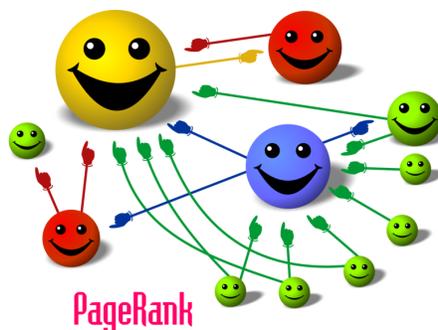


MATH 1220 A01: Linear Algebra 1

Course Information Sheet and Syllabus

Winter 2020



BASIC COURSE DETAILS

Instructor: Dr. Susan Cooper

Class Times and Location: MWF 10:30 – 11:20 a.m., 201 Armes Lecture Building

Tutorial Times, Location and TA: *All tutorial sessions are held on Fridays.*

Section	Time	Location	TA
B01	8:30 a.m. – 9:20 a.m.	Machray Hall 315	Tessa Reimer (reimer46@myumanitoba.ca)
B02	12:30 p.m. - 1:20 p.m.	Machray Hall 315	Sooyeong Kim (kims3428@myumanitoba.ca)
B03	2:30 p.m. – 3:20 p.m.	Machray Hall 315	Tessa Reimer (reimer46@myumanitoba.ca)

Credit Hours: 3

Pre-Requisites: Pre-calculus Mathematics 40S (70%) or the former Mathematics 40S (300) (70%), or the MSKL 0100 offered Extended Education (B).

Note: MATH 1220 may not to be held with MATH 1210, MATH 1211, MATH 1300, MATH 1301, MATH 1310, or the former MATH 1680.

INSTRUCTOR CONTACT INFORMATION

Instructor: Dr. Susan Cooper

Email: susan.cooper@umanitoba.ca

Office: Machray Hall, Room 476/520

Office Phone: (204) 474-9701

Office Hours: Mondays & Wednesdays 11:30 a.m. – 12:30 p.m.; or by appointment

Correspondences and Appointments: The most reliable way to contact me is via email. I will generally reply to an email within 24 hours of receiving it Monday – Thursday; an email received Friday – Sunday will receive a reply the following Monday. *All appointments are to be made via email.*

COURSE DESCRIPTION AND GOALS

“Mathematics is the music of reason.”
— James Joseph Sylvester

University of Manitoba Course Calendar Description: (Laboratory required) This course is intended for students in mathematically rich disciplines including those planning to enter an Honours or Major program in Mathematics or Statistics. An introduction to vectors, matrices, systems of linear equations and three-dimensional geometry.

General Course Description and Goals: One of the great advantages of studying mathematics is that it helps us develop the ability to handle abstract ideas. Linear algebra allows us to cultivate this ability with concrete examples, mathematical rigour, and beautiful applications. The subject has a very rich history and continues to provide sophisticated answers to modern problems such as Google’s PageRank Problem (as depicted on page 1; taken from <https://en.wikipedia.org/wiki/PageRank>). The study of linear algebra involves topics that are important branches of mathematics which are thriving and intriguing in their own right. As such, it is not surprising that linear algebra hosts many applications to subjects such as astronomy, geometry, computer science, physics, and economics (just to name a few!).

MATH 1220 is a one-term undergraduate course that provides an in-depth study of Euclidean n -space \mathbb{R}^n . We will study properties of vectors and vector operations (such as addition, scalar multiplication, dot product, projections). We will also investigate solving systems of linear equations in Euclidean space. In doing so we will be led to consider properties of matrices (rectangular arrays of numbers which take care of the book-keeping for solving systems of linear equations). The properties we will look at include determinants, inverses, eigenvalues and eigenvectors, and diagonalization. Moreover, we will look at linear transformations. A linear transformations between two Euclidean spaces is a function between the two spaces which preserves addition and scalar multiplication. Examples of linear transformations include reflections and projections. We will ask questions such as: what does it mean for two spaces to “behave the same”? A deep understanding of linear algebra is fundamental for higher-level pure mathematics as well as for subjects that make use of its vast utility. With numerous applications, the language used for the subject may seem abstract so that it can be substituted in many different ways.

By considering concrete examples, you will make conjectures and then try to verify or disprove them. You will gain facility and become confident that you can *do* mathematics and you will experience the joy of discovering hidden patterns and mathematical truths. After successful completion of the course, students will be able to state, prove, apply fundamental theorems, and construct and work with a variety of concrete examples. In addition, students will be well-prepared for higher-level mathematics courses such as MATH 2090 (Linear Algebra 2).

COURSE MATERIALS

Textbook: *Linear Algebra And Its Applications*, fifth edition, by David C. Lay, Steven R. Lay, Judi J. McDonald via *MyLab Mathematics*. Instructions to obtain access to *MyLab Mathematics* are provided in a separate handout.

Course Web-Page: We will use UM Learn and the instructor’s web-page which can be found at http://server.math.umanitoba.ca/~coopers5/courses_umanitoba/math1220_w2020.html

ASSESSMENTS AND COURSE GRADES

Tutorial Worksheets: Mathematics is not a spectator sport. The best way to learn mathematics is by doing mathematics! The weekly tutorial sessions are designed to deepen your knowledge of the course material. In every tutorial session, you will be asked to work on a *Tutorial Worksheet*. The teaching assistant will be available to answer your questions and help you work through any problems re-emphasizing course content. Although your solutions will not be collected for credit, you are encouraged and welcome to discuss your solutions with a TA or myself for feedback either in office hours or before/after class meetings. It is highly recommended that you carefully read the relevant material and attempt the tutorial worksheets - these will help you keep on track and make sure you have solid foundations before moving on to the next topics.

Weekly On-Line Homework Sets: The more you practice and engage in problem solving, the deeper you will understand the material and hence perform stronger on assessments. To enhance your learning, a collection of weekly practice exercises will be assigned and completed via *MyLab Mathematics*. The Homework Sets will be due on Thursdays at 5:00 p.m. Although you will not submit work to solutions to the exercises, this is an opportunity to receive instant feedback on your progress and understanding. Note that late submissions will not be accepted for any reason. Your lowest On-Line Homework Set score will be dropped from your course grade.

Mastery Quizzes: Eleven *Mastery Quizzes* will be given based on suggested exercises, tutorial worksheets, On-Line Homework Sets, and notes from class. The mastery of mathematics requires knowing and understanding many definitions, especially for linear algebra which has numerous and varied applications, and so you will be responsible for definitions on the Mastery Quizzes. Mastery Quizzes will be administered in tutorial sessions and returned in the following tutorial. Calculators and reference material (texts, notes, translators, cell phone, etc.) will **not** be allowed on the Mastery Quizzes. These quizzes are intended to gauge your understanding of the material while presenting opportunities for you to practice writing solutions in a timed-setting. Solutions will be graded based on correctness, clarity, and style/creativity. Any necessary special grading rules will be provided beforehand. All feedback is meant to *improve* your mathematical abilities and communication. Deferred quizzes will not be given for any reason. Your lowest Mastery Quiz score will be dropped from your course grade.

Examinations: There will be one 60-minute Mid-Term Examination and one 3-hour cumulative Final Examination administered in MATH 1220. The schedule is:

Examination	Date	Time and Location
Mid-Term Exam	Tuesday, February 11	5:45 p.m. – 6:45 p.m., location TBA
Final Exam	In April – TBA	TBA (set by U of M Registrar)

Calculators and/or reference material (including electronic devices) will **not** be allowed on the Mid-Term and Final Examinations. Any necessary special grading rules for the examinations will be announced and discussed prior. In general, solutions to problems will be assessed based on correctness, clarity, and style. Feedback on your solutions will be provided on your Mid-Term Examination and is meant to improve your mathematical abilities and communication. Grades and feedback for the Mid-Term Examination will be provided prior to the Voluntary Withdrawal Deadline.

Class Attendance and Participation: This course covers a large amount of material and may seem very fast-paced and abstract. Your understanding of the course material will be greatly supported by regular attendance and engagement in class meetings. Although you are expected to attend every class and tutorial meeting and to fully participate in class discussions, attendance will not be taken or be used in the calculation of course grades. However, you are responsible for any missed material when absent.

In class discussions, students will be asked to share their ideas. To encourage constant engagement with the class, each student will be provided with a colour-coded voting card and often asked to participate by voting and/or working in small groups. Please take your turn in these activities – it will greatly improve your understanding of the material. In particular, if you are absent from class then you will miss the opportunity to learn from your classmates. Learning from others is invaluable and simply cannot be replaced.

Evaluation Scheme and Letter Grades: Final course grades will be determined as follows:

Task	Percentage of Grade
On-Line Homework Sets	5% (best 10 out of 11)
Mastery Quizzes	15% (best 10 out of 11)
Mid-Term Examination	30%
Final Examination	50%

Below are the minimum cut-off ranges for grades; these may decrease at the instructors' discretion.

Letter Grade	Percentage Out Of 100	Final Grade Point Value
A+	95–100	4.5
A	86–94	4.0
B+	80–85	3.5
B	72–79	3.0
C+	65–71	2.5
C	60–64	2.0
D	50–59	1.0
F	Less than 50	0

Deferred Work: Late On-Line Homework Set submissions will not be accepted for any reason. Also, there will be no deferred Mastery Quizzes or Mid-Term Examinations for any reason. If you miss the Mid-Term Examination, you will be assigned a mark of “zero” unless there is an unavoidable, documented circumstance as described below:

Circumstance	Required documentation
Illness or other medical situation	Official note from clinic, hospital, doctor, nurse, or other health care provider
Military service	Official military activation orders
Funeral or other family emergency	Official documentation from newspaper, funeral, or medical official
Sports or other official U of M activity	Official documentation from U of M athletics or activity's faculty adviser

In that case the weight of the Mid-Term Examination will be re-assigned to the Final Examination. Students who miss the Mid-Term Examination and wish to request a re-weighting to the Final Examination must contact the instructor within 48 hours of the start time of the test (initial email contact is sufficient). Please note that recreational activities do not qualify as an unavoidable circumstance. If you have a pre-existing conflict with an assessment, you are expected to make alternative arrangements *beforehand*.

As per university policy, requests for deferred Final Examinations are made to the student's faculty, school, or academic advising office and must be filed within 48 hours of the date of the missed examination. Full information on this policy can be found at:

<http://umanitoba.ca/student/records/finals/682.html>

COURSE SCHEDULE AND IMPORTANT DATES

The topics schedule below is subject to change at the discretion of the instructor and/or based on learning needs of the students (subject to Section 2.8 of Responsibilities Of Academic Staff With Regard To Students). Assessment dates will not change. *On-Line Homework Sets (HS)* are due by 5:00 p.m. and *Mastery Quizzes (Q)* will be administered in the tutorials.

Dates	Topic	Sections	HS Due/Quiz
Jan. 6–10	systems of linear equations, row reduction, echelon forms	§1.1–1.2	
Jan. 13–17	vector and matrix equations, solution sets of linear systems	§1.3–1.5	# 1 Jan. 16/17
Jan. 20–24	applications, linear independence, linear transformations	§1.6–1.8	# 2 Jan. 23/24
Jan. 27–31	linear transformations, matrix of linear transformations	§1.8–1.9	# 3 Jan. 30/31
Feb. 3–7	matrix operations, matrix inverse	§2.1–2.2	# 4 Feb. 6/7
Mid-Term Examination: Tuesday, February 11 (5:45–6:45 p.m., location TBA)			
Feb. 10–14	invertible matrices, applications, subspaces of \mathbb{R}^n	§2.3, 2.6, 2.8	# 5 Feb. 13/14
No Classes: February 17–21 (Louis Riel Day & Winter Term Break)			
Feb. 24–28	subspaces of \mathbb{R}^n , dimension, rank, determinants	§2.8–3.1	# 6 Feb. 27/28
March 2–6	determinants, Cramer’s Rule, volume, linear transformations	§3.1–3.3	# 7 March 5/6
March 9–13	complex numbers, eigenvalues, eigenvectors, characteristic equation	§A2, 5.1–5.2	# 8 March 12/13
Voluntary Withdrawal Deadline: Wednesday, March 18			
March 16–20	characteristic equation, diagonalization, eigenvectors and linear transformations	§5.2–5.4	# 9 March 19/20
March 23–27	eigenvectors and linear transformation, complex eigenvalues, applications	§5.4, 5.5, 4.9/5.6	# 10 March 26/27
March 30–April 3	inner product, length, orthogonal sets	§6.1–6.2	# 11 April 2/3
April 6	orthogonal projections	§6.3	
Final Examination: Date, Time, Location To Be Determined By U of M Registrar			

UNIVERSITY AND DEPARTMENT OF MATHEMATICS SUPPORT OFFICES AND POLICIES

A list (entitled Schedule “A”) of supports available to students, including mathematical support, can be found on the course web-page(s).

FIPPA STATEMENT OF PURPOSE: CROWDMARK

We may use the platform *Crowdmark* in order to assess quizzes and examinations. In such instances, your personal information is being collected under the authority of The University of Manitoba Act. It will be used for the purposes of grading papers and providing feedback to students. Personal information will not be used or disclosed for other purposes, unless permitted by The Freedom of Information and Protection of Privacy Act (FIPPA). The University of Manitoba has taken steps to ensure that its agreement with Crowdmark, Inc. for services provided by the Crowdmark application is in compliance with FIPPA. Please be aware that information held by Crowdmark Inc. may be transmitted to and stored on servers outside of the University of Manitoba, or Canada. The University of Manitoba cannot and does not guarantee protection against the possible disclosure of your data including, without limitation, against possible secret disclosures of data to a foreign authority in accordance with the laws of another jurisdiction. If you have any questions about the collection of personal information, contact the Access and Privacy Office (tel. (204) 474-9462), The University of Manitoba, 233 Elizabeth Dafoe Library, Winnipeg, Manitoba, Canada, R3T 2N2.

EXPECTATIONS

Recording Class Lectures: Susan Cooper and the University of Manitoba hold copyright over the course materials, presentations, and lectures which form part of this course. No audio or video recording of lectures or presentations is allowed in any format (including photographs), openly or surreptitiously, in whole or in part without permission. Course materials (both paper and digital) are for the participant's private study and research.

Using Copyrighted Material: Please respect copyright. We will use copyrighted material 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. 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. For more information, see the University's Copyright Office web-site at <http://umanitoba.ca/copyright/> or contact um_copyright@umanitoba.ca.

Course Technology: It is the University of Manitoba policy that all technology resources are to be used in a responsible, efficient, ethical and legal manner. During class meetings and for Homework Sets, quizzes, and examinations, it is expected that you only use technology for educational purposes and that the only technology used is approved by myself and/or the University of Manitoba Student Accessibility Services. You should not participate in personal direct electronic message/posting activities (such as e-mail, texting, video, social networking, etc.) during scheduled class time – this is not only in your best interests for understanding the course material but is respectful behaviour for your classmates. If you absolutely need to take an expected call, then please use the vibrate mode on your cell phone and leave the classroom before using the phone.

Class Communication: You are required to obtain and use your University of Manitoba email account for all communication between yourself and the university. All communication must comply with the Electronic Communication with Students Policy.

Student Accessibility Services: The University of Manitoba is committed to providing an accessible academic community. *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. Students are welcome to meet with the instructor to discuss the accommodations recommended by SAS.

Student Accessibility Services

<http://umanitoba.ca/student-supports/accessibility>

520 University Centre

Phone: (204) 474-7423

Email: Student_accessibility@umantioba.ca

Academic Integrity: You are expected to be academically honest. This means, for example, providing a list of the people (if any) with whom you worked and providing a list of sources other than the textbook (if any) that you used to complete an assignment. Although you are encouraged to work together, you should never submit anything that you do not understand or is not written in your own words. The following excerpt about Academic Honesty is taken from the Department of Mathematics web-page:

The Department of Mathematics, the Faculty of Science and the University of Manitoba 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 the sections entitled “Academic Integrity” and “Final Examinations” (in particular, the section “Examination Personations”) in the “General Academic Regulations” section of the current Undergraduate Calendar.

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. Information regarding Academic Integrity is also available from the Faculty of Science web-page.

Students are encouraged to visit the University of Manitoba Academic Integrity site for further information.

Classroom Atmosphere: A part of learning is making mistakes. We want to establish a classroom atmosphere where the inevitable false starts and mistakes become an opportunity to improve – not an opportunity for embarrassment. Please be constructive and polite in questioning your colleagues.

Other Expectations and Tips for Success: I ask that you have a well-defined sense of professionalism, that you always put forth your best effort, and that you develop a sense of responsibility to your educational community. I ask that you exhibit a persistent desire to learn. In return I will provide you with significant support. Also:

- Be positive, open, and responsive to feedback.
- Be an active participant - mathematics is learned by doing; this includes participating fully in classroom activities (please, turn your cell phones off during class), completing the Homework Sets, critically thinking about the mathematics during and outside of class. *In order for this class to be successful, it is imperative that you commit to attending class/tutorial sessions regularly, that you commit to preparing beforehand for class meetings, and that you commit to participating in class meetings!*
- Be/become a “risk taker”.
- Be committed.
- Be patient with yourself - it takes time to master newly learned things. Ask for assistance when it is needed. Constantly try to improve yourself as a mathematician.
- Starting with the first class, study in-depth and regularly. This means, for example, that you should do any suggested readings and exercises *before* the next class period.

- It is tempting to just copy available solutions. However, struggling through the exercises on your own is an important phase of the learning process.
- Get help as soon as you need it: ask questions in class and office hours; form a study group; read alternate resources; consider getting a tutor; use the Math Help Center (located in 412 Machray Hall); use the program LevelUp (see Schedule “A”), etc.
- For examination preparation, practice exercises that have not been assigned.
- Save your solutions to Homework Sets and suggested exercises for later use. You may find it helpful to organize your work in a 3-ring binder or notebook for your suggested exercises. You should be able to look at the solutions a month later and understand what is on the paper.
- Mathematics is a language in itself that is common to many sciences across the world. It is crucial that we all use consistent and correct notation. For example, when using the equal sign you should make sure that the quantities on either side of the equal sign are indeed equal.
- Take pride in your work and take your work seriously. This means you should: use complete sentences with proper grammar and correct spelling, write legibly, provide justification for your claims, show all of your work, clearly state all the hypotheses being used, etc.
- Like in all areas of life, constructive feedback can be difficult to digest and accept. Please know that the feedback provided in this course is meant to *improve* your mathematical solutions and communication. Please take the feedback seriously and apply it to your future work.
- Everyone wants you to succeed. Please speak with me regarding any concerns you may have.
- Relax and have fun with the course!