COURSE INFORMATION

Course title:	Analyzing and Modeling Uncertainty		
Course code:	BABS 506	Credits:	1.5
Session, term, period:	2023W1, Period 1	Class location:	ANGU 435
Section(s):	BA1	Class times:	Tue/Thu 8am-10am
	BA2		Tue/Thu 10am-12pm
Course duration:	Sept 5 to Oct 14, 2023	Pre-requisites:	n/a
Division:	Operations & Logistics	Co-requisites:	n/a
Program:	MBAN		

INSTRUCTOR INFORMATION

Instructor:	Hao Zhang, PhD		
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Teaching assistants: Cong Yang
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COURSE DESCRIPTION

Randomness or uncertainty is an essential phenomenon in the modern business world. Probability theory provides the foundation for understanding and analyzing real-world situations and problems involving uncertainty. This course is designed to acquaint students with basic probability concepts, methods, and models. Particular emphasis is given to widely applicable probability models such as distributions of random variables and discrete-time Markov chains. Applications are drawn from various areas in business, economics, science, and technology.

COURSE FORMAT

Class time will be used for a combination of lectures, discussion, and solving sample problems. Attendance is expected to accomplish the learning objectives below. Lectures and discussions will assume that students have pre-read the corresponding chapters as listed in the course schedule below.

LEARNING OBJECTIVES

By the end of this course, students will be able to:

1. Explain fundamental concepts, models, and methods of probability theory
2. Develop intuitions for models incorporating uncertainty
3. Build models for real-world situations involving uncertainty
4. Analyze probability models using popular tools such as the programming language R

SUSTAINABLE DEVELOPMENT GOALS (SDGS)

At UBC Sauder, we are committed to responsible business practices that can have transformative impacts on society. One of the ways we are reinforcing our commitment to responsible business is by showcasing relevant content in our courses via the lens of the United Nations Sustainable Development Goals. In this course, we will touch on topics that relate to the following goals:

Sustainable Development Goal	Description of how and when the goal is covered in the course.
GOAL 3: Good Health and Well-being 	We will study models and examples related to human health and well-being. For instance, Bayes' Rule (to be discussed in Lecture 3) is the basis for understanding many healthcare topics such as the efficacy of COVID tests.
Goal 8: Decent Work and Economic Growth 	This course is about the basics of probability theory, which is one of the central pillars of machine learning (or artificial intelligence). The latter has profound impacts on the economy and work environments. We want to understand the foundations of machine learning and make better use of the tools for the benefit of the society.
Goal 9: Industry, Innovation and Infrastructure 	Built upon probability theory (optimization theory, …), data analytics and machine learning are transforming industries and driving the reconstruction of infrastructure. They are also stimulating social, economical, and technological innovations.

ASSESSMENTS

Summary

Component	Weight
In-class Exercise	5%
Homework Assignments	30%
Individual Assignment	10%
Final exam	45%
Class participation	10%
Total	100%

Details of Assessments

Homework Assignments:
There will be weekly assignments throughout the course. You will be randomly paired with another student as a study partner for each assignment, and you should work primarily with your partner on the assignment. Submit your answers on *Canvas* by yourself before 8am on the due date of each assignment.

Individual Assignment:
There will be one individual assignment, consisting of a set of questions. The assignment will be announced in Week 3 and due by the end of Week 5. It should be completed by yourself independently and submitted on *Canvas*.

In-class Exercises:
There will be a random number of exercises in class. Some of them will be answered individually and be graded. Answers will be submitted through Canvas Assignments/Quizzes. For this purpose, you may use a laptop or smartphone during the class when instructed to do so.

Final Exam:
Students are responsible for making sure they appear for the exam on time. No latecomers will be allowed. Students who fail to write the exam, without prior instructor's permission, will not be given any "make-up'" exam. The exam will be open book and open notes.

Class Participation:
We all bring experience and knowledge into the classroom, and all class participants should share this and benefit by it. Effective class participation includes

- Being prepared for class participation
- asking questions about concepts from lectures or readings
- sharing your experience or point of view with the class
- building on points raised by others;
- clarifying issues or
- relating topics discussed to previous class discussions.

The in-class interactions should be both positive and courteous even when your opinions differ. Class attendance is important. Regular and punctual attendance is a necessary but not a sufficient criterion for high class participation grades. Positive contributions to class discussion increase your score. Failing to attend significant portions of a class session and detrimental participation (including being disrespectful to any class member) decrease your participation score.

LEARNING MATERIALS

Recommended but not required

Ross, S.M. (2009) *Introduction to Probability Models* (10th edition). Academic Press. (Chapters 1-4; other editions are acceptable.)

- This textbook is available for free at: http://bayanbox.ir/view/7776870545953264619/introduction-to-probability-model-S.Ross-math-cs.blog.ir.pdf

Pishro-Nik, H. (2014) *Introduction to probability, statistics, and random processes*. Kappa Research LLC.

- This textbook is available for free at: https://www.probabilitycourse.com

COURSE-SPECIFIC POLICIES AND RESOURCES

Missed or late assignments, and regrading of assessments

Late submissions will not be accepted and will receive a grade of zero.

Academic Concessions

If extenuating circumstances arise, please contact the RHL Graduate School program office as early as reasonably possible, and submit an Academic Concession Request & Declaration Form https://webforms.sauder.ubc.ca/academic-concession-rhlee. If an academic concession is granted

during the course, the student will be provided options by RHL, or by the instructor in consultation with RHL, per UBC's policy on Academic Concession.

Code Plagiarism

Code plagiarism falls under the UBC policy for Academic Misconduct. Students must correctly cite any code that has been authored by someone else or by the student themselves for other assignments. Cases of "reuse" may include, but are not limited to:

- the reproduction (copying and pasting) of code with none or minimal reformatting (e.g., changing the name of the variables)
- the translation of an algorithm or a script from a language to another
- the generation of code by automatic code-generations software

An "adequate acknowledgement" requires a detailed identification of the (parts of the) code reused and a full citation of the original source code that has been reused.
Students are responsible for ensuring that any work submitted does not constitute plagiarism. Students who are in any doubt as to what constitutes plagiarism should consult their instructor before handing in any assignments.

POLICIES APPLICABLE TO COURSES IN THE ROBERT H. LEE GRADUATE SCHOOL

Attendance

Excepting extenuating circumstances, students are expected to attend 100% of their scheduled class hours. Absent students limit their own academic potential, and that of their classmates, and cause unnecessary disruption to the learning environment. Students missing more than 20% of the total scheduled class hours for a course (including classes held during the add/drop period) without having received an academic concession will be withdrawn from that course. Withdrawals, depending on timing, could result in a "W" or an "F" standing on the transcript.

Punctuality

Students are expected to arrive for classes and activities on time and fully prepared to engage. Late arrivals may be refused entry at the discretion of the instructor or activity lead. Students arriving later than halfway through a scheduled class will be treated as absent for that class.

Electronic Devices

Devices such as laptops, tablets, and cell phones are not permitted to be used in class unless directed by the instructor for in-class activities. Students who do not follow the School's policy in this regard may be required to leave the room for the remainder of the class, so that they do not distract others. Research shows that students' use of laptops in class has negative implications for the learning environment, including reducing their own grades and the grades of those sitting around them.

Citation Style

Please use the American Psychological Association (APA) reference style to cite your sources.

Details of the above policies and other RHL Policies are available at:
http://www.calendar.ubc.ca/vancouver/index.cfm?tree=12,199,506,1625

UNIVERSITY POLICIES AND RESOURCES

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic

community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available on the UBC Senate website at https://senate.ubc.ca/policies-resources-support-student-success.

Respect for Equity, Diversity, and Inclusion

The UBC Sauder School of Business strives to promote an intellectual community that is enhanced by diversity along various dimensions including Indigeneity (including identification as First Nation, Métis, or Inuit), race, ethnicity, gender identity, sexual orientation, religion, political beliefs, social class, and/or disability. It is critical that students from diverse backgrounds and perspectives be valued in and well-served by their courses. Furthermore, the diversity that students bring to the classroom should be viewed as a resource, benefit, and source of strength for your learning experience. It is expected that all students and members of our community conduct themselves with empathy and respect for others.

Academic Integrity

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

Use of Artificial Intelligence

Generative AI Permitted Where Specified With Attribution

For this course, students may use generative artificial intelligence (AI), including ChatGPT, for specific assessments or coursework, where it is expressly specified by the instructor. In these cases of permitted use, students must disclose any use of AI-generated material as per the assessment guidelines.

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ACKNOWLEDGEMENT

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəy̓əm (Musqueam) people, who for millennia have passed on their culture, history, and traditions from one generation to the next on this site.

COURSE SCHEDULE

(Subject to change with class consultation)

Class	Date	Topic	Readings or Activities	Assignments due
1	Sep 5	**Preview** Counting techniques **Introduction to Probability Theory (Ch1)** Sample space, events, probabilities	R: §1.1-1.3 P: §1.0-1.3, §2	
2	Sep 7	Conditional probabilities, probability tree, independent events	R: §1.4-1.5 P: §1.4	
3	Sep 12	Bayes' rule **Random Variables (Ch2)** Discrete RVs, PMF, CDF, expectation, variance	R: §1.6, §2.1-2.2 P: §1.4, §3	HW1
4	Sep 14	Examples of Discrete RV: Bernoulli, binomial, geometric & Poisson; Continuous RVs, PDF, CDF, expectation, variance	R: §2.3-2.4 P: §3, §4	
5	Sep 19	Examples of Continuous RV: uniform, exponential & normal; Jointly distributed RVs, joint/marginal PMF/PDF/CDF	R: §2.5.1-2.5.3 P: §4, §5.1.0-5.1.2	HW2
6	Sep 21	Functions of joint RVs, independent RVs, covariance; Sample mean & variance	R: §2.5.1-2.5.3 P: §5.1.4, §6.1.1-6.1.2	
7	Sep 26	Limit theorems (Strong Law of Large Numbers, Central Limit Theorem) **Conditional Probability & Expectation (Ch3)** Discrete and continuous cases	R: §2.8, §3.1-3.3 P: §7.1, §5.1.3	HW3
8	Sep 28	Computing expectations and probabilities by conditioning (Law of Iterated Expectations, Law of Total Probability); Compound RVs, applications	R: §3.4, first few pages of §3.5 P: §5.1.3, §5.1.5	
9	Oct 3	**Discrete-Time Markov Chains (Ch4)** Introduction to stochastic processes, Markov property, transition matrix & diagram, modeling Markov chains, Chapman-Kolmogorov equations	R: §2.9, §4.1-4.2 P: §10.1.0, §11.2	HW4
10	Oct 5	Classification of states (recurrent vs. transient, periodic vs. aperiodic), limiting & stationary distributions	R: §4.3-4.4 P: §11.2	HW5 (Oct 7)
	Oct 10-14	Final Exam (To be scheduled)		