



Davao del Sur State College
Brgy. Matti, Digos City, Davao del Sur

LINEAR ALGEBRA





PREFACE

Linear Algebra is one of the most fundamental branches of mathematics, serving as the language of science, engineering, economics, computer science, statistics, and many other disciplines. It provides the mathematical framework for solving systems of equations, analyzing data, modeling real-world phenomena, and understanding higher-dimensional spaces. A solid foundation in linear algebra equips students with the analytical and computational skills necessary for advanced mathematical studies and professional applications.

This course pack has been developed to provide students with a comprehensive, learner-centered, self-paced guide to the study of Linear Algebra. It is designed to support undergraduate students enrolled in mathematics and related programs by presenting concepts in a logical sequence, from the fundamentals of systems of linear equations to matrices, determinants, vectors, vector spaces, linear independence, basis, dimension, and the relationship between matrix rank and systems of equations and eigenvalues, eigenvectors and diagonalization. The modules included in this course pack closely follow the progression of topics presented in the course, enabling learners to build conceptual understanding alongside procedural competence.

Each module contains clearly stated learning outcomes, concise discussions, illustrative examples, guided exercises, applications, and assessment activities that encourage critical thinking and problem-solving. The course pack promotes independent learning while providing opportunities for collaborative discussions and classroom engagement. Students are encouraged to actively participate in every activity, reflect on mathematical concepts, and apply learned principles to practical and real-life situations.

It is hoped that this material will serve as a valuable companion throughout the course. May this course pack inspire you to appreciate the beauty, power, and practical significance of Linear Algebra as an essential foundation for mathematics and its diverse applications.



DAVAO DEL SUR STATE COLLEGE

Brgy. Matti, Digos City, Davao del Sur

LINEAR ALGEBRA

MATH 615



FOUNDATION.
APPLICATION.
EXCELLENCE.



BUILDING SOLUTIONS.
TRANSFORMING
POSSIBILITIES.



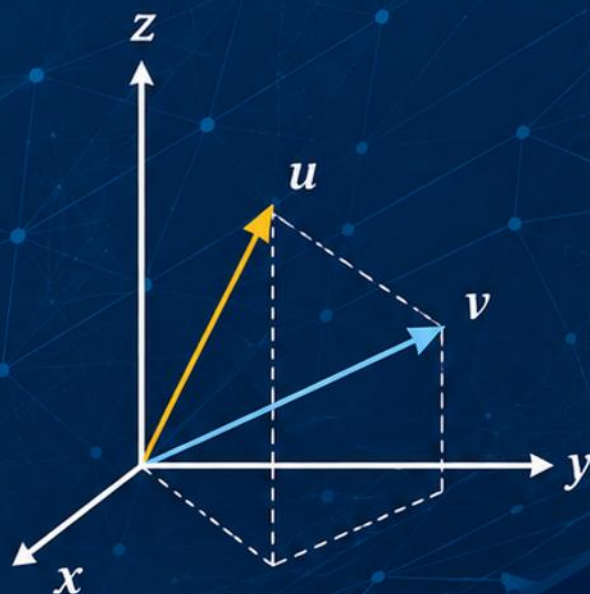
THINK LINEAR.
SOLVE REAL.
CREATE IMPACT.

$$Ax = b$$

$$\begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_m \end{bmatrix}$$

$$\begin{cases} a_1x + b_1y + c_1z = d_1 \\ a_2x + b_2y + c_2z = d_2 \\ a_3x + b_3y + c_3z = d_3 \end{cases}$$

$$\det(A) = \begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix}$$



Leonardo Jr. S. Rulida

Instructor



College of Teacher Education
Davao del Sur State College
Digos City, Davao del Sur



TABLE OF CONTENTS

	PAGE
PREFACE	i
Title Page	ii
Table of Contents	iii
Module 1: Systems of Linear Equations	5
Lesson 1: Linear Equations	6
Lesson 2: Systems of Linear Equations	10
Module Summary	22
Module Assessment	23
Reference	24
Module 2: Matrices	25
Lesson 1: Operations with Matrices	26
Lesson 2: Properties of Matrix Operations	31
Lesson 2: The Inverse of a Matrix	35
Module Summary	43
Module Assessment	44
Reference	45
Module 3: Determinants	46
Lesson 1: Determinant of a Matrix	47
Lesson 2: Properties of Determinants	55
Module Summary	59
Module Assessment	60
Reference	62
Module 4: Vectors	63
Lesson 1: Vectors in R^n	64
Lesson 2: Vectors Spaces and Subspaces of Vectors Space	70
Lesson 3: Spanning Set and Linear Independence	76
Lesson 4: Basis and Dimension of Vectors	82
Lesson 5: Rank of a Matrix and Systems of Linear Equations	89
Module Summary	98
Module Assessment	100
Reference	101
Module 5: Eigenvalues, Eigenvectors, and Diagonalization	103
Lesson 1: Mathematical Proof, Eigenvalues, and Eigenvectors	104
Lesson 2: Matrix Diagonalization	110
Lesson 3: Gram–Schmidt Process and Orthonormal Bases	116
Module Summary	123
Module Assessment	124
Reference	126



Appendix

127

Course Syllabus
Course Outline