

Business 9812 – Applications of Stochastic Modelling**Winter 2026**

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Thursdays 1 p.m. – 4 p.m.
Location: Ivey 2348
(12 Sessions Jan 8-Mar 26,
Final Exam: April 2)

INTRODUCTION

The course Learn website, <https://learn.ivey.ca/courses/6671>, will be the main resource and place to visit for the latest about the course (e.g., assignments, schedule and any other updates).

Some sessions may be asynchronous, virtual and some live sessions may also include asynchronous parts. The sessions may include lectures, case discussions, problem solving, paper presentations/discussions as well as student presentations.

We make decisions in our personal, professional, and family lives daily, constantly and all the time. Each one we try to make good decisions for the best possible outcomes. Decision making is not easy under regular circumstances, and it is especially hard when there is uncertainty (stochasticity). For example, demand may not be known, costs can be higher or lower, a new product may be a big hit or a miss or a big catastrophic event such as an earthquake, a global pandemic, extreme weather, or financial crisis may happen. Then the question arises, how do we take uncertainty into account in our decision making? How do we deal with uncertainty? In this course we will study some of the ways we can model stochasticity and use them in decision making.

COURSE DESCRIPTION

This course is about modelling uncertainty (stochasticity). Many systems involve uncertainty, e.g., call centers (e.g., number of people calling in a time interval), airports (e.g., flight delays and cancellations), retail businesses (e.g., demand, supply), hospitals (e.g., emergencies, surgery durations, demand, staff availability) and they evolve over time with randomness. The questions are how to analyze these systems in the short and long run, how to develop performance measures and how to optimize these systems subject to uncertainty. In this course we will use probability, stochastic processes and optimization to answer some of these questions. The ability to think stochastically is a fundamental capability and

necessity to understand and provide solutions to some of the complex problems of our time. We will strive to do this in the course.

The study of probability models for stochastic processes involves a broad range of mathematical and computational tools. Familiarity with basic probability theory and calculus is required. This course aims to strike a balance between mathematics and applications.

Some key words for the course are probability, conditional probability, expectation, variability, random variables, probability distributions, decision trees, decision theory, Markov Chains, Markov and Semi-Markov Decision Process, Poisson Process, Brownian Motion, Renewal Theory, Queuing Theory, dynamic programming, stopping times, martingales, simulation, applications, estimation.

LEARNING OUTCOMES/OBJECTIVES

- Learn about basic probability theory and stochastic processes and apply to modelling real-world and research problems.
- Identify the need for and make reasonable and justifiable assumptions to abstract a complex business problem into a model.
- Construct a suitable models of stochastic systems problem or situations.
- Analyze stochastic systems to develop relevant performance measures.
- Develop reasoned recommendations based on modelling and quantitative analysis of decisions to improve performance (e.g., optimize).
- Manipulate model inputs to evaluate the influence of specific values and assumptions on outcomes. Perform sensitivity analysis.
- Articulate analysis and conclusions in class discussions, written exams and reports.
- Develop evidence, analysis, and data-based decision-making skills.
- Learn and study different applications of systems with uncertainty and uncertainty modelling to increase our portfolio of available tools for future problems.

METHODS OF EVALUATION

Grading:

- 15% Class Contribution
- 25% Homework
- 15% Leading Article Discussions and Class Presentations (During each class, I will ask students to present the solutions to preassigned problems, and present preassigned papers, summarize key results from previous class).
- Two quizzes worth 10% each. Dates of quizzes: Jan 29; Feb 26
- Final Exam 25% (If approved, may be substituted by a research paper. Up to 15% may be replaced with case writing.) Exam will be held on April 2.
- Quizzes and exams will be paper bases with no books or computer available. Hower, each student may bring a preapproved sheet of formulas and descriptions...no proofs or examples.

Grading description:

Class Contribution: Students are expected to actively participate and contribute to the class-room discussion. Students are therefore required to have read the required reading and prepared questions and discussion points to share with their classmates.

Homework: Students will be given a set of questions weekly or every few weeks. Students are required to turn in the assignments before their due date.

Quizzes: There will be a few quizzes throughout the term to enforce learning. The quizzes may be live/asynchronous.

In Class Presentations: Papers (Fifteen Minutes per Paper):

- Prepare PowerPoint Slides. Distribute before class.

- Bottom Line
- Motivation
- Brief Literature Review
- Assumptions Made. Methodology. Model Framework.
- Results
- Positive and/or Negative Comments
- Future Research
- Conclusions
- Grading of Presentation
 - Would an audience member who has not seen the paper before understand the main results, applicability and possible extensions?
 - Clarity is very important
 - Brevity is important if it does not detract from needed understanding
 - Quality of slides
 - Organization of slides

In Class Presentations: Problems (No More than Fifteen Minutes per Problem)

- Prepare slides or careful handwritten solution. Distribute before class.
- Grading of Presentation
 - Clarity
 - Completeness
 - Organization

In Class Presentations: Summary of Major Points from Previous Class (No More than Fifteen Minutes.)

- Prepare no more than two PowerPoint slides. Distribute before class.
- Grading of Presentation
 - Clarity
 - Completeness
 - Organization

Regular UWO graduate course passing requirements apply.

Attendance at all sessions in this course is mandatory and it is your responsibility to advise me if you are unable to attend a class. Circumstances may arise which make it impossible for you to attend such as due to health-related reasons. Students missing class, regardless of the reason, will not receive credit for class contribution, nor will class contribution grades be pro-rated to accommodate the number of missed classes. Any student who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course may be reported to the PhD Director. Specifically, any student missing more than 25 percent of the classes may not be permitted to receive credit for the course. See also Western's Policy on Accommodation for Illness at

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf

In the event of an illness requiring medical documentation, please contact PhD Program Services for instructions.

Late submissions for assignments, quizzes and other requirements may not be accepted, may be penalized or may be counted as zero. The instructor may accept late submissions with a penalty under extenuating circumstances.

Contribution can be negative as well as positive. Negative contributions, including lack of preparation, lack of respect, inappropriate use of the wireless network/computers, negative comments, lateness or absence from class without notice, and other disruptive behaviors will also be taken into account.

You are welcome to discuss homework questions/term projects with your classmates. However **your assignments/quizzes should be your own work**, i.e., to be done individually unless stated otherwise. Violators will be given a grade of [-25% *(# cumulative of incidents)].

MATERIALS/REQUIRED READING

Textbooks

- Ross, Sheldon M. *Applied Probability Models with Optimization Applications*. Dover. Any edition is acceptable. Cost is \$17.50 on Amazon.ca.
- Parzen, Emmanuel. *Stochastic Processes* (No cost. pdf available online.)

Any other related materials may be posted on Learn site.

COURSE TIMELINE AND FORMAT

Our course is planned to be in person on Thursday afternoons for about 12 sessions. If exceptions rise, it will be communicated in advance (e.g., a schedule change or a virtual live class or an asynchronous class). The following is a tentative outline. Applications (including inventory theory and queuing theory) will be sprinkled throughout. Statistical estimation will be discussed as appropriate as issues arise.

Sessions 1-4: Poisson Processes; Renewal Theory; Markov process Part 1.

Sessions 5-8: Markov Processes Part 2. . Markov Decision Processes Part1

Sessions 9-12: Markov Decision Process Part 2. Semi Markov Decision Processes. Brownian motion

USE OF GENERATIVE ARTIFICIAL INTELLIGENCE (AI)

Students may use AI except for quizzes and the final exam. All use of AI must be recorded and documented with a summary uploaded to Learn.

GENDER-BASED SEXUAL VIOLENCE SUPPORT

Western is committed to reducing incidents of gender-based and sexual violence (GBSV) and providing compassionate support to anyone who is going through or has gone through these traumatic events. If you are experiencing or have experienced GBSV (either recently or in the past), you will find information about support services for survivors, including emergency contacts at the following website: https://www.uwo.ca/health/student_support/survivor_support/get-help.html. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

LEARNING TOOLS AND RESOURCES

Additional recommendations (for books/articles/websites) may be posted on Learn.

ENROLLMENT RESTRICTIONS

Enrollment in this course is restricted to graduate students in the Ivey PhD Program, as well as any student that has obtained special permission to enroll in this course from the course instructor as well as the Graduate Chair (or equivalent) from the student's home program.

ACADEMIC OFFENCES: PLAGIARISM AND ACADEMIC INTEGRITY

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf.

All required papers may be subject to submission for textual similarity review to the commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

HEALTH AND WELLNESS SERVICES

As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several on campus health-related services to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. See <https://www.uwo.ca/health>.

Students who are in emotional/mental distress should refer to Mental Health Support at <https://www.uwo.ca/health/psych/index.html> for a complete list of options about how to obtain help. Additionally, students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director or program coordinator.

ACCESSIBLE EDUCATION WESTERN

Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program.

Graduate students with disabilities (for example, chronic illnesses, mental health conditions, mobility impairments) are strongly encouraged to register with [Accessible Education Western \(AEW\)](#), a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction.

A FINAL WELCOME AND REQUEST OF STUDENTS

I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability, and other visible and nonvisible differences. I consider this classroom to be a place where you will be treated with respect. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. If it is appropriate to our learning and you feel comfortable doing so, I ask that you share your unique point of view as we explore the course content.