THE UNIVERSITY OF THE WEST INDIES
MONA CAMPUS
Department of Economics
Kingston 7
Jamaica, W.I.

ECON2015: Matrix Algebra

Academic year:	Semester 1, 2020/2021
Pre-requisite:	ECON1003 or ECON1004, A-LEVEL MATH OR MATH1142
Anti-requisite:	MATH2410
Lecturer:	Dr. Alrick K. Campbell
Lecture details:	Tuesdays 10–11 am & Thursdays 10–11 am (online)
Email address:	alrick.campbell02@uwimona.edu.jm
Office location:	Alister McIntyre Building, E207
Office hours:	Tuesdays 12 – 2 pm & Thursdays 12–1 pm

Rationale

This course provides students with problem solving tools and approaches in Matrix Algebra that are essential for economic modelling and analysis. It provides a bridge between their mathematical skills and econometric analysis, understanding of which is critical for understanding economic literature.

Description

This course prepares students to understand the characteristics and composition of matrices and a variety of matrix methodologies that can be used to determine the solution set of a system of equations. 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 critical component of which is learning how to prove or disprove statements.

This course will be taught using examples and modelling of problem-solving techniques. Students will then need to practice these skills. Applications to Economics will be used therefore non-Economics students ought to be prepared to acquire economic thinking and work with basic economic models.

Learning outcomes

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

- Discuss and understand the relevance of Matrix Algebra to Economics (theme that runs throughout the semester)
- Identify and manipulate different types of matrices
- Compose each type/format of a matrix
- Identify the appropriate technique to be used to solve a system of equations

- 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 and calculate eigenvalues and eigenvectors
- Use eigenvalues and eigenvectors to develop characteristic polynomials
- Diagonalize a matrix to facilitate simpler solution processes
- Apply matrix methods to quadratic forms – a building block of certain types of regressions

Course content

This course is divided into six (6) units. Topics to be covered in this course are as follows:

Unit I – Concepts and Methods

1. What are Matrices?
2. Properties of Matrices
3. Arithmetic Operations with Matrices
4. Parallels to Simultaneous Equations
5. Types of Matrices

Unit II – Solving Systems of Equations in n-dimensions

6. Simultaneous Equations Methods (Quick Review)
7. Extension to n-dimension
8. Symmetric Matrices
9. Transposes
10. Properties of Transpose
11. Row Operations
12. Row-Echelon Form

Unit III – Determinants and Inverses

13. The matrix way to divide by a matrix
14. Definition
15. Application
16. The 2 by 2 case
17. The n by n case
18. Gauss Jordan elimination
19. Elementary Matrices (three types)
20. Row Equivalent Matrices
21. Properties of Determinants
22. Cofactor of a Matrix
23. La'Place's Expansion
24. Calculating the Inverse of a Matrix
25. Cramer's Rule

Unit IV – Vectors: Matrices in n by n dimensions

26. Vector Spaces
27. Subspaces
28. Null-Space of a Matrix
29. Span & Basis of a Vector
30. Linear Combinations
31. Linear Independence
32. Change of Basis
33. Change of coordinates
34. Row & Column Space
35. Rank of a Matrix

Unit V – Eigenspaces

36. Eigenvalues
37. Eigenvectors
38. Cayley Hamilton Theorem
39. Similar Matrices
40. Diagonalizing a Matrix

Unit VI – Quadratic Forms

41. Quadratic Form of a Matrix
42. Q-form of a Matrix
43. Definiteness of Matrices
44. Rank, Index, Signature

Modes of delivery

Two lecture hours and one tutorial hour per week. Both are MANDATORY.

Assessment

This course will be assessed heavily by coursework as indicated in the table below. Therefore, it is imperative that you maintain consistent effort during the semester. The additional benefit of this is that you will be adequately prepared for the final examination, when it comes.

Assessment items	**Mode of submission**	**Weighting**	**Proposed dates**
Online MCQ Exam	Submitted online	25%	TBA
Take-home long-form math problems	Submitted online	25%	TBA
Online MCQ Exam & take-home long-form math problems	Submitted online	50%	TBA
Total		**100%**	

Student responsibility

Your regular attendance at lectures and participation in tutorials is expected. All communication about this course will be made through the OurVLE course site and/or your official email provided by the University. Announcements made via OurVLE and your ocial email are deemed to be made to the entire class.

Performing well

You need to:

1. Read the course material and review upcoming assignments before class. If you are following the Khan Academy videos, please view the relevant video and do the relevant quiz BEFORE CLASS.
2. Engage with the material and lecturer during class, tutorials and office hours.
3. Work consistently throughout the semester. Rule of thumb – 3 hours every week minimum apart from lecture, tutorials and office hour visits.
4. Keep track of the questions you have and raise them in lecture, tutorial or office hours.

Resources

Required text

- Leon, Steven. ***Linear Algebra with Applications***, 8^{th} edition, Pearson New International Edition.

Free online resources

- Khan Academy: https://www.khanacademy.org/math/linear-algebra. This site has videos as well as tests that you can take to assess your knowledge. You can sign up and follow the videos and test yourself along the way.
- Youtube: https://www.youtube.com/playlist?list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab
- Other Youtube channels – choose your preferred site