DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus
Department of Mathematics & Statistics
Stat 3340/Math3340
Regression and Analysis of Variance
Fall 2019

Instructor(s): Bruce Smith bruce.smith@dal.ca Chase 309

Lectures: TR 10:35-11:25 LSC 240 F 10:30-11:25 LSC 242

Course Description: A thorough treatment of the theory and practice of regression analysis. Topics include: fitting general linear models using matrices, optimality of least squares estimators (Gauss-Markov theorem), inferences, simple and partial correlation, analysis of residuals, case-deletion diagnostics, polynomial regression, transformations, use of indicator variables for analysis of variance and covariance problems, model selection, and an introduction to nonlinear least squares. This course makes extensive use of computer packages.

Course Prerequisites: ***STAT 2080.03, (MATH 2030.03 OR MATH 1030.03), and (MATH 1010.03 OR STAT 2060.03 OR DISP)***

Course Objectives/Learning Outcomes

1. Calculate the least squares intercept and slope given (x_i, y_i) data.
2. Evaluate expectation and variance of linear combinations of random variables using matrix operations.
3. Calculate least squares estimates for the multiple regression model using matrix operations.
4. Prove that the least squares estimates are unbiased, and evaluate their covariance matrix.
5. Calculate and interpret entries in the analysis of variance table.
6. Calculate case deletion diagnostics given residuals and leverage values.
7. Determine adequacy of regression models using residual plots, leverage measures and case deletion diagnostics.
8. Choose a transformation of the response to produce variance homogeneity, using computer plots and likelihood methods.
7. Select an appropriate multiple regression model given plots and descriptions of the variables.
8. Describe the importance and use of the Gauss-Markov and Cochran's theorem in regression modelling.
9. Construct confidence intervals for model parameters given computer output or formulae for the standard error.
10. Carry out hypothesis tests on single or several model parameters to determine whether some variables can be removed from a model, using computer output.
11. Given replicate observations, test for lack of fit of a model.
12. Use the statistical package R to plot and manipulate date and to fit simple and multiple regression models.
13. Use R to calculate automatic variable selection strategies, given a response and several predictor variables.

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Course Materials

- Recommended text: Introduction to Linear Regression Analysis, 5th Edition, Montgomery, Peck and Vining. Copy on 2 hour reserve in Killam library.
- Linear algebra reference: Matrix Theory and Linear Algebra, Selinger, online at https://www.mathstat.dal.ca/~selinger/linear-algebra/downloads/LinearAlgebra.pdf
- Most assignments will require use of the statistical software package R. You can download the software at http://www.r-project.org/
- Rstudio, with the Markdown addon is required to organize assignments. It is available at https://www.rstudio.com/
- Lecture notes, assignments, etc., are at bsmith.mathstat.dal.ca/stat3340

Course Assessment

Component	Weight (% of final grade)	Date
Midterm exam	20%	Tuesday, October 15, 7:30-9:30 PM, Dunn 117
Final exam	40%	(Scheduled by Registrar)
Assignments	*6* assignments totalling 40%,	roughly every two weeks.

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 Policies

Assignments are to be submitted at the beginning of class on the due date.
Late assignments will not be accepted.
It is expected that each student will write up their assignment independently. Students submitting identical assignments will receive a mark of 0 for that assignment.
If you are ill on the day of a test, you must advise me of this fact before the test, and you will need to submit a Student Declaration of Absence form before you can write a make-up test.

Course Content

- Multiple linear regression and its matrix formulation
- Assessing model adequacy and transformations
- Regression diagnostics (influential points and multicollinearity)
- Special types of regression: polynomial and indicator variable regression
- Model building and variable selection
- Special topics (generalized linear models, nonlinear regression) - time permitting

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Faculty of Science Course Syllabus (Section B) (revised June-2018)

Stat/Math 3340

Please ensure that the following information on University Policies and Student Resources is available to all students in your course. This document may be posted on your Brightspace course site, or elements may be copied into your **Course Syllabus, Section A.**

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

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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

Missed or Late Academic Requirements due to Student Absence (policy)
https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.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