

University of Manitoba
Department of Statistics

STAT 3690 — Multivariate Analysis

Winter Term 2023

Course Details

Course Number & Title: STAT 3690 Multivariate Analysis
Section & CRN: Section A01, CRN: 59793
Course Schedule: Mon/Wed/Fri, 9:30 – 10:20 a.m.
Prerequisites: The comfort with manipulating matrices and necessary knowledge on the statistical inference and R software; specifically, [STAT 2800, former STAT 3400, or former STAT 3500] AND [STAT 3450, former STAT 3470, or former STAT 3120] AND [MATH 2150, MATH 2151, MATH 2720, MATH 2721, or former MATH 2750] OR the consent of instructor.

Instructor Contact Information

Instructor: Zhiyang Zhou
Office Location: 330 Machray Hall
Email: zhiyang.zhou@umanitoba.ca
(merely responding to University of Manitoba (UM) email addresses)
Homepage: <https://zhiyanggeezhou.github.io/>
Office Hours: TBD

Course Materials and Technology

References: (Recommended but NOT required)
[J&W] R. A. Johnson & D. W. Wichern. (2007). *Applied Multivariate Statistical Analysis*, 6th Ed.. London: Pearson Education.
[R&C] A. C. Rencher & W. F. Christensen. (2012). *Methods of Multivariate Analysis*, 3rd Ed. Hoboken: Wiley.

Notes/Slides: To be regularly posted at the instructor’s homepage and UM Learn.

Software: The data analysis is to be implemented via R (<http://cran.r-project.org/>) and RStudio (<https://www.rstudio.com/products/rstudio/download/#download>). In addition, the R Markdown (<https://rmarkdown.rstudio.com/lesson-1.html>) may be helpful when you are drafting manuscripts containing both numerical outputs and source codes. These three are all freely available for Linux, Macintosh, and Windows. Please download and install them in advance.

Course Description

This course is designed as an applied one, while it is inevitable to involve the theoretical background of each technique. In addition, there is an extensive usage of matrices; one may not succeed in this course without a sophistication in manipulating matrices. If time permits, this course is going to cover all the following topics, where the first three serve as the prerequisite for remaining portions.

- The manipulation of matrices (J&W Chp. 2);
- Basic concepts on statistical modeling (J&W Chp. 3);
- Multivariate normal distribution (J&W Chp. 4);
- Inference on a mean vector (J&W Chp. 5);
- Comparisons of multiple multivariate means (J&W Chp. 6);
- Multivariate linear regression (J&W Chp. 7);
- Principal component analysis (J&W Chp. 8);
- Factor analysis (J&W Chp. 9);
- Canonical correlation analysis (J&W Chp. 10).

Course Objectives

This course aims to offer you an overview of basic statistical techniques that may be used in analyzing multivariate data, including principal component analysis, factor analysis, and other commonly used methods. Also, it will prepare you for higher-level courses such as STAT 4250 Statistical Learning. After succeeding in this course, you are able to analyze real data with appropriate strategies and to get to sound statistical conclusions. Moreover, you familiarize yourself with R by the training in this course.

Course Assessment

Assignments: There will be four/five assignments in total. You are encouraged to discuss questions (but not answers) with peer students, whereas you must submit the written work individually. Copying, in whole or in part, the work of another will not be tolerated and will result in disciplinary action (see Academic Integrity section). Assignment due dates will be specified as soon as questions are released. NO late submission will be accepted. Punctual submissions will be graded and returned within TWO weeks.

Midterm: One midterm exam is scheduled NOT later than Mar. 20, 2023. The testing content is defined by lecture notes along with relevant chapters of textbook. There will be no make-up test. If you miss the midterm with a reasonable cause and inform the instructor as soon as possible (ideally within 24 hours), the weight of other assessments may be rescaled accordingly.

Final Project: There is going to be NO final exam. Instead, you will be required to hand in a report after analyzing a recently collected dataset. Detailed guidelines about the final project will be provided in class.

Final Grading: For each attendee of this course, the assignments, midterm and final project contribute to the final percentage score with proportion 30%, 35% and 35%, respectively. Final letter grades will be assigned based on final percentage grades per the following thresholds.

| Letter Grade | Percentage Score | Letter Grade | Percentage Score |
|--------------|------------------|--------------|------------------|
| A+ | [90, 100] | C+ | [65, 70] |
| A | [80, 90] | C | [60, 65] |
| B+ | [75, 80] | D | [50, 60] |
| B | [70, 75] | F | [0, 50] |

Important Dates

The following schedule is subject to change at the discretion of the instructor and/or based on the learning needs of the students. But such changes are subject to Section 2.8 of ROASS.

| Date | Information |
|--------------|--|
| Jan. 9 | First instructional day |
| Jan. 20 | Last date to DROP this course |
| Jan. 23 | Last date to ADD this course |
| Feb. 20 | No class (Louis Riel Day) |
| Feb. 21 – 24 | No class (winter term break) |
| Mar. 22 | Winter term voluntary withdrawal (VW) deadline |
| Apr. 7 | No class (Good Friday) |
| Apr. 12 | Last instructional day |
| Apr. 14 – 28 | Final exam period |

Expectations and Policies

Attendance: Though there is no penalty on absence, it is better to be present in the designated lecture room punctually. Since the course will be delivered without any forms of recording, there is no alternative way of attendance.

Professional Conduct: Please be familiar with the UM Respectful Work and Learning Environment (RWLE) Section 2.5(c) of the Student Non-Academic Misconduct and Concerning Behaviour Procedure that describes types of inappropriate or disruptive behaviour.

Class Communication: You are required to obtain and use UM email accounts for all communication with the university (including all instructors). All the communication must comply with the Electronic Communication with Student Policy.

Student Accessibility Services: UM is committed to providing an accessible academic community. The Students Accessibility Services (SAS) offers 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.

Recording of Lectures: No audio or video recording of this material, lectures, or presentations is allowed in any format, openly or surreptitiously, in whole or in part, without permission of the instructor.

Sharing of Course Materials: Course materials (both hardcopy and digital) are for participants' private study and research, and must not be shared. They must be used in a responsible, efficient, ethical and legal manner for educational purposes only. Violation of this policy and other Academic Integrity principles, will lead to serious disciplinary action.

Voluntary Withdrawal (VW), Authorized Withdrawal (AW) and Limited Access Policies (LAP)

- VW:** You have the opportunity to voluntarily withdraw (VW) from this class up to Mar. 22, 2023 (inclusive). By then, you will have received feedback to allow you to assess your progress and determine if you are achieving the grade you are aiming for in this course. If you are unlikely to be successful in the course, or you are not achieving the grade that you are aiming for, you should consider a VW from the course. You may discuss the VW option with an academic advisor. Students enrolled in the course after the VW deadline will be assigned with final grades. See http://umanitoba.ca/u1/know_yourself/573.html for more details.
- AW:** If medical/compassionate circumstances arise in your life and prevent you from performing as you would in normal circumstances, please contact an academic advisor to discuss your options. Be prepared to provide documentation, which supports your situation. See http://www.umanitoba.ca/student/resource/student_advocacy/authorized-withdrawal/index.html for details.
- LAP:** The Senate Executive Committee approved, on behalf of Senate, that Section 2.5(a) of the Repeated Course Policy is to be suspended indefinitely. It means that you can retake the course you have decided to VW in the next semester.

Copyrights

Please respect copyright. We will use copyrighted content in this course. University guidelines state that copyrighted works, including those created by instructors, are made available for private study and research and must not be distributed in any format without permission. Since it is illegal, do not upload copyrighted works to a learning management system (such as UM Learn), or any website, unless an exception to the Copyright Act applies or written permission has been confirmed. All students are required to respect copyright as per Canada's Copyright Act. Staff and students play a key role in the University's copyright compliance as we balance user rights for educational purposes with the rights of content creators from around the world. The Copyright Office provides copyright resources and support for all members of UM community. For more information, see the University's Copyright Office website at <http://umanitoba.ca/copyright/> or contact um_copyright@umanitoba.ca.

Academic Integrity

Academic integrity is taking responsibility for and being honest with your work and respecting the work of others. Since you are a member of the university community, I want you to learn what that responsibility and honesty entails and how to respect the work of others. The Faculty of Science continues to uphold high standards of academic integrity. I count on each of you to do your part. Impersonation, plagiarism, and using unauthorized materials are all very serious offences. When in doubt, do not hesitate to contact me to discuss what is and what is not allowed. Asking is a sign of integrity instead of a signal that you are planning to cheat. I expect you to follow the rules: ignorance is not an acceptable excuse for academic misconduct. Useful resources can be found at https://www.umanitoba.ca/student/resource/student_advocacy/academicintegrity/students/a-to-i-what-is-academic-integrity.html

and

<https://www.sci.umanitoba.ca/students/undergraduate-students/academic-integrity-2/>.

ROASS Schedule A

Schedule “A” of the Responsibilities of Academic Staff with regards to Students (ROASS) policies of UM 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/courses-and-programs/outlines/>.

University of Manitoba Acknowledgement of Traditional Territories

UM 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.

COVID-19 - Syllabus Insert

UM is committed to maintaining a safe learning environment for all students, faculty, and staff. Should campus operations change because of health concerns related to the COVID-19 pandemic or other campus-wide emergency, it is possible that this course will move to a fully remote delivery format. Should the instructor be required to stay at home for an extended period and an alternate instructor not be available, the course may move temporarily to a remote delivery format. In that instance, you may be provided with an asynchronous option to minimize the impact the change may have on your schedule.

In a face-to-face environment, our commitment to safety requires students to observe all physical distancing (2m) and personal protective equipment (PPE) guidelines set by the University (<https://umanitoba.ca/coronavirus>).

While on campus and in class, you must wear PPE (Personal Protective Equipment) as stipulated in current University policies, procedures, and guidelines. Students who fail to comply are subject to disciplinary action in accordance with the Student Discipline Bylaw and the Non-Academic Misconduct and Concerning Behaviour Procedure.

Medical-grade 3-ply masks are available at many locations on campus, including specific classroom locations, designated by your unit, the Elizabeth Dafoe Library (Fort Garry Campus) and the Brodie Centre main doors (Bannatyne Campus). Additional PPE, if necessary for a specific learning environment, will be provided to you by the teaching unit.

If you do not follow masking and other requirements you will be asked to leave the learning space and may only return to the class already in progress when you have complied with these requirements. Repeated issues will result in disciplinary action as previously noted. **Students should not eat or drink during class time.**

Stay home if you have symptoms or are ill. If you become sick or are required to self-isolate you should notify your instructor by email so you can develop a plan to complete the course learning outcomes while you are absent. If you have symptoms, do not come to campus or any UM facilities. Complete the self-assessment on the Manitoba Public Health site and follow the guidelines, which may include booking a COVID-19 test.

What to do if you become ill while at UM: 1) Leave the classroom, lab or workspace immediately. Continue to wear your mask while leaving the premises and/or while waiting for transportation. 2) Perform hand hygiene (soap and water or hand sanitizer) and avoid contact with others, and minimize contact with the physical environment. 3) Once at home, complete the MB self-assessment and follow the directions that are provided. 4) Inform your supervisor(s), instructor(s) or, if in residence, the appropriate individual. 5) You must remain off campus and all UM facilities until

cleared to return in accordance with self-assessment, testing results, or MB Health requirements.

Recommended transportation options (in order): 1) Drive yourself home. 2) Pick-up by family or friend – remember to keep your mask on and to distance as much as possible, and where possible, open a window to improve ventilation. 3) Pickup by taxi/Uber. 4) Winnipeg Transit buses - Winnipeg Transit has indicated that individuals that are ill **may not use Transit**.