DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus
Department of Mathematics & Statistics

STAT 2080/MATH 2080/ECON 2280
Statistical Methods for Data Analysis and Inference
Fall 2019

Instructors:

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Office Hours: MWF 14:30-15:30

Teaching Assistant

Joey Mingrone

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Lectures:

Section 1: MWF 13:30-14:30, LSC C240

Section 2: TRF 8:30-9:30, LSC C332

Tutorial: Mondays 17:30-18:30, McCain AUD-1

Course Description

This course introduces a number of techniques for data analysis and statistical inference commonly used in the experimental sciences. Major topics covered include one-way and two-way analysis of variance, simple and multiple regression, as well as parametric and non-parametric statistical tests (see detailed list of topics later in this document).

Course Prerequisites

Formal Pre-requisite(s): STAT 1060 or STAT 2060

The material you are expected to be familiar with prior to the course is the following. The computation and use of various measures of central tendency and variability; the preparation and interpretation of graphical displays of data such as boxplots, histograms and scatterplots; the 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; the construction and interpretation of confidence intervals; the elements of hypothesis testing; the formation of null and alternative hypotheses and the computation and interpretation of p-values.

Course Objectives & Learning Outcomes

The main objective of this course is to provide a solid practical grounding in data analysis and the foundational statistical methods that one will encounter in scientific research. Towards this end, the central emphasis of the course is on Analysis of Variance (ANOVA) and Linear Regression.

Outcomes

- A full understanding of the statistical comparison of two means using both parametric and non-parametric methods
- A thorough understanding of one-way and two-way analysis of variance (including assumptions, setup, calculations of key quantities, interpretation, and post-hoc diagnostics).
- A thorough understanding of correlation as a measure of dependence, including both parametric (Pearsons) and non-parametric (Spearmans) measures of correlation.
- A basic understanding of regression methods for both simple linear regression and multiple regression (assumptions, key quantities and formulae, implementation, interpretation, and graphical assessment via residuals)
- Experience in the statistical analysis of categorical/count data in one-way and two-way tables (e.g. chi-squared tests and contingency tables).
- The ability to use and interpret output from modern statistical software

Course Materials

- There is no required text for this course. However, a detailed set of course notes will be provided.   It is suggested that the books used recently in STAT 1060 (*Stats, Data and Models* by DeVeaux, Velleman and Bock), and STAT 2060 (*Probability and Statistics* by J. Devore) will provide further information on the course topics.
- The LON-CAPA (Learning Online Network with Computer-Assisted Personalized Approach) e-learning software will be used for course notes, assignments, and midterms (as well as for disseminating assignment and midterm marks). LON-CAPA can be accessed from our Brightspace course space, or directly at capa.mathstat.dal.ca . Details on its use will be provided at the beginning of the course.
- There is a Brightspace site for the course, for which you will be automatically enrolled. Brightspace will only be used for communications regarding course logistics and initially to post the syllabus. LON-CAPA is the primary course delivery software.
- The use of Statistical Software will be required for this course. We will make use of both the Minitab statistical package, as well as R statistical software. Minitab is available in Campus computer labs and through Dalhousie ITS free of charge (Windows only, not Mac OS). The state-of-the-art open-source statistical package R is available from www.r-project.org for Mac OS, Windows, and Linux.

Course Assessment

Component	Weight (% of final grade)	Date
Midterm 1	*15%*	*Monday, Oct 7, 17:30-19:00*
Midterm 2	*15%*	*Monday, Nov 18, 17:30-19:00*
Final exam	*45%*	*(Scheduled by Registrar, exam period)*
Assignments	*25%*	*weekly to bi-weekly*

- The midterms (80 minutes each) are scheduled **OUTSIDE OF CLASS TIME** on October 7 and November 18 from 5:30PM – 7:00PM. They do however coincide closely with tutorial time. They are computer based and use the same CAPA software you will be using for your assignments. The exams will take place in computer labs on campus (details TBA).
- The final exam is a written exam (not a CAPA-based exam) and takes place during the regular exam period as scheduled by the registrar.
- Assignments are computer-based and will be done using the CAPA software. These will be due on a roughly weekly to biweekly basis, depending on class progress and midterm dates. Assignment 0 is a test assignment and does not contribute to your grade. *All other assignments will have equal value.*

Other course requirements

There is a weekly tutorial that takes place Mondays 5:30-6:30PM in McCain, AUD-1. There are no marks associated with this tutorial. The tutorial is given by the Teaching Assistant for the course. Its primary purpose is to review assignment materials, and to provide assistance with using statistical software. Tutorials are not mandatory, but you are strongly encouraged to attend.

Conversion of numerical grades to Final Letter Grades follows the <u>Dalhousie Common Grade Scale</u>

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:* late assignments will receive a zero grade. Note that the assignments are online and have a specific time and date they are due. Don't wait until the last minute to submit them, as unexpected technical difficulties can arise.

- *Midterms:* (i) *Time Conflict with the Exam*. Since the midterms are scheduled outside of class time and slightly exceed the allotted tutorial time, a small number of people may have a legitimate conflict with the time of the midterm exam (this means another course, or an exam scheduled for the same time). If so, inform your instructor by email at least 3 weeks in advance of the exam with details of the conflict. Please plan ahead! (ii) *Missing the exam*. If a midterm exam is missed for any other legitimate reason (e.g. illness), please inform us within 12 hours of the exam - the midterm mark will then be assigned to final exam (e.g. if you miss midterm 1, then your final exam would be worth 60%). If the midterm exam is missed without a legitimate excuse, or you fail to inform us of your absence within 12 hours, you will receive a zero grade.

- *Final Exam:* We must be informed immediately of non-attendance for the final exam. Proper written documentation of your absence is required within 12 hours.

- Other information relevant to class logistics will be communicated via messages on the course website.

Course Content

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

- Inference: 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 and verifying statistical model assumptions
- Non-parametric one way ANOVA - Kruskall-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
- χ^2 tests and contingency tables
- Scatterplots, Pearson's correlation, Spearman's rank correlation
- Regression and least squares estimates
- 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

Extra Help

The Mathematics and Statistics Student Resource Centre is in Room 119 of the Chase building. Please refer to the website http://www.dal.ca/faculty/science/math-stats/about/learning-centre.html for more information. Tutors with expertise in Statistics will be there and available to answer questions (on a first come first served basis). There are large tables available for groups to work together. **THIS IS YOUR PRIMARY SOURCE FOR EXTRA HELP** – make good use of it!

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ACCOMMODATION POLICY FOR STUDENTS

Students may request accommodation as a result of barriers related to disability, religious obligation, or any characteristic protected under Canadian Human Rights legislation. The full text of Dalhousie's Student Accommodation Policy can be accessed here:
http://www.dal.ca/dept/university_secretariat/policies/academic/student-accommodation-policy-wef-sep--1--2014.html

Students who require accommodation for classroom participation or the writing of tests and exams should make their request to the **Advising and Access Services Centre (AASC)** prior to or at the outset of the regular academic year. More information and the *Request for Accommodation* form are available at www.dal.ca/access.

ACADEMIC INTEGRITY

Academic integrity, with its embodied values, is seen as a foundation of Dalhousie University. It is the responsibility of all students to be familiar with behaviours and practices associated with academic integrity. Instructors are required to forward any suspected cases of plagiarism or other forms of academic cheating to the Academic Integrity Officer for their Faculty.

The Academic Integrity website (http://academicintegrity.dal.ca) provides students and faculty with information on plagiarism and other forms of academic dishonesty, and has resources to help students

succeed honestly. The full text of Dalhousie's **Policy on Intellectual Honesty** and **Faculty Discipline Procedures** is available here:

http://www.dal.ca/dept/university_secretariat/academic-integrity/academic-policies.html

STUDENT CODE OF CONDUCT

Dalhousie University has a student code of conduct, and it is expected that students will adhere to the code during their participation in lectures and other activities associated with this course. In general:

"The University treats students as adults free to organize their own personal lives, behaviour and associations subject only to the law, and to University regulations that are necessary to protect
  * the integrity and proper functioning of the academic and non – academic programs and activities of the University or its faculties, schools or departments;
  * the peaceful and safe enjoyment of University facilities by other members of the University and the public;
  * the freedom of members of the University to participate reasonably in the programs of the University and in activities on the University's premises;
  * the property of the University or its members."

The full text of the code can be found here:
http://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

DALHOUSIE UNIVERSITY

SERVICES AVAILABLE TO STUDENTS

The following campus services are available to help students develop skills in library research, scientific writing, and effective study habits. The services are available to all Dalhousie students and, unless noted otherwise, are <u>free</u>.

Service	Support Provided	Location	Contact
General Academic Advising	Help with - understanding degree requirements and academic regulations - choosing your major - achieving your educational or career goals - dealing with academic or other difficulties	**Killam Library Ground floor** Rm G28 ***Bissett Centre for Academic Success***	In person: Killam Library Rm G28 By appointment: - e-mail: advising@dal.ca - Phone: (902) 494-3077 - Book online through MyDal
Dalhousie Libraries	Help to find books and articles for assignments Help with citing sources in the text of your paper and preparation of bibliography	**Killam Library Ground floor** Librarian offices	In person: Service Point (Ground floor) By appointment: Identify your subject librarian (URL below) and contact by email or phone to arrange a time: http://dal.beta.libguides.com/sb.php?subject_id=34328
Studying for Success (SFS)	Help to develop essential study skills through small group workshops or one-on-one coaching sessions Match to a tutor for help in course-specific content (for a reasonable fee)	**Killam Library 3rd floor** Coordinator Rm 3104 Study Coaches Rm 3103	To make an appointment: - Visit main office (Killam Library main floor, Rm G28) - Call (902) 494-3077 - email Coordinator at: sfs@dal.ca or - Simply drop in to see us during posted office hours **All information can be found on our website: www.dal.ca/sfs**
Writing Centre	Meet with coach/tutor to discuss writing assignments (e.g., lab report, research paper, thesis, poster) - Learn to integrate source material into your own work appropriately - Learn about disciplinary writing from a peer or staff member in your field	**Killam Library Ground floor** Learning Commons & Rm G25	To make an appointment: - Visit the Centre (Rm G25) and book an appointment - Call (902) 494-1963 - email writingcentre@dal.ca - Book online through MyDal We are open six days a week **See our website: writingcentre.dal.ca**