Stochastic Processes II
Graduate Course E E 381M, Spring 2015

Instructor

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Objectives

The course will be focused on tools from the theory of stochastic processes which are of central importance in research in network science. For each tool, classical examples and applications will be discussed. The instructional objective is that students be in a position to use these tools in their research.

Contents

I. Stochastic Processes and Network Dynamics

The basic notions to be covered are:

- Coupling techniques for stochastic recurrences and Markov chains: Loynes' construction; perfect simulation and the Propp and Wilson construction.
- Point processes on the real line: renewal theory, Palm calculus, the stationary ergodic framework.
- Martingales techniques: stochastic intensity, stochastic integration.

Applications include protocol analysis, and advanced queuing network analysis: PASTA, conservation rules, priority queuing. For this part of the course, the following material will be used:

[BB] F. Baccelli & P. Brémaud, *Elements of Queueing Theory*, Springer Verlag, second edition, 2003.

[Bo] A. Borovkov, *Ergodicity and Stability of Stochastic Processes*, Wiley, 1998.

II. Comparison of Stochastic Processes

Stochastic order relations provide insight into the behavior of complex stochastic systems. The aim of this part will be to discuss the comparison and monotonicity properties of stochastic models represented by Markov chains, Gibbs fields and stochastic recurrences. The following topics will be discussed:

- Univariate stochastic orders: strong and convex ordering.
- Theory of integral stochastic orders: Strassen's theorems.
- Multivariate stochastic orders: association, FKG inequality.

Application areas include queuing systems, stochastic networks, decision making and stochastic simulation. For this part of the course, the following material will be used:

[BB] F. Baccelli & P. Brémaud, *Elements of Queueing Theory*, Springer Verlag, second edition, 2003.

[MS] A Muller & D. Stoyan, *Comparison Methods for Stochastic Models and Risks*, Wiley, 2002.

Grading Policy

- Assignments: 1/3;
- 2 midterm exams: 1/3;
- One research paper to read and present (from a list of proposed papers) at the end of the semester: 1/3.

Practical Information

Class Hours: M-W 3.00-4.30pm UTC 1.142.

Office Hours: Tentatively, the instructor F. Baccelli will have his office hours on M-W 10.00-11.30 am in RLM 11.136.

Course Policy: Course material will be available on Blackboard.

Accommodations: Students with disabilities may request appropriate academic accommodations from the Division of Diversity and Community Engagement, Services for Students with Disabilities, 512-471-6259, http://www.utexas.edu/diversity/ddce/ssd/