

STAT 4500 A/STAT 5600

Parametric Estimation/ Mathematical Statistics I

COURSE OUTLINE

Term Fall 2020
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Lectures Lecturers will be delivered through posting lecture notes on cuLearn on a weekly basis, every Monday, starting the week of September 7th. The introductory lecture on September 10th will be delivered synchronously via Big Blue Button and starts at 10:05 am.

Office hours Tuesdays, 10:30 pm – 11:30 pm, or by appointment. Office hours will be conducted synchronously via Big Blue Button. Questions pertaining to general course material may be asked during the BBB session or sent to the instructor by email at least one hour prior to the start of the BBB session.

Assessment Scheme Final Exam: 50% Midterm Test: 30% Assignments: 20% (5% each)

Textbook *Statistical Inference*, 2nd ed., by George Casella, Roger L. Berger
References *Mathematical Statistics*, 1st or 2nd ed, by P. Bickel and K. Doksum; *A First Course in Mathematical Statistics*, by G. Roussas

One open-book 80-minute midterm test will be held on **Thursday, November 5th**, from 10:00 am to 11:20 am. Test question paper will be available on cuLearn during the scheduled test hours. You will be given extra 15 minutes, from 11:20 am to 11:35 am, to scan and submit your test answer paper via cuLearn. There are no make-up tests in this course. There will be **four** assignments. All assignments count towards the term mark. Due dates for Assignments 1 to 4 are tentatively scheduled for October 8, October 22, November 12, and December 3. Late assignments will not be accepted. In addition to assignments, there will be four problem sets. They will be given for your practice and will not be counted towards the term mark. Three-hour open-book final exam will be scheduled by Carleton University.

Important Notes:

1. Lecture notes, assignments and solutions, problem sets and their solutions, as well as announcements will be posted on cuLearn. Students should check the course web page on cuLearn on a regular basis.
2. **All materials created for this course** (including lecture notes, assignments, posted solutions, etc.) **remain the intellectual property of the instructor**. These materials are intended for the personal and non-transferable use of students registered in the current offering of the course. **Reposting, reproducing, or redistributing any course materials**, in part or in whole, without the written consent of the instructor, **is strictly prohibited**.

3. There is a separate **Plagiarism Policy** document for this course that is located on cuLearn. Students **must read** the document thoroughly and **must agree to adhere to this policy** (and to all policies stated in this Course Outline) **within the first two weeks of classes**.

Assignments, tests, and final exam policies:

1. Assignments are **mandatory** and you will use cuLearn to submit your assignments. Be sure to write your own solutions and show all of your work (i.e., include every step). **All assignments count towards the term mark**. You are expected to work on your assignments consistently once they are released. As a result, you will never be granted an exemption from an assignment, even for a legitimate medical reason, and no extra credit assignments will be available. Assignments submissions will be handled electronically (i.e., via cuLearn) and there is no “grace period” with respect to a deadline – an assignment submitted even one minute after the deadline is late and will receive a mark of zero. Technical problems do not exempt you from this requirement. Consequently, you are advised to attempt to submit your assignment at least one hour prior to the due date and time. For each assignment, you will be submitting exactly one (1) pdf-file created using Microsoft Office, Google Docs, or LaTeX. Compressed files (e.g., “zip”, “rar”, etc.) or documents in another format (e.g., “doc”, “rtf”, etc.) will be penalized and may receive a mark of zero. If any of the files you submit cannot be opened it will receive a mark of zero. Consequently, after you upload your submission on cuLearn you must re-download it immediately and ensure that: (a) your submission is the correct type of file and has the correct filename; (b) each of your pdf-files can be opened with Adobe Acrobat Reader (for marking purposes).
2. Test is **mandatory** and, due to the online nature of this class, **open-book**. **Open-book** refers to class materials only (lecture notes, textbook, and references). Test question paper will be available on cuLearn during the scheduled test hours. You will be given extra 15 minutes to scan and submit your test answer paper via cuLearn. There will be no make-up tests.
3. Three-hour **open-book** final exam will be scheduled by Carleton University. **Open-book** refers to class materials only (lecture notes, textbook, and references). Exam question paper will be available on cuLearn during the scheduled exam hours.
4. In normal circumstances, students with **illness during the span of time a test or exam is offered** might be granted an exemption only if they provide a copy of the Carleton University Medical Certificate https://carleton.ca/registrar/wp-content/uploads/med_cert.pdf that has been completed and signed by a physician covering the period in question. **COVID-19 note:** We understand during the current COVID-19 situation, a medical note by a physician may be difficult to obtain. If you miss midterm test, you may elect to submit the self-declaration form https://carleton.ca/registrar/wp-content/uploads/COVID-19_Self-declaration.pdf instead of obtaining a medical note, in which case the instructor might consider shifting the weight of the test to the final exam. (Currently the university process for accommodations is being reviewed. An update will be provided as soon as new accommodation policies are released.)

The course topics below include selected sections of Chapters 5, 6, 7, 9, and 10 in the textbook and some (not much) material that is not from the textbook.

COURSE TOPICS

1. **Review of Probability:** Some modes of convergence; relationships among the various modes of convergence; some limit theorems; conditional expectation and its properties

2. **Sufficiency and Related Theorems:** Parametric models; definition of a sufficient statistic and some basic results; minimal sufficient statistics; complete sufficient statistics; Basu's theorem; exponential family of distributions; completeness and uniqueness: Rao-Blackwell theorem and Lehmann-Scheffé theorem
3. **Criteria for Selecting an Estimator:** Unbiased estimators and UMVU estimators; Fisher information; Cramér-Rao inequality; loss functions; admissible and inadmissible estimators; Bayes estimators; minimax estimators; relationships among the Bayes, admissible and minimax estimators
4. **Classical Methods of Estimation:** Method of moments estimators and their properties; maximum likelihood estimators and their properties; least square estimators and their properties; minimaxity of the least square estimator (and the maximum likelihood estimator) in linear regression models; asymptotic relative efficiency in estimation; superefficient estimators; M-estimators
5. **Confidence Intervals and Regions:** Definition of a confidence interval and some examples; general procedure for construction of a confidence interval; construction of a confidence interval in the Bayesian case; construction of a shortest length confidence interval; definition of a confidence region and some examples

Objectives of the course: the course is designed to present in depth the basic theories and methods of the classical Estimation Theory whose knowledge is required in various fields of modern Statistics. It is anticipated that through reading the course materials, attending online office hours, and solving homework problems the students will acquire valuable skills in constructing efficient estimation procedures in univariate and multivariate parametric settings.

Academic Accommodation

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Pregnancy obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website <http://www2.carleton.ca/equity/accommodation/>.

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Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet

with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable) at <http://www2.carleton.ca/pmc/new-and-current-students/dates-and-deadlines/>. You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at <http://www2.carleton.ca/equity/>.

Academic Integrity: The University states unequivocally that it demands academic integrity from all its members. Academic dishonesty, in whatever form, is ultimately destructive to the values of the University. Students who violate the principles of academic integrity through dishonest practices undermine the value of the Carleton degree. Dishonesty in scholarly activity cannot be tolerated. Any student who violates the standards of academic integrity will be subject to appropriate sanctions. For more details visit the Registrar's Office website <https://carleton.ca/registrar/academic-integrity/>.

Important dates:

- September 9, 2020: Fall term begins. Fall and fall/winter classes begin.
- September 23, 2020: Last day of registration for fall term and fall/winter courses. Last day to change courses or sections (including auditing) for fall term and fall/winter courses.
- September 30, 2020: Last day to withdraw from fall term and fall/winter courses with a full fee adjustment. Withdrawals after this date will result in a permanent notation of WDN on the official transcript.
- October 9, 2020: December examination schedule (fall term final and fall/winter mid-terms) available online.
- October 12, 2020: Statutory holiday. University closed.
- October 15, 2020: Last day for receipt of applications for admission to an undergraduate degree program for the winter term from applicants whose documents originate from outside Canada or the United States.
- October 26-30, 2020: Fall break, no classes.
- November 13, 2020: Last day to request Formal Examination Accommodation Forms for December examinations to the Paul Menton Centre for Students with Disabilities. Note that it may not be possible to fulfil accommodation requests received after the specified deadlines.
- November 15, 2020: Last day for receipt of applications for admission to an undergraduate degree program for the winter term.
- November 27, 2020: Last day for summative tests or examinations - or for formative and/or practical tests or examinations totaling more than 15% of the final grade - before the official examination period (see examinations regulations in the Academic Regulations of the University section of the Undergraduate Calendar/General Regulations of the Graduate Calendar).
- December 1, 2020: Last day for receipt of applications from potential winter (February) graduates.
- December 11, 2020: Fall term ends. Last day of fall term classes. Last day for academic withdrawal from fall term courses. Last day for handing in term work and the last day that can be specified by a course instructor as a due date for term work for fall term courses. Last day for receipt of applications for undergraduate degree program transfers for winter term.

- December 12-23, 2020: Final examinations in fall term courses and mid-term examinations in fall/winter courses may be held.
- December 25 through January 1, 2021 (inclusive): University closed.