APMA 1200: OPERATIONAL ANALYSIS: PROBABILISTIC MODELS

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Meeting: MWF 2:00 – 2:50 pm, Wilson Hall 102.

Office Hours: MW 11:00 am - 11:55 am.

Teaching Assistant: Steven Kim (Tu 10 am – 11 am), Ivana Petrovic (M 6 pm – 7 pm) , and Seungjoon Lee (Th 5 pm – 6 pm). Recitation hours: Tu 5 pm – 6 pm; Th 3 pm – 4 pm.

Prerequisite: APMA 1650 or MATH 1610 or equivalent.

Course description: This course serves as an introduction to stochastic processes and stochastic optimization. It will cover basic stochastic processes such as simple random walk, Markov chains, Poisson processes, and Brownian motion. It will also offer introductory level treatment to stochastic optimization problems, such as optimal stopping and optimal control, based on dynamic programming principle.

General Policies: There will be one in-class test (midterm) on March 14, 2014, and a take-home final exam. Make-up exams are rarely given.

Here is how these items will be weighted:

- Homework: 30%.
- Midterm Exam: 30%.
- Final Exam: 40%.

Homework: Weekly homework will be graded by the teaching assistant. Please staple your pages together and put problems in the correct order. No late homework will be accepted unless an adequate reason is given before the due day.

Textbook: The lecture notes written by Prof. Hui Wang will be used during the semester. Students can download them from the course webpage on Canvas.

A Tentative Schedule:

- Review of basic probability theory.
  (1) Sample space, probability, events, random variables.
  (2) Basic probability rules, expectation, variance and covariance.
  (3) Discrete and continuous distributions, conditional distribution, conditional expectation.
  (4) Independence, law of total probability, tower property.
- Simple random walk.
  (1) Definitions, hitting times, and gamblers ruin problem.
  (2) First step analysis.
  (3) Recurrence and transience.
  (4) Walds identity.

Date: January 31, 2014.

    (5) Combinatorics, reflection principle.
- Markov chains.
    (1) Definitions, transition probability matrix, Chapman-Kolmogorov Equation.
    (2) Hitting times, strong Markov property.
    (3) Classification of states, recurrence and transience, null recurrent and positive recurrent
    (4) Stationary distribution, and convergence to stationary distribution, coupling argument.
    (5) Branching processes.
- Martingales.
    (1) Definitions.
    (2) Examples of classical martingales.
    (3) Optional sampling theorem and its application.
- Poisson process.
    (1) Definitions and basic properties.
    (2) Interarrival times and waiting times.
    (3) Inspectors paradox.
    (4) Poisson process with classified events.
- Brownian motion.
    (1) Definitions and basic properties.
    (2) Reflection principle, hitting times, running maxima.
    (3) Basic martingales associated with Brownian motion and their applications.
    (4) Various topics Brownian motion.
- Stochastic optimization and its applications.
    (1) Optimal Stopping.
    (2) Optimal control.
    (3) Dynamic programming principle, Hamilton-Jacobi-Bellman (HJB) Equation.
    (4) Verification argument.
    (5) Applications.