STOR 893 – Markov Processes and Related Topics
Spring 2021
Tuesday-Thursday 11:00-12.15

This course will cover Markov processes and related topics in continuous time. In particular we will cover basic elements of stochastic calculus with respect to continuous local martingales. The mathematical tools developed here are useful in many different areas such as mathematical finance, systems biology, engineering, physical sciences etc. The course should be accessible to anyone with background in measure theoretic probability. For example, STOR 634-635 is more than adequate preparation for this course. There will be no exams. Grades will be based on homework and active class participation.

Syllabus:

- Brownian motion.
- Continuous time countable state Markov processes.
- Infinitesimal generators and semigroups.
- Continuous time martingales. Connections between martingales and Markov processes through Dynkin formula.
- Elements of stochastic integration, stochastic differential equations and diffusion processes.
- Some weak convergence theory and convergence of Markov chains to diffusions.
- Ergodic theory of Markov processes (transience, positive recurrence, geometric ergodicity, convergence to stationary distributions, Lyapunov-Foster stability criteria etc.)
- Poisson equation, Feynman-Kac formula, and the problems of Dirichlet and Cauchy.

References: Lectures will be based on instructor's notes and there is no required textbook for this class. However, the following books may be useful.

- *Stochastic Analysis and Markov Processes*: Karatzas and Shreve, Revusz and Yor, Protter, Ethier and Kurtz, Liggett (*Continuous Time Markov Processes*), Oksendal.
- *Probability Background*: Durrett (Probability: Theory and Examples), Williams (Probability with Martingales), Chung (A Course in Probability Theory).
- *Topology, Analysis and Functional Analysis Background*: Royden(Real Analysis), Munkres(Topology), Kolmogorov and Fomin (Functional Analysis).