

Linear Algebra

MATH 202, Fall 2015

Sections 01 and 02

Instructor: Stephen Flood

Office: DMF 443, in the Center for Science & Mathematics (near the Rondileau Campus Center).

Office Hours: Tuesday and Friday 3:30-4:30pm, and Thursday 2:00-3:00pm.

Open Door Policy: If my door is open, then I am happy to answer quick questions!

Email: stephen.flood@bridgew.edu

Email Policy: I try to respond to questions by some time the next business day.

Textbook: *Linear Algebra and its Applications* 5th edition by Lay, Lay, and McDonald.

As of 8/28/15, it was available at Amazon.com for \$155.08 (New) and \$39.99 (Rental)

<http://www.amazon.com/Linear-Algebra-Its-Applications-5th/dp/032198238X/>

If you already bought a copy from the bookstore, ask them about their "Price Match Program"

Important Websites

1. **My Website:** General information about this section, including my office hours, and some study aids will be posted at <http://www.mathlogic.org/stephenflood/teaching.html>
2. **Email:** It is important to regularly check your Bridgewater email.

Course Description

Prerequisite: MATH 180; and MATH 142 or MATH 152 or MATH 162; MATH 162 may be taken concurrently

Topics: Vector spaces, linear transformations, matrices, systems of linear equations and determinants.

Learning Outcomes. By the end of the course, you will be able to:

1. Represent every system of linear equations in *four different ways*.
2. Solve a given linear system. Describe the set of solutions both numerically and geometrically.
3. Use 1. and 2. to (i) decide if one vector is a linear combination of a set of other vectors, (ii) find the *span* of a set of vectors, and (iii) decide if a set of vectors is linearly independent or linearly dependent
4. Describe the properties of a linear transformation.
5. Know the connection between matrices and linear transformations.
Use this to rephrase the concepts from #1-3. in the language of functions.
6. Manipulate matrices algebraically, and explain these operations using the language of functions.
7. Explain the definition and properties of vector spaces and subspaces.
8. Express concepts from #1-6. using the language of vector spaces and subspaces.
9. Determine eigenvalues and eigenvectors of a matrix.
10. Use eigenvalues & eigenvectors to see what happens when you repeatedly apply a linear transformation.
11. State similarities and differences between the main topics in the course.

Formats and Procedures

The course consists of 3 parts

1. In class lectures, worksheets, & quizzes (4 hours/week)¹
2. Regular Homework Assignments (8-12 hours/week)
3. Studying to prepare for homework and quizzes (normally \sim 4 hours/week, but more before an exam).

The suggested study times for the *average* student (see any website about studying in college). If you are weak in mathematics, you will require more time, but **please talk to me** and I can help you work more efficiently. You can also find useful advice online:

- Math Study Skills: <http://mathcs.slu.edu/undergrad-math/success-in-mathematics>

Grades

Your grade will be earned as follows. There is no extra credit.

Exam I, II, III	15% <i>each</i>
Homework & Quizzes	25%
Final Exam	30%
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Total	100%

Exams, homework, and quizzes will be graded for correctness, completeness, and clarity. The more clear your explanation and organization, the more points you will earn! This also means that points may be deducted for confusing organization and poor handwriting, as well as for incomplete or incorrect work.

How to succeed in this class

Linear Algebra is about a mixture of *Concepts*, *Computations*, and *Communication*.

Some problems on the homework simply practice ideas covered in class. Other problems will combine the “computations” and “concepts” in *a variety of new ways*. To succeed, you will also need to *communicate* clearly. You *must* clearly organize your work in each “computation” problem. In the “concept” problems, you must give clear explanations, and use correct terminology and notation.

From time to time **you will** become stumped by a problem. In this case, **you should** come to my office hours, drop by my office, or email me to ask for a hint or explanation.

Exams

There will be three in-class exams and one final exam. The final exam will be cumulative: anything we’ve studied is fair game. The in-class exams generally cover the material since the last exam. No calculators are permitted on any exam, unless otherwise stated.

No makeup exams are scheduled. If you miss an exam for a valid reason (documented illness, documented family emergency, etc.), your exam grade will be determined by averaging the other exams. At my discretion, I may choose to assign a makeup exam instead.

Tentative dates are given in the Approximate Calendar of Study, below. *Please contact me before the exam* if you will need to miss it. It is much harder to document “valid reasons” after you have missed the exam.

¹Because of the University’s Academic Calendar, the two sections of this course will not always be aligned. To keep things uniform, I will refer to the n^{th} 50-minute lecture as “class # n ”.

Quizzes

There will be occasional quizzes. These will be short assignments, and their main purpose is to give you a chance to use, practice, and explore the concepts and tools that we are learning.

In class quizzes and graded worksheets will be announced in advance, and cannot be made up.

Homework

The best way to learn mathematics is to get a lot of practice with (i) performing computations, (ii) using and connecting concepts, and (iii) writing clear explanations.

Graded Homework will be assigned from every class, and collected each week. Your assignment grade will depend on two things. (1) Part of your grade is based on whether *all problems were attempted* with complete and clear work, and (2) Part of your grade is based on *grading a few problems for correctness* of your answer and work.

In addition to the graded homework, you also have recommended homework: read the book and do as many practice problems as you can. You can find a list of recommended practice problems on the course page.

Group Work and Study Aids

You have many excellent resources available to aid you as you work. For example, *you can ask me any and all questions during office hours!* You also have answers to the odd numbered problems in the textbook.

Group work can be helpful. **But** I strongly encourage you to *work on problems yourself first*, before discussing them with your peers. Probably the best way to check that you understand a problem is to ask this question: “Can I reproduce the solution and explain it to a classmate a whole 10 minutes after I finished the problem?” Try this with the people you are studying with, and have them check your reasoning.

But always remember: you will benefit the most if you *make a serious effort to solve the problems on your own* before you obtain hints or other assistance.

Students with Disabilities

At BSU, we are committed to making our facilities, services, and programs accessible to all students in compliance with applicable law. Students with disabilities who desire reasonable accommodations should contact the Disability Resources Office to discuss the availability of reasonable accommodations or to obtain documentation guidelines. They are located in the Maxwell Library Ground Floor (AAS). You should also contact me by email or during office hours to discuss accommodations due to a documented disability.

Final Letter Grades

The final letter grade cutoffs are as follows:

Percentage:	94	90	87	83	80	77	73	70	60	0
Letter Grade:	A	A-	B+	B	B-	C+	C	C -	D	F

NOTE: Official grades cannot *and will not* be changed once posted.²

²Unless there was an error in the grade computation

Academic Integrity

Academic honesty is expected of all students. Plagiarism and cheating are subject to academic penalty, which may result in a grade of F for the whole course. In fact, *a violation may result in a reduced grade, suspension, or dismissal from the university.*

You must not not cheat, fabricate, plagiarize, or facilitate academic dishonesty. If you passively engage in cheating (i.e. allowing others to cheat off you) you may receive the same consequences as the person copying.

Important Dates

Last day to add/drop: September 10, 2015. *Last day to withdraw:* November 16, 2015.

Tentative Exam Dates (subject to change!)

Section 01: September 29, October 22, November 19.
Final Exam: Tuesday, December 15, 2:00-4:00.

Section 02: September 25, October 23, November 23.
Finals Exam: Monday, December 14, 11:00-1:00

Approximate Calendar of Study

This schedule is a preliminary outline, and you should expect it to change from time to time.

Note: Because of the University's Academic Calendar, the two sections of this course will not always be aligned. To keep things uniform, I will refer to the n^{th} 50-minute lecture as "class # n ".

Lesson	Section	Topic	Remarks
1	1.1	Systems of Linear Equations	
2	1.2	Row Reduction and Echelon Forms	
3	1.3	Vector Equations I	
4	1.3	Vector Equations II	
5	1.4	The Matrix Equation $A\mathbf{x} = \mathbf{b}$	
6	1.5	Solution sets of Linear Equations I	
7	1.5	Solution sets of Linear Equations II	
8	1.7	Linear Independence	
9	1.7	Linear Independence	
10		Exam 1	
11	1.8	Linear Transformations	
12	1.8	Linear Transformations	
13	1.9	The Matrix of a Linear Transformation	
14	1.9	The Matrix of a Linear Transformation	
15	2.1	Matrix Operations	

Lesson	Section	Topic	Remarks
16	2.1	Matrix Operations	
17	2.2	Inverse of a Matrix	
18	2.2	Inverse of a Matrix	
19	2.3	Characterizations of Invertible Matrices	
20	2.3	Characterizations of Invertible Matrices	
21		Exam 2	
22	3.1	Introduction to Determinants	
23	3.2	Properties of Determinants	
24	4.1	Vector Spaces and Subspaces	
25	4.2	Null Spaces, Column Spaces, and Linear Transformations	
26	4.2	Null Spaces, Column Spaces, and Linear Transformations	
27	4.3	Linearly Independent Sets; Bases	
28	4.3	Linearly Independent Sets; Bases	
29	4.4	Coordinate Systems	
30	4.4	Coordinate Systems	
31	4.5	Dimension of a Vector Space	
32	4.5	Dimension of a Vector Space	
33		Exam 3	
34	4.6	Rank	
35	4.6	Rank	
36	5.1	Eigenvectors and Eigenvalues	
37	5.1	Eigenvectors and Eigenvalues	
38	5.2	The Characteristic Equation	
39	5.2	The Characteristic Equation	
		Final Exam	

Additional Topics:

- §1.10 – Linear Models in Application
- §2.7 – Computer Graphics
- §3.3 – Cranmer’s Rule, Volume, Linear Transformations
- §5.6 – Discrete Dynamical Systems and a quick application of Eigenvector Bases.