

Course Outline for MATH 1151, Linear Algebra

MATH 1151 Linear Algebra (3 units)

Prerequisite: One of the following: MATH 141, [MATH 1261](#), or DATA/[MATH 1264](#).

Systems of linear equations, linear transformations, vector spaces and subspaces, determinants, eigenvalues, eigenvectors, and diagonalization. Orthogonality, Markov chains and discrete dynamical systems, symmetric matrices and quadratic forms. 3 lectures. Formerly MATH 206.

Course Learning Objectives	
1	Prove elementary results in linear algebra.
2	Solve linear systems using matrices and Gaussian elimination.
3	Classify solution sets of linear systems using the language and ideas of linear independence and dependence, matrix invertibility, rank, nullity, and dimension.
4	Perform operations on matrices to solve problems in linear algebra and applied mathematics.
5	Prove elementary properties of matrix inverses, compute matrix inverses, and use them to solve linear systems.
6	Prove elementary properties of determinants, compute determinants, and use properties of determinants to solve problems.
7	Identify the geometric linear transformation associated with a matrix, and vice versa.
8	Use matrices and Markov chains to construct models of problems in biology, business, chemistry, engineering, physics, and other fields.
9	Prove elementary properties of eigenvalues and eigenvectors of a matrix, compute eigenvalues and eigenvectors, and use them to diagonalize a matrix and to analyze discrete dynamical systems.
10	Find orthogonal projections and use orthogonal projections to construct least-squares approximations.
11	Diagonalize symmetric matrices and construct the spectral decomposition of a symmetric matrix.
12	Construct the singular value decomposition of a matrix.

Expanded Course Content

Textbooks, materials, and/or other resources

Text to be chosen by the instructor. Suggested textbooks include:

- Lay, David C., Linear Algebra and its Applications
- Bretscher, Otto, Linear Algebra with Applications

Week	Readings	Topics of Discussion
1	Lay 1.1, 1.2	Systems of Linear Equations, Gaussian Elimination, Row Reduction and Echelon Forms
2	Lay 1.3, 1.4	Vector and Matrix Equations, Span
3	Lay 1.5, 1.7	Solution Sets of Linear Systems, Linear Independence
4	Lay 1.8	Linear Transformations, Geometry of Linear Transformations
5	Lay 2.1, 2.2	Matrix Operations, Matrix Inverses
6	Lay 2.3, 2.8	Characterizations of Invertible Matrices, Subspaces of n-Dimensional Euclidean space
7	Lay 2.6, 2.9, 4.4	Leontief Input-Output Model, Dimension and Rank, Coordinate Systems and Change of Basis
8	Lay 3.1, 3.2	Introduction to Determinants, Properties of Determinants
9	Lay 3.3, 4.9	Cramer's Rule, Volume, and Linear Transformations, Applications to Markov Chains
10	Lay 5.1, 5.2	Eigenvectors and Eigenvalues, Characteristic Equation
11	Lay 5.3, 5.4, 5.6	Diagonalization, Eigenvectors and Linear Transformations, Discrete Dynamical Systems
12	Lay 6.1, 6.2	Dot Product, Length, and Orthogonality, Orthogonal Sets

Week	Readings	Topics of Discussion
13	Lay 6.3, 6.4, 6.5	Orthogonal Projections, Gram-Schmidt Process, Least-Squares Problems
14	Lay 7.1, 7.3	Diagonalization of Symmetric Matrices, Constrained Optimization
15	Lay 7.4, 7.5	The Singular Value Decomposition, Applications to Image Processing and Statistics

Method of Assessment

The possible methods of assessment are written individual examinations, quizzes, in-class worksheets or presentations, projects, and homework. All exams are to be proctored in-person, and one or more midterms and a cumulative final exam are required.

Instructional Mode

The instructional mode for this class is face-to-face. This designation means that the essential academic standards of the course require in-class student engagement, and thus remote instruction is not appropriate.