilistic Models
Fall 2007
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Course Meeting Times: TuTh 3:05-4:25pm
Course Classroom: IC105
Instructor Office Hours: TuTh 9-10am or by appointment

Course Objective

This course will introduce the student to a basic set of mathematical tools which are appropriate for dealing with the randomness / stochasticity that underlies the operation of many technological, economic and social systems. The overall development will seek a balance between (i) the systematic exposition of the considered models and their properties, and (ii) the applicability of these models in the aforementioned applications.

Tentative Course Outline

1. Introduction:
   - Course Objectives, Context, and Outline
   - Probability review: sample spaces and events, probabilities, conditional probabilities, independece, Baye's formula, random variables, expectation, moment generating functions, jointly distributed random variables and stochastic processes.

2. Conditional Probability and Conditional Expectation and Applications
   - The basic methodology
   - Computing expectations and variances by conditioning
   - Application to Compound random variables and other examples

3. Discrete Time Markov Chains
   - Basic concepts
   - Chapman-Kolmogorov equations
   - State classification
   - Limiting probabilities
   - Examples
   - Mean Time Spent in Transient States
   - Time Reversibility
   - Introduction to Markov Decision Processes

4. Exponential Distribution and Poisson Processes
   - The exponential distribution and its properties
   - Convolution of exponential random variables
   - The Poisson process and its properties
   - Generalization of the Poisson process: Non-homogeneous and compound Poisson processes

5. Continuous Time Markov Chains
   - Basic definitions
   - Birth-Death processes
   - Time-dependent probability distribution

- Limiting probability distribution
- Semi-Markov processes
- Approximation of non-Markovian behavior through CTMC's

6. Queueing Theory
   - Exponential models: M/M/1, M/M/c and M/M/1/m queues
   - M/G/1 and G/M/1 queues
   - Queueing networks: open and closed QN's

7. Introduction to Renewal theory

Course Policies

Homework: Homework will be assigned at the completion of each course unit, and it will consist of conceptual, theoretical and computationally oriented problems. Collaboration towards its solution is allowed, but each student must turn in his/her work; photocopies will *not* be accepted. Homework must be turned in on the specified due date.

Exams: There will be two midterms and a final exam. The detailed exam dates will be specified during the course development.
Exams will be closed-book, with 2 pages of notes allowed for each midterm and 6 pages for the final. The final exam will be comprehensive, while the covered material for the midterms will be specified during the course development. Naturally, it is expected that the *Academic Honor Code* will be respected.

Grading:
- Homework: 25%
- Midterms: 20% each
- Final: 35%

Course Reading Material

- **Textbook:** S. Ross, *Introduction to Probability Models, 9th ed.*, Academic Press.
- Course slides and any other material posted at my homepage and/or the library electronic reserves.