University of Manitoba – Department of Statistics

STAT 2150 : Statistics and Computing

Fall Term 2019

Course Details

Course Number & Title	STAT 2150, Statistics and Computing
Section & CRN	Section A01, CRN: 17120
Class Schedule	TuTh 1:00 PM – 2:15 PM
Class Location	111 Armes
Lab Schedule	B01: M 3:30 PM – 4:20 PM B02: Tu 8:30 AM – 9:20 AM B03: W 2:30 PM – 2:20 PM
Lab Location	311 Machray Hall

Instructor Contact Information

Instructor	Dr. Elif Acar
Office Location	369 Machray Hall
Phone	(204) 480-1820
Email	elif.acar@umanitoba.ca I will only respond to emails concerning administrative matters sent from UMNetID's. Course-related questions will be answered only during lectures and office hours.
Office Hours	MTh 10:30 AM – 12:00 PM, or by appointment.

Calendar Description and Prerequisites

Calendar Description	(Lab required) This course is recommended for students in mathematically rich disciplines, including Statistics, Mathematics, Actuarial Science, Computer Science, and related interdisciplinary programs. Topics to be covered include: exploratory data analysis and visualization, graphical methods, random number generation, random variables, simple statistical models and computing, Monte Carlo methods, large sample and simulation-based inference, statistical software packages.
Prerequisites	[STAT 1150 (C) or STAT 2000 (B) or STAT 2001 (B)] and [a C or better in one of: MATH 1230, MATH 1500, MATH 1501, MATH 1510, the former MATH 1530, or MATH 1690 (C)].

Textbook and Course Material

Course Material

All course related material will be posted on the UM Learn system.

Textbook

There is no required textbook for the course. However, the following textbooks, all available in the form of e-books through the UM Libraries, are excellent resources to learn the basics of statistical computing.

T1. *Understanding Statistics Using R*, Randall Schumacker and Sara Tomek, Springer (2013)

T2. *Statistical Analysis and Data Display: An Intermediate Course with Examples in R*, Richard M. Heiberger and Burt Holland, Springer (2015)

T3. *Introduction to Statistics and Data Analysis*, Christian Heumann, Michael Schomaker and Shalabh, Springer (2016)

T4. *Data Wrangling with R*, Bradley C. Boehmke, Springer (2016)

Statistical Software

The course will make use of the R statistical software in both lectures and labs. R is available in lab computers at 311 Machray Hall. You can download R for free (for Windows, Mac, UNIX or LINUX, including PDF documentation) from the *Comprehensive R Archive Network* (CRAN) at: http://cran.r-project.org/. The preferred interface for R is RStudio, which can be downloaded from https://www.rstudio.com/.

Course Assessment

Assignments

There will be four assignments during the term. All assignments must be submitted by their due date using UM Learn Dropbox. Specific submission instructions for assignments will be posted on UM Learn. **No late submission will be accepted.** You are expected to work independently on the assignments: 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 will include problems which require you to use R, and your submission must accompany the R code solely written by you.

Labs & Quizzes

You will attend a mandatory computer lab session once per week starting from the 2nd week. The lab sessions will be held in 311 Machray Hall. **You must attend the lab session in which you are registered.** There will be two lab quizzes, tentatively scheduled during **Oct 7, 8, 9** and **November 18, 19, 20** lab sessions. **There will be no make-up quizzes**. If you miss the first quiz due to a legitimate reason, your quiz weight will be transferred to the midterm test. If you miss the second quiz due to a legitimate reason, your quiz weight will be transferred to the final exam.

Midterm Test The in-class midterm test is tentatively scheduled on **October 31, 2019**. Test location will be announced later in class. **There will be no make-up test**. If you miss the test due to a legitimate reason, your test weight will be transferred to the final exam.

Final Exam There will be a 3-hour final exam in this course. The final exam date and location will be set by the Registrar's office and announced later in the semester.

Attendance During the lectures, I will explain and demonstrate the course material using the R programming software. The computer lab sessions will further provide you with hands-on experience in programming with R. Therefore, I strongly encourage you to attend lectures and lab sessions regularly.

Course Evaluation and Grading Scheme

Final Marks The final mark for the course will be based on the following components.

UM Learn Assignments (4)	10%
Computer Lab Quizzes (2)	10%
Midterm Test	30%
Final Exam	50%

Letter Grades The following cutoffs will be used when assigning the 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

Outline of Topics

The course is expected to cover the following topics.

1. Exploratory Data Analysis
    - Summarizing different data types: categorical, numerical, bivariate and time series data
    - Summarizing distributional patterns: quantiles and normal quantile plots, skewness and kurtosis
    - Visualization techniques for complex and high dimensional data: contour plots, 3D plots, matrix plots, parallel coordinates, multidimensional scaling, pivot tables, slice and dice

2. Discovering Statistics Using R

    - Data exploration and representation in R
    - Reading data from various sources and writing data
    - Data wrangling in R
    - Loops/if/while and other control-flow constructs
    - Basics of writing R functions

3. Random Variables and Probability Distributions

    - Conditional probability
    - Discrete and continuous random variables and their distributions
    - Expectation and variance of a discrete and continuous random variables

4. Estimation

    - Estimation methods
    - Properties of estimators
    - Confidence intervals
    - Pivotal quantity

5. Hypothesis Testing

    - Terminology and notation
    - Types of hypotheses and types of errors
    - Cross-tabulations and tests of association
    - Goodness-of-Fit (GOF) tests

6. Data Simulation and Resampling Methods

    - Generating data from distributions
    - Evaluating statistical procedures and understanding large sample results
    - Introduction to permutation and bootstrapping
    - Cross-validation methods
    - Bootstrap confidence intervals and hypothesis tests
    - Introduction to Monte-Carlo methods

7. Regression and Analysis of Variance (ANOVA)

    - Inference for simple linear regression
    - Building the ANOVA table
    - Diagnostic checks

8. Use of R Markdown for Scientific Reports (if time permits)

Important Dates

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

Date	Information
Sep 5	First lecture
Sep 9, 10, 11	First lab session
Oct 7, 8, 9	**Quiz 1**
Oct 31	**Midterm Test**
Nov 18	Last day to VW
Nov 18, 19, 20	**Quiz 2**
Dec 5	Last lecture

The dates for the quizzes and term test are 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.

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

Academic Integrity

It is important that you understand what constitutes academic dishonesty and that you are familiar with the very serious consequences. Links to resources that describe academic dishonesty (including plagiarism, cheating, inappropriate collaboration and examination impersonation, as well as typical penalties) can be found at:
http://www.sci.umanitoba.ca/undergraduate-students/academic-resources/academic-integrity-2/

You may also want to check:
http://www.umanitoba.ca/student/resource/student_advocacy/academicintegrity/students

Copyrights

Copyrighted Material 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 work 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/

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:
http://umanitoba.ca/science/statistics/files/pages/2016/09/Schedule-A-ROASS-Statistics.pdf