

MATH 7370

Linear Algebra and Matrix Analysis

Fall 2021

Instructor

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Course details

Class schedule : **Online**, no set time (pre-recorded videos)
Office hours : **Online, by appointment only**
Course page : UMLearn

Course number. This course is available to undergraduate students only as MATH 4370 (Linear Algebra and Matrix Analysis) and to graduate students as either MATH 4370 or MATH 7370. Assignments and the project are less involved for those enrolled in MATH 4370 (see separate MATH 4370 syllabus).

Course videos. Videos for the course are available on YouTube as unlisted videos. A sorted playlist is here <https://www.youtube.com/playlist?list=PLfRaznSpWo2smo27Nq-zGK5H51mYWfSWk>, but links to individual videos together with content description will be posted on UMLearn. The videos are a mix of content recorded in Fall 2018 and newer recordings. Newer material will be posted throughout the term.

Office hours. Until the double vaccination mandate has come into effect at the end of October 2021, there will only be online office hours. If you are watching the course videos at a time different from the official class time (11:30–12:45 on Tuesdays and Thursdays), then I recommend that you seek to use the official class time to connect with me. If not, email me and we will find a mutually suitable time.

Textbook. We will not be using a textbook in the regular way, but most of the material will be based on **Horn & Johnson**, *Matrix Analysis* (Second Edition), Cambridge University Press, 2013 and **Fiedler**, *Special Matrices and Their Applications in Numerical Mathematics: Second Edition*, Dover, 2013. Lecture notes were developed during the Fall 2018 session and will be available for download on UMLearn. Please bear in mind that they may contain typos. Extracts from other books as well as slides will also be distributed as we progress. A list of useful books (all available online from the Libraries) will be distributed and updated throughout the term.

Feedback on course material. As indicated, the course notes might contain typos. It is also possible that the videos will have issues. If you see a problem, please let me know.

Course objectives. Matrices are ubiquitous in many aspects of mathematics and in particular, applied mathematics. They show up, for instance, when considering the local asymptotic stability of equilibria of systems of ordinary differential equations, the long term behaviour of Markov chains, the study of graphs and the discretization of reaction-diffusion equations. The objective of this course is 1) to explore the role of matrices in several fields of mathematics and 2) to study important properties of these matrices.

Program We will focus on matrices that arise in the aforementioned four topic areas of ODE, Markov chains, graphs and discretization of PDE.

Evaluation There will be no formal tests or examinations. Evaluation of the performance in this course will involve two components: eleven assignments and one final project. The final mark will be decomposed as follows:

Type of evaluation	Weight per evaluation	Total weight
Mathematics assignments (4)	5% each	20%
Coding assignments (4)	5% each	20%
Project assignments (3)	10% each	30%
Final project (1)	30%	30%

Notes on Assignments

1. All assignments will be posted on UMLearn shortly after the start of term. There are 3 types of assignments.
 - (a) **4 mathematics assignments (MA)**. Each of these assignments involves answering a certain number of questions selected from a list. These assignments roughly correspond to topics in the course but can be returned at any time and in any order, bearing in mind the constraint of *cumulative evaluation weight* detailed below. (Numbering is just there to distinguish them.) MATH 7370 students must pick more questions and some harder questions than students in MATH 4370. (This is clearly indicated in the assignments.)
 - (b) **4 coding assignments (CA)**. Each of these assignments involves writing some matrix analysis functions. Authorised languages are **R** and **Octave** (a **MatLab** lookalike), although **R** is preferred. (syzygy.ca is now available to UofM students and works well with R.) Coding assignments 1–3 can be returned in any order and at any time before coding assignment 4, bearing in mind the constraint of *cumulative evaluation weight* detailed below. Coding assignment 4 is summative of preceding assignments and due (electronically) Friday 3 December at 23:59.
 - (c) **3 project assignments (PA)**. These assignments are designed to help you define and work on your final project. They must be returned in sequence and have due dates. These assignments are due just before midnight on the last day of each month: project assignment 1 is due at 23:59 on 30 September, project assignment 2 is due at 23:59 on 31 October and project assignment 3 is due at 23:59 on 30 November.
2. Further remarks on assignments.
 - (a) **Cumulative evaluation weight constraint**. Although most assignments do not have due dates, it is **imperative** that by 16 November at 23:59, I have received 3 out of the 4 mathematics assignments, 3 out of the 4 coding assignments and, of course, the 2 project assignments due before then. I will only mark 1 more mathematics assignment, 1 more coding assignments and 1 project assignment received after that date.
 - (b) All *assignments* (i.e., except the Final project) must have been handed out by the last day of classes, 10 December 2021 at 23:59. Any assignment handed in after that date will receive a mark of zero.

- (c) All assignments should be submitted electronically on UMLearn. Hand-written mathematics or project assignments are **not** acceptable for students registered in MATH 7370. \LaTeX is preferred, but projects using LibreOffice or Word are acceptable. Instructions on typesetting will be distributed during the term.
 - (d) For those assignments with due dates, late assignments will not be accepted.
3. The **Final project** will be assigned during the term using project assignments. Some remarks.
- (a) The Final project is due during the Final Examination period (11-23 December).
 - (b) The project must be typeset. \LaTeX is preferred, but projects using LibreOffice or Word are acceptable. Instructions on project typesetting will be distributed during the term.
 - (c) If time permits, oral presentations of the projects will be organised. If that is the case, then this presentation will count as part of the mark for the project. (This will be discussed during term.)

Voluntary Withdrawal deadline The Voluntary Withdrawal deadline is 23 November 2021.

Academic Dishonesty Policy The Department of Mathematics, the Faculty of Science and the University of Manitoba all regard acts of academic dishonesty in quizzes, tests, examinations or assignments as serious offences and may assess a variety of penalties depending on the nature of the offence.

Acts of academic dishonesty include bringing unauthorized materials into a test or exam, copying from another student, plagiarism and examination personation. Students are advised to read section 7 (Academic Integrity) and section 4.2.8 (Examinations: Personations) in the General Academic Regulations and Requirements of the current Undergraduate Calendar. Note, in particular, that cell phones and pagers are explicitly listed as unauthorized materials, and hence may not be present during tests or examinations.

Penalties for violation include being assigned a grade of zero on a test or assignment, being assigned a grade of "F" in a course, compulsory withdrawal from a course or program, suspension from a course/program/faculty or even expulsion from the University. For specific details about the nature of penalties that may be assessed upon conviction of an act of academic dishonesty, students are referred to University Policy 1202 (Student Discipline Bylaw) and to the Department of Mathematics policy concerning minimum penalties for acts of academic dishonesty.

All students are advised to familiarize themselves with the Student Discipline Bylaw, which is printed in its entirety in the Student Guide, and is also available on-line or through the Office of the University Secretary. Minimum penalties assessed by the Department of Mathematics for acts of academic dishonesty are available on the Department of Mathematics web-page.