IVEY PhD Business School
WESTERN UNIVERSITY · CANADA

COURSE SYLLABUS

Business 9812 – Applications of Stochastic Modelling

Fall 2023

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Tuesdays 1 p.m. – 4 p.m.
Location: Ivey TBA
(12 Sessions)

INTRODUCTION

The course Learn website, https://learn.ivey.ca/courses/5184, 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, 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 of us is trying 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 to take uncertainty into account in our decision making? How to 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. Then question is 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 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 this 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 the mathematics and the applications.

We will study the topics (concepts, models, and applications) with lectures, cases, articles and book chapters.

Some key words for the course are probability, conditional probability, expectation, variability, random variables, probability distributions, decision trees, decision theory, Markov Chains, Poisson Process, Queening Theory, dynamic programming, simulation, and applications.

LEARNING OUTCOMES/OBJECTIVES

- Learn about the basic probability theory and stochastic processes and apply them in 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 model of a stochastic system, problem or situation.
- Analyze a stochastic system 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 (individual)
35% Homework (individual)
25% Quizzes (individual)
10% Leading Article Discussions (individual)
15% Report & Presentation: Research Proposal (groups of 2/3) (Exact group sizes will be determined later after first few classes.)

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.

Leading Article Discussions: From time to time, we will discuss a research article. Students will sign-up to lead class-discussions. The discussion should include a description of the problem, motivation, brief literature review, model framework, assumptions, analysis/results explanation, and future work or extensions.

Report & Presentations: Each student will write a term report and give a minute presentation at the end of the term. The objective is to write a research project proposal on a problem of choice (related to topics discussed in the course). The proposal should include a problem description/motivation, research questions/objective, model framework and assumptions, and how the analysis will address the research questions. (Details of the report and presentation will be discussed later in the course.)

Up to date course schedule (e.g., session packs, homework, papers, ……) will be available on Learn.

Regular UWO graduate course passing requirements apply.

Attendance at all sessions in this course are 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

Textbook: Ross, Sheldon M. *Introduction to probability models*. Academic press. (I think the most recent version if 12th edition, but most editions should work.) (The book is available (online reviewing as well as hard copies) from our UWO library (link).

Any other related materials may be posted on Learn site.

COURSE TIMELINE AND FORMAT

Our course is planned to be in person on Tuesday 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 a asynchronous class).

Sessions 1-5: Introduction, random variables, distributions, moment generating functions, conditional distributions and conditional expectation.

Sessions 5-7: Markov Chains

Sessions 7-11: Continuous Markov Chains, Poisson Process, Queueing Theory, Decision Analysis and DP

Session 11-12: In-class preparations

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.