



COSC 405/DATA 405/COSC 505/DATA 505

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Academic Calendar Entry

DATA_O 405 (3) Stochastic Modelling and Simulation

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. [3-2-0] Prerequisite: One of STAT 205, STAT 230 [with 60% or above].

COSC_O 405/505 (3) Modelling and Simulation

Numeric dynamic systems models and emphasis on discrete stochastic systems. State description of models, common model components, entities. Common simulation language. Simulation using algebraic languages. Simulation methodology: data collection, model design, output analysis, optimization, validation. Elements of queuing theory, relationship to simulation. Applications to computer systems models. Credit will be granted for only one of COSC 405, DATA 405, COSC 505, or DATA 505. [3-2-0] Prerequisite: All of COSC 221, COSC 222.

Required Textbook: Braun, W.J. (2024) *A Crash Course in Modelling and Simulation with R*. (available online)

Additional Notes (to be made available online as required)

Course Format

Lecture format in-person.

Schedule

Lectures are held in EME 1121 Tuesday and Thursday 2:00 – 3:30 PM.
There are no labs in this course.

Course Overview, Content and Objectives

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. There will be an emphasis on the mathematical foundations underlying the concepts and techniques. 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, spatial processes, and optimization.



Objectives of the course are:

- 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

Learning Outcomes

After completing this course, students will be able to:

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

Evaluation Criteria and Grading

- 4 Assignments (due September 17, October 8, October 29, November 19).
- 4 Online Quizzes (posted at various times during term with completion deadlines of December 5).
- 4 In-person Term Tests (September 26, October 17, November 7, November 28)
 - Assignments 10%
 - Quizzes 10%
 - Term Tests 80%

Late assignments will be accepted up to 3 days after the due date but with a 20% reduction of their assignment grade, unless proper medical documentation is provided for serious illness, etc.

With proper documentation for serious illness, a missed test can be re-taken at a re-scheduled time within 2 weeks of the original test date. Otherwise, a missed test will receive a grade of 0.

Use of generative artificial intelligence (AI):

Students are permitted to use artificial intelligence tools, including generative AI, to gather information, review concepts or to help produce assignments. However, students are ultimately accountable for the work they submit, and any content generated or supported by an artificial intelligence tool must be cited appropriately. Plagiarism will not be tolerated. Use of AI tools is not permitted during midterm exams and final exams in this course.

Course Schedule (on a separate document)

UBC values

UBC creates an exceptional learning environment that fosters global citizenship, advances a civil and sustainable society, and supports outstanding research to serve the people of British Columbia, Canada, and the world. UBC's core values are excellence, integrity, respect, academic freedom, and accountability.

Visit [UBC Okanagan's Academic Calendar](#) for a list of campus-wide regulations and policies, as well as term dates and deadlines.



Resources to support student success

Student supports, resources and campus services: Visit [the Student Support and Resources page](#) to find one-on-one help or explore resources to support your experience at UBC Okanagan, as well as many other campus services available to all students.

Email etiquette

In the context of a university course, an email is a professional communication; it should be formal and polite. Specifically, emails should include:

- 1) a salutation and a name (e.g. Hi John, Dear Dr. Braun—I'm fine if you use my first name, but please use whatever makes you most comfortable),
- 2) a clear and polite statement of your question or issue written in full sentences with appropriate punctuation,
- 3) a close (e.g. sincerely, thank you), then your first and last name. I do not want or need your student number in emails.

If your concern is easy to respond to via email, I will do so during work hours and usually within 24 hours of your email. If the matter is more complex, I will ask that you set up an appointment. I will not respond to emails on weekends, holidays, or evenings.

You can either send email via the Canvas shell or directly to john.braun@ubc.ca

A note on when and how to ask for my help

If you need to reach out for an extension or other support, I encourage you to do so. If you need mental health support, I can help you connect with university providers.

Academically, what we're doing is challenging. If you find yourself stuck, confused, uncertain how to tackle content, whatever—that's when you should ask me for help. I know this content can be hard to work through, so the mental model you should have is to use me as a coach. . .tell me where you're having an issue or a problem or don't understand something, and I can help as needed. It's not a sign of weakness to find some of this material difficult.

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>.

UBC Okanagan Disability Resource Centre

The Disability Resource Centre ensures educational equity for students with disabilities, injuries or illness. 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 Commons Corner in the University Centre building (UNC 227).

UNC 227A 250.807.9263

email earllene.roberts@ubc.ca

Web: www.ubc.ca/okanagan/students/drc

UBC Okanagan Ombuds Office

The Ombuds Office offers independent, impartial, and confidential support to students in navigating UBC policies, processes, and resources, as well as guidance in resolving concerns related to fairness.

UNC 227B 250.807.9818

email: ombuds.office.ok@ubc.ca

Web: <http://ombudsoffice.ubc.ca/ubc-okanagan-2/>



a place of mind
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UBC Okanagan Equity and Inclusion Office

UBC Okanagan is a place where every student, staff and faculty member should be able to study and work in an environment that is free from discrimination and harassment. UBC prohibits discrimination and harassment on the basis of the following grounds: age, ancestry, colour, family status, marital status, physical or mental disability, place of origin, political belief, race, religion, sex, sexual orientation or unrelated criminal conviction. If you require assistance related to an issue of equity, discrimination or harassment, please contact the Equity and Inclusion Office.

UNC 227C 250.807.9291

email: equity.ubco@ubc.ca

Web: www.ubc.ca/okanagan/equity

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:

<http://www.ubc.ca/okanagan/students/campuslife/safewalk.html>