

Faculty of Science Course Syllabus
Department of Mathematics and Statistics
Predictive Analytics — ACSC/STAT 3740
WINTER 2024

Instructor(s):	Toby Kenney	tkenney@mathstat.dal.ca
Lectures:	Monday, Wednesday 10:05–11:25	
Course Brightspace Page	https://dal.brightspace.com/d2l/home/311758	
Laboratories:	None	
Tutorials:	None	

Course Description

This course teaches students to analyse data in a real-world context, going through all stages of the data analysis: problem formulation; initial data exploration; model selection and validation; and communication of results. It is intended that this course should prepare students for the Society of Actuaries Predictive Analytics examination.

Course Prerequisites/Corequisites

STAT 2450, MATH/STAT 3340

Course Objectives/Learning Outcomes

- Understand the different types of predictive modeling problems.
- Translate informal questions into formal questions that can be analysed with statistics and predictive analytics.
- Consider factors such as available data, significance of problem, and implementation challenges to define the problem.
- Import datasets into R, correct any errors, and reformat the data in a suitable way for analysis.
- Understand the key principles of constructing graphs.
- Use the `ggplot2` package to create graphs.

- Understand basic methods of handling missing data.
- Implement effective data design with respect to time frame, sampling, and granularity.
- Apply univariate and multivariate data exploration techniques.
- Evaluate the quality of data sources.
- Create additional features from data.
- Identify outliers and other data issues.
- Handle non-linear relationships via transformations.
- Identify ethical and regulatory issues.
- Understand the model assumptions of a GLM.
- Interpret parameters fitted by a GLM.
- Select and validate a GLM appropriately.
- Understand the bias-variance trade-off.
- Construct regression and classification trees.
- Use bagging, random forests and boosting to improve accuracy.
- Select appropriate tuning parameters for various methods.
- Understand and apply K -means clustering and hierarchical clustering.
- Explain and justify the methods used.
- Communicate conclusions in a clear and appropriate manner.

Course Materials

Textbook:

Regression Modeling with Actuarial and Financial Applications, Edward W. Frees, 2010, New York: Cambridge. ISBN: 978-0-521-13596-2.

Additional References:

- An Introduction to Statistical Learning, with Applications in R, James, Witten, Hastie, Tibshirani, 2013, New York: Springer.
- Data Visualization: A Practical Introduction, Healy, 2018, Princeton University Press

Course Assessment

Component	Weight (% of final grade)	Date
Project	40	Tuesday 18th April
Final Exam	40	TBA (Online During Final exam period)
Assignments	20	Assignment 1 — Wednesday 24th January Assignment 2 — Wednesday 7th February Assignment 3 — Wednesday 2nd March Assignment 4 — Wednesday 21st March Assignment 5 — Wednesday 4th April

Other Course Requirements

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)	D	< 50
A-	(80–84)	B-	(70–72)	C-	(55–59)	D	(50–54)

Delivery of Material

The course will be delivered through lectures and discussion sessions. Videos of lectures from previous years are available on Brightspace. Because of the practical hands-on nature of the course material, **participation in the discussion sessions, including doing the preparatory work in advance is strongly encouraged.**

Course Policies

Late assignments will receive a grade of zero, as solutions are posted online immediately after the due date. Assignments submitted online should be in pdf or jpeg format. The overall assignment mark is made up from the best 4 out of 5 assignments. Students unable to take the final exam should, wherever possible, notify the instructor prior to the start of the exam, and submit the Student Declaration of Absence. All reasonable efforts to provide a make-up exam will be made.

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

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>