

University of Manitoba – Department of Statistics

STAT 4600: Computational Statistics

Winter Term 2018

Course Details

Course Number & Title: STAT 4600, Computational Statistics

Section & CRN: Section A01, CRN: 56168

Course Schedule: Tuesday/Thursday, 10:00 to 11:30 a.m. (Slot 5),
in 316 Machray Hall.

Prerequisites: The only formal prerequisite for this course is STAT 3800 (C), or
permission of the instructor.

Previous programming experience (e.g., COMP 1010 and 1020)
is not required, but is definitely a big asset. Familiarity with
computer systems is expected.

Instructor Contact Information

Instructor: Alexandre Leblanc

Office Location: 367 Machray Hall

Phone: (204) 474-6273

Email: Alex.Leblanc@umanitoba.ca

Office Hours: Monday, from 1:30 to 3:00 p.m. and Wednesday, from 10:30 to 11:30 a.m.,
or by appointment.

General Goals for this Course

This course will be focusing on learning

- the fundamentals of the R statistical software,
- some computational/numerical aspects of classical Statistics,
- some modern computer-intensive methods used in Statistics.

Obviously, you will need to make extensive use of the computer throughout the whole course for
your homework/assignments but also, sometimes, for class.

Textbook and Other Materials

Textbook: The course will be based roughly on

- Rizzo, M.L. (2008), *Statistical Computing with R*, Chapman & Hall/CRC.
which will be placed on reserve at the Science Library. However, you are not
expected to buy the textbook.

Lecture notes: Lecture notes and other materials (e.g. assignments, examples, sample codes) will be posted on the UM Learn system regularly.

Other references: The course material can be found in many other useful references that are available for free (downloadable in PDF) through the online catalogue of the University of Manitoba Libraries. Some interesting references are:

Computational Statistics:

- Gentle, J.E. (2009), *Computational Statistics*, Springer.
- Lange, K. (2010), *Numerical Analysis for Statisticians*, Springer.

Statistics using R:

- Marin, J.-M. and Robert, C.P. (2014), *Bayesian Essentials with R*, Springer.
- Robert, C.P. and Casella, G. (2011), *Introducing Monte Carlo Methods with R*, Springer.
- Albert, J. (2007), *Bayesian Computation with R*, Springer.

Programming in R:

- Lafaye de Micheaux, P., Drouilhet, R. and Lique, B. (2013), *The R Software: Fundamentals of Programming and Statistical Analysis*, Springer.
- Chambers, J.M. (2008), *Software for Data Analysis: Programming with R*, Springer.

Statistical Software: As mentioned above, you will need to make extensive use of the computer throughout the whole course for your homework/assignments.

Specifically, we will use the statistical software R which can be downloaded for free (for Windows, Mac, UNIX or LINUX, including PDF documentation) from the *Comprehensive R Archive Network* at: <http://cran.r-project.org/>

Sample codes for all examples seen in class will be provided to students through the UM Learn system.

Online resources: The following are very useful online resources:

- <http://www.rstudio.com> (for downloading R Studio)
- <http://rmarkdown.rstudio.com> (to learn about R Markdown)
- <http://r-pkgs.had.co.nz/style.html>
(a simple R style guide that is generally good to follow)
- <http://cran.r-project.org> (R software, documentation and contributed packages)

Assignments, Test and Exam

Readings/Homework: From time to time, you will be required to do some reading – research – homework (not to be turned in for marking).

- Assignments:** Assignments (to be graded) will be handed out at a rate of about one assignment per one or two weeks of class, for a total of up to 10 assignments. See below for details on how to turn in your work.
- Midterm Test:** This will be a take-home test and will tentatively start on Thursday, March 1 (due the next Sunday), the exact details to be confirmed later. The test will require extensive use of the R software and R Markdown, and will be subject to the rules given below for turning in your work.
- Final Exam:** The Final Exam will be held on a date to be selected later by the Registrar's office and should be 3 hours in duration. The Final Exam will also have a take-home part as described above.
- Grading timeline:** Work should normally be graded and returned promptly, within two weeks of submission.

Course Evaluation and Grading Scheme

Final Mark: The final mark for the course will be obtained from the following rule.

Assignments (6 to 10)	40%
Midterm Test	20%
Final Exam	40%

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 different cutoffs (i.e. lower thresholds) if I think they are more appropriate. I will not use higher thresholds.

Outline of Covered Topics and Approximate Timeline

The course is expected to proceed as follows.

Chapter and Title	Approximate Duration (in weeks)
1. Introduction to R	3
2. Principles of Monte Carlo Simulation	1
3. The Bootstrap	1.5
4. Permutation Tests	1.5
5. (Pseudo) Random Number Generation	1
6. Monte Carlo Numerical Integration Methods	1.5
7. Some Methods of Statistical Inference	1.5
8. Some More Advanced Numerical Methods	2

Important Dates

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

Date	Information
January 4	First lecture
January 16	End of the registration revision period
Feb 19 - 23	Spring break, no classes
March 1	Tentative start date for take-home midterm test
March 16	Last day to VW the course
April 5	Last lecture
April 9	First day of final examination period
April 23	Last day of final examination period

The date for the midterm test 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.

Work Submission Guidelines and Policies

Unless otherwise noted, all work (assignments and take-home examinations) must be turned in

1. electronically, by e-mailing the instructor,
2. in hard copy, in class.

All work must be submitted in the R Markdown format, which allows for incorporating R code within regular text, and should be written in a style that smoothly integrates prose, code, tables and graphics. All your code should be *human-readable*.

Make sure your submission properly compiles with “Knit HTML” before turning it in. Every file you submit should have your name and be properly labeled (Assignment 1, etc.)

Work submitted without following the above guidelines will not be marked and given a grade of 0.

Work submitted late will normally not be marked and be given a grade of 0.

Collaboration, Copying, and Plagiarism

Students are encouraged to discuss course material, including assignments. However, each student must hand in his or her own copy of each assignment with personalized solutions, including comments, discussions, explanations and interpretations, and R code. Copying from anywhere, including other students, books and the web,

1. does not help you to learn the course material,
2. constitutes a case of academic dishonesty and could have serious consequences.

If you are unclear on what is acceptable, please ask me or visit the Faculty of Science page on cheating and plagiarism at: <http://umanitoba.ca/faculties/science/undergrad/resources/webdisciplinedocuments.html>

Technology in the Classroom

It is the general University of Manitoba policy that all technology resources are to be used in a responsible, efficient, ethical and legal manner. Students should restrict their use of technology to those approved by the instructor *for educational purposes only*. Electronic messaging, email, social networking, gaming, etc. should be avoided during class time. Cell phones should be turned off. If a student is on call for emergencies, their cell phone should be on vibrate mode and the student should leave the classroom before using it.

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

Copyrights

Copyrighted Materials: 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.

Lectures: No audio or video recording of lectures or presentations is allowed in any format, openly or surreptitiously, in whole or in part without my permission.

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

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: <http://umanitoba.ca/science/statistics/>.