

University of Manitoba – Department of Statistics
STAT 4690/ 7200 : Applied Multivariate Analysis
Fall Term 2016

Course Details

Course Number & Title	STAT 4690, Applied Multivariate Analysis STAT 7200, Multivariate Analysis 1
Section & CRN	Section A01, CRN: 14745 / 14747
Class Schedule	MWF 9:30 AM – 10:20 AM
Class Location	316 Machray Hall
Prerequisites	Students should have a good working knowledge of statistical inference and linear models: STAT 3480 (005.348) (C); and a C or better in one of MATH 1220 (or the former MATH 2300 or MATH 2301) and MATH 2150 (or the former MATH 2720 or MATH 2721 or MATH 2750); or consent of the instructor. Prior programming experience in R is useful but not required.

Instructor Contact Information

Instructor	Elif Acar
Office Location	369 Machray Hall
Phone	(204) 480-1820
Email	elif.acar@umanitoba.ca
Office Hours	MW 10:30 AM – 12:00 PM, or by appointment. If the above times are not convenient for you, please send me an email to arrange an alternate time to meet.

General Goals for this Course

This course aims to provide students with a broad overview of techniques used in multivariate statistical analysis. Despite the course title, equal emphasis will be placed on the theoretical and applied aspects of covered techniques.

At the end of the course, students will be able to

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

The course also aims to make students familiar, or competent, with the R statistical software and the L^AT_EX document preparation system.

Textbook and Other Materials

Textbook	<p><i>Applied Multivariate Statistical Analysis</i>, 6th edition R. A. Johnson and D. W. Wichern, Prentice Hall, 2007.</p> <p>The textbook is not required but strongly recommended. A hard-copy will be available on course reserve.</p>
Lecture notes	<p>Lecture notes and other materials (e.g. assignments, sample R codes) will be posted on the UM Learn system regularly.</p>
Supplementary Text	<p><i>An introduction to applied multivariate analysis with R</i>, B. Everitt and T. Hothorn, Springer, 2011.</p> <p>E-book is available through the University of Manitoba Libraries.</p>
Statistical Software	<p>The course requires you to make extensive use of the R statistical software for your assignments and final data project. Sample codes will be provided to students through the UM Learn system.</p> <p>You can download R for free (for Windows, Mac, UNIX or LINUX, including PDF documentation) from the <i>Comprehensive R Archive Network</i> at: http://cran.r-project.org/</p>

Course Assessment

Assignments	<p>There will be two assignments (each worth 5%) 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.</p>
Term Tests	<p>There will be two term tests. These are tentatively scheduled to be held outside of the class time on October 21 and November 28. 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 test will be shifted to the other. If you miss both tests, your term test grade will be zero.</p>
Final Exam	<p>There is no final exam in this course.</p>
Data Project	<p>The data project will be a team project, where students will analyze real data using the techniques covered in the course. Teams 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 15. Part of the last two weeks' classes will be devoted to group presentations (contributing 10% to final grade). Detailed guidelines about the project will be provided in class.</p>

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

Course Evaluation and Grading Scheme

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

Assignments ($\times 2$)	10%
Term Test I	25%
Term Test II	25%
Data Project	40%

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

Requirements for STAT 7200

Students enrolled in STAT 7200 will be required to do additional work in the form of extra assignment and exam questions appropriate at the graduate level.

Outline of Topics

The course is expected to cover the following topics.

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 and covariance matrices (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. Discrimination and Classification (Chapter 11) – *if time permits*

Important Dates

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

Date	Information
Sep 9	First lecture
Sep 21	End of the registration revision period
Oct 6–7	Fall term break, no class
Oct 10	Thanksgiving, no class
Oct 21	Term Test I
Nov 11	Remembrance Day, no class
Nov 18	Last day to VW the course
Nov 28	Term Test II
Dec 2–7	Group Presentations
Dec 7	Last lecture
Dec 9	No class

The dates for the term tests and group presentations 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://umanitoba.ca/faculties/science/undergrad/resources/webdisciplinedocuments.html>

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>