MSCI 431- Stochastic Models and Methods
SYLLABUS

Course Hours 1.00-2:20 PM Tuesdays and Thursdays, Room: CPH 3681

Tutorial Hours Friday 9:30-10:20 PM, Room: DWE 2527

Instructor Fatih **Safa** Erenay, Room: CPH 4323, Email: ferenay@uwaterloo.ca

Office Hour Monday 4.00-5.00 PM or by appointment.

TAs Haoran Wu
Room: CPH 4343, email: haoran.wu@uwaterloo.ca
OH: 2.30-3.30pm, Friday

Hsiu-Chuan Chang
Room: CPH ?4361 Email: h38chang@uwaterloo.ca
Office Hour: 4.00-5.00pm, Tuesday

Web Page Available on LEARN

Course Description This course focuses on classification of stochastic processes, recurrent events including birth and death processes, and branching processes, waiting line models and applications, Markov processes and decision problems. Applications include healthcare, inventory control, reliability, equipment replacement, maintenance, design of service facilities, etc.

Course Learning Outcomes

By the end of the course, students should be able to:

1. Describe the key elements of probability theory.
2. Describe simple stochastic models and Markov processes.
3. Identify the components of queuing, reliability, and inventory theories.
4. Critique and propose areas of improvement for Markov chain models by addressing weak points and unrealistic issues.
5. Develop an efficient and realistic stochastic model using engineering tools (e.g. Excel, transition matrix, flow chart) that addresses the needs of a real-life application.
6. Generate a concise report that explains technical material and follows proper writing conventions.

Prerequisites (MSCI 331 or SYDE 311) and one of CHE 22/220, CIVE 224, ECE 316, ENVE 224, ME 202, MTE 201 or SYDE 213; Not open to students in the Faculty of Mathematics.

Textbook S. M. Ross, *Introduction to probability models* (11th Edition). References to book pages and example numbers will be given from the 11th Edition. However, you can use earlier editions (conversion to 10th edition will be given on the website.)

References J.J. Solberg, Modeling Random Processes for Engineers and Managers

Tentative Grading Policy:

5 x Quizzes: 20% (The worst quiz will be disregarded)
Term Project: 20%
Midterm Exam: 25%
Final Exam: 35%
Bonus: 5% (In addition to 100 points of course credit)

Passing Condition: Students have to write at least 3 quizzes, submit the course project, and write the final exam to pass this class. Incompliance to this condition may cause a failure in this course.

Quizzes: Quizzes will take place at below-specified dates during the tutorials or class hours. Note that, **students must** write the quizzes at these dates. There will be **no make-up quizzes**; thus, students must arrange their agendas according to these pre-specified quiz dates. In case of emergencies (**given the proof of a globally accepted emergency at least 1 day before the quiz hour**), the un-attended quiz grade might be distributed to the other quizzes. For any non-emergency causes, the instructor may give zero credit to the unattended quiz or apply a penalty of **50% grade reduction.**

Sickness and co-op interviews are the two most common reasons for which students ask for special accommodations. For sickness, students will be allowed to miss the quiz; however, instructor should be informed **at least 1 day before the quiz hour**. In addition, students **must obtain a valid doctor's note** to verify their condition. For conflicting co-op interviews, students must communicate with the instructor **at least 2 days before the quiz hour** and seek an alternative arrangement (e.g., start writing the quiz later or earlier on the quiz date).

Twenty points of course credit will be distributed to the students based on the best four quiz grades. However, students should attend all quizzes (if they are able) because the grade of the worst quiz will be rewarded up to 1 point of bonus grade. **Note that, disregarding the worst quiz grade will not be applied to the students who miss one or two quizzes.**

Quiz Dates:

Quiz 1: Jan 19, Friday
Quiz 2: Feb 2, Friday
Quiz 3: Feb 16, Friday
Quiz 4: March 16, Friday
Quiz 5: April 4, Wednesday

Pick-up Marked Work: Marked quizzes will be available from your TA during your tutorial sessions or his office hours. If you have questions about the grading, please contact the TA first. If the TA hasn't answered your concerns to your satisfaction, please submit the quiz and a written explanation to me **no later than a week** after that quiz date.

Project: Written reports are due by 11.59 pm on April 4. Projects should be submitted to the drop box on the second floor of the connection between CPH and E2. The project topic will be announced on Learn. The project group size will be announced on Jan 19 via email. The project groups should be formed and **reported to Haoran** via email by Jan 26; otherwise, **a penalty of 10% grade reduction is applicable**.

Exams: The midterm exam is on 1th March. The date and location of the final exam will be announced later in the term. The exams will be cumulative; however, later materials will be prioritized for the final exam.

The exams will be written in **a class** (not necessarily in the class hour). The book and notes will not be allowed, however, students are allowed to bring a **single page-long (only one side of an A4 paper)** sheet of memoranda to the midterm exam and **a single sheet (both sides of an A4 paper)** of memoranda to the final exam. Sheet of memoranda has to be **handwritten**. A typed or copied sheet of memoranda **is not allowed**.

Note that, the graded Midterm exam papers will not be given back to the students. However, students will be allowed to see their exam papers and solution at a specified time under the supervision of the TA.

Bonus: Bonus assignments will be announced during the classes and will be due next class (unless otherwise stated in the class). They will worth around 4-5% of the grades. Note that, bonus questions are a part of class participation; therefore, **the instructor may not post the questions on the course slides or the course webpage.** It is students' responsibility to be available in the class for noting the bonus questions.

Attendance: Attendance will not be taken at lectures or tutorials, however it is strongly suggested that you attend all scheduled lectures since you are responsible for all of the information discussed in lecture, tutorials, and assignments. Often, the quiz and exam questions involve specific material only discussed in class in details.

Tutorials: Unless otherwise stated, tutorials will be held on Fridays for which no quiz exams are scheduled.

Tentative Course Outline

1. Review of Probability Theory (week 1)
2. Distributions (week 2)
3. Expected Values, Conditional Expectation, and Distributions (week 3-4)
4. Discrete-time Markov Chains (week 5-7)
5. Properties of Poisson Process and Exponential Distribution (week 8)
6. Continuous Time Markov Chains (week 9-10)
7. Basic Concepts of Queuing Theory (week11-12)

Rules for Correspondence: If you have any special issues that need attention, please inform me as soon as possible. If you choose to contact the instructor/TA per email, then the following apply: All emails should have the following subject line: *MSCI 431: (describe your message here)*; be polite, respectful and professional; proofread your email; use email only if you cannot wait until the next course meeting to ask your question; give the instructor/TA at least 24 hours to respond; if it the matter is urgent, mention that in the subject line.
If your email does not comply with basic rules of correspondence – it will be ignored.

Expectation of Academic Integrity:

Please refer to www.uwaterloo.ca/accountability/documents/courseoutlinestmts.pdf. The text of this document is listed below:

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check www.uwaterloo.ca/academicintegrity/ for more information.]

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity [check www.uwaterloo.ca/academicintegrity/] to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties check Guidelines for the Assessment of Penalties, www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

Appeals: A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

Note for Students with Disabilities: The Office for persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.

MSCI Important dates

Jan 19: Quiz 1
Jan 19: Project Group Size Determination
Jan 26: Due Date for Project Groups
Feb 2: Quiz 2
Feb 16: Quiz 3
March 1: Midterm I Exam.
March 16: Quiz 4
April 4: Quiz 5
April 4: Project Due Date