Stochastic Processes and Applications

Stat 3506, Winter 2020

• **Instructor:** Gennady Shaikhet

• **Office:** 5259 HP • **E-mail:** gennady@math.carleton.ca

• **Office hours:** Tuesday, 10:00 – 11:30, or by appointment

Course schedule

• **Lectures:** Tuesday and Thursday, 8:35 am – 9:55 am, at Mackenzie Building 3174.

• **Tutorials:** Thursday, 4:35 pm – 5:25 pm, at Southam Hall 505.

Course overview

A first course on stochastic processes. Introduction to Markovian modelling of random time-dependent phenomena in discrete and continuous time, mostly on discrete state spaces. We will consider various real-life applications, such as queueing models; computer and tele-communication systems and finance. Some more advanced topics, i.e., famous Markov Chain Monte Carlo (MCMC), are also covered.

Textbooks

– there is no particular textbook. The following **free** books are good references, in addition to my lecture notes. The books are available online at Carleton Library.

• Understanding Markov Chains (by Nicolas Privault), Springer.

• Introduction to Probability Models, (by Sheldon Ross, 9ed or later), Elsevier Science & Technology.

• Performance Modeling and Design of Computer Systems (by Mor Harchol-Balter), Cambridge.

Course grade policy

The course grade is composed of homework (10%), two in-class tests (2x15%=30%) and the final exam (60%). To pass the course, a student must obtain at least 50% of the total grade.

- **Homework:** there will be 5 or 6 home assignments, to be submitted individually. Late assignments will be accepted under special circumstances only.

- **Tests:** there will be two in-class tests during the semester. **Test 1 (February 11, 8:35am)** and **Test 2 (March 24, 8:35am)** … please mark your calendars… You are expected to take all the tests. No makeup, early or delayed tests. Each test counts 15% of a term performance.

- **Final exam:** a 3-hour written exam (scheduled by the University) will be given during the official examination period.

For your attention

- Students must respect the principles of academic integrity. For the university policy see: https://carleton.ca/senate/wp-content/uploads/Academic-Integrity-Policy-1.pdf

- Only **basic calculators** are allowed for tests and for the final exam.

- It is each student's responsibility to be available at the time of the examination. In particular, no travel plans should be made until the examination schedule is published. It is each student's responsibility to find out the correct date and time of the exam and the room where it takes place.

- Students who miss the examination may be eligible for a deferred exam. Contact the Registrar's Office for more details.

- Students wishing to see their examination papers must make an appointment with the instructor within two weeks of the examination. Kindly note that this is a privilege for students to learn where they went wrong, not an opportunity to argue about the marking.

Academic Accommodations for Students with Disabilities

The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at **613-520-6608** or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send the instructor your ***Letter of Accommodation*** at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation. After requesting accommodation from PMC, meet with the instructor to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally scheduled exam.

Tentative class outline for Winter 2020

WEEK	TESTS	TOPICS
1		Conditional probability and conditional expectation
2		Discrete-Time Markov chains, Transition probabilities, Simulation
3		First-step analysis
4		Classification of states
5		Long-Run Behavior of Markov Chains
6	**Test 1** **February, 11** **(8:35 - 9:55)**	Branching Processes
7		Exponential Distribution and the Poisson Process. Simulation
8		Continuous-Time Markov Chains, Infinitesimal Generator, Backward and Forward Kolmogorov equations
9		Limiting and Stationary Distributions
10		Queueing theory: M/M/K, Burke theorem, Jackson networks
11	**Test 2** **March, 24** **(8:35 - 9:55)**	Markov Chain Monte Carlo (MCMC)
12		Review