STAT 4508A/5701W (MAT 5198) Stochastic Models
School of Mathematics and Statistics
Carleton University
Winter 2021

Instructor: Dr. Minyi Huang
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Text: Sheldon M. Ross, *Introduction to Probability Models*, 12th Edition, Academic Press, 2019.

References: The following references are not required for the course. However, contents of them are closely related to the course material. Copies of them are on reserve in the library.

Howard M. Taylor and Samuel Karlin: *An Introduction to Stochastic Modeling*, Academic Press, 1998.

James R. Norris: *Markov Chains*, Cambridge University Press, 1997.

Lecture: This is an online course. The lectures will be delivered on cuLearn as a combination of
(i) posted short videos,
(ii) synchronous lecturing through ZOOM and/or BigBlueButton (BBB),
(iii) posted lecture slides.
For (ii), the scheduled meeting time is Tue and Thurs, 8:35 am – 9:55 am.
Announcements regarding (ii) will be made on cuLearn in advance.
For admission to ZOOM, you are required to indicate your name by Given name + Family name.
The tests and final examination may be e-proctored.

Prerequisites: STAT 3506; or permission of the School

Description: STAT 4508 is a continuation of STAT 3506, and it gives an introduction to continuous time stochastic processes. It is also offered at the graduate level as STAT 5701 (MAT 5198 at U. of Ottawa). Students registered in STAT 5701 are required to complete additional course work.

Office Hours: Thursday 5:00pm – 6:00pm (online)

Marking Scheme: Assignments (4): 16%
Minitest: 4%
Term tests (2): 30%
Final exam: 50%

Important dates:	Jan 12	First lecture
	Jan 25	Last day for registration or change of courses
	Jan 31	Last day to withdraw
	Feb 15-19	Winter break
	Apr 13	Last lecture

Time used in this outline: All dates and time in this outline mean the Ottawa local time; see https://www.timeanddate.com/worldclock/canada/ottawa.

Email communication with instructor: Please use your Carleton account ONLY for all course related email, and write on the **subject line** your course code STAT4508 or STAT5701, which I will use to manage email.

Announcements: You are responsible for keeping up with information announced through cuLearn, or sent to your e-mail account.

Assignments (16%): There will be four (4) assignments due at 23:59 on the following dates:

Jan 26, Feb 23, Mar 23, Apr 15

Though you are required to submit your assignments by the due dates, they will not be marked. Instead, solutions key will be posted for the purpose of self-marking and your reference. Students should do independent work on the assignments and no collaboration on the assignments is allowed, otherwise it would result in a zero mark for the assignment. Careful work on the assignments during the term is important and will make you better prepared for the tests and final exam.

Minitest (4%): There will be an in-class Minitest (30 min) on **Thursday January 21**, before the last day for registration and course changes.

Term tests (30%): There will be two (2) 70-minute tests (worth 15% each) from 8:35 am to 9:45 am on

Thursday, February 25 and March 25,

respectively. **You are given extra 20 minutes to upload your solution to cuLearn**. You are required to take both tests (and also the minitest). No make up, early or late tests (including the Minitest) will be given; absence is excused only for medical reasons (for a proof, a doctor's note may be presented), or situations in accordance with Carleton's accommodation policies. Any missing test will be counted as zero. Due to the pandemic situation, we understand it may be difficult to obtain a doctor's note. If you miss a midterm test due to illness, you may elect to submit within 3 business days the self-declaration form https://carleton.ca/registrar/wp-content/uploads/COVID-19_Self-declaration.pdf

Final examination (50%): This is a three (3) hour open-book exam scheduled by the University during the final exam period from April 16–27, 2021. By open-book, it means you may consult the course materials. Collaboration with another person on the solution is prohibited. **When the exam is completed, you are given 20 minutes to upload your solution**. It is the responsibility of each student to be available at the time of the examination.

Solution submission for assignments, tests and final exam: For each assignment or test or the final, you are required to submit the solution as **a single PDF file**. No other format is accepted for grading. If your solution is scanned, make sure you convert it into the PDF format.

Never wait until the last minute to submit. In particular, when it seems you do not have enough time to complete your test or final solution, you must reserve time to scan and submit first. After your submission, make sure to immediately download from cuLearn to verify that your submitted PDF file is readable. No late submission or resubmission will be granted. A late submission actually submitted will **not** be counted.

Conditions to pass the course: You are required to achieve at least 30% of your overall term work (including Assignments, Minitest, and term tests) and 40% of the final examination to pass the course. Although the absence from some tests for medical reasons may be excused, this course requires the student's adequate workload and participation. If a student has missed too many parts of all assignments and tests, the student cannot pass this course due to inadequate workload and participation, regardless of the performance in the final examination.

Calculators: You may use only non-programmable, non-graphing calculators for the tests and the final examination in this course.

Intellectual property notice: All materials created for this course (including lecture notes, posted/recorded videos, assignments and tests and posted solutions, the final exam, etc) remain the intellectual property of the instructor. These materials are intended for the personal and non-transferable use of students registered in the current offering of the course. Students registered in the course may take notes and make copies of course materials for their own educational use only. Students are not permitted to reproduce or distribute lecture notes and course materials publicly for commercial or non-commercial purposes without written consent from the instructor. A student who publicly posts or sells an instructor's work, without the instructor's expressed consent, may be charged with misconduct under Carleton's Academic Integrity Policy and/or Code of Conduct.

Academic Accommodation: You may need special arrangements to meet your academic obligations during the term because of disability, pregnancy or religious obligations. Please review the course outline promptly and write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. Please make sure you respect these timelines particularly for tests and final exams.

You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at http://www2.carleton.ca/equity/accommodation.

Paul Menton Centre: 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 me 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 (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. The deadline for submitting completed forms to the Paul Menton Centre for April Examinations is March 19, 2021.

Academic Integrity: Any student violating the University's standards of academic integrity, including but not limited to misconduct in their coursework, tests, and final examination, will be subject to appropriate sanctions. For more details, visit the Registrar's Office website https://carleton.ca/registrar/academic-integrity/.

Course Outline (tentative):

Week	Sections	Topics
1	Ch4, Ch5	Review of discrete time Markov chains and Poisson process
2	5.4	Generalizations of the Poisson process
3	6.1, 6.2, 6.3	Continuous time Markov chains, birth and death processes
4	6.4, 6.5	Transition probabilities, limiting probabilities
5	6.6, 6.7, 6.8, 6.9	Time reversibility, uniformization, computing transition probabilities
6	7.1, 7.2	Introduction to renewal theory
7	7.3, 7.4–7.10	Limiting theorems, selected topics on renewal theory
8	8.1, 8.2	Introduction to queueing theory
9	8.3, 8.4	Exponential models, networks of queues
10	8.5–8.9	Selected topics on queueing theory from these sections
11	10.1, 10.2	Introduction to Brownian motion
12	10.3	Variations on Brownian motion
13		Review