University of Manitoba
Department of Statistics

STAT 4690—Applied Multivariate Analysis

Fall Term 2019

Course Details

Course Number & Title:	STAT 4690, Applied Multivariate Analysis
Section & CRN:	Section A01, CRN: 18520
Course Schedule:	Monday/Wednesday/Friday, 10:30 to 11:20 a.m. (Slot 3), in 500A Machray Hall.
Prerequisites:	STAT 3480 (C), and a C or better in one of MATH 1220 and MATH 2150, or consent of the instructor.
Course Website:	`https://maxturgeon.ca/f19-stat4690/`

Instructor Contact Information

Instructor:	Max Turgeon
Office Location:	373 Machray Hall
Phone:	(204) 220-1169
Email:	Max.Turgeon@umanitoba.ca
Office Hours:	Tuesday from 9:30AM to 11:00AM, Thursday from 1:00PM to 2:30PM, or by appointment.

General Goals for this Course

This course aims to provide students with a broad overview of techniques used in multivariate statistical analysis, with an emphasis on **Multivariate Linear Regression** and **Principal Component Analysis**. At the end of the course, students will be able to

- make decisions on how and when to use the techniques discussed in class;
- apply and assess multivariate methods on real data;
- make sound statistical conclusions based on a multivariate analysis.

Moreover, the course aims to make students familiar, or competent, with the `R` statistical software.

Textbook and Other Materials

Textbook: The following textbook is *not* required, but strongly recommended:

- Johnson & Wichern, *Applied Multivariate Statistical Analysis*. Prentice Hall (2007).

A copy of the textbook will be available on twelve-hour reserve at the Science Library.

Lecture notes: Lecture handouts will be posted on the course website regularly.

Course Assessment

Assignments: There will be two assignments (each worth 15%) during the term. 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 at the beginning of class on the due date. **No late submission will be accepted.**

Midterm: There will be one midterm test. It is tentatively scheduled to be held outside of the class time on October 31. 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, the weight of the other assessments will be scaled accordingly.

Final Exam: There is no final exam in this course.

Course Project: Students will analyze real data using the techniques covered in the course. They will find their multivariate dataset for the project and detail their multivariate analysis in a project report (contributing 30% to final grade) to be submitted by December 6. Part of the last two weeks' classes will be devoted to presentations (contributing 10% to final grade). Detailed guidelines about the project will be provided in class.

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 from the following rule.

Assignments (2)	30%
Midterm Test	30%
Course Project	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 lower thresholds for some letter grades if I think they are more appropriate. I will not use higher thresholds.

Outline of Covered Topics

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

1. *Aspects of multivariate analysis*: handling multivariate data, graphical displays, statistical distance (Chapter 1)
2. *Matrix algebra and random vectors*: eigenvalues and eigenvectors, positive definite matrices, mean vectors, covariance matrices and matrix decompositions (Chapter 2)
3. *Random Samples*: sample geometry, characterizing random samples (Chapter 3)
4. *Multivariate normal distribution*: definition and properties, estimation and sampling distributions (Chapter 4)
5. *Inferences about a mean vector*: Hotelling's T^2 and likelihood ratio tests, confidence regions and multiple comparisons (Chapter 5)
6. *Multivariate linear regression*: least squares estimation and inference (Chapter 7)
7. *Principal Component Analysis*: interpretation and use of principal components (Chapter 8)
8. *Factor Analysis*: orthogonal factor model, estimation and inference (Chapter 9)
9. *Canonical Correlation Analysis*: canonical variables and canonical correlations (Chapter 10)
10. Kernel methods and Manifold Learning (if time permits)

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.

Important Dates

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

Date	Information
Sep 4	First lecture
Oct 14	Thanksgiving - no class or lab
Oct 31	Tentative date for Midterm
Nov 11	Remembrance Day - no class
Nov 12-15	Fall Term break - no class
Nov 18	Last day to VW the course
Dec 6	Last lecture
Dec 9-20	Final Examination Period

The date for the midterm 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.

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/`.

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/`.

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.