

University of Manitoba
Department of Statistics

STAT 3150—Statistical Computing

Fall Term 2021

Course Details

Course Number & Title: STAT 3150—Statistical Computing
Section & CRN: Section A01, CRN: 19998
Course Schedule: Tuesday/Thursday, 10:00 to 11:15 am,
on Zoom.
Prerequisites: STAT 2150 (Statistics and Computing) and
STAT 2400 (Introduction to Probability 1)

Instructor Contact Information

Instructor: Max Turgeon
Office Location: 373 Machray Hall
Email: Max.Turgeon@umanitoba.ca
Office Hours: By appointment only.

Student Learning Objectives

This course aims to provide students with a broad overview of computational techniques used in modern statistical analysis. Throughout the course, students will:

- Become proficient in R, to the level that they can analyze data using the tools from this class.
- Learn how to sample from various distributions, directly and indirectly.
- Design and conduct a simulation to study a particular statistical question.
- Become familiar with several resampling techniques and know which one to use for a particular problem.
- Be introduced to numerical methods and optimisation techniques.

Textbook and Other Materials

Textbook: The following textbook is not required, but *strongly recommended*:
Statistical Computing with R (2nd ed.) by Maria L. Rizzo, CRC Press, 2019.

Course Material: Lecture videos, lecture slides, and any additional material will be made available on UM Learn.

Course Assessment

Assignments: There will be six (6) assignments during the term, worth a total of 50% of the final grade. Only five of the six assignments will count towards the final grade:

- Once during the semester, a student can choose to **not** submit an assignment. The remaining five assignments will then all be worth 10% of the final mark.
- If a student submits all six assignments, then only the five assignments with the highest mark will count equally towards the final grade.

Students are encouraged to form study groups to discuss assignment questions but not the answers. Each student must submit his or her own individual written work. Copying, in whole or in part, the work of another will not be tolerated and will result in disciplinary action (see Academic Integrity section). Assignments should be handed in electronically via UM Learn on the due date. **Late submissions will be accepted**, but 5% will be deducted from your assignment mark for each 24h period following the submission deadline (e.g. for an assignment worth 10% of the final and submitted 2 days after the deadline, the penalty will correspond to 1% of the final mark).

Midterm: There will be two (2) midterm tests. They are tentatively scheduled to be held during class time on October 12 and November 16. Each test will be worth 15% of the final mark, for a total of 30%. Test content is defined by the lecture notes along with the relevant chapters from the textbook. There will be no make-up tests. If you miss a test with a valid reason and inform me within 48 hours of the start of the exam, the weight of the other assessments will be scaled accordingly.

Final Exam: There will be one (1) final exam in this course. It will be worth 15% of the final grade.

Quizzes: Students will be assessed according to the completion of the quizzes on UM Learn. This assessment will represent 5% of the final mark.

Grading Timeline: Work will be graded and returned within two weeks of submission.

Course Evaluation and Grading Scheme

Final Mark: The final mark for the course will be obtained according to the following rule:

Assignments (6)	50%
Midterm Tests (2)	30%
Final Exam	15%
Quizzes	5%

Letter Grade: I normally follow the following cutoffs when assigning letter grades:

Letter Grade	Mark out of 100
A+	[90 – 100]
A	[80 – 90)
B+	[75 – 80)
B	[70 – 75)
C+	[65 – 70)
C	[60 – 65)
D	[50 – 60)
F	below 50

However, I might elect to use lower thresholds for some letter grades if I think they are more appropriate (i.e. use a smaller lower bound for the ranges above). I will not use higher thresholds.

Outline of Covered Topics

The course is expected to cover the following topics, as time permits:

1. Numerical Methods (Chapter 13)
2. Introduction to Optimisation (Chapter 14)
3. Generating Random Variables (Chapter 3)
4. Monte Carlo Integration (Chapter 6)
5. Importance Sampling (Chapter 6)
6. Monte Carlo Methods for Inference (Chapter 7)
7. Bootstrap and Jackknife (Chapter 8)
8. Resampling Applications (Chapter 9)
9. Permutation Tests (Chapter 10)

Important Dates

The following dates are important to how the course will progress throughout the term.

Date	Information
Sep 9	First lecture
Sep 30	National Day for Truth and Reconciliation (No Lecture)
Oct 12	Tentative date for First Midterm
Nov 8-12	Fall Term break (No Lectures)
Nov 16	Tentative date for Second Midterm
Nov 23	Last day to VW the course
Dec 9	Last lecture
Dec 11-23	Final Examination Period

The date for the midterm tests is tentative (and subject to change at my discretion and/or based on the learning needs of the students). Changes are subject to Section 2.8 of the ROASS Procedure.

Tentative Schedule

The following schedule is tentative and may be adjusted as needed during the semester.

	Date	Topic	Comments
1	Thu Sep 9	Introduction	
2	Tue Sep 14	Numerical Methods	Assignment 0 due on Sep 13
3	Thu Sep 16	Maximum Likelihood	
4	Tue Sep 21	Optimisation	Assignment 1 due on Sep 20
5	Thu Sep 23	Optimisation	
6	Tue Sep 28	Generating RVs	
7	Thu Sep 30	Generating RVs	
8	Tue Oct 5	MC Integration	Assignment 2 due on Oct 4
9	Thu Oct 7	Variance Reduction	
10	Tue Oct 12	First Midterm	
11	Thu Oct 14	Importance Sampling	
12	Tue Oct 19	Importance Sampling	
13	Thu Oct 21	MC Methods for Inference	Assignment 3 due on Oct 22
14	Tue Oct 26	MC Methods for Inference	
15	Thu Oct 28	MC Methods for Inference	
16	Tue Nov 2	Jackknife	
17	Thu Nov 4	Bootstrap	Assignment 4 due on Nov 8
18	Tue Nov 16	Second Midterm	
19	Thu Nov 18	Bootstrap CIs	
20	Tue Nov 23	Linear Regression	
21	Thu Nov 25	Resampling applications	Assignment 5 due on Nov 26
22	Tue Nov 30	Resampling applications	
23	Thu Dec 2	Permutation Tests	
24	Tue Dec 7	Modern optimization	
25	Thu Dec 9	Recap	Assignment 6 due on Dec 10

Class Communications

The University requires all students to activate an official U of M email account, which should be used for all communications between yourself and the university (including all your instructors). All these email communications should comply with the University's policy on electronic communication with students, which can be found at: http://umanitoba.ca/admin/governance/governing_documents/community/electronic_communication_with_students_policy.html

Questions of an administrative nature should be directed to me via email. Questions related to the course content should be directed to the Discussion Groups on UM Learn (which I will regularly visit). This is in order to provide an opportunity for learning and collaboration between the students.

Copyrights

We will use copyrighted content in this course. I have ensured that the content I use is appropriately acknowledged and is copied in accordance with copyright laws and University guidelines. Copyrighted works, including those created by me, are made available for private study and research and must not be distributed in any format without permission.

More details are available online at <http://umanitoba.ca/copyright/>.

Student Accessibility Services

If you are a student with a disability, please contact Student Accessibility Services (SAS) for academic accommodation supports and services such as note-taking, interpreting, assistive technology and exam accommodations. Students who have, or think they may have, a disability (e.g. mental illness, learning, medical, hearing, injury-related, visual) are invited to contact SAS to arrange a confidential consultation.

ROASS Schedule A

Schedule “A” of the *Responsibilities of Academic Staff with regards to Students* (ROASS) policies of the University of Manitoba lists resources and policies for students. It is important that you familiarize yourself with these resources and policies. This document is available from the Department of Statistics web page at: <https://sci.umanitoba.ca/statistics/>.

Students enrolled in this course must ensure they satisfy the following minimum technological requirements:

1. A computing device where one can create and edit documents,
2. An internet connection capable of streaming videos and downloading software, and
3. Access to a web-cam and microphone.

University of Manitoba Acknowledgement of Traditional Territories

The University of Manitoba campuses are located on original lands of Anishinaabeg, Cree, Oji-Cree, Dakota, and Dene peoples, and on the homeland of the Métis Nation.

We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of reconciliation and collaboration.