

Course Outline
Statistical Computing
STAT *4000/(6920)
University of Guelph, F20

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 normally require verification of illness (doctor's notes) for fall 2020 or winter 2021 semester courses. However, requests for Academic Consideration may still require medical documentation as appropriate.

I. General Information**Calendar description:** (0.5 credits)

The topics in this course will include pseudorandom number generation, numerical optimization as used in statistics, simulation study design, Monte Carlo integration and variance reduction, and bootstrapping. Other topics may include permutation tests, visualization of multivariate data, and Big Data.

Prerequisite(s): MATH*2130, STAT*3110, STAT*2050

Instructor: Julie Horrocks, jhorrock@uoguelph.ca

TA: Patrick McMillan, pmcmilla@uoguelph.ca

Course Support:

- Discussion board on Courselink for questions on Assessments.
- Marking questions: Email the TA with questions.
- Office Hours: Email the instructor. Please put STAT4000/6920 in Subject line.

Lecture Days and Times: Asynchronous.

II. Learning outcomes

After successful completion of the course, students will be able to:

(Note that additional criteria for STAT6920 are in brackets)

1. Literacy: Read and extract (and identify, critically evaluate) information from simple (standard) articles in the statistical literature.
2. Ethical: Demonstrate professional and ethical behaviour in statistical practice.
Practice academic integrity
3. Communicating: Describe (Explain) various techniques and methods in statistical computing, and effectively communicate the results of statistical computing procedures and simulations, both verbally and visually.
4. Critical and Creative: Select and implement appropriate (and efficient) methods for generating pseudo-random numbers.
5. Critical and Creative: Design and implement simulation studies to test and compare simple (advanced) statistical methods.
6. Critical and Creative: Gain familiarity with (facility in) in data manipulation.
7. Critical and Creative: Show proficiency in statistical programming including writing, debugging, testing, and commenting code.

III. Course content

All course content will be posted on Courserlink.

WEEKLY SCHEDULE: A=Assignment, C=Challenge, W=week

Week	Dates	Topics (tentative)	Assessments - due
Week 0	Sept 10-11	Introduction: Instructor Intro. Course Outline. Professional Practice: R, R studio, packages	
Week 1	Sept 14-18	Background: Academic Integrity. Basic programming in R (if, loops, functions) Chpt 4: Data Visualization.	CW1 - Sept 18
Week 2	Sept 21-25	Simulations in Statistics. Chpt 3: Generating uniforms. RNG: Inverse CDF Transform method.	A1 - Sept 22 CW2- Sept 25
Week 3	Sept 28-Oct 2	Chpt 3: RNG: Rejection method. Mixtures.	A2- Sept 29 CW3 - Oct 2
Week 4	Oct 5-9	Chpt 5: Monte Carlo integration, Variance reduction. Chpt 6: Simulation. Estimation - Bias and Variability.	A3 - Oct 6 CW4- Oct 9
Week 5	(No Class Oct 12-13) Oct 14-16	Chpt 6. Simulation. Tests - size.	CW5 - Oct 16

Week 6	Oct 19-23	Chpt 6. Simulation. Tests – power. Contaminated distributions.	A4 - Oct 20 CW6 – Oct 23
Week 7	Oct 26-30	Chapter 6. Simulation. CI's. INFO ON PROJECT	A5 – Oct 27 CW7 – Oct 30
Week 8	Nov 2-6	Chpt 7 Bootstrap and Jackknife	A6- Nov 3 CW8 – Nov 6
Week 9	Nov 9-13	Chpt 11: Numerical Methods in Stats	A7 – Nov 10 CW9 – Nov 13
Week 10	Nov 16-19	Big Data: Data Wrangling. Project Draft	A8 – Nov 17 Project Draft – Nov 20
Week 11	Nov 23-27	Big Data: Other Topics.	A9 – Nov 24 CW11 – Nov 27
Week 12	Nov 30 – Dec 4		Project – Dec 4

A=Assignment, C=Challenge, W=week

IV. Course Resources

Recommended Textbook

Available on Ares, Electronic Reserve:

- Maria Rizzo, Statistical Computing with R, Chapman and Hall / CRC (2008).

Other Resources

Available on Ares, Electronic Reserve:

- Zuur, A.F., Ieno E.N., & Meesters, E.H.W.G., A Beginner's Guide to R, Springer (2009).
- Venables, W.N. & Ripley, B.D. Modern Applied Statistics with S (4thEd.) Springer (2002).
- Murrell, P., R Graphics, Chapman & Hall/CRC (2006).

Freely available on the internet:

- Golemund & Wickham, R for Data Science, <https://r4ds.had.co.nz/>

Statistical software:

- R. Free! Download it here: <http://cran.r-project.org>
- RStudio. Also free. Get it here: <https://www.rstudio.com>

V. Methods of Assessment

- **NO LATE ASSESSMENTS WILL BE ACCEPTED.**
- Submit all assessments before the due date/time. All assessments are **due at 4pm** on the stated date.
- Most assessments will be submitted **as a single pdf file** to Dropbox on Courselink. TurnItIn will be used to check for originality. Use Word, LaTeX, or some other text editor to produce your assessments. Formulas can be hand-written and captured with your phone. Graphics should be shrunk to ¼ page at most. Convert all components to a single pdf document, then upload to Dropbox on Courselink.
- Grad students will generally have extra or harder questions on each Assignment or Challenge. Undergrads can do these as well, but they will not count for marks.
- Discussion often leads to better understanding, so I encourage you to discuss course concepts and assessment problems with other students or instructional personnel. However, for individual assessments, each individual is responsible for their own work. Each individual must hand in a separate complete assessment, that is entirely their own work. Academic dishonesty, such as plagiarism (including copying all or part of an assignment) and impersonation is grounds for loss of course credit and dismissal. More information on the subject of academic misconduct can be found at the following website: http://www.uoguelph.ca/undergrad_calendar/c08/c08-amisconduct.shtml

	Due Dates	Percent of Final Grade	
Challenges (best 9 of 10)	Sept 18, 25 Oct 2, 9, 16, 23, 30 Nov 6, 13, 27		20%
Assignments (best 8 of 9)	Sept 22, 29 Oct 6, 20, 27 Nov 3, 10, 17, 24		50%
Project			
Draft (Title and Intro)	Nov 20	5%	
Final Version	Dec 4	25%	
Total			30%

Challenges: Challenges will be due on Fridays. Challenges may require you to write a short reflection or fragment of code, partake in an online discussion, or do some other activity.

Assignments: Assignments will be due on Tuesdays. Assignments may require you to e.g.

- write a summary and reflection on a journal article. The article will be posted on Courselink along with a set of questions to address.
- write code (in R) to implement computer methods or short simulations and write short reports summarizing simulation results.

Project: This will be report of a substantial simulation, programmed in R. Topics will be chosen from a list. More details will follow.

Late/Missed Assessments. Late assessments are not accepted. If you are late or do not hand in a Challenge, for whatever reason, you get a mark of 0. If this happens once, it counts as your dropped Challenge. The same goes for Assignments. Please do **not** get a note from your doctor.

VI. Course Policies

Academic Accommodation of Religious Obligations

If you are unable to complete a course requirement due to religious obligations, please let the instructor know within the first two weeks of class. See the academic calendar for more information:

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml>

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, and be prepared to provide supporting documentation. See the undergraduate calendar for information on regulations and procedures for Academic Consideration.

Consideration:

Consideration may be granted at the instructors discretion. Please note that consideration for medical, compassionate or university-related conflicts (e.g., varsity sports) may require additional discussion with your program counsellor. Consideration is generally more likely when the student proactively advises the instructor of issues well in advance of deadlines.

<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>

Calendars: The calendar is the source of information about the University of Guelph's procedures, policies and regulations that apply to undergraduate, graduate and diploma programs:

<http://www.uoguelph.ca/registrar/calendars/index.cfm?index>

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.

Course evaluations: Each course taught by the Mathematics and Statistics Department is evaluated in the last two weeks of the semester. Note that the completed evaluation and any comments will not be passed on to the instructor, the Chair, and the Departmental Tenure and Promotion Committee until after all the final grades have been submitted following the final examination period.

- Your input provides important feedback to the instructor and becomes an important part of the Departmental Tenure and Promotion Committee's teaching evaluation of the instructor.
- Numerical results calculated from the 7 questions are provided to the instructor and are used by the Departmental Tenure and Promotion Committee in making faculty salary and promotion decisions.
- Comments from unsigned evaluation forms are passed only to the instructor after the final grades have been submitted following the final examination period.
- If you wish your comments to also go to the Chair and the Departmental Tenure and Promotion Committee, you must include your clearly legible handwritten signature, with your legibly printed name and student number in the provided spaces. Note that comments that do not include a clearly legible handwritten signature are not allowed to be passed on to the Chair and the Departmental Tenure and Promotion Committee.
- These comments are made available to the Promotion and Tenure Committee only after the faculty member has had the opportunity to read and respond to the contents. Your identity will be made available to the Chair, the Department committee and the faculty member after final grades have been submitted.

Drop date: The last date to drop one-semester courses, without academic penalty, is the last day of classes, Dec 4. For regulations and procedures for dropping courses, see the Undergraduate Calendar:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

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

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.

Student responsibilities: You should plan on spending between 10 to 12 hours per week working on this course, including the time spent in lectures. This time includes reading the required sections of the textbook, reviewing and/or rewriting lecture notes, preparing questions on any material with which you need help, doing practice problems, and working on your assignments. The Instructors and TAs will offer as much assistance as possible. However, remember that this is your learning experience, and you will get as much out of this class as you put into it.

VII. Campus Resources

If you are concerned about any aspect of your academic program:

-make an appointment with a program counsellor in your degree program.

<http://www.bsc.uoguelph.ca/index.shtml> or
<https://www.uoguelph.ca/uaic/programcounsellors>

If you are struggling to succeed academically:

-There are numerous academic resources offered by the Learning Commons including Supported Learning Groups for a variety of courses, and workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist.

<http://www.learningcommons.uoguelph.ca/>

If you are struggling with personal or health issues:

-Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance.

<https://www.uoguelph.ca/counselling/>

-Student Health Services is located on campus and is available to provide medical attention. <https://www.uoguelph.ca/studenthealthservices/clinic>

-In addition to Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations. <http://www.uoguelph.ca/~ksomers/>

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 Student Accessibilities Services (SAS) as soon as possible. For more information, contact SAS at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: <http://www.uoguelph.ca/csd/>