Syllabus for Math 27: Linear Algebra
Fall 2021

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Course Meeting Times: Tuesdays and Thursdays: 11:20am-12:35pm ET (Science Center 128)

Office Hours:
Mondays: 2:30pm-3:30pm ET (Math 66 Priority), 3:30pm-4:30pm ET (Math 27 Priority)
Wednesdays: 1pm-2pm ET (Math 66 Priority), 2pm-3pm ET (Math 27 Priority)

Feel free to come by if you would like a place to work on homework, ask questions, or chat.
I am also always happy to meet by appointment!

Course Description: This course covers systems of linear equations, matrices, vector spaces, linear transformations, determinants, and eigenvalues. Applications to other disciplines are presented. This course is a step up from calculus: It includes more abstract reasoning and structures.

Required Text:
Linear Algebra and Its Applications, 5th Edition*, by D. Lay, S. Lay, and J. McDonald

This course will primarily cover chapters 1-6 in the text. Textbook sections covered each week will be posted on Moodle. You may use older editions and/or online versions of the textbook.

Course Objectives: Upon successful completion of this course, students should be able to:
1. Interpret and determine the solutions to linear systems of equations.
2. Construct coherent and concise mathematical arguments and proofs.
3. Think abstractly about topics such as vector spaces, bases, orthogonality, and linear transformations.
4. Understand the computation of matrix inverses, orthogonal bases, matrix determinants, eigenvalues/eigenvectors, least squares approximations, and transformation matrices.

Assignments and Evaluation Methods:

Homework: Especially in mathematics, the saying "practice makes perfect" holds very true. Homework will be given approximately every week. Each homework assignment will consist of a problem set that will be collected for grading. The collected problem sets must be turned in on their due dates for full credit and ultimately be written up individually. Students may still ask for help from the instructor on homework and are encouraged to discuss problems with their classmates. Unless specified otherwise, all problems require solutions to be computed by hand. Starting the homework early is highly recommended. The collected problem sets are meant to give students steady feedback on their work and help improve mathematical skills. Optional problems may also be suggested, but they will not be graded and do not need to be turned in.

Classroom Environment: This course strives to provide an inclusive environment that is respectful and welcoming for *all* classroom citizens. Let's work together to maintain a learning environment that is equitable, inclusive, and welcoming for all students, regardless of race, ethnicity, religion, gender and gender identities, sexual orientation, disability, socioeconomic background, and nationality. I encourage you to inform me of your preferred name (correct my pronunciation if I butcher it) and pronouns, so that I may appropriately address you. Please let me know if there is any personal information you would like to share that will help you thrive in this course.

Participation: Students are always encouraged to ask questions and make thoughtful comments in class. Attendance will not formally be taken, but students should strive to demonstrate active engagement in the course and attend the majority of class meetings. Extra credit may be added to a student's course grade for especially helpful contributions in class meetings or regular engagement in class discussions on Slack.

Examinations: There will be three exams total: two mid-semester exams given during class and a final. Only the final will be fully cumulative. Material not covered in the exams will be more heavily tested in the final. Exams are meant to ensure that students understand key concepts and have an opportunity to synthesize course material.

Exam Schedule:
>   Exam 1 will be given in the beginning of October and covers topics 1a-2a.
>   Exam 2 will be given in the beginning of November and covers topics 2b-3e.
>   The Final Exam will be given during the final examination period in December and covers all course material, heavily weighting topics covered after Exam 2.

Course Grades: Raw class averages will be computed using the following scheme:

- Homework: 20%
- Exam 1: 23%
- Exam 2: 25%
- Final: 30%
- Participation: 2%

Class Topics:
1. Vectors and Matrix Algebra (3-4 weeks)
    a. Vectors and Vector Operations
    b. Linear Systems of Equations and Gaussian Elimination
    c. Matrix Operations and Classes of Matrices
    d. Linear Combinations, Linear Independence, and Nonsingular Matrices
    e. Matrix Inverses
    f. Determinants
2. Theory of Vector Spaces and Subspaces (3 weeks)
    a. Vector Spaces and Subspaces: Definitions, Proofs, and Examples
    b. Coordinates and Bases
    c. Dimension of Subspaces
    d. Fundamental Theorem of Linear Algebra
3. Linear Transformations and Orthogonality (3-4 weeks)

     a. Linear Transformations
     b. Transformation Matrices
     c. Change of Basis
     d. Orthogonality and Projections
     e. Least Squares Approximations
     f. Orthogonal Bases and Orthogonal Matrices

4. Eigenvalue Problems and Inner Product Spaces (2 weeks)
     a. Introduction to Eigenvalues and Eigenvectors
     b. Spectral Theory
     c. Diagonalization
     d. Inner Product Spaces
     e. Assorted Applications

Electronic Resources:

1. *Moodle:* Class documents and major announcements will be posted on Moodle, so please check it regularly. I will highlight these announcements during class meetings. Homework will also be submitted and returned on Moodle.
2. *Slack:* I encourage you to use Slack to communicate with your classmates and ask general questions on course material that you might want me and/or your classmates to discuss. If you think a particular question would be of help to others, please ask it on Slack rather than via email. If it is personal, feel free to reach out to me over email or chat with me privately.

Other Policies and Tips:

1. *Homework Submission:* You may turn in your homework any time during the day that it is due (ET). Homework must be uploaded on Moodle in the form of a *single pdf document.* There are various helpful phone apps that can make this possible by converting a set of pictures of each page of your assignment taken with your phone into a single pdf (CamScanner and TinyScanner are common app choices). Graded assignments will also be returned on Moodle.
2. *Dropped Homework:* The lowest homework grade will be dropped to account for a potential missed assignment or low grade due to unforeseen circumstances. This is also meant to ensure students have ample opportunity to do well in the course.
3. *Late Homework:* Late homework will generally not be accepted, so students stay up to date with course material and assignments may be passed back in a timely manner. However, if you receive permission from me before the due date, you may turn in homework late without penalty.
4. *Missing Exams:* You must be present for all exams unless you have a valid reason for your absence. If you are unsure, do talk to me beforehand. In general, I will try to accommodate you in extraordinary circumstances, especially if you contact me ahead of time.
5. *Grading:* For full credit, homework and exam solutions must be clearly written, demonstrate a logical progression through each problem or proof, and be mathematically correct. All steps in proofs should be justified and use mathematically correct notation.
6. *Contesting Grades:* If you wish to contest a grade, you must do so within one week of the assignment or exam being returned to the class. After that deadline, the grade will be final.
7. *Exam Material:* The best guide for what will be on exams is the material covered in class and the homework problems. It is a good idea to both have and understand notes from every class.
8. *Academic Honesty:* All work turned in for grading should be completely your own. I encourage you to talk with other students about homework, but be sure to write up a final version on your

own. If you consulted an outside resource, this must be acknowledged. Be aware that copying solutions of assignments from the internet, another student, or a solution manual and giving your own assignment to another student to be copied are all examples of academic dishonesty. Any violation of this could be considered a serious act of academic misconduct. If you are ever unsure, please talk to me.

9. *Struggle:* The fact that you may struggle in this course is not a reflection on your talent, potential, or ability as a mathematician. Math can be challenging and can involve struggle, but that does not mean you should always be struggling alone. Let me know if there is ever something standing in the way of your full success in this course so we can figure out a plan to address it.

10. *Enjoy this class and learn as much as you can! I want you to have a successful semester!*

Accommodations of Students with Documented Disabilities:
If you believe you need accommodations for a disability or a chronic medical condition, please contact Student Disability Services via email at studentdisabilityservices@swarthmore.edu to arrange an appointment to discuss your needs. As appropriate, the office will issue students with documented disabilities or medical conditions a formal Accommodations Letter. Since accommodations require early planning and are not retroactive, please contact Student Disability Services as soon as possible. For details about the accommodations process, visit the Student Disability Services website. You are also welcome to contact me privately to discuss your academic needs. However, all disability-related accommodations must be arranged, in advance, through Student Disability Services.

Math Clinic:
Math Clinics are drop-in study sessions run by friendly and knowledgeable upperclassmen every night Sunday through Thursday 7-10pm starting the first day of classes. Clinics are a wonderful opportunity to study, do homework, meet/work with classmates, and ask questions about mathematics. Because clinics are drop-in, you are welcome to come and go as you please. To make the most of your time at clinic, be sure to first try problems on your own, or bring questions you have from your text or lecture. Having your textbook and lecture notes handy is essential because these are helpful resources for both you and the Clinician working with you. There will likely be other students at Clinic with questions for the Clinician, so do not expect to get individual attention the entire time you are at clinic. Be open to working on other problems, thinking about and trying to work through the question you have for the Clinician, working with classmates, or doing other coursework while you wait to speak with the Clinician. For questions about Math Clinics please visit https://www.swarthmore.edu/math-stat-academic-support/math-and-stat-clinics or contact the Academic Support Coordinator for the Math/Stat Department.

Linear Algebra Clinic:
In addition to Math Clinic, which is open to all students enrolled in a math course, students enrolled in this course are welcome to attend the Linear Algebra held weekly 7-10pm (EST) Monday. This specialized clinic is the same as described above, but is course specific. All students in attendance will be coming from various sections of Linear Algebra.