

MA 405. Introduction to Linear Algebra and Matrices

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Moodle page: <http://moodle.wolfware.ncsu.edu>

Lectures will be held MWF 9:35 am - 10:25 am in SAS 2235.

Communication: Office hours will be held Mondays 10:30 - 12:30 in SAS 4121.

Moodle forums will be used for most communications in this course. You are encouraged to discuss concepts and homework in the forums with your fellow students; the discussions will be monitored by Mr. Summers.

Course text

There is no assigned textbook for this course. The class notes and video lectures are available in Moodle. The following texts are good resources:

1. *Linear Algebra Done Right*, by Sheldon Axler, Springer International Publishing : Imprint: Springer, 2015 ISBN: 9783319110806 - available through NCSU libraries.
2. *Linear Algebra - A Free text for a standard US undergraduate course*, by Jim Hefferon - link to open source book available in Moodle

The Math Multimedia Center is a tutorial center for undergraduate students that need help in their mathematics courses (100- through 300-level), and is staffed by math graduate students familiar with the material taught in these courses.

Location: SAS Hall 2103/2105

Hours: Monday - Friday 8:00 am - 5:00 pm

You can also get help with your courses (not only math) at the NCSU Undergraduate Tutorial Center.

Catalog Description

Prerequisite: MA 241 (Co-requisite MA 242)

This course offers a rigorous treatment of linear algebra, including systems of linear equations, matrices, determinants, abstract vector spaces, bases, linear independence, spanning sets, linear transformations, eigenvalues and eigenvectors, similarity, inner product spaces, orthogonality and orthogonal bases, factorization of matrices. Compared with MA 305 Introductory Linear Algebra, more emphasis is placed on theory and proofs. MA 225 is recommended as a prerequisite. Credit is not allowed for both MA 305 and MA 405.

Course overview

Linear Algebra provides one of the cornerstones for much of modern Mathematics, and has important applications in Physics, Chemistry, Engineering, Economics, Game Theory, Cryptography, Differential Equations, Genetics, Coding Theory and Sociology, and just about any other field of study involving mathematics you can imagine. The main purpose of this course is to introduce the basic concepts from linear algebra, explain the underlying theory, the computational techniques, and study how these concepts and results can be productively used in other areas of mathematics and physical sciences. Among the topics covered in this course will be: solving systems of linear equations using Gauss elimination, row echelon form, determinants, vector spaces, linear independence, bases, dimension, linear maps, orthogonality, eigenvalues, and reduction of matrices to diagonal forms. If time permits, we will discuss applications of linear algebra to differential equations and/or Fibonacci sequences. The subject involves a mixture of both the practical and the theoretical, and will provide in particular a good introduction to mathematical proofs. The student should be prepared to invest considerable amount of time in understanding the class material and doing homework. Credit is not allowed for both MA 305 and MA 405.

Learning Objectives

Upon successful completion of this course, students will be able to:

1. **Use Mathematical Notation and Terminology.** The students will demonstrate mastery in using the mathematical notation and terminology of linear algebra. Students will read, interpret, and use the vocabulary, symbolism and basic definitions.
2. **Understand and Describe the Fundamental Concepts of Linear Algebra.** Students will identify and apply the theorems about abstract vector spaces and linear transformations; will gain a clear understanding of the basic concepts of linear algebra, such as linear independence of vectors, spanning sets, basis, dimension,

linear maps, isomorphism, similarity, eigenvalues and eigenvectors.

- 3. Identify and Utilize Linear Algebra Tools.** The students will be able to apply course material along with techniques and procedures covered in this course to solve problems. Students will master techniques for solving linear systems by various matrix methods, compute the determinant and the inverse of a square matrix, work with matrix representations of linear maps, compute various factorizations of matrices, apply the Gram-Schmidt process, calculate and analyze the characteristic equation of a matrix to determine its eigenvalues and eigenvectors. Moreover, students will apply properties and theorems about vector spaces to specific mathematical structures that satisfy the vector space axioms, will analyze the differences and similarities between spanning sets, bases, and orthogonal bases and will use the knowledge gained in this course to determine appropriate methods of proof for specific problems.
- 4. Develop Cognitive Skills.** Students will demonstrate the ability to reason with abstract linear algebra concepts, to read and comprehend mathematical arguments utilizing direct and indirect proof, case analysis, and mathematical induction. Students will develop familiarity with axiomatic approach in mathematics through the study of vector spaces and linear transformations. They will acquire a level of proficiency in manipulating linear algebra concepts, in analyzing and evaluating their applicability in their future studies, including graduate work, in academic areas requiring linear algebra as a prerequisite for work in occupational fields requiring a background in linear algebra.

Grading Policy

The grading will be assigned on a 10-point scale: **A: 90 – 100, B: 80 – 89, C: 70 – 79, D: 60 – 69, F: < 60**

The cutoffs for the +/- grades are determined at the end of the semester. Your final grade in this course will be determined by points earned on homework assignments, three in-class tests, in-class quizzes and a final exam. The weighting of these components are as follows:

Homework + quizzes = 15 %

Three term tests = 50 %

Final Exam = 35 %

Note: I do NOT curve grades in this course. It is theoretically possible for everyone in the class to get an A (or an F). Your performance depends only on how you do, not on how everyone else in the class does. It is therefore in your best interests to help your classmates, while keeping the academic integrity policy in mind.

In-Class Tests

There will be three closed book, closed notes in-class tests during the usual class times on the following days: *Monday Feb 4, Monday Mar 1 and Wednesday April 10*. Make up tests will be allowed in only the most extreme and unforeseen of circumstances. If you miss a test because of an undocumented or unexcused absence, a zero will be entered for that test grade. Students who are unable to take the test at those times (with a documented excuse cannot, not just that you don't want to) will contact the instructor to schedule an alternate time to take the exam.

Final Exam

The final exam is mandatory, cumulative and will be held **in class Wednesday May 1, 8am - 11am**.

Homework Assignments will be assigned online through Moodle. The written assignments will be printed and given to the grader before or on the day of the deadline.

The lowest homework grade will be dropped. Use this drop wisely!

Corrections to the grading

If you believe an error has been made in grading on a test send an email to the instructor with an explanation. I will give partial credit for partially correct solutions that are neatly presented. You have *1 week after the test is returned* to request re-grading.

Test Make-Up Policy

All *anticipated absences* must be excused in advance of the test date. These include university duties or trips (certified by an appropriate faculty or staff member), required court attendance (certified by the Clerk of Court), or religious observances (certified by the Department of Parent and Family Services 515-2441). *Emergency absences* must be reported as soon as possible once returning to class and must be appropriately documented (illness by an attending physician or family emergencies by Parent and Family Services).

Add/Drop Regulation

Undergraduate students are expected to complete all courses for which they are enrolled as of census date (the official enrollment date defined as the 10th day of fall and spring terms and the 3rd day of summer terms). Undergraduate course drops after census date will now be considered to be course withdrawals and will result in W grades on the transcript. Undergraduates will be limited to a maximum of 16 hours of course withdrawals after census date and before the drop date Monday March 4 for their entire undergraduate career at NC State. These course withdrawals will count as attempted hours for course repeat, financial aid satisfactory academic progress, and tuition surcharge calculations.

Students with disabilities

“Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students at 1900 Student Health Center, Campus Box 7509, 515-7653. For more information on NC State’s policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (REG02.20.1)”

Student Evaluations

Online class evaluations will be available for students to complete during the last three weeks of classes. You will receive an email message directing you to a website where you can login using your Unity ID and complete the evaluation. All evaluations are confidential; instructors will not know how any one student responded to any question, and students will not know the ratings for any instructors.

Academic Integrity Statement and Academic Dishonesty

Both faculty and students at North Carolina State University have a responsibility to maintain academic integrity. An informational brochure about academic integrity is available from the university and students are encouraged to obtain a copy.

”Academic dishonesty is the giving, taking, or presenting of information or material by a student that unethically or fraudulently aids oneself or another on any work which is to be considered in the determination of a grade or the completion of academic requirements or the enhancement of that student’s record or academic career.” (NCSU Code of Student Conduct)

Scholarly activity is marked by honesty, fairness and rigor. A scholar does not take credit for the work of others, does not take unfair advantage of others, and does not perform acts that frustrate the scholarly efforts of others. The violation of any of these principles is academic dishonesty. Penalties for a violation: For the first violation, you will receive a zero for your work and be put on academic integrity probation for the remainder of your stay at NCSU. The second violation may result in your suspension from NCSU. Both situations will involve the Office of Student Conduct.

Other Remarks

- A good way to contact your instructor is by email (not phone). Please make sure that you include your name and the course number and section in the subject line of your email.
- Your email address registered with the NCSU online directory will be used for announcements associated with this class. It is your responsibility to maintain a valid email address and check/empty your Inbox regularly.
- The test and homework grades will be recorded in the gradebook on Moodle. Please notify me immediately if you notice any discrepancies in your grades. Keep all your quizzes and tests for future reference.
- Please check the course webpage regularly, as it will be continuously updated with announcements, any changes in the schedule, homework problems, solutions, review sheets, and other additional course materials.
- Please mark the test dates on your calendar and schedule your tests early.