Math 35 : Introduction to Linear Algebra

California State University, Sacramento · Department of Mathematics & Statistics

Math 35 is designed to introduce the concepts of linear algebra from a formal point of view. This encourages an appreciation for abstract structure and logical processes needed to prove mathematical results, while simultaneously introducing the classical topics of linear algebra. All "abstract" topics and proofs in the textbook should be covered. Students will be given periodic writing assignments that will encourage them to think through the concepts of the course.

Catalog Description

Careful development of matrices, system of equations, determinants, vector spaces, linear transformations, orthogonality, real and complex eigenvalues; $\mathbb{R}^3$ viewed as a vector space with generalization to $\mathbb{R}^n$. **Graded**: Graded Student. **Units**: 4.0.

Prerequisites

Math 30 or AP credit for AB calculus in high school

Learning Objectives

- Understand Gaussian elimination method and use this method to solve $m \times n$ systems of equations $(n, m < 6)$ and to interpret the solution.
- Understand the representation of linear transformation as matrices, interpret the elementary matrices as linear transformations, find the matrix representation of expansions, contractions, translations, rotations, reflections, understand the relationship between Gaussian elimination and the elementary matrices, and use elementary matrices to find the inverse of an $n \times n$ $(n < 5)$ matrix. Understand and apply the definitions of a subspace, a spanning set, a linearly independent set, a basis, and dimension to $\mathbb{R}^2$ and $\mathbb{R}^3$, understand the connections between these concepts, and generalize these ideas to general vector space.
- Find the kernel and range of a linear transformation, understand relationship between the dimension of the kernel and range, find the eigenvalues and eigenvectors of a linear transformation and use the eigenvectors to diagonalize an $n \times n$ matrix.

Text

Elementary Linear Algebra, 9/e, by Howard Anton

Coverage

Chapters 1-8

Writing Component

This is an area B4 GE course and has a writing component. To satisfy the writing requirement graded assignments involving writing and understanding of complex technical prose, interpretation of theoretical ideas, and the use of mathematical ideas will be part of the course.

Area B-4 Mathematical Concepts and Quantitative Reasoning Student Learning Outcomes

Students will be able to:

1. Solve problems by thinking logically, making conjectures, and constructing valid mathematical arguments.
2. Make valid inferences from numerical, graphical and symbolic information.
3. Apply mathematical reasoning to both abstract and applied problems, and to both scientific and non-scientific problems.

Assignments

A variety of reading and problem solving assignments will be part of the course.

Examinations

There will be regular midterm examinations and a comprehensive final examination for this course.

Course Outline

I. Systems of linear equations (2 Weeks)
   A. Introduction
   B. Gaussian elimination
   C. Homogeneous systems
   D. Matrices and matrix operations
   E. Elementary matrices
   F. Methods for finding the inverse of a matrix
   G. Further results on invertibility

II. Determinants (2 Weeks)
   A. The Determinant function
   B. Evaluating determinants by row reduction
   C. Properties of the determinant function
   D. Cramer's rule

III. Vectors in 2-Space and 3-Space (2 Weeks)
   A. Norm of a vector
   B. Dot product and projections
   C. Cross product

IV. Vector Spaces (3 Weeks)
   A. Euclidean n-space
   B. General vector spaces
   C. Subspaces
   D. Linear independence

E. Basis and dimension
F. Rank of a matrix
G. Length and angle in inner product spaces
H. Orthonormal bases
I. Coordinates: change of basis

V. Linear Transformations (2 Weeks)

A. Introduction
B. Properties of linear transformations
C. Kernel and range
D. Matrices of linear transformations
E. Similarity

VI. Eigenvalues and Eigenvectors (3 Weeks)

A. Definitions and properties
B. Diagonalization
C. Orthogonal diagonalization