MATH 355: Linear Algebra

29 June-14 August 2020 (Block B2)

Online

(last updated: 08/10/2020)

Disclaimer

The policies of this syllabus are subject to change with reasonable advance notice.

Course Description:

Many models from the sciences have a natural expression in the language of linear algebra, and even more can be approximated by an expression in linear algebra. My goal for students is a fluency with the basic vocabulary, tools, and fundamental ideas of linear algebra. Main topics include the solutions of linear equations, linear transformations and matrices, inner products, eigenvalues, eigenvectors, and the spectral theorem for real symmetric finite matrices. We will strive to balance the abstraction that gives linear algebra its power with many concrete examples.

Course Objectives & Expected Learning Outcomes:

We aim by the end of the course for you to be able to…

…translate between linear systems and matrix-vector equations.
…realize matrix multiplication as linear transformation and vice-versa.
…visualize diagonalization of 2x2 matrices.
…anticipate invertibility of a matrix by a variety of means.
…build matrices exhibiting prescribed properties, e.g., 0 determinant, diagonalizable, etc.
…appreciate the usefulness of abstraction.

Texts and materials:

Most of the material we will cover comes from:

- *Linear Algebra and its Applications* by David C. Lay, Steven R. Lay, and Judi J. McDonald, fifth edition.

You are not required to purchase a copy of the textbook. Your learning will be well served if you secure access to material covering the following topics:

1. Matrix multiplication and row reduction
2. Determinants
3. Invertibility of matrices
4. Vector spaces, linear independence, span
5. Linear Transformations
6. Diagonalization of matrices
7. Real symmetric matrix spectral theorem
8. Inner products

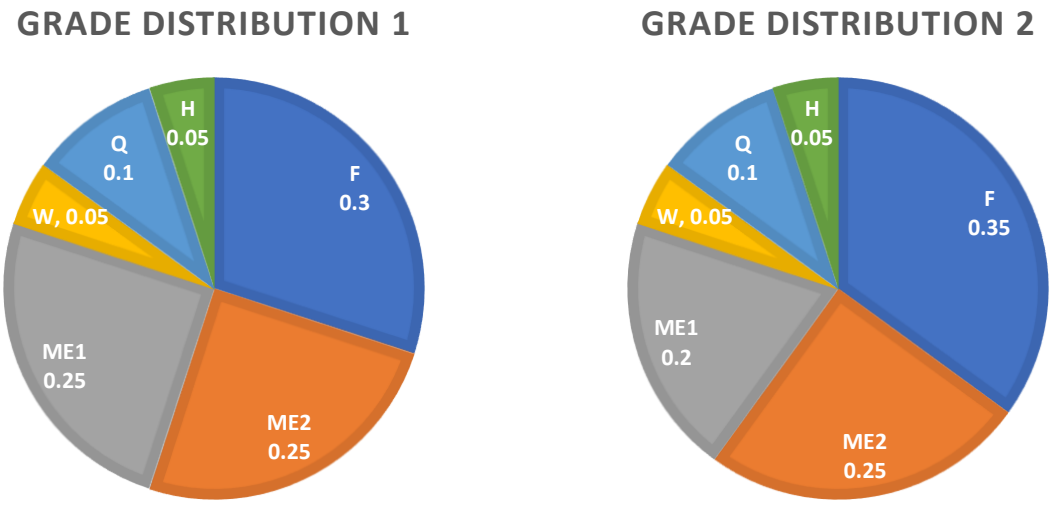
We will also use WeBWorK, which you can access at the following link:
http://webwork.math.rice.edu/webwork2/Math355Summer20Gwaltney/.
Your username is your NetID and your password is initially set to your student ID (S########).

Instructor: Ethan Gwaltney, ethan.gwaltney@rice.edu
Office Hours: TWR 2:15-3:15pm CST, or by appointment
Time: MTWRF 1-2:10pm CST

Grading Policy: We will assess progress using the following tools:

1. WebWork (W). WebWork will be assigned daily and will be due at the beginning of the subsequent class. Late WebWork will not be accepted. WebWork is intended to be analogous to the 'immersive' aspect of a language learning course since math *is* a language, in a sense.
2. Homework (H). Written homework will be due to Gradescope at the beginning of class on the Friday following its assignment. Written homework will give you practice in logically supporting your solutions as will be expected of you on quizzes and exams.
3. Quizzes (Q). Weekly 'take home' quizzes will be due to Gradescope at the beginning of class on the Monday following their assignment. Quizzes are practice for exams, and, as such, should first be taken timed and with no external resources in one color, then reviewed and edited using notes or a textbook in a different color. Instructions with more details can be found on each quiz. If you follow these steps, quizzes are graded based on your edited solutions.
4. Exams (E). There will be two midterm exams (ME) and one final exam (FE). The midterm on which you receive higher marks we will call ME2, the one on which you receive lower marks, ME1. ME1 will be worth less that ME2 in your final grade distribution (see the chart below). See below for exam dates.

How is your grade calculated? Your final average is determined by the above assessments by the maximum of the following distributions:



Absence Policy: As this course is online, recordings of lessons will be uploaded to Canvas. However, pedagogical research suggests that attending live lessons is more effective towards student learning than watching recorded lessons. As such, you are strongly encouraged, but not required, to attend live lessons whenever possible.

Rice Honor Code

As a student enrolled at or visiting Rice University, you pledge to uphold the Rice Honor Code, of which you can remind yourself in the Honor System Handbook.

On homework, all resources are permitted. In particular, you are strongly encouraged to work with one another, if possible. The purpose of the homework is to internalize the language and practice of linear algebra, which is often best facilitated in communication with peers.

No external resources are permitted on exams. The purpose of quizzes and exams is to help you see what you can do so far and what you need to work on, as well as to help me, as instructor, see where the course has catalyzed your learning and where it could do so better. See the grading policy for more information about allowable resources for quizzes.

Hospitality

My ideal for the classroom is one in which every student is excited about the course and feels welcome. We might think of me as a host—I set the tone and decide the meal, as it were, and, if I'm a good host, I make you feel welcome. This vision motivates several of the design elements for the course (e.g., grading policy). If you have ideas on how the course might be more hospitable, please email me with subject "Hospitality". If you'd prefer to remain anonymous, use the following email account:
Address: anonymousowl.355@gmail.com
Password: Math355Summer2020

Students with Disabilities

If you are a student with a documented disability that requires accommodation, I encourage you to contact the Rice Disability Resource Center (adarice@rice.edu) and me (ewg3@rice.edu).

Resources

Here are some potentially helpful resources:

- 3blue1brown's video series on linear algebra: https://www.youtube.com/playlist?list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab

Calendar

Below is a preliminary schedule of class topics and events. Section numbers and exercise numbers refer to Lay et al. unless indicated otherwise. Assignments are due the Friday after they are listed at the beginning of class, unless otherwise indicated.

Day	Date	Topic(s)	Sections	Assignments
M	29 June	Systems of linear equations, RREF	1.1-1.2	1.1#33 1.2#25,27,29-31,33
T	30 June	Matrix & vector equations	1.3-1.4	1.3#25,33, 1.4#21-22,31,34
W	1 July	Linear (in)dependence	1.7	1.7#23-25,29,33-35
R	2 July	Linear transformations	1.8	1.8#24-25,28,36
F	3 July	The matrix of a linear transformation	1.9	1.9#29-32,34,36
M	6 July	Matrix operations	2.1	2.1#17,21,23-24
T	7 July	The inverse of a matrix	2.2	2.2#13-15,20,24
W	8 July	Introducing the invertible matrix theorem	2.3	2.3#11,12,38
R	9 July	Partitioning matrices	2.4	2.4#25
F	10 July	Wassily Leontief & economics	2.6	2.6#9-11
M	13 July	Determinants & their properties	3.1-3.2	3.1#25,30-32,38, 3.2#26,29,31,39
T	14 July	Linear transformations & volume	3.3	3.3#23,27,30,31
W	15 July	Vector spaces	4.1	4.1#8,20,22,32
R	16 July	Linear transformations & subspaces	4.2	4.2#8,15,19,24,32

F	17 July	A basis of a vector space	4.3	4.3#11,15,29-32,34
F	**17 July**	**Midterm 1**	**1.1-3.3**	**Posted Friday, due Monday**
M	20 July	Coordinates	4.4	4.4#21,25,30
T	21 July	The dimension of a vector space	4.5	4.5#5,13,29-31
W	22 July	Rank	4.6	4.6#3,5,13,15,21
R	23 July	Changing bases	4.7	4.7#5,20a
F	24 July	Difference equations	4.8	
M	27 July	Eigenstuff	5.1	
T	28 July	The characteristic equation (finding eigenstuff)	5.2	
W	29 July	Diagonalizing a matrix	5.3	
R	30 July	Linear transformations & eigenstuff	5.4	
F	31 July	Complex eigenstuff	5.5	
M	3 Aug	Inner products	6.1	
T	4 Aug	Orthogonal Sets	6.2	
W	5 Aug	Orthogonal projection & Gram-Schmidt	6.3-6.4	
W	5 Aug	**Midterm 2**	**4.1-5.5**	**Posted Wednesday, due Saturday**
R	6 Aug	Least-squares regression & linear models	6.5-6.6	
F	7 Aug	Inner product spaces	6.7	
M	10 Aug	The spectral theorem for real symmetric matrices	7.1	
T	11 Aug	The spectral theorem for real symmetric matrices	7.1	
W	12 Aug	Quadratic forms	7.2	
R	13 Aug	Singular value decomposition	7.4	
F	14 Aug	Singular value decomposition	7.4	
F	**14 Aug**	**Final**	**1.1-7.4**	**Posted Friday, due Monday**