

STAT 3506 - Stochastic Processes and Applications

Winter 2022

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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 also consider various real-life applications, such as queueing models, computer and tele-communication systems and finance. Some more advanced topics, i.e., Markov Chain Monte Carlo (MCMC), are also covered.

Prerequisites: STAT 2655 with a grade C- or higher; or permission of the School.

Textbook: Sheldon Ross, *Introduction to Probability Models*, 12th Edition, Academic Press, 2019.

Lectures:

This is an **online** course. The lectures will be delivered on Brightspace as a combination of

- a) synchronous lecturing (via Zoom), **Tues and Thurs, 11:35 am – 12:55 pm.**
- b) posted short videos
- c) posted lecture slides

Announcements regarding Zoom meetings will be made on Brightspace in advance. For admission to Zoom, you are required to indicate your name by Given name + Family name.

Tutorials: **Thursday, 1:35pm – 2:25pm**, via Zoom and/or BigBlueButton (BBB).

Office Hours: **Tuesdays 1:30 pm – 2:30 pm**, or by appointment

Course grade policy

The course grade is composed of homework (**10%**), five quizzes (**10%**), three term tests (**30%**) and the final exam (**50%**).

- **Homework:** there will be **5** home assignments.
- **Quizzes:** there will be **5** short quizzes. **See the schedule below!**
- **Term tests**– there will be **3** tests. **Two best marks (out of three) will be counted.**
- **Final exam:** to be scheduled by the University, during the official examination period.

Quizzes and Tests: (all during the lecture sessions)

Week N	Date	Activity
2	Jan 20	Quiz 1
3	Jan 27	Quiz 2
4	Feb 3	Test 1
5	Feb 10	Quiz 3
6	Feb 17	Quiz 4
-	Winter Break	
7	Mar 3	Test 2
8		
9	Mar 17	Quiz 5
10	Mar 24	Test 3

All quizzes and tests are scheduled for **Thursdays**, during the **formal lecture time slots**. Quizzes will be 20 minutes of length, after which we will continue the lecture. Tests will take the whole lecture slot ~80 minutes. The works will be done in the **'pen and paper'** way, to be then scanned and submitted electronically, as a **single PDF file**. You will be given additional 10 minutes to scan and upload your solution to the Brightspace.

Dates of home assignment submission (due at 23:59 of that day):

Assignment 1 (Feb 1, week 3), assignment 2 (Feb 15, week 6), assignment 3 (Mar 8, week 8), assignment 4 (Mar 22, week 10), assignment 5 (Apr 5, week 12).

Tentative List of topics

1. Conditional probability and conditional expectation
2. Computing probabilities and expectations by conditioning; First step analysis
3. Discrete-Time Markov chains, Transition probabilities matrix,
4. Simulation of Markov chains
5. Classification of states
6. Long-Run Behavior of Markov Chains: stationary and limiting distribution
7. Time spent in transient states
8. Reversibility
9. Branching processes
10. Markov Chain Monte Carlo (MCMC)
11. Exponential Distribution
12. Poisson Process. Simulation, Applications
(Also, if time permits)
13. Introduction to Continuous-Time Markov Chains
14. Basic queueing models

Policies

Academic Integrity

All tests, quizzes, assignments and exams are to be done independently. Any instance of suspected cheating or plagiarism will not be tolerated. Suspected cheating will be reported to the Dean, according to the policies stated in General Regulations. For more information, please consult: <https://carleton.ca/registrar/academic-integrity/>

Quizzes, and tests: No make-up, early or late tests or quizzes will be arranged; absence is excused only for medical reasons (a doctor's note may be presented), or situations in accordance with Carleton's accommodation policies.

Assignments: Students should do independent work on the assignments. Late assignments will not

be accepted unless a written request, describing the reason why you could not complete the work on time, has been submitted to the instructor before the due date, and an arrangement made by the instructor. Due to lack of TA support, your assignments might only be reviewed and roughly checked. **The assignments are due at 23:59 of the due date.** 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. You should start to work early instead of waiting until the last minute. No medical declaration is accepted for missing an assignment deadline, except for extraordinary circumstances (like prolonged and severe illness with an official proof or a hospitalization record).

Final examination (50%): This is a three (3) hour open-book exam scheduled by the University during the final exam period in April 2022. 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, quizzes, 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 it from Brightspace 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.

Intellectual property notice

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.

Deferrals, Petitions and Appeals

Students are expected to be available for the duration of a course including the examination period. Dates and deadlines are made available to students in the Carleton University Undergraduate Calendar well in advance of registration. For more information, please consult:

<https://carleton.ca/registrar/special-requests/deferral/>

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 course 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 (if applicable).

After requesting accommodation from PMC, communicate 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. For more information, see: <https://carleton.ca/pmc/>

Other accommodations

Contact the instructor 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. Visit

<https://carleton.ca/edc/teachingresources/administrative-pedagogy/academic-accommodations/>