

SYLLABUS

MA242 Linear Algebra

Fall 2020

Professor: Steve Rosenberg

Office: MCS 278 – but I’m not on campus this semester

Virtual Office Hours: Tuesday, 1 – 2:30 pm, and Wednesday, 8:30 – 10 am, or by appointment. (All times are Boston time.)

Course Lectures: TR 5-6:15 in WED 130

Discussion Sections:

- MA242 C2: Monday, 8-8:50 am, PSY B37
- MA243 C3: Monday, 9:05-9:55 am, PSY B37
- MA242 C4: Monday, 10:10-11:00 am, PSY B37
- MA242 C5: Monday, 11:15 am - 12:05 pm, STH 318
- MA242 C6: Monday, 12:20 - 1:10 pm, STH 318

Text: Lay, *Linear Algebra and its Applications*, 5th edition

Website: math.bu.edu/people/sr

Course Website: Blackboard via learn.bu.edu and Gradescope via gradescope.com

Email: sr@math.bu.edu; Be sure to check your BU email regularly for course announcements.

Course Organization: All lectures will be given remotely and synchronously, which means they will be given at the lecture time TR 5-6:15. The lectures will be recorded and uploaded to the Blackboard course web site. You can watch them by going to Tools and clicking on Media Gallery.

Don’t forget that the clock moves back one hour in Boston on November 1!

All homework assignments, quizzes and exams will be given on the Gradescope course web site. The time limits are explained below. You must upload your answers as a pdf file. You can either take photos of your written answers and convert them to a pdf file by hand, or use an app that converts photos to pdf files – there are many free ones available. *Every uploaded page must have your name and BU ID number at the top.* For detailed instructions on uploading homework, go to https://www.gradescope.com/get_started: Under the column Assignment Workflow, click on “For students: Submit PDF homework.”

The Blackboard course is linked to the Gradescope course. In theory, you should be able to log onto the Blackboard site to the course and jump to the Gradescope site for quizzes and exams.

Material: The course will cover the basic concepts of systems of linear equations and their solutions. The first half of the course will emphasize calculational techniques, with applications to physics, applied mathematics, economics and engineering. The second half of the course will cover matrices as linear transformations on vector spaces. We will cover Chapters 1-6.

We will spend a good portion of the time doing proofs of linear algebra theorems. This may be the first course for you with lots of proofs, which is a crucial part of doing mathematics, and it may take a little time to get used to the format of a good proof. Homework, quizzes and exams may contain some simple proofs, but you won't be asked to memorize proofs.

Grading: A) Exams: There will be two midterm exams and a final. There will be a 24 hour period during which you can start the midterm exams. The midterm exams will be last for 90 minutes, so you must start the exam before 22 1/2 hours have passed. *Be sure to leave enough time to upload your answers! Remember that you can resubmit answers as many times as you like within the 90 minutes.* There will also be a 24 hour period during which you can start the final exam. The final exam is two hours and 15 minutes, so you must start the exam before 21 3/4 hours have passed.

Did I mention that the clock moves back one hour in Boston on November 1!?

B) There will be a brief quiz every Monday at 10 am Boston time. You will have 24 hours to start the quiz, and 20 minutes to complete and upload each quiz.

C) The in-class exams each count for 10% of the grade, the final counts for 20%, the quizzes count for 10%, and homework counts for 50%.

D) The only acceptable excuses for missing an exam, quiz or homework due date are substantiated illness, family emergency, legal reasons such as jury duty, or religious reasons. *If internet connectivity is an issue, talk to me before the exam time or homework due time.* Make-up exams for midterm exams are not given. If you miss a midterm exam for an acceptable reason, your remaining in-class exam will count for 20% of your grade.

Homework: The homework assignments are listed below. Homework will be due one week after it is assigned. Late homework will not be accepted. Since the answers to the odd-numbered problems are in the back of the book, you must give complete answers on all problems to receive credit. I cannot emphasize enough the importance of doing the homework problems – I think it is impossible to do well in the course without keeping up with the homework. You are welcome to work with others on your homework.

Computer packages: Some homework problems will involve computer calculations. The easiest website is Wolfram Alpha, which has worked linear algebra examples at <https://www.wolframalpha.com/examples/Matrices.html>. You must include a screenshot of your work for these problems.

There are several other computer algebra packages available. Go to the book's website at http://wps.aw.com/aw_lay_linearalgebra_5/ and click on student resources to find introductions to computer algebra packages (*Getting Started with Technology* in the left hand column) such as Mathematica and Matlab. You can download all data sets to avoid

tedious typing in of data by clicking on *Data Sets* in the left hand column. Free student versions of Matlab and Mathematica are available if you log onto your BU account at the computer lab Common@Mugar at Mugar Library. Once you log on, hit the Start button, then select Run, then enter Matlab or Mathematica. Both programs come with tutorials.

For remote access to Matlab and Mathematica, you will need to get an account on the scc-lite.bu.edu server. You will need to install X window software on you computer. Information on getting an scc-lite account and free versions of X window software for PCs and Macs are available at

<http://www.bu.edu/tech/services/support/desktop/computer-labs/unix/>

You can use another system (such as our old friends the TI-86, TI-85, etc.) if you prefer.

Cheating: Boston University's policies on cheating and plagiarism are spelled out in the BU Academic Conduct Code at

<http://www.bu.edu/academics/resources/academic-conduct-code/>

Remember that copying answers from other students or from a website is both cheating and plagiarism. Please don't be tempted to use sites like Chegg and CourseHero; if you're caught, you can both fail the course and be suspended.

Outline of Contents

Chapter 1. Linear Equations in Linear Algebra

- 1.1 Systems of Linear Equations Hwk: #1,5,8,9,14,19,30,33,34
- 1.2 Row Reduction and Echelon Forms Hwk: #1,6,9,16,25,26,33,34
- 1.3 Vector Equations Hwk: #1,4,5,8,9,12,27,28,29
- 1.4 The Matrix Equation $Ax = b$ Hwk: #1,5,7,10,12,13,17,20,26,31,35
- 1.5 Solution Sets of Linear Systems Hwk: #1,5,8,11,13,16,18,36
- 1.6 Applications of Linear Systems Hwk: #3, 12, 14
- 1.7 Linear Independence Hwk: #1,6,19,20,31,32,40
- 1.8 Intro to Linear Transformations Hwk: #1,4,9,11,14,16,19,22,23,25,29
- 1.9 The Matrix of a Linear Transformation Hwk: #1,6,7,8,12, 18, 24
- 1.10 Business, Science, Engineering Applications Hwk: #2,8, 10, 11

Chapter 2. Matrix Algebra

- 2.1 Matrix Operations Hwk: #1,4,5,23,24,28,30,31,33
- 2.2 Inverse Matrix Hwk: #1,5,7,10bc,12,21,22, 40
- 2.3 Characterizations of Invertible Matrices Hwk: #1,5,10,16,26,32
- 2.7 Computer Graphics Hwk: #1,3,4,5,8,11,15,16,19,20,21

Test 1: Thursday, October 22*

Chapter 3. Determinants

- 3.1 Introduction to Determinants Hwk: #1,2,9,10,15,16,38, 41
- 3.2 Properties of Determinants Hwk: #5,11,15,17,19,28, 29

3.3 Cramer's rule, etc. Hwk: #19,21,23,32

Chapter 4. Vector Spaces

4.1 Vector Spaces and Subspaces Hwk: #1,3,4,5,6,9,11,14,16,19,20,21,27

4.2 Null spaces, etc. Hwk: #1,5,6,7,9, 14, 16,29,31,33,34,38,39

4.3 Bases Hwk: #1,8,11,14,33

4.4 Coordinate Systems Hwk: #1,8,9,12,13,17,21,28,36

4.5 Dimension of a Vector Space Hwk: #1,8,9,12,13,20,21,24,27,29,34

4.7 Change of Basis Hwk: #1,4,6,9,13,14,17,18

4.9 Applications to Markov Chains Hwk: #1,4,5,7,15

Test 2: Thursday, December 3*

Chapter 5. Eigenvalues and Eigenvectors

5.1 Eigenvectors and Eigenvalues Hwk: #1,6,11,22abd,31,37,38

5.2 The Characteristic Equation Hwk: #1,10,13,20,21,24 30

5.3 Diagonalization Hwk: #1,6,11,22,23,28,31,33

5.5 Complex Eigenvalues Hwk: #1, 7, 8, 13, 27

5.6 Discrete Dynamical Systems Hwk: #1,3,4,5,9,10,16

Chapter 6. Orthogonality and Least Squares

6.1 Inner Product, etc. Hwk: #1,4,7,11,14,17,20,30

6.2 Orthogonal Sets Hwk: #1,8,11,14,17,24,26,27

6.3 Orthogonal Projections Hwk: #1,4,7,11,14,17,25

6.4 Gram-Schmidt Hwk: #1,9,24

6.5 Least-Squares Problems Hwk: #1,3,5,7,10

6.6 Applications to Linear Models Hwk: #1,7,8,10,11

Final Exam: Not announced yet. The last day of Final Exams is Saturday, December 19, so don't plan to leave campus before then.

***Warning:** The dates of the in-class exams may be changed.