

Math 312 — Linear Algebra

Summer 2016, Session II

Instructor	Sebastian Moore
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Course website	www.math.upenn.edu/~moose/teaching.html and Canvas
Lectures	MTWR 10AM–12:10PM in DRL 4C6
Office hours	MW 1-2 or by appointment — in DRL 4C15
Extra help	Math help is available MTWR 9AM–1PM in DRL 4E19

Course overview: Linear algebra begins with a set of algorithms for solving systems of linear equations. The main insight of the subject is that these techniques apply to a wider class of objects that may not look like vectors in Euclidean space but may be treated in exactly the same way; this is the concept of a vector space. The methods of linear algebra are indispensable in the analysis of so-called “big data” that increasingly pervades our lives.

Prerequisite: You are expected to be comfortable with integrating and differentiating functions as well as with the concepts of multivariable geometry (vectors vs. scalars, equations defining lines and planes, parameterized paths, etc.). There will be a brief review of matrix operations (addition, subtraction and multiplication) but it is assumed that you have seen these before.

Material: The following is a mostly complete list of the concepts covered this summer:

solving linear systems, Gauss-Jordan elimination, existence and uniqueness of solutions, vector spaces, subspaces, dimension, linear transformations, determinants, eigenvectors and eigenvalues, diagonalization, dynamical systems, Markov chains, orthonormal bases, Gram-Schmidt process, orthogonal projection, inner product spaces, least-squares approximation, singular value decomposition, Fourier series

Text: The following text is required:

Linear Algebra with Applications, 5th edition, by Otto Bretscher.

Grade components:

* Last updated: July 8, 2016

Homework	25%
Quizzes	20%
Group project	15%
Midterm	15%
Final	25%

Important dates: (may be subject to change)

7/7	Quiz 1
7/13	Quiz 2
7/18	Midterm Exam
7/20	Quiz 3
7/27	Quiz 4
8/2	Quiz 5
8/2	Group Presentations
8/4	Final Exam

Also see the official SAS summer calendar at www.sas.upenn.edu/summer/calendar.

Exams: There will be a one-hour midterm exam administered during normal class time. The last day of class will be devoted to the final exam, which will draw on material from the entire summer session. Any makeup exams, if necessary, will take the form of oral exams.

Group project: After the midterm, you will be assigned a project to be done in groups of 2 or 3. For the project, you will read a few articles about a topic related to linear algebra and then give a short (10 minute) presentation to the class about your topic. This is an opportunity for you to apply linear algebra to a subject you are interested in, and an experience in learning new mathematics outside of class. You should consider the group presentation your second midterm; the project and your midterm receive equal weight in your final grade.

Quizzes: Fifteen minute quizzes will take place at the start of class on the dates indicated above. The quiz will strongly resemble one of the previous week's homework problems. Let me know *in advance* if you will be absent for one or more of the quizzes.

Homework: Homework will be assigned daily, except for classes preceeding an exam, and collected at the beginning of class. Homework assigned on Tuesdays and Wednesdays will be short (about 2 problems) with longer assignments on Mondays and Thursdays. Short assignments are due the next day, Monday assignments are due on Thursday, and Thursday assignments are due on Monday. Doing homework is the *most* effective way to prepare for the quizzes and exams, and will best prepare you to apply the material we learn this summer in your future endeavors. Homework will be accepted late at a penalty of 10% per day, but not more than a week late.

Collaboration and academic integrity: I encourage you to work together to study and do homework. However, in order to assign you a grade as an individual, I ask that any work that is handed in for a grade be written up individually. This means that you may work with your fellow students to figure out how to solve a problem, then put away any notes or other

written material produced in collaboration and write the solution on your own, using only the understanding you have gained. You should not show each other your written up solutions, nor should you copy solutions from someone else. Please see the University's Code of Academic Integrity for more information. Any instances of academic dishonesty may be brought up with the Mathematics Department and/or the Office of Academic Integrity. It is your responsibility to know what constitutes cheating and clarify any ambiguities with me ahead of time.

Getting help: The pace of this course is very fast. If you are confused about anything, don't hesitate to take advantage of the many resources available to you:

- **Me!** Ask questions in class. No question is too basic. Come to my office hours if you don't want to speak up in class. If you can't, make an appointment.
- **Math help** is available Monday–Thursday 9AM–1PM in DRL 4E19. No appointment necessary. This is a good place to work together on homework, which extra assistance available if you need it.
- **The Tutoring Center** www.vpul.upenn.edu/tutoring/
- **Math Department Approved Tutors** www.math.upenn.edu/ugrad/tutors.html
- **Weingarten Learning Resource Center** in Stouffer Commons, Suite 300, 3702 Spruce Street. Stop by to use the study lounge or computer lab or to pick up self-help brochures and semester calendars. To schedule an appointment with a Learning Instructor, call (215) 573-9235 or visit in person. To learn more about Weingarten's services, visit www.vpul.upenn.edu/lrc/lr/.

Extra resources: The following resources may be useful supplements to our textbook and your notes from class:

- **MIT Open Courseware** This is actually an entire linear algebra course online. You can watch videos or read transcripts of both the lectures and recitations, view problem sets with solutions, and even try taking the exams and check your answers afterwards.
ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/
- **Khan Academy** I'm sure this is not the first time you've heard of Khan Academy. These videos are more focused on teaching you techniques, rather than theory, and they don't cover the more advanced topics.
www.khanacademy.org/math/algebra-home/prec calculus/prec calc-matrices and
www.khanacademy.org/math/linear-algebra
- **Wikibooks** The Linear Algebra textbook on Wikibooks is fairly comprehensive and includes a large collection of examples and practice problems with detailed solutions.
en.wikibooks.org/wiki/Linear_Algebra
- **Math 240 slides** Lower down on my webpage you can find slides from when I taught Math 240 in 2015 and 2013. The first half of that course covers linear algebra. It may be useful as a refresher.

Disabilities: Any student who requires special accomodation should contact the Office of Student Disabilities Services (SDS) at the Weingarten Learning Resources Center. For more information see www.vpul.upenn.edu/lrc/sds/.