

Math 223 — Linear Algebra and Matrix Theory

Fall 2014

Instructor Information

Instructor: Ben Salisbury, Assistant Professor
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Office Hours: Tuesdays and Wednesdays 2–3:30pm, and by appointment

Course Information

Meeting Times: TuTh 11:00am–12:15pm in Pearce 137 (Section 22259360)
TuTh 12:30pm–1:45pm in Pearce 137 (Section 22259361)
Course Text: *Linear Algebra and Its Applications*, fourth edition, by David C. Lay
Webpage: <http://people.cst.cmich.edu/salis1bt/courses/mth223f14/index.htm>

Description: Systems of linear equations, matrices, determinants, vectors, vector spaces, eigenvalues, linear transformations, applications and numerical methods.

Expectations: You are expected to work *very, very hard!* Mathematics is a challenging subject which is best learned through practice, practice, and more practice. You are expected to read the material to be covered in class *ahead of time* so you will be better equipped to ask and answer questions during the lecture. My lectures should serve as a guide and additional explanation, as well as a venue to ask questions and receive evaluation, as *you* learn the material. Additionally, homework exercises and practice, which are addressed below, may be even more beneficial if attempted after the first reading of the corresponding section but before the class in which they are covered. This way you have an opportunity to think about the problems ahead of time and form any coherent and well-thought-out questions to be asked during class. In my experience, one of the aspects that students struggle with most, in general, is how to form the question to which they need answering.

Suggestion: Given the difficulty of the topics being presented throughout this semester, I cannot stress how important it is not to let yourself fall behind. If at any point you feel that you are not understanding the material as well as you should, then you need to formulate thoughtful questions to be asked during class that address your difficulties or, perhaps better, visit me during office hours or schedule an appointment to discuss the matter directly. You are urged to take advantage of office hours as often as you need!!

Course Outline

Week	Section	Title
1	1.1	Systems of Linear Equations
	1.2	Row Reduction and Echelon Forms
	1.3	Vector Equations
2	1.4	The Matrix Equation $A\mathbf{x} = \mathbf{b}$
	1.5	Solution Sets of Linear Systems
	1.6	Applications of Linear Systems
	1.7	Linear Independence
3	1.8	Introduction to Linear Transformations
	1.9	The Matrix of a Linear Transformation
	2.1	Matrix Operations
4	2.2	The Inverse of a Matrix
	2.3	Characterizations of Invertible Matrices
	2.8	Subspaces of \mathbb{R}^n
	2.9	Dimension and Rank
5	Review and Exam 1	
6	3.1	Introduction to Determinants
	3.2	Properties of Determinants
	3.3	Cramer's Rule, Volume, and Linear Transformations
7	4.1	Vector Spaces and Subspaces
	4.2	Null Spaces, Column Spaces, and Linear Transformations
	4.3	Linearly Independent Sets; Bases
8	4.4	Coordinate Systems
	4.5	The Dimension of a Vector Space
	4.6	Rank
9	4.7	Change of Basis
	5.1	Eigenvectors and Eigenvalues
	5.2	The Characteristic Equation
10	Review and Exam 2	
11	5.3	Diagonalization
	5.4	Eigenvectors and Linear Transformations
	6.1	Inner Product, Length, and Orthogonality
12	6.2	Orthogonal Sets
	6.3	Orthogonal Projections
	6.4	The Gram-Schmidt Process
13	6.5	Least-Squares Problems
	7.1	Diagonalization of Symmetric Matrices
	7.2	Quadratic Forms
14	2.5	Matrix Factorizations
	7.4	The Singular Value Decomposition
15	Review and Exam 3	

Homework, Quizzes, and Exams

Homework. There will be no collected homework, however there will be a set of suggested exercises on which the quizzes and exams will be based. You are encouraged to complete all these suggested exercises, and to work with others from class whenever possible.

Quizzes. There will be a quiz on the Thursday of each week (except for the weeks in which there is an exam). The quizzes will have two questions, and both questions will be taken exactly from the suggested exercises.

Exams. Exams will reflect the material covered in class and practiced on the suggested exercises and quizzes. Moreover, there will be a number of questions that will be taken verbatim from the quizzes. Additionally, on each exam, there will be a number of questions taken directly from examples worked out in class. The remaining questions will be new questions, but relevant to the sections covered for exam. For example, on an exam of 10 questions, 3 may be taken directly from the quizzes, 2 may be taken directly from worked examples in class, and the remaining 5 questions will be new questions.

Suggested Exercises

Chapter 1

- 1.1 #1,4,7,9,12,13,17,18,19,22,25,26,29,30
- 1.2 #1,3,8,11,12,14,22,24,26,29,31
- 1.3 #1,2,3,6,9,11,13,14,17,19,21,23,25,26,32
- 1.4 #2,4,6,8,10,11,12,13,16,18,20,22,23,25,27,33,38,40
- 1.5 #1,4,5,8,11,13,18,19,22,23,24,26,32,35,38,39
- 1.6 #1,2,5,6,8,12,14
- 1.7 #2,3,5,8,9,11,12,17,20,21,22,25,27,31,33,34,36,38
- 1.8 #1,3,4,6,8,9,12,14,15,16,17,19,21,22,25,28,29,31,34
- 1.9 #1,4,5,8,12,16,18,20,21,23,24,31,34,35

Chapter 2

- 2.1 #2,4,6,7,9,10,11,12,15,16,19,22,25,27,40
- 2.2 #1,4,5,8,9,10,11,16,17,19,29,32,33,37
- 2.3 #1,4,7,8,9,11,12,13,15,17,18,21,27,33,35,38
- 2.5 #1,3,6,7,11,14,15,18,19
- 2.8 #5,7,11,12,13,15,17,20,21,22,23,25,29
- 2.9 #2,3,5,7,9,12,14,17,18,19,21,23

Chapter 3

- 3.1 #1,4,7,9,12,13,21,23,25,28,39,40,41
- 3.2 #2,4,5,8,9,12,13,15,18,19,21,22,24,26,27,28,29,31,33,34,35,39,42
- 3.3 #2,5,6,7,10,11,14,15,19,20,23,27,30,31

Chapter 4

- 4.1 #2,6,8,10,13,15,18,23,24,26,27,29,31,32,35
- 4.2 #2,4,5,7,10,11,15,19,25,26,27,29,33,35,37
- 4.3 #1,2,5,7,10,14,15,17,19,21,22,23,25,26,31
- 4.4 #2,3,4,6,7,10,11,13,14,15,16,17,18,20,24,25,28,29,32
- 4.5 #3,6,7,13,14,19,20,21,23,25,29,30,31,33
- 4.6 #1,2,4,5,7,9,10,13,16,17,18,20,26,27,28,29,30,31,32
- 4.7 #1,3,5,7,10,11,12,13,15

Chapter 5

- 5.1 #2,3,5,7,9,12,13,15,19,21,22,25,26,27,29,31,38,39
- 5.2 #2,3,7,9,10,13,16,18,19,21,22,23
- 5.3 #1,4,5,11,14,18,21,22,33,34
- 5.4 #1,3,7,8,11,19,22,23

Chapter 6

- 6.1 #1,4,5,8,9,11,12,15,16,17,18,19,20,24,26,28,30
- 6.2 #1,2,3,4,5,6,8,9,10,11,13,17,18,19,20,21,22,23,24
- 6.3 #1,3,6,7,9,10,12,14,15,17,19,21,22,23
- 6.4 #1,3,4,6,9,12,14,17,18,24
- 6.5 #1,2,5,9,12,15,17,18,19,22,23,25

Chapter 7

- 7.1 #13,18,29,21,23,25,26,28,37
- 7.2 #1,3,5,7,9,12,13,15,18,21,22
- 7.4 #1,6,9,11,17,19,26

Grading Breakdown

Quizzes	Every (non-exam) Thursday	20%
Exam 1	Thursday, September 25	20%
Exam 2	Thursday, October 30	20%
Exam 3	Tuesday, December 2	20%
Final Exam	Thursday, December 11, 10am–11:50am (Section 22259360) Thursday, December 11, 12pm–1:50pm (Section 22259361)	20%

Important: There are no make-ups for quizzes nor exams. In the event of an extreme emergency, an exception to this policy may be made. However, this exception is at the discretion of the instructor.

Additional Notes

- No attendance will be taken in class *but* you are responsible for knowing the material, assignments, and anything else presented and announced in class. While attendance in class is (theoretically) optional, be advised that your grade will most assuredly suffer from repeated absence from the lectures.
- Calculators are allowed, and your particular choice of calculator brand and model is up to you. However, be aware that all work must be shown on quizzes and exams in order to receive full credit. Please also know that I am aware that there exist calculators in which entire collections of notes may be stored and retrieved upon command, which may not be used on quizzes nor exams. Moreover, you may not use an app on a cell phone, iPod, or any device which transmits or takes photographs. Violation of this calculator policy is a violation of the CMU Academic Integrity policy and will be dealt with accordingly.
- The *Mathematics Assistance Center* offers students free tutoring for our course. They are located in Park Library, Room 428 and in Troutman Hall, Room 002.
- Blackboard will be incorporated to some extent in this course. If you have a technical issue related to Blackboard, please contact the OIT Help Desk at (989) 774-3662, <http://helpdesk.cmich.edu>, or helpdesk@cmich.edu.
- The last day to drop the class with a refund is Friday, August 29. The final day to withdraw from a sixteen week course with an automatic “W” is Friday, October 31. You can find a more detailed semester calendar at <https://www.cmich.edu/ess/registrar/RegistrarCalendars/Pages/default.aspx>.
- CMU provides students with disabilities reasonable accommodation to participate in educational programs, activities, or services. Students with disabilities requiring accommodation to participate in class activities or meet course requirements should first register with the office of Student Disability Services (120 Park Library, telephone: 989-774-3018, TDD 989-774-2568), and then contact me as soon as possible.