

STAT 513: STATISTICAL COMPUTING

Course Information, Winter 2025

INSTRUCTOR Ivan Mizera (imizera@ualberta.ca, CAB 441).

CLASS TIME AND VENUE MWF 12:00–12:50, BUS 3-10.

OFFICE HOURS Tentatively, MWF 9:00–9:40 and 11:10–11:40 in CAB 441; otherwise by appointment.

CALENDAR DESCRIPTION Introduction to contemporary computational culture: reproducible coding, literate programming. Monte Carlo methods: random number generation, variance reduction, numerical integration, statistical simulations. Optimization (linear search, gradient descent, Newton-Raphson, method of scoring, and their specifics in the statistical context), EM algorithm. Fundamentals of convex optimization with constraints. Prerequisites: consent of the instructor.

PREREQUISITES While the course assumes some experience with programming, preferably in the R environment (if not, there should be willingness to adapt, as all course programming, lectures, assignments, exams, will be done strictly in R), the most important prerequisite is a decent mathematical culture: from technical aspects, what is required is knowledge and experience with the mathematical notion of probability and related concepts, in particular versatility in probabilistic calculations, especially with expected values. Another required topic is linear and matrix algebra; minimal knowledge of calculus (including also very few multivariable topics) is expected too. On the other hand, the coverage of statistical topics is relatively self-contained.

TEXT There is no required text covering all the topics. Some possibly helpful references include but are not limited to: Maria L. Rizzo, *Statistical Computing with R*, Second Edition, CRC Press 2019; George S. Fishman, *Monte Carlo: Concepts, Algorithms, and Applications*, Springer 1996; Stephen Boyd and Lieven Vandenberghe, *Convex Optimization*, Cambridge University Press 2004.

COURSE OBJECTIVES AND EXPECTED LEARNING OUTCOMES Understanding of algorithmic and mathematical principles underlying numerical realizations of selected statistical methods, as well as certain numerical methods using statistical and probabilistic ideas.

GRADING COMPONENTS AND DATES

- four homework assignments (40%)
(*tentatively* due, subject to change, Jan 24, Feb 7, Mar 19, Apr 2)
- midterm examination (22%)
Friday, February 28, in class
- final examination (38%) *tentatively* Wednesday, April 16, 2025, 8:30
(The date of the final examination is set by the Registrar and takes precedence over the final examination date reported in this document. Students must verify this date on BearTracks when the Final Exam Schedule is posted.)

GRADING POLICY The raw cumulative score computed from the performance in all course components, with the indicated weights, will determine the final grade in the following manner: those who achieve *91% or more* will qualify for *A*; those with *76% or more* for *B*; *61% or more* guarantees *C* (and *51% or more* the passing grade *D*). Fine distinctions (+ and -) will be determined accordingly, and may be influenced by the scores of the whole class – similarly, several of the above cutpoints may be lowered (but not raised) if circumstances render it necessary. Grades are unofficial until approved by the Department and/or Faculty offering the course. Samples of representative evaluative course material will be made available throughout the course.

APPROPRIATE COLLABORATION AND USE OF RESOURCES The main tenet, the main guideline here is: it is permitted to receive ideas, but not to reuse texts. For instance, the exchange of ideas between students regarding homework assignments, which typically means verbal communication,

possibly accompanied with some writing on paper or similar medium, is permitted; the exchange of computer files, pieces of written code, mathematical derivations, figures, verbatim pieces of text, or any other final products of this character is not. Those are to be generated by the students themselves. The same applies for reusing the text or code from books, from the internet, from so-called artificial intelligence software and online portals, and so on.

The exception to the above, however, applies to the examination environment: students there are not supposed to receive any information from any outside sources, including but not limited to their peers, notes, books, internet, and their supervisor; they are to fare entirely on their own.

POLICIES FOR MISSED WORK There are neither deferred term exams nor extended deadlines for the homework. A student who cannot complete the assignment or misses a term examination because of an incapacitating illness, severe domestic affliction or other compelling reasons must contact the instructor within two working days following the scheduled date of the term work or term exam missed, or as soon as possible, to request an excused absence. If an excused absence is granted, the missed component weight will be deferred to the next term exam, or the final exam. An excused absence is a privilege and not a right. An excused absence granted for a missed midterm may be retracted if a student has worked on less than 50% of the homework assignments over the term. Misrepresentation of facts to gain an excused absence is a serious breach of the Code of Student Behaviour. In all cases, instructors may request adequate documentation to substantiate the reason for the absence at their discretion.

Although no attendance is taken, students are normally supposed to attend the lectures—unless they have compelling reasons, similar to those above, for their absence. In particular, the instructor is not taking the responsibility for ensuring that the information missed because of the absence will be communicated by other means (messages, online postings, lecture notes).

Students that wish to have their term work re-evaluated should request it within two weeks of the return of the graded assessment, and in any case by the last day of classess, whichever comes earlier.

A student who cannot write the final examination due to incapacitating illness, severe domestic affliction or other compelling reasons can apply for a deferred final examination. Such an application must be made directly to the student's Faculty office within two working days of the missed examination and must be supported by appropriate documentation or a Statutory Declaration (see calendar on [Attendance](#)). Deferred examinations are a privilege and not a right; there is no guarantee that a deferred examination will be granted. The Faculty may deny deferral requests in cases where less than 50% of term work has been completed. Misrepresentation of facts to gain a deferred examination is a serious breach of the Code of Student Behaviour.

Students who are absent for an extended period of time (i.e., three weeks or more) for whatever reason (medical or other) should communicate with their instructor as soon as possible. If such a situation arises, students are strongly encouraged to reach out to an academic advisor in their faculty to discuss options that may be appropriate in situations of extended absence (e.g. withdrawing from the course).

The date for the Deferred Final Examination for Winter Term 2025 classes has been set for *Saturday May 10, 2025 (time and venue TBA)*. There is no possibility of a re-examination in this course.

When a term assessment or final exam presents a conflict based on [non-medical protected grounds](#), students must apply to the Academic Success Centre for accommodations via their [Register for Accommodations website](#). Students can review their eligibility and choose the application process specific for *Accommodations Based on Non-medical Protected Grounds*. It is imperative that students review the dates of all course assessments upon receipt of the course syllabus, and apply **as soon as possible** to ensure the timely application of the accommodation. Students who apply later in the term may experience unavoidable delays in the processing of the application, which can affect the accommodation.

ACADEMIC INTEGRITY The University of Alberta is committed to the highest standards of academic integrity and honesty, as well as maintaining a learning environment that fosters the safety, security, and the inherent dignity of each member of the community, ensuring students conduct themselves accordingly. Students are expected to be familiar with the standards of academic honesty and appropriate student conduct, and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the [Code of Student Behaviour](#) and the [Student Conduct Policy](#), and avoid any behaviour that could potentially result in suspicions of academic misconduct (e.g., cheating, plagiarism, misrepresentation of facts) and non-academic misconduct (e.g., discrimination, harassment, physical assault). Academic and non-academic misconduct are taken very seriously and can result in suspension or expulsion from the University.

All students are expected to consult the [Academic Integrity website](#) for clarification on the various academic offences. All forms of academic dishonesty are unacceptable at the University. Any suspected academic offence in this course will be reported to the College of Natural and Applied Sciences. Suspected cases of non-academic misconduct will be reported to the Dean of Students. The College, the Faculty of Science, and the Dean of Students are committed to student rights and responsibilities, and adhere to due process and administrative fairness, as outlined in the Code of Student Behaviour and the Student Conduct Policy. Anyone who is found in violation is likely to receive a sanction. Typical sanctions for academic misconduct include conduct probation, a mark reduction or a mark of 0 on an assessment, a grade reduction or a grade of F in a course, a remark on the transcript, and a recommendation for suspension or expulsion. Sanctions for non-academic misconduct include conduct conditions, fines, suspension of essential or non-essential University services and resources, and suspension or expulsion from the University.

The College of Natural and Applied Sciences (CNAS) has created an [Academic Integrity for CNAS Students](#) eClass site. Students can enroll and review the various resources provided, including the importance of academic integrity, examples of academic misconduct and possible sanctions, the academic misconduct and appeal process, and a *Test yourself: Academic integrity quiz*.

EXAM CONDUCT For the (traditional) exams in person, students have to bring their photo I.D. so that their identity can be verified. Students will not be allowed to begin an examination after it has been in progress for 30 minutes, and must remain in the exam room until at least 30 minutes has elapsed. Only electronic equipment approved by the instructor can be brought into the examination room; in particular, cellphones must be turned off and stowed in bags. In the time of the exam, any communication regarding the course with any other person, a fellow student or other, is strictly prohibited. Students are not to use internet at that time.

STUDENTS ELIGIBLE FOR ACCESSIBILITY-RELATED ACCOMMODATIONS In accordance with the University of Alberta's [Discrimination, Harassment, and Duty to Accommodate policy](#), accommodation support is available to eligible students who encounter limitations or restrictions to their ability to perform the daily activities necessary to pursue studies at a post-secondary level due to medical conditions and/or non-medical protected grounds. Accommodations are coordinated through the [Academic Success Centre](#), and students can learn more about eligibility on the [Register for Accommodations website](#).

It is recommended that students apply as early as possible in order to ensure sufficient time to complete accommodation registration and coordination. Students are advised to review and adhere to published deadlines for accommodation approval and for specific accommodation requests (e.g., exam registration submission deadlines). Students who request accommodations less than a month in advance of the academic term for which they require accommodations may experience unavoidable delays or consequences in their academic programs, and may need to consider alternative academic schedules.

RECORDING AND/OR DISTRIBUTION OF COURSE MATERIALS Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan. Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study, and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

LEARNING AND WORKING ENVIRONMENT The Faculty of Science is committed to ensuring that all students, faculty and staff are able to work and study in an environment that is safe and free from discrimination, harassment, and violence of any kind. It does not tolerate behaviour that undermines that environment. This includes virtual environments and platforms.

If you are experiencing harassment, discrimination, fraud, theft or any other issue and would like to get confidential advice, please contact any of these campus services:

- **Office of Safe Disclosure and Human Rights:** *A safe, neutral and confidential space to disclose concerns about how the University of Alberta policies, procedures or ethical standards are being applied. They provide strategic advice and referral on matters such as discrimination, harassment, duty to accommodate and wrong-doings. Disclosures can be made in person or online using the Online Reporting Tool.*
- **University of Alberta Protective Services:** *Peace officers dedicated to ensuring the safety and security of U of A campuses and community. Staff or students can contact UAPS to make a report if they feel unsafe, threatened, or targeted on campus or by another member of the university community.*
- **Office of the Student Ombuds:** *confidential and free service that strives to ensure that university processes related to students operate as fairly as possible. They offer information, advice, and support to students, faculty, and staff as they deal with academic, discipline, interpersonal, and financial issues related to student programs.*
- **Office of the Dean of Students:** *They can assist students in navigating services to ensure they receive appropriate and timely resources. For students who are unsure of the support they may need, are concerned about how to access services on campus, or feel like they may need interim support while you wait to access a service, the Dean of Students office is here to help.*

STUDENTS SELF-CARE GUIDE: *This [Self-Care Guide](#), originally designed by the Faculty of Native Studies, has broader application for use during students' learning. It provides some ideas and strategies to consider that can help navigate emotionally challenging or triggering material.*

OTHER Policy about course outlines can be found in [Course Requirements, Evaluations Procedures and Grading](#) of the University Calendar. Any typographical errors in this Course Outline are subject to change and will be corrected and announced in class, if necessary.