

Course Outline Form: Winter 2023

General Information

Course Title: STAT*4340 Statistical Inference

Course Description: This course reviews and extends the theory of estimation introduced in STAT*3110. Topics including point estimation, interval estimation, hypothesis testing and decision theory will be presented from both the frequentist and likelihood-based perspectives. Foundational issues concerning the frequentist and Bayesian paradigms will also be discussed.

Prerequisites: STAT*3110, STAT*3240

Credit Weight: 0.5

Academic Department (or campus): Mathematics & Statistics

Campus: University of Guelph

Semester Offering: Winter

Class Schedule and Location: M/F 8:30am – 9:50am in MCKN 261.

Instructor Information

Instructor Name: Dr. Lorna Deeth

Instructor Email: Ldeeth@uoguelph.ca

Office location and office hours: MACN 548, office hours 2 – 3pm on M/W/F. Note that these office hours are shared with the other course I am teaching.

Course Content

Specific Learning Outcomes:

By the end of this course, students should be able to:

- Implement various methods of point estimation for parametric models; likelihood, Bayes and method of moments; understand their strengths and limitations; understand concepts such as bias, variance and mean-squared error.
- Utilize various methods of interval estimation: such as, pivotal methods or inversion of tests in the frequentist context, likelihood intervals in the likelihood context, and posterior credible intervals in the Bayesian context. Experiment with simple bootstrap intervals using R.
- Understand various approaches to testing hypotheses, be able to critique each of these approaches.
- Implement the Bayesian approach and compare and contrast with the likelihood and frequency approach for simple models; learn the basics of the decision-theoretic approach.
- Use software such as R to implement approaches to statistical inference such as the Bayesian and the bootstrap approach.
- Understand basic principles of statistical inference, likelihood, sufficiency and conditionality; ask questions critically about the concept of statistical evidence. Discuss flaws in statistical inference as conventionally applied in subject matter journals.

Lecture Content:

- Review of probability and distribution theory
- Random sample and sampling distribution
- Large sample theory, stochastic convergence
- Point estimation, properties of estimators, unbiasedness, efficiency, sufficiency, completeness, UMVUE, exponential family, best linear unbiased estimator.
- Methods of finding estimators, method of moments, maximum likelihood, Bayes estimator, equivalent estimators, estimating function, asymptotic properties of estimators.
- Testing statistical hypothesis, uniformly most powerful test, unbiased test, generalized likelihood ratio test, UMPUT.
- Interval estimation, likelihood interval, pivotal quantities

Course Assignments and Tests:

Course Component	Date*	Time	Location	Weight
Assignment 1	Monday, January 30	Due by 11:59pm	Online	10% each Total: 40%
Assignment 2	Monday, February 27	Due by 11:59pm	Online	
Assignment 3	Monday, March 20	Due by 11:59pm	Online	
Assignment 4	Monday, April 10	Due by 11:59pm	Online	
Midterm	Friday, March 3	8:30am – 9:50am	In class	20%
Final Exam	Friday, April 21	8:30am – 10:30am	TBA	40%

*Note: Assignment deadlines are approximate, and subject to minor variations based on material coverage.

Course Resources

Recommended Texts:

Casella, G. and Berger, R.L. *Statistical Inference*, 2nd edition (2002).

Other Resources: A set of incomplete lecture notes will be posted on Courselink. It is expected students will have a copy of these notes available, and will fill them in during lectures. Completed lecture notes will not be posted online.

THE LECTURE NOTES ARE FOR INDEPENDENT USE ONLY AND ARE NOT TO BE RE-DISTRIBUTED IN ANY FORM WITHOUT MY WRITTEN PERMISSION.

Lectures: Students are expected to attend lectures and participate in any discussion or questions that are asked. Face-to-face lectures are not recorded, and students who miss lectures will be required to obtain a copy of the notes on their own. In case of illness on my part, lectures will be given online, where they will be recorded and posted to Courselink shortly after class and remain posted for 1 week (after which time they will be removed).

R Statistical Software: Students will be using the statistical software program R/RStudio for their course work. Students should download and install R/RStudio on their personal computers. R/RStudio is freely available, and runs on both Windows and Mac machines.

Course Policies

Communication Policies: Email communication is our primary form of communication this semester. You must use your University of Guelph email account, include STAT*4340 in your subject line, and include your name and student ID number in all correspondence. Emails that do not include a name and ID number, or from non-uoguelph accounts, will not be answered; otherwise, I will try to respond to emails within 3 business days. Please note that only administrative inquiries will be answered via email; questions regarding assignments, course content, etc. will only be answered during office hours or on the Courselink Discussion Board. Questions regarding course content that are sent via email will be posted (anonymously) and answered on the Discussion Board.

Grading Policies:

Assignments: There will be a total of 4 written assignments throughout the semester. All assignments must be completed individually. Assignments will be submitted through the online system Gradescope and must be submitted by the specified date and time. Details about how to submit assignments will be posted on Courselink. Assignments can be submitted up to three days late, subject to a 5% per day late penalty. After the three-day grace period, no further assignments will be accepted, and any outstanding assignments will receive a grade of 0. **NO EXCEPTIONS.** Students are expected to complete all 4 assignments. Students who cannot complete an assignment for a valid reason should speak with me **before** the assignment deadline to discuss their situation.

Midterm: The midterm will be held in class, and therefore no student should have a conflict with the date or time. If a conflict does exist, **it is your responsibility to resolve it immediately.** Students who miss the midterm for a valid, documented reason (such as a medical illness) must contact me within 2 business days of the missed test and provide the appropriate documentation if requested. If you cannot write a test for mental health reasons or are seeking accommodation on compassionate grounds, you must speak with your Program Counsellor (and include them in all communication with me) before any accommodations will be considered. In the event accommodation is granted, students may be required to complete an alternate assessment in a format of my discretion.

Final Exam: The final exam (date, time, and location) is scheduled by the Registrar's Office. Students who miss the final exam due to a valid, documented reason must contact their Program Counsellor for advice on University regulations regarding final exams. These procedures are based on University policy, and are not under the control of the course instructor.

Students are required to complete both the midterm and final exam **independently.** You are permitted to use one letter-sized (8.5" X 11") double-sided cheat sheet for each exam, on which you can write anything you like. The use of class notes, assignments, or other resources during the exams is not allowed.

Regrade Request Procedures: In the event a student wishes to have an assignment or test question regraded, the student must submit a **Regrade Request Form** (available on Courselink) within one week of the graded work being returned. After one week, the grade in question is considered final, and regrade requests can no longer be submitted. **NO EXCEPTIONS.** Note that in the event a student submits a question for regrading, I reserve the right to regrade the entire assignment/test.

Course Policy on Group Work:

Students are encouraged to work together to discuss course content, share ideas, and ask/answer questions. However, work submitted for grading, including the assignments, must reflect the independent work of each student.

All exams must be completed independently.

Any unauthorized collaboration, completing another student's work, or having another student complete your work, will constitute academic misconduct.

Recording of Lecture Materials:

By enrolling in a course, unless explicitly stated and brought forward to their instructor, it is assumed that students agree to the possibility of being recorded during lecture, seminar or other "live" course activities, whether delivery is in-class or online/remote.

If a student prefers not to be distinguishable during a recording, they may:

- turn off their camera
- mute their microphone
- edit their name (e.g., initials only) upon entry to each session
- use the chat function to pose questions.

Students who express to their instructor that they, or a reference to their name or person, do not wish to be recorded may discuss possible alternatives or accommodations with their instructor.

University Policies

Disclaimer:

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via Courselink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

COVID-19 Safety Protocols:

For information on current safety protocols, follow these links:

<https://news.uoguelph.ca/return-to-campus/how-u-of-g-is-preparing-for-your-safe-return/>

<https://news.uoguelph.ca/return-to-campus/spaces/#ClassroomSpaces>

Please note, that these guidelines may be updated as required in response to evolving University, Public Health or government directives.

Email Communication:

As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

When You Cannot Meet a Course Requirement:

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your

name, id#, and e-mail contact. See the Undergraduate Calendar for information on regulations and procedures for [Academic Consideration](#).

Accommodation due to Illness:

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g., final exam or major assignment).

Drop Date:

Courses that are one semester long must be dropped by the end of the last day of classes; two-semester courses must be dropped by the last day of classes in the second semester. The regulations and procedures for [Dropping Courses](#) are available in the Undergraduate Calendar.

Copies of Out-of-class Assignments:

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

Accessibility:

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

More information: www.uoguelph.ca/sas

Academic Misconduct:

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying

the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The [Academic Misconduct Policy](#) is outlined in the Undergraduate Calendar.

Recording of Materials:

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Resources:

The [Academic Calendars](#) are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

Mental Health Services:

One out of every five students in Canada experiences some sort of mental health issue at some point in their academic career. If you find yourself facing a mental health crisis, or just need to talk to someone, please consider taking advantage of one of the following resources available to University of Guelph students:

Counselling Services: Visit the Counselling Services website (<https://wellness.uoguelph.ca/counselling>) to get information on resources available to you, both online and in-person. You can also visit them at Health Services (J.T. Powell Building, ext 53244) where they offer individual and group counselling sessions by appointment or walk-in.

Student Support Network: is located in the Wellness & Education Promotion Centre in the J.T. Powell Building and offers confidential, peer-based, drop-in support.

Good2Talk: ([1-866-925-5454](tel:1-866-925-5454)) is a free, 24/7 student hotline that provides professional counselling and referrals for mental health, addictions and well-being.

Here 24/7: ([1-844-437-3247](tel:1-844-437-3247)) specializes in assessment, referral and appointment booking and is available 24/7 for crisis support.

You are not alone and you will not be judged for asking for help.