



ECON2015: Matrix Algebra

Semester I, 2019-20

Pre-requisites: ECON1003 or ECON1006, A-LEVEL MATH OR MATH1140

Anti-requisites: MATH2110

Lecturer: Dujon Dunn

Room Number: TBD

Office Hours: Monday (9-10) am and Fri (5-6) pm

Description

This course introduces you to key topics in Matrix Algebra in order to prepare you for further econometric analysis. It assumes that you have a solid foundation in algebra and Calculus 1. During the term we will cover material that facilitates solutions to both applied and theoretical econometrics; a part of which is learning how to prove or disprove statements. Where possible applications to Economics will be used; non-Economics students ought therefore to be prepared to acquire some amount of economic thinking.

Learning Outcomes

Upon successful completion of the course, the student should be able to:

- See the relevance of Matrix Algebra to Economics
- Identify the different types of matrices and know the usefulness of their properties
- Perform computations such as multiplication, addition, subtraction and finding the inverse of matrices.
- Explain how to compose each type of matrix
- Set-up systems of equations into matrix format and solve using row-operations
- Determine the conditions under which systems of equations have unique, infinitely many, or no solutions
- Understand the use of determinants in solving systems of equations

- Implement the determinant methods to solve systems of equations □ Prove or disprove essential theorems in Matrix Algebra □ Understand vectors and their properties.
- Understand the concepts linear independence and linear dependence
- Understand basis and dimension of vectors
- Understand eigenvalues and eigenvectors
- Use eigenvalues and eigenvectors to develop characteristic polynomials
- Diagonalize and factorize a matrix to facilitate simpler solution processes
- Apply matrix methods to quadratic forms – a building block of certain types of regressions

Modes of Delivery

Two lecture hours (Tuesdays and Thursdays 10-11 am) and a minimum of one tutorial hour per week.

Assessment

- FIVE (5) homework assignments of which the best FOUR will count to your grade each of which will contribute 5% to your final grade (summing to 25%) □ ONE (1) midterm worth 25% constitute your coursework.
- ONE (1) comprehensive final examination worth 50%.

Syllabus

Concepts and Methods (Quick Review)

- What are Matrices?
- Properties of Matrices
- Arithmetic Operations with Matrices
- Parallels to Simultaneous Equations
- Types of Matrices

Solving Systems of Equations in n-dimensions (Quick Review)

- Simultaneous Equations Methods
- Extension to n-dimension
- Symmetric and Square Matrices
- Transposes
- Properties of Transpose
- Row Operations
- Row-Echelon and Reduced Row-Echelon Form

Determinants

- Definition
- The matrix way to divide by a matrix
- Application

- The 2 by 2 case
- The n by n case
- Gauss Jordan elimination
- Elementary Matrices (three types)
- Row Equivalent Matrices
- Properties of Determinants
- Cofactor of a Matrix
- La'Place's Expansion
- Calculating the Inverse of a Matrix
- Cramer's Rule
- Proofs using determinants as a property

Vectors: Matrices in n by n dimensions

- Vector Spaces
- Linear Combinations
- Linear Independence and Dependence
- Change of Basis
- Change of coordinates
- Row & Column Space $\square$ Rank of a Matrix

Eigenspaces

- Eigenvalues
- Eigenvectors
- Cayley Hamilton Theorem
- Similar Matrices
- Diagonalizing and Factorizing a Matrix

Quadratic Forms

- Quadratic Form of a Matrix
- Definiteness of Matrices $\square$ Rank, Index, Signature

Resources

Prescribed

- $\square$ Linear Algebra with Applications by Steven J. Leon (any edition)

Recommended

- Applied Linear Algebra and Matrix Analysis by Thomas S. Shores
- Linear Algebra Demystified by David McMahon
- **Other Resources:** MIT's Prof. Gilbert Strang has an excellent set of lectures found here:
<https://www.youtube.com/playlist?list=PLE7DDD91010BC51F8>