Course Outline STAT*4340: Winter 2021
Provisional outline awaiting approval

Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings and academic schedules. Any such changes will be announced via CourseLink and/or class email. All University-wide decisions will be posted on the COVID-19 website https://news.uoguelph.ca/2019-novel-coronavirus-information/

and circulated by email.

Illness

The University will not require verification of illness (doctor's notes) for the fall 2020 or winter 2021 semesters.

General Information

Course Title: Statistical Inference

Course Description: This course extends and deepens the theory of estimation and inference introduced in STAT*3110. Topics including point estimation, interval estimation, hypothesis testing and decision theory will be presented from the frequentist, likelihood and Bayesian perspectives. Foundational issues concerning the frequentist, likelihood and Bayesian paradigms will also be discussed. While this course builds on STAT*3110, the level is considerably deeper and much new material is introduced.

Credit Weight: 0.5

Academic Department (or campus): Math and Stats

Campus: Guelph

Semester Offering: Winter 2021

Class Schedule: Remote Asynchronous + 1 Synchronous Meeting on Mondays: 3:30-4:20

Instructor Information

Instructor Name: Tony Desmond
Instructor Email: tdesmond@uoguelph.ca

Course Content

Specific Learning Outcomes:
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, whether Neyman-Pearsonian, Fisherian or Bayesian; 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:

1. **PRINCIPLES OF DATA REDUCTION**: LIKELIHOOD, SUFFICIENCY, CONDITIONALITY.

2. **POINT ESTIMATION**: (A) METHOD OF MOMENTS, MAXIMUM LIKELIHOOD, BAYES ESTIMATION. CRAMER-RAO BOUND. EXPONENTIAL FAMILIES

(B) PROPERTIES OF ESTIMATORS: UNBIASEDNESS, MEAN-SQUARED ERROR, CONSISTENCY, SUFFICIENCY, EFFICIENCY, ASYMPTOTICS. NEYMAN-FISHER, RAO- BLACKWELL AND LEHMAN-SCHEFFE THEOREMS.

3. **HYPOTHESIS TESTING**: LIKELIHOOD RATIO, NEYMAN-PEARSON LEMMA, BAYES TESTS, ASYMPTOTICS OF TESTS, KARLIN-RUBIN THEOREM.

4. **INTERVAL ESTIMATION**: PIVOTAL METHOD, INVERSION OF TESTS, BAYESIAN INTERVALS, ASYMPTOTIC LIKELIHOOD INTERVALS, FIDUCIAL INTERVALS, DELTA METHOD, BOOTSTRAP INTERVALS

5. **DECISION THEORY**. RISK FUNCTIONS (BAYESIAN AND FREQUENTIST), MINIMAXITY, ADMISSIBILITY

6. **OTHER TOPICS.** MONTE CARLO METHODS, E.G. BOOTSTRAP AND MCMC.

Course Assignments and Tests:

4 or 5 assignments, worth 30%.

Take Home Midterm Test will be posted on Courselink Monday February 22 and due in the Dropbox on Courselink Tuesday February 23 at 11:59pm, worth 30%.

Take Home Final Examination will be posted on Courselink Monday, April 19 and due in the Dropbox on Courselink Tuesday April 20 at 11:59pm, worth 40%.

Course Resources

Required Texts: Statistical Inference. Casella, G. and Berger, R. 2nd Edition. (A copy will be on reserve.)

Applied Bayesian Statistics with R and OpenBUGS Examples. Cowles, M.K. (An electronic copy is available in the Library and will be placed on Reserve)

Recommended Texts:

All of Statistics: A Concise Course in Statistical Inference. Wasserman, L. Springer. On Reserve and Online.

In all Likelihood: Statistical Modelling and Inference Using Likelihood. Pawitan, Yudi. Oxford University Press. On Reserve.

Principles of Statistical Inference. Cox, D.R. Cambridge University Press. On Reserve.

Statistics on the Table: the History of Statistical Concepts and Methods. Stigler, Stephen. Harvard University Press. On Reserve.

Comparative Statistical Inference, 3rd Edition. Barnett, Vic. Wiley. On Reserve.

Course Policies

Late Assignments or Exams will not be accepted except under very exceptional circumstances.

Course Policy on Group Work:

Assignment solutions should be your own work, be clear, legible and well organized. You may discuss assignments with other classmates, but the work handed in should be your own. Work on take-home exams should be entirely your own,

Course Policy regarding use of electronic devices and recording of lectures

Electronic recording of classes is expressly forbidden without consent of the instructor. When recordings are permitted they are solely for the use of the authorized student and may not be reproduced, or transmitted to others, without the express written consent of the instructor.

University Policies

Academic Consideration

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor in writing, with your name, id#, and e-mail contact. See the academic calendar for information on regulations and procedures for

Academic Consideration:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

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 detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Accessibility

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Centre for Students with Disabilities as soon as possible.

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

Course Evaluation Information

Please see http://www.mathstat.uoguelph.ca/files/TeachevaluationformF10.pdf

Drop date

The last date to drop one-semester courses, without academic penalty is ***Monday*, April 12 2020**.
For regulations and procedures for Dropping Courses, see the Academic Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Additional Course Information

Additional Course Information will be provided in class.