DALHOUSIE UNIVERSITY
*Inspiring Minds*

**Faculty of Science Course Syllabus**
**Department of Mathematics and Statistics**
**Intermediate Statistical Theory — STAT/MATH 3460**
**Winter 2021 online course**


| | | |
|---|---|---|
| **Instructor(s):** | Hong Gu | hgu@dal.ca |
| **Lectures:** | Asynchronous | on Brighspace |
| **Laboratories:** | None | |
| **Tutorials:** | None | |


**Office hours** An online synchronous session using collaborate Ultra on Tues. 13:05-14:25 (AST) will be used to discuss the course materials, attendancy is optional, recordings will be posted. Other appointments of meetings can be made by emails.

# Course Description

This course provides an intermediate level coverage of statistical theory to provide a framework for valid inferences from sample data. The topics covered include sampling distribution, main methods for point estimation and their properties including bias, variance, mean squared error, consistency, efficiency, and MVUE; interval estimation for unknown parameters, including the mean, differences of two means, variances, and proportions; hypothesis test including Neyman-Pearson lemma, significance and power, likelihood ratio test and tests for mean, variance, contingency tables, and goodness-of-fit. Some basic Bayesian inference is also covered in this course.

# Course Prerequisites

STAT/MATH 3360

# Course Objectives/Learning Outcomes

- Derive the moment estimates and maximum likelihood estimates (MLE) for a prabability model with one or two parameters, including for censored data.

- Understand and apply the knowledge of several properties of estimators, including unbiasedness, efficiency and consistency.
- Learn important sampling distributions including chi-square distribution, t distribution and F distribution.
- Derive the confidence intervals for means, difference between means, proportions, difference between proportions, variances and ratio of two variances based on the corresponding sampling distributions.
- Master the basic concepts in hypothesis testing, including type I error, type II error and power, and calculate the power function for the composite hypotheses.
- understand the concept of the most powerful test and derive the Neyman-Pearson Lemma.
- Use likelihood ratio test to derive the tests concerning means, variances, proportions, and tests for several binomial probabilities, multinomial probabilities, independence for contingency tables and goodness of fit test.
- Understand and apply the chi-square approximation for likelihood ratio statistics for simple and composite hypotheses.
- Understand the basic Bayesian inference and can calculate the posterior densities and the posterior predictive distributions for Normal, Binomial and Poisson models.

# Course Materials

**Textbook:** "John E. Freund's Mathematical Statistics with Applications" (Eighth Edition) by Irwin Miller and Marylees Miller, published by Pearson

**Note:** Textbook (either hard copy or digital) can be purchased through Dalhouse University bookstore or elsewhere online.

**Other reference** "Probability and Statistical Inference; Volume 2: Statistical Inference" (Second Edition) by J. G. Kalbfleisch, published by Springer-Verlag, 1985

**Course Brightspace page**: All course materail can be accessed through
`https://dal.brightspace.com/d2l/home/145301`

# Course Assessment

| **Component** | **Weight (% of final grade)** | **Date** |
|---|---|---|
| Assignments | 24 | 8 assignments, approximately weekly |
| Tests | 30 | 3 tests, online open book, 1.5 hour for each test |
| Final Exam | 46 | Time TBA, an 3 hour online exam |

### Sections of the text covered

We expect to cover chapters 10, 11, 12, 8, 13 in the textbook and in this order. For certain parts, the course covers the syllabus in more depth than the text book. There is also an added "Bayesian data analysis" section at the end which is not covered by the text book.

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

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|---|---|---|---|---|---|---|---|
| **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

There will also be (approximately) weekly homework assignments, which must be handed in before the due date. After this, I will put the model solutions on Brightspace. **No credit can be given for late homework.** The assignment weights will be shifted to the rest of the assignments if the missed assignments are due to illness. The overall homework mark will be made up of an average of the weekly homework marks.

There is no make-up for the tests. If the missed test is due to illness, the weight for the test will be transferred to the final exam. If there is no decent reason for the missed test, the test grade will be zero.

For the above weight transfer to apply, students need to provide the **Student Declaration of Absence form** for missed academic requirement in this course. Each student can use the **Student Declaration of Absence form** maximally twice in the term. Students need to contact the instructor prior to the start of the exam if students cannot write a final exam, in which case the make-up final will be arranged. Final exam weight cannot be shifted to the other course components. The final exam will be a three hour comprehensive exam.

Students need to finish all assignment, test and final exam questions independently, collaboration or copying solutions from any other sources are not allowed and thus deemed as plagiarism for this course.

Students in different time zones who can't finish the tests and the final exam at the scheduled time need to email in advance and a different time will be arranged to suit you.

## 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 dont follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal mannerperhaps through a restorative justice process. If an informal resolution cant 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 Mikmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mikmaq 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 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

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