THE UNIVERSITY OF BRITISH COLUMBIA

Department of Computer Science, Mathematics, Physics and Statistics
Okanagan Campus

DATA 405/505-001 – STOCHASTIC MODELLING AND SIMULATION
2022W TERM -1 (SEPT. 6TH, 2022 – DEC. 8TH ,2022)

INSTRUCTOR:
Name: Yas Yamin
Contact: yas.yamin@ubc.ca
Office Location: SCI 238B
Office Hours: Thursday 15:00-16:00
Class Location: EME 1202

SCHEDULE:
Lecture: Tuesday and Thursday
Hours: 17:00 – 18:30

LABORATORY COORDINATOR/INSTRUCTOR/TA:

L01:	Name of TA	Nima Eslami	Friday	8:00am – 10:00am
L02:	Name of TA	Nima Eslami	Friday	10:00am – 12:00pm

All TA's can be contacted on Canvas.

TEXTBOOK AND OTHER REFERENCE MATERIAL:
Braun, W.J. (2020) *A Crash Course in Modelling and Simulation with R.*

COURSE DESCRIPTION:
Course Website:
Course materials are available at https://canvas.ubc.ca.

Academic Calendar Entry:
Pseudorandom number generation and testing. Simulation and modelling of univariate and multivariate data; stochastic models, including Poisson processes and Markov chains; MCMC simulation, hidden Markov models, and queuing systems. Credit will be granted for only one of COSC 405, DATA 405, COSC 505, or DATA 505.

Prerequisite: A score of 60% or higher in STAT 230.

Course Overview: This course will provide an overview of statistical modelling and simulation techniques to students whose background is primarily in computer science and for those students who are studying data science. The course will begin with a review of the R Language for statistical and graphical programming. Course topics will include Monte Carlo simulation, including pseudorandom number generation and testing, simulation of discrete state stochastic processes as well as linear and nonlinear time series, elements of numerical linear algebra, and optimization.

Learning Outcomes: After completing this course, students will be able to:

- construct functions and graphs using the R Language
- construct and test basic pseudorandom number generators
- simulate realistic data having a variety of dependence structures
- assess the adequacy of various statistical models, graphically and through simulation
- solve linear and quadratic programming problems

Course Objectives:

- to demonstrate how Monte Carlo simulation can be used to create realistic data scenarios
- to demonstrate how digital computers can generate apparently random output
- to demonstrate how simulation models can be used to assess the level of uncertainty in estimates and predictions, based on data

Course Format: In Person

LATE POLICY:
The assignments are due on Sunday at 23:59 PT. **Late assignment will not be marked.**

PASSING CRITERIA:
In order to pass the course:
- Students MUST receive a score of at least 40% on the final exam

EXPECTATIONS:

The mode of delivery for lectures and labs will be in-person attendance. Pre-lecture slides will be uploaded before the class, and students are expected to read them first before attending the class. During the class, there will be multiple informal assessments in periodic points in the lecture, where students will be given questions to work on. There will also be graded in-class/in-person quizzes and in-class/in-person exams (see schedule below).

TENTATIVE COURSE SCHEDULE AND REQUIRED READINGS:

Date	Topic	Textbook
Lecture 1	Introduction of R	Chapter 1
Lecture 2	Review of R	Chapter 1
Lecture 3	Statistical Modelling with R I	Chapter 2
Lecture 4	Simulation: Random Number Generation	Chapter 3
Lecture 5	Simulation: Random Number Generation	Chapter 3
Lecture 6	Simulation: Random Number Generation	Chapter 3
Lecture 7	Discrete Models	Chapter 4
Lecture 8	Discrete Models	Chapter 4
Lecture 9	Discrete Models	Chapter 4
Lecture 10	Frist Midterm (October 6th)	
Lecture 11	Continuous Models	Chapter 5
Lecture 12	Continuous Models	Chapter 5
Lecture 13	Multivariate	Chapter 6
Lecture 14	Multivariate	Chapter 6
Lecture 15	Multivariate	Chapter 6
Lecture 16	Regression and Time Series	Chapter 7
Lecture 17	Regression and Time Series	Chapter 7
Lecture 18	Markov Chains	Chapter 8
Lecture 19	Markov Chains	Chapter 8
Lecture 20	Second Midterm (November 17th)	
Lecture 21	MCMC Simulation	Chapter 8
Lecture 22	MCMC Simulation	Chapter 8
Lecture 23	Hidden Markov Models	Chapter 8
Lecture 24	Hidden Markov Models	Chapter 8
Lecture 25	Queueing and Continuous Time Markov Chains	Chapter 8

EVALUATION CRITERIA AND GRADING:

Assignments   20%
Misterm Exams   40%
Final Exam   40%

Final grades will be based on the evaluations listed above and the final grade will be assigned according to the standardized grading system outlined in the UBC Okanagan Calendar.

LABORATORY SCHEDULE:
The weekly laboratory time will be spent performing assignments and practice questions.

GRADING PRACTICES
Faculties, departments, and schools reserve the right to scale grades in order to maintain equity among sections and conformity to University, faculty, department, or school norms. Students should therefore note that an unofficial grade given by an instructor might be changed by the faculty, department, or school. Grades are not official until they appear on a student's academic record.
http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,41,90,1014

FINAL EXAMINATIONS
The examination period for W2022 is **Sunday December 11th, 2022, to Thursday December 22nd, 2022**. Except in the case of examination clashes and hardships (three or more formal examinations scheduled within a 24-hour period) or unforeseen events, students will be permitted to apply for out-of-time final examinations only if they are representing the University, the province, or the country in a competition or performance; serving in the Canadian military; observing a religious rite; working to support themselves or their family; or caring for a family member. Unforeseen events include (but may not be limited to) the following: ill health or other personal challenges that arise during a term and changes in the requirements of an ongoing job. Further information on **Academic Concession** can be found under **Policies and Regulation in the Okanagan Academic Calendar** http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,48,0,0

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.

A more detailed description of academic integrity, including the University's policies and procedures, may be found in the Academic Calendar at: http://okanagan.students.ubc.ca/calendar/index.cfm?tree=3,54,111,0.

COOPERATION VS. CHEATING

Working with others on assignments is a good way to learn the material and we encourage it. However, there are limits to the degree of cooperation that we will permit. Any level of cooperation beyond what is permitted is considered cheating.

When working on programming assignments, you must work only with others whose understanding of the material is approximately equal to yours. In this situation, working together to find a good approach for solving a programming problem is cooperation; listening while someone dictates a solution is cheating. You must limit collaboration to a high-level discussion of solution strategies, and stop short of actually writing down a group answer. Anything that you hand in, whether it is a written problem or a computer program, must be written by you, from scratch, in your own words. If you base your solution on any other written solution, you are cheating. If you provide your solution for others to use, you are also cheating.

COPYRIGHT DISCLAIMER

Diagrams and figures included in lecture presentations adhere to Copyright Guidelines for UBC Faculty, Staff and Students http://copyright.ubc.ca/requirements/copyright-guidelines/ and UBC Fair Dealing Requirements for Faculty and Staff http://copyright.ubc.ca/requirements/fair-dealing/. Some of these figures and images are subject to copyright and will not be posted to *Canvas.* All material uploaded to *Canvas* that contain diagrams and figures are used with permission of the publisher; are in the public domain; are licensed by Creative Commons; meet the permitted terms of use of UBC's library license agreements for electronic items; and/or adhere to the UBC Fair Dealing Requirements for Faculty and Staff. Access to the *Canvas* course site is limited to students currently registered in this course. Under no circumstance are students permitted to provide any other person with means to access this material. Anyone violating these restrictions may be subject to legal action. Permission to electronically record any course materials must be granted by the instructor. Distribution of this material to a third party is forbidden.

GRIEVANCES AND COMPLAINTS PROCEDURES

A student who has a complaint related to this course should follow the procedures summarized below:

- The student should attempt to resolve the matter with the instructor first. Students may talk first to someone other than the instructor if they do not feel, for whatever reason, that they can directly approach the instructor.
- If the complaint is not resolved to the student's satisfaction, the student should e-mail the Associate Head, Dr. Sylvie Desjardins at sylvie.desjardins@ubc.ca or the Department Head, Dr. John Braun at cmps.depthead@ubc.ca

STUDENT SERVICE RESOURCES

Disability Resource Centre

The Disability Resource Centre ensures educational equity for students with disabilities and chronic medical conditions. If you are disabled, have an injury or illness and require academic accommodations to meet the course objectives, please contact Earllene Roberts, the Diversity Advisor for the Disability Resource Centre located in the University Centre building (UNC 215).

UNC 215 250.807.9263
email: earllene.roberts@ubc.ca
Web: www.students.ok.ubc.ca/drc

Equity and Inclusion Office

Through leadership, vision, and collaborative action, the Equity & Inclusion Office (EIO) develops action strategies in support of efforts to embed equity and inclusion in the daily operations across the campus. The EIO provides education and training from cultivating respectful, inclusive spaces and communities to understanding unconscious/implicit bias and its operation within in campus environments. UBC Policy 3 prohibits discrimination and harassment on the basis of BC's Human Rights Code. If you require assistance related to an issue of equity, educational programs, discrimination or harassment please contact the EIO.

UNC 325H 250.807.9291
email: equity.ubco@ubc.ca
Web: www.equity.ok.ubc.ca

Office of the Ombudsperson for Students

The Office of the Ombudsperson for Students is an independent, confidential and impartial resource to ensure students are treated fairly. The Ombuds Office helps students navigate campus-related fairness concerns. They work with UBC community members individually and at the systemic level to ensure students are treated fairly and can learn, work and live in a fair, equitable and respectful environment. Ombuds helps students gain clarity on UBC policies and procedures, explore options, identify next steps, recommend resources, plan strategies and receive objective feedback to promote constructive problem solving. If you require assistance, please feel free to reach out for more information or to arrange an appointment.

UNC 328 250.807.9818
email: ombuds.office.ok@ubc.ca
Web: www.ombudsoffice.ubc.ca

Sexual Violence Prevention and Response Office (SVPRO)

A safe and confidential place for UBC students, staff and faculty who have experienced sexual violence regardless of when or where it took place. Just want to talk? We are here to listen and help you explore your options. We can help you find a safe place to stay, explain your reporting options (UBC or police), accompany you to the hospital, or support you with academic accommodations. You have the right to choose what happens next. We support your decision, whatever you decide.
Visit svpro.ok.ubc.ca or call us at 250-807-9640.

Independent Investigations Office (IIO)

If you or someone you know has experienced sexual assault or some other form of sexual misconduct by a UBC community member and you want the Independent Investigations Office (IIO) at UBC to investigate, please contact the **IIO**. Investigations are conducted in a trauma informed, confidential and respectful manner in accordance with the principles of procedural fairness.

You can report your experience directly to the **IIO by** calling 604-827-2060.
Web: https://investigationsoffice.ubc.ca/
E-mail: director.of.investigations@ubc.ca

Student Learning Hub
The Student Learning Hub (LIB 237) is your go-to resource for free math, science, writing, and language learning support. The Hub welcomes undergraduate students from all disciplines and year levels to access a range of supports that include **tutoring in math, sciences, languages, and writing, as well as help with study skills and learning strategies**.
For more information, please visit the Hub's website (https://students.ok.ubc.ca/student-learning-hub/) or call 250-807-9185.

Student Wellness
At UBC Okanagan health services to students are provided by Student Wellness. Nurses, physicians and counsellors provide health care and counselling related to physical health, emotional/mental health and sexual/reproductive health concerns. As well, health promotion, education and research activities are provided to the campus community. If you require assistance with your health, please contact Student Wellness for more information or to book an appointment.

UNC 337 250.807.9270
email: healthwellness.okanagan@ubc.ca
Web: www.students.ok.ubc.ca/health-wellness

SAFEWALK
Don't want to walk alone at night? Not too sure how to get somewhere on campus? Call Safewalk at
250-807-8076.
For more information, see: www.security.ok.ubc.ca

Course Instructor: Dr. Yas Yamin   *Course Code: DATA 405/505-001*