DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus (Section A)
Department of Mathematics and Statistics
STAT 4620/5620
Data Analysis
Winter 2022

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.

Instructor(s):	Dr. Joanna Mills Flemming	Joanna.Flemming@Dal.Ca
Lectures:	TR 1:05pm-2:25pm	LSC-COMMON AREA C202
Office Hours:	TR 10:30am-12:00pm	Chase Building 103
Course delivery:	In-person	

Course Description

At the beginning of this course students must select a dataset of relevance to their field of study (or interest). Each student must analyze their dataset and prepare a report (due at the end of the term) describing their data, analyses, and findings. Graduate students are required to orally present both their proposal and final report. If preferred, students may work in groups.

This course begins with a thorough description of the multi-disciplinary field of *data science*, making clear the role of statistics therein. Issues surrounding *data ethics* and *reproducibility* will then be discussed followed by a review of tools for *exploratory data analysis* (EDA). *Statistical models* will be described commencing with *linear models* (LMs) and *generalized linear models* (GLMs). Next, *additive,* and *generalized additive models* (GAMs) will be introduced followed by their *mixed model* extensions. *Tree-based methods*, *longitudinal models* and *spatial statistics* will be demonstrated with a view to enhancing each student's ***statistical toolbox***. Emphasis will be placed on understanding model assumptions and method implementation. Real and relevant data sets will be used throughout the course to demonstrate best practices for data analysis. **The R programming language** will be used exclusively.

Course Prerequisites

STAT 3340, STAT 3460, or the instructor's consent.

Course Exclusion

None.

Learning Objectives

This course aims to provide (upper level undergraduate and graduate) students with an awareness of important considerations when undertaking data analysis along with working knowledge of a range of statistical methodologies. Students will develop the confidence to perform appropriate data analyses to answer scientific (and other) questions of interest.

List of knowledge/skills student are expected to have upon completion of this course:

- Capacity to recognize important features of data (e.g., heterogeneity, dependence).
- Understanding of zero-inflation, zero-truncation, and over/under-dispersion.

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- Proficiency with fitting GLMs, GAMs and their extensions.
- Knowledge of hierarchical modelling frameworks and interpretation of random effects.
- Understanding of tree-based methods and longitudinal models.
- Appreciation for the field of spatial statistics.
- Working knowledge of the R language and environment for statistical computing and graphics.

Course Materials

Suggested reference texts:

- Generalized Additive Models: An Introduction with R, Second Edition. Simon N. Wood.
- Core Statistics. Simon N. Wood.

Course Assessment

Assessment	Weight (% of final grade)	Date
Project Proposal	***0% Undergrad / 5% Grad***	***Feb 10th***
Assignments (4)	***40% Undergrad / 30% Grad***	***Jan 20th, Feb 3rd, Mar 3rd, Mar 17th***
Project Presentation	***0% Undergrad / 5% Grad***	***Mar 29th & Mar 31st***
Final exam	***30%***	***Apr 5th***
Project Report	***30% Undergrad / 30% Grad***	***Apr 8th***

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D	(50-54)
A (85-89)	B (73-76)	C (60-64)	F	(<50)
A- (80-84)	B- (70-72)	C- (55-59)		

Course Content

*Indicates that an assignment is due.

Week 1		Jan 6th What is Data Science?
Week 2	Jan 11th Data Ethics and Reproducibility	Jan 13th Tools for Exploratory Data Analysis
Week 3	Jan 18th Tools for EDA	Jan 20th Linear Models*
Week 4	Jan 25th LMs in R	Jan 27th Generalized Linear Models
Week 5	Feb 1st GLMs in R	Feb 3rd Overdispersion*
Week 6	Feb 8th Zero-Inflated Data	Feb 10th *PROPOSAL PRESENTATIONS*
Week 7	Feb 15th Additive Models	Feb 17th AMs in R
STUDY BREAK		
Week 8	Mar 1st Linear Mixed Models	Mar 3rd LMMs in R*
Week 9	Mar 8th Longitudinal Models	Mar 10th Tree Based Methods
Week 10	Mar 15th GLMMs and GAMMs	Mar 17th GLMMs and GAMMs in R*
Week 11	Mar 22nd Spatial Statistics	Mar 24th Your Statistical Toolbox
Week 12	Mar 29th *PROJECT PRESENTATIONS*	Mar 31st *PROJECT PRESENTATIONS*
Week 13	Apr 5th *FINAL EXAM*	April 8th *FINAL Report Due*

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Course Policies on Missed or Late Academic Requirements

There will be four assignments. These will provide students with the opportunity to review the statistical **theory and methods** discussed in class and apply these techniques to analyze real and relevant datasets. These assignments *must* be completed using R (https://www.r-project.org). Late assignments will not be accepted.

Course Policies related to Academic Integrity

Students are allowed to work together on assignments and projects.

University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.
Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).
Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.
Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness
Statement: http://www.dal.ca/cultureofrespect.html

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca).
Information: https://www.dal.ca/campus_life/communities/indigenous.html

Important Dates in the Academic Year (including add/drop dates)
https://www.dal.ca/academics/important_dates.html

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University Grading Practices
https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Student Resources and Support

Advising

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: https://www.dal.ca/faculty/science/current-students/academic-advising.html

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: https://libraries.dal.ca/

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: https://libraries.dal.ca/services/copyright-office.html

Fair Dealing Guidelines https://libraries.dal.ca/services/copyright-office/fair-dealing.html

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness/services-support/student-health-and-wellness.html

Student Advocacy: https://dsu.ca/dsas

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Biosafety: https://www.dal.ca/dept/safety/programs-services/biosafety.html

Chemical Safety: https://www.dal.ca/dept/safety/programs-services/chemical-safety.html

Radiation Safety: https://www.dal.ca/dept/safety/programs-services/radiation-safety.html

Scent-Free Program: https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html

Dalhousie COVID-19 information and updates: https://www.dal.ca/covid-19-information-and-updates.html