

Faculty of Science Course Syllabus Winter 2021 (revised October 2020)**Department of Mathematics and Statistics***Statistical Methods for Data Analysis and Inference**Stat 2080/Math 2080**Winter 2021*

Instructor(s): *Jing Zhang* jingzhang@dal.ca *Office Hours: Friday 10-11am (Halifax Time)*

Lectures: *MWF 0835-0925 (Live Lecture on Brightspace)*

Tutorials: *Monday 1735-1825 (Live Tutorial Session on Brightspace)*

Note: Recording of synchronous lectures and tutorial sessions will be posted on Brightspace as well.

Course Description

This is the usual sequel to STAT 1060.03 or STAT 2060.03. This course introduces a number of techniques for data analysis and inference commonly used in the experimental sciences. Topics covered include linear model building, multiple regression, analysis of variance, factorial designs, analysis of covariance using the general techniques for linear models, two and three way tables, along with logistic regression. A natural sequel for this course is STAT 3340.03.

Course Prerequisites

STAT 1060.03 or STAT 2060.03 or DISP

The materials you are expected to be familiar with are the following: computation and use of various measures of central tendency and variability; preparation and interpretation of graphical displays of data such as boxplots, histograms and scatterplots; normal and t distributions and the use of tables for these distributions; the difference between populations and samples, parameters and estimates; the concept of sampling distributions and why they are important; construction and interpretation of confidence intervals; elements of hypothesis testing; formation of null and alternative hypotheses and computation and interpretation of p-values.

Course Exclusion

Course exclusions are COMM 2502 and MGMT 2502.

Learning Objectives

The main objective of this course is to provide a solid grounding in practical data analysis using common statistical methods encountered in scientific research. To this end the central emphasis of the course is on Analysis of Variance (ANOVA) and Regression. A secondary objective is to become comfortable analysing data using the R statistical software.

Outcomes:

- Full understanding of the statistical comparison of two means using both parametric and nonparametric methods.

- Full understanding of one-way and two-way analysis of variance (including assumptions, setup, calculations of key quantities, interpretation, and post-hoc diagnostics).
- Full understanding of correlation as a measure of dependence, including both parametric (Pearson's) and non-parametric (Spearman's) measures of correlation.
- Full understanding of simple linear regression (assumptions, key quantities and formulae, implementation, interpretation and graphical assessment via residuals).
- Basic understanding of multiple regression (assumptions, key quantities and formulae, implementation, interpretation and graphical assessment via residuals).
- Experience with the statistical analysis of categorical/count data in one-way and two-way tables (e.g. chi-squared tests and contingency tables).
- Ability to use modern statistical software (R).

Course Materials

There is no required textbook for this course. However, textbooks used in STAT1060 (Stats, Data and Models by DeVeaux, Velleman and Bock) and STAT2060 (Probability and Statistics by J. Devore) are excellent resources. Another recommended book is Statistics Explained: An Introductory Guide for Life Scientists by Steve McKillup.

Students will be required to use statistical software as part of this course. The software used in the course will be the state-of-the-art open-source statistical package R. R is available from www.r-project.org for Mac OS, Windows, and Linux. An online environment for R is also available at rstudio.cloud.

Course Delivery (online)

This course is offered in a synchronous mode, but it is understood that this may present challenges for some students. Lectures will be delivered through the Collaborate Ultra on Brightspace. Attendance is encouraged, but not required. All lectures will be recorded. Class notes for each class will also be posted.

Course Assessment

The LON-CAPA e-learning software will be used for assessments and exams (as well as for disseminating marks). LON-CAPA can be accessed at capa.mathstat.dal.ca. Further details will be provided on the BrightSpace course space.

Component	Weight (% of final grade)	Date Due
<i>Assessment (6 in total)</i>	<i>60%</i>	
<i>Midterm Exam</i>	<i>20%</i>	<i>TBA</i>
<i>Final exam</i>	<i>20%</i>	<i>(Scheduled exam period)</i>

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 on Missed or Late Academic Requirement

Students should work on assignments individually, but may take advantage of the Brightspace discussion boards to discuss the assignment with TAs. The discussion boards will not be available for the midterm or final exam.

This course follows the university policy on “missed or late academic requirements due to student absence” for assessments:

https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academicrequirements-due-to-student-absence.html

Students experiencing a short-term absence which results in an assessment being missed must do the following:

- Contact the instructor(s) by e-mail prior to the scheduled due date of the assessment,
- Complete a Student Declaration of Absence Form within 3 calendar days of the last day of absence.

Note that a maximum of one Student Declaration of Absence will be accepted and no make-up assessment will be offered. Instead, the weight of the missed assessment will be transferred to the corresponding exam, such that the cumulative assessment will then be worth 25%. If a student misses an assessment and does not submit a Student Declaration of Absence, the mark for the missed assessment will be zero.

Conflicts with the midterm or final exam should be discussed with the instructor. Conflicts will likely be resolved by offering a make-up exam time.

Students who are ill for an extended period and thus miss multiple requirements should contact Patricia Laws, Assistant Dean (Student Affairs).

If there is a legitimate conflict with the time of an exam students must inform the professors of this at least 3 weeks in advance of the assessment and provide details of the conflict. Medical notes are not required.

Late assignments will not be accepted without prior arrangement with the instructor.

Course Content

Listed below in roughly chronological order are the topics to be covered. Note that these may be altered slightly as the term progresses.

- Study design, causal inference and inference to population
- The central limit theorem; hypothesis testing and confidence intervals
- Comparison of two means - paired samples and independent samples
- Comparison of two means - permutation test, Wilcoxon rank-sum test
- One-way analysis of variance
- Bonferroni method for multiple comparisons
- Assessing the model assumptions - residual plot
- Non-parametric one-way ANOVA - Kruskal-Wallis test
- Two-way ANOVA without interaction
- Two-way ANOVA, with interaction, Randomized block design, Post-hoc comparisons of means
- Categorical data, multinomial distribution and goodness of fit test
- Chi-square tests and contingency tables
- Scatterplots, Pearson's correlation, Spearman's rank correlation

- Regression and least squares estimators
- Coefficient of determination, Residual plots, remedies and transformation
- Inference in regression
- Multiple regression basics, hypothesis testing and inference
- Issues in multiple regression
- ANOVA using regression
- Special topics and review

University Policies and Statements

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

Missed or Late Academic Requirements due to Student Absence

As per Senate decision instructors may not require medical notes of students who must miss an academic requirement, **including the final exam**, for courses offered during fall or winter 2020-21 (until April 30, 2021). Information on regular policy, including the use of the Student Declaration of Absence can be found here: https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html.

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>