



DATA*6600 Applications of Data Science Summer 2024

0 COURSE PREAMBLE

Mental Health. One out of every five students in Canada experiences some sort of mental health issue at some point in their academic career. If you find yourself facing a mental health crisis, or just need to talk to someone, please consider taking advantage of one of the following resources available to University of Guelph students:

Counseling Services: (x53244) is located at Health Services (J.T. Powell Building) and offers individual and group counselling sessions by appointment or walk-in.

Student Support Network is located in Raithby House (across from the cannon) and offers confidential, peer-based, drop-in support.

Good2Talk: (1-866-925-5454) is a free, 24/7 student hotline that provides professional counselling and referrals for mental health, addictions and well-being.

Here 24/7: (1-844-437-3247) specializes in assessment, referral and appointment booking and is available 24/7 for crisis support.

You are not alone and you will not be judged for asking for help.

For information on current safety protocols, follow these links:

<https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-your-safe-return/>

<https://news.uoguelph.ca/return-to-campuses/spaces/\#ClassroomSpaces>

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives. Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g. final exam or major assignment).

1 INSTRUCTOR

This course is team-taught by graduate faculty from Department of Mathematics and Statistics, and the School of Computer Science at the University of Guelph. In its first iteration, the course will be taught by the following team:

2 AIMS & OBJECTIVES

2.1 Calendar Description

This interdisciplinary team-taught seminar provides students the opportunity to synthesize information, research methods, and present cutting-edge applications of data science. Learning outcomes include identifying reliable sources, understanding and presenting relevant contemporary data science methods, thinking critically about practical implementations of data science, and effective peer collaboration. Emphasis is placed on effective communication to a non-technical audience.

2.2 Course Description

Data Science is constantly evolving as a field and requires technically literate individuals that are effective communicators and critical thinkers. This course aims to refine students' skills in these areas while exposing them to cutting-edge applications of data science. As a team-taught course, the course is divided into 4 short (equally-weighted) modules, students will see data science from the perspectives of faculty in Mathematics, Statistics and/or Computer Science. Students will be expected to work in groups, as well as read, critique and present current articles related to data science. Each group may also be required to present their own solutions to problems presented through case studies.

Prerequisite(s): DATA*6200 and DATA*6300

Restriction(s): Restricted to Master of Data Science students

Academic Department: Mathematics & Statistics

Credit Weight: 0.5

2.3 Learning Outcomes

Upon successful completion of this course, students will have demonstrated the ability to:

1. Identify and discuss various data science applications (such as genetic programming, cybersecurity, informed policymaking, to name a few) and potential real-world problems in these fields;
2. Propose multiple methodological approaches to resolving data-science related problems;
3. Collaborate with peers and employ a multidisciplinary approach to developing design solutions to data science related problems;
4. Consider, question, and critique alternative solutions presented by peer groups in consideration of technical, social, and ethical themes;
5. Clearly present proposed solutions to data science-related problems through written and oral forms of communication; and
6. Reflect upon and discuss ethical and social implications of data science applications.

2.4 Instructor's Role and Responsibility to Students

The role of each instructor is to facilitate discussion and provide feedback to students in each of their respective modules.

3 TEACHING AND LEARNING ACTIVITIES

3.1 Timetable

Lectures: Tu, Th at 8:30-9:50am EST Room: MCKN 224

Office hours: TBD and provided on Courselink once set. Office hours may change.

3.2 Course Topics and Schedule

Week	Topic
Weeks 1-3	Module 1: Communication and Reflection, Case Study 1
Weeks 4-6	Module 2: Cloud Computing, Case Study 2
Weeks 7-9	Module 3: Causal Inference, Case Study 3
Weeks 10-12	Module 4: Cybersecurity, Case Study 4

4 LEARNING RESOURCES

4.1 Course Website

Course material, news, announcements, and grades will be regularly posted to the DATA*6600 Courselink site. You are responsible for checking the site regularly.

4.2 Required Resources

The course may use multiple resources* (textbooks, articles, and websites), including:

Suzan Last, *Technical Writing Essentials*, University of Victoria, 2019.

Cynthia Dwork and Aaron Roth, [The Algorithmic Foundations of Differential Privacy](#), Foundations and Trends in Theoretical Computer Science, 2014.

**Additional resources or readings will be provided by instructors as needed. Please consult Courselink for module-specific reading references throughout the semester.*

5 ASSESSMENT

5.1 Dates and Distribution

Assignment	Due Date	Weighting	Learning Outcome(s) Assessed
Case Study 1: Group Presentation*	Week 3	25%	2-6
Case Study 2: Group Presentation*	Week 6	25%	1-6
Case Study 3: Group Presentation*	Week 9	25%	1-6
Case Study 4: Group Presentation*	Week 12	25%	1-6

* When individuals work in groups, their grade will be based on the group mark and peer-reviews by their fellow group members. Course instructors may also introduce an explicit part of the assignment that is completed individually.

5.2 Module Descriptions

Module 1: Communication and Reflection

Instructor: Ayesha Ali

This module will prompt students to critically assess their own ability to communicate effectively and to refine these soft skills that are essential for today's data scientist. Class discussions will involve critiquing samples of written and oral presentations of technical analyses. By the end of this module, students should be able to self-critique their own written and oral work and demonstrate proficiency in synthesizing technical information into a coherent presentation aimed at a non-technical audience.

Module 2: Spatial Data Science with Focus on Spatial Point Processes

Instructor: Fekadu Bayissa

This module examines spatial data science techniques, with emphasis on spatial point processes. Spatial point processes are used to model the spatial distribution of events or phenomena, making them essential tools for analyzing a wide range of spatial data, from environmental occurrences to urban crime patterns. Students will delve into spatial geometries and point pattern analysis, enabling students to describe patterns of points over space and make informed inferences about underlying processes. Using the R programming language, students will gain hands-on experience visualizing spatial data, simulating point patterns, and presenting analytical results.

Module 3: Data Science Applications in Cybersecurity

Instructor: Rozita Dara

This module reviews two aspects of data science in cybersecurity, which together comprise case study 3: 1) differential privacy and its applications in protecting individuals' data; and 2) applications of data science in data security. Balancing ethics of privacy, transparency and utility will be discussed throughout.

Case study 3a: Differential privacy is an effective approach for protecting individuals' privacy while preserving data utility for analytics purposes. The first part of this case study, students will examine methods and software tools that can be used to anonymize and de-identify sensitive data in applications such as healthcare and finance. Group presentations and class discussions will focus on differential privacy techniques (e.g. machine learning and statistical), applications such as answering distributed queries, and examining privacy and data utility trade-offs.

Case study 3b: The second part of this case study will focus on applications of machine learning and statistical modeling in data security will be discussed. Students will work in groups to investigate a security application such as intrusion detection and present approaches that

can be used to detect threats and cyber attacks. Presentations will review the data sources, different methods that the problem can be formulated, potential algorithms that can be used to tackle threat identification tasks, methods for evaluation of the approach, and best practices for reporting the results.

Module 4: Data Science Applications in Disaster Risk Management

Instructor: Khurram Nadeem

This module investigates the intricate challenges of Disaster Risk Management (DRM) with a specific focus on wildland fire disasters in Canada. It analyzes the complexities inherent in decision-making processes across mitigation, readiness, reaction, and restoration phases, emphasizing interdependencies and uncertainties. Furthermore, it explores the burgeoning role of Big Data-driven Artificial Intelligence (AI) and Machine Learning (ML) models in informing DRM strategies, while also addressing the ethical considerations associated with their integration. Through group presentations, students will examine select AI/ML applications in DRM, spanning various natural disasters like wildland fires, floods, hurricanes, and earthquakes. By dissecting these examples, the module aims to introduce applications of AI/ML methodology in enhancing risk mitigation, preparedness, response efficiency, and recovery efforts in the face of diverse calamities, thereby contributing to a more resilient DRM framework.

5.3 Course Grading Policies

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the graduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations:

https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/sec_d0e2228.shtml

Passing grade: To pass the course, students must obtain a grade of 65% or higher on the total mark of all assessments.

6 UNIVERSITY STATEMENTS

6.1 Email Communication

As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

6.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the Undergraduate Calendar for information on regulations and procedures for [Academic Consideration](#).

Academic Consideration, Appeals and Petitions

[<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-consideration-appeals-petitions/>]

6.3 Accommodations of Religious Obligations

If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements.

6.4 Health and Wellbeing

The University of Guelph provides a wide range of health and wellbeing services at the [Vaccarino Centre for Student Wellness](#). If you are concerned about your mental health and not sure where to start, connect with a [Student Wellness Navigator](#) who can help develop a plan to manage and support your mental health or check out our [mental wellbeing resources](#). The Student Wellness team are here to help and welcome the opportunity to connect with you.

6.5 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g., final exam or major assignment).

6.6 Drop Date

Courses that are one semester long must be dropped by the end of the last day of classes; two-semester courses must be dropped by the last day of classes in the second semester. The regulations and procedures for [Dropping Courses](#) are available in the Graduate Calendar.

6.7 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments; you may be asked to resubmit work at any time.

6.8 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS).

Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 10 business days in advance, and no later than the first business day in November, March or July as appropriate for the semester. Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

More information: www.uoguelph.ca/sas

6.9 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is outlined in the Graduate Calendar.]

Inappropriate online behaviour will not be tolerated. Examples of inappropriate online behaviour include:

- Posting inflammatory messages about your instructor or fellow students
- Using obscene or offensive language online
- Copying or presenting someone else's work as your own
- Adapting information from the Internet without using proper citations or references
- Buying or selling term papers or assignments
- Posting or selling course materials to course notes websites
- Having someone else complete your quiz or completing a quiz for/with another student
- Making false claims about lost quiz answers or other assignment submissions
- Threatening or harassing a student or instructor online
- Discriminating against fellow students, instructors or TAs

- Using the course website to promote profit-driven products or services
- Attempting to compromise the security or functionality of the learning management system
- Sharing your username and password
- Recording lectures without the permission of the instructor

6.10 Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

6.11 Other University Resources

The Academic Calendars [<https://www.uoguelph.ca/academics/calendars>] are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.