**COURSE TITLE:** MATRIX ALGEBRA FOR ECONOMICS

**COURSE CODE:** ECON 2015

**LEVEL:** UNDERGRADUATE LEVEL (SECOND YEAR)

**SEMESTER IN WHICH COURSE WILL BE OFFERED**: SEMESTER 1

**COURSE START DATE**: SEPTEMBER 16th, 2020

**DEPARTMENT AND FACULTY**: ECONOMICS, SOCIAL SCIENCES

**NO OF CREDITS:** 3

**PREREQUISITES:** ECON1001, ECON1002, ECON1003, ECON1003 (pre 2014), ECON1004

**TEACHING METHODS:**

The course will be taught in 2-hour online lectures via myElearning Blackboard Collaborate (BBC) and then a 2-hour tutorial where worksheets will be looked over and any additional questions will be answered. This is an analytical course that is all quantitative

**ESTIMATED STUDY HOURS:**

Overall students must invest a minimum of **seven (7) hours per week** apart from lectures, tutorial classes and online quizzes to this course

**TOTAL NUMBER OF ASSESMENTS**

Coursework 40%

- Diagnostic Activity 3%
- 3 Online Quizzes 10%
- Class participation/homework 2%
- Graded In-Class Tests 25%

Final Examination 60%

**IMPORTANT NOTICE TO STUDENTS**

## INSTRUCTOR INFORMATION

**LECTURERS:** Mr. Richard Quarless

**TUTOR**: Mr. Richard Quarless

**EMAIL CONTACT:** richard.quarless@sta.uwi.edu
richieque@gmail.com

**PHONE CONTACT:** 351-5817

**Office hours:** TBD
Communication policy – Please contact lecturer during assigned office hours or by appointment.

## LETTER TO THE STUDENT

Dear Students,

Matrix Algebra is a course that will allow you to get a better understanding of practical issues of modeling in economics.

This course is going to be very interactive. Units 1, 2 4 and 6 builds on topics covered in ECON1004 - Math for Econ II and unit 7 builds on topics covered in ECON1003. It will be to your benefit to participate during lectures as your questions is what will guide the sessions and make the class more interesting. The lecturer will apply the material and techniques taught to issues relating to economic principles and theories.

Note that your success with the material depends on you. Welcome to Matrix Algebra for Economics. I look forward to your participation and engagement

## COURSE DESCRIPTION

This course will provide economics students with the tools required to undertake mathematical analysis in their field. The course covers a wide range of topics including mathematical induction and linear programming.
Students are expected to be fully engaged in the traditional classroom, cooperative learning activities, office consultations with your Lecturer & Tutor, all online activities and all coursework activities.

Assessment of exams and assignments will place a greater emphasis on a clear demonstration of understanding underling principles, theory and appropriate applications of various topics to economic problems

**RATIONALE:**

This course fits well with the mission of the Department and the University in terms of its contribution to preparing students with an in-depth knowledge of Matrices Algebra which have applications in Statistical Methods, Mathematics Methods for Economics III and Econometrics. Students who take this course will have a good foundation and mathematical maturity to not only confidently pursue level 3 quantitative courses but graduate economic studies

**AIMS**

To equip students with an adequate set of tools; theoretical and practical; to understand the application of mathematics to economic principles

**LEARNING OUTCOMES/OBJECTIVES**

Students will be able to:

Knowledge Level

1. Recognize various characteristics of matrices
2. Aware of the relationship between rank, nullity and dimension of matrices
3. Properties of equivalent matrices
4. Familiarity with various types of vector spaces
5. Relationship between linear combinations, independence, span of vectors
6. Appreciation of matrix algebra to solve large systems of equations
7. Know the relationship between linear transformations and matrices
8. Identify when a transformation is linear
9. Recognize that matrix simultaneous equation solutions represent a linear transformation from one vector space to another

Skill/Competency

1. Perform matrix arithmetic including partitioned matrices
2. Prove or disprove essential theorems in Matrix Algebra
3. Use Matrix Algebra to analyze and solve economic problems.
4. Elementary and echelon form transformations
5. Determine whether a set of objects can be classified as a vector space
6. Determine or identify a basis and dimension of a vector space
7. Represent vectors by various bases. Change the basis of a vector space. Transition matrices
8. General solutions of consistent simultaneous equations system using Matrix Algebra
9. Represent a linear transformation by a matrix using different bases
10. Determine orthogonal vectors
11. Analyze normal equations and derive solutions for inconsistent simultaneous equations system using Matrix Algebra
12. Derive eigenvalues and eigenvectors and relate it to linear transformations
13. Perform two different methods of Linear Programming

## OUTLINE OF COURSE CONTENT

1. **Matrices and Systems of Equations**
   Introduction, Systems of Linear Equations; Equivalent Systems; Elementary Row Operations; Echelon Form; Review of Matrix Arithmetic; Elementary Matrices; Matrix Inverse Determinants; Partitioned Matrices

2. **Vector Spaces**
   Introduction; Definition of a Field; Definition and Examples of Vector Spaces; Subspaces; Spanning Set; Linear Independence; Basis and Dimension; Row Space and Column Space.

3. **Solving Linear Equations**
   Solving a system of simultaneous equations by the inverse method; Economic Application; Solving Linear Equations by Cramer's Rule; Proof of Cramer's Theorem; Economic Application; Solving Linear Equations by the Gaussian Elimination Method; Economic Application; Linear Equations: Homogenous and Non – Homogenous; Homogenous System of Equation; Non – Homogeneous System of Equations; Finding the General Solution

4. **Linear Transformations**
   Definitions and Examples; Matrix Representation; Similarity

5. **Orthogonality**
   Scalar Product in $R^n$; Orthogonal Subspaces; Least Squares Problems; Inner Product Spaces; Orthonormal Sets

6. **Eigenspaces**
   Eigenvalues and Eigenvectors; Cayley Hamilton Theorem; Diagonalization; Orthogonal Diagonalization; Quadratic Forms; Positive Definite Matrices; Spectral Decomposition

7. **Linear Programming: Graphical method**
   Introduction; Constrained Maximization: Setting up a LP Model Extreme Point Theorem; The Basis Theorem; Constrained Minimization: Setting up a LP Model

8. **Linear programming: Simplex Method**
   Simplex Algorithm for Maximization Problem; Converting the Primal to a Dual; Solving and Interpreting Results of the Dual

## TEACHING STRATEGIES

The course will be taught in 2-hour lectures and then 2-hour tutorials where worksheets will be looked over and any additional questions will be answered. This is an analytical course that is all quantitative. The course will be assessed through two means as there will be, a diagnostic activity, a class participation component, three (3) online quizzes and three (3) in-class exams, which accounts for 40% of students' grades and then the final exam which will make up the next 60% of the grade

## RESOURCES

Lecture notes will be available to the class in the form of material posted on myelearning.

**READINGS**

- Linear Algebra with Applications – Stephen J. Leon (any edition)
- A First Course in Linear Algebra, by Rob Beezer.
- Lecturer PowerPoint slides used in class

**COURSE CALENDAR**

| Week | Activity | Reference |
|---|---|---|
| 1<br>16th Sept | Diagnostic Exercise utilizing the ECON1003 and ECON1004 Semester II 2017 - 2018 Examination Paper. Introduction to Vectors, Linear Algebra, Proofs by Induction, Complex Numbers, Proof Techniques; Theorems; Definitions; Unit 1 | Myelearning Material; Linear Algebra Chapter 1 |
| 2<br>23rd Sept | Unit 1 Lecture; Consultation with Lecturer & Tutors on the Diagnostic Exercise | Linear Algebra Chapter 1 |
| 3<br>30th Sept | Unit 1 Lecture; Tutorial; | Linear Algebra Chapter 1 |
| 4<br>25th Sept | Unit 2 Lecture; Tutorial; Pre-Lecture Online Quiz I on Unit 2 | Linear Algebra Chapter 3 |
| 5<br>7th Oct | Unit 2 Lecture; Tutorial; **In-Class Test I on Unit 1** | Linear Algebra Chapter 3 |
| 6<br>14th Oct | Unit 3 Lecture; Tutorial; | Linear Algebra Chapter 4 |
| 7<br>21st Oct | Unit 4 Lecture; Tutorial; Pre-Lecture Online Quiz II on Unit 4 | Linear Algebra Chapter 4 |
| 8<br>28th Oct | Unit 4 Lecture; Tutorial; **In-Class Test II on Unit 2 and 3** | Lecture Notes Chapter 8 |
| 9<br>30th Oct | Unit 5 Lecture; Tutorial; Pre-Lecture Online Quiz III on Unit 5 | Linear Algebra Chapter 5 |
| 10<br>4th Nov | Unit 6 Lecture; Tutorial; **In-Class Test III on Unit 4,** | Linear Algebra Chapter 6 |
| 11<br>11th Nov | Unit 6 Lecture; Tutorial | Linear Algebra Chapter 6 |
| 12<br>18th Nov | Units 7-8 Lecture; Tutorial | Lecture Notes Chapter 11, 12 |
| 13<br>25th Nov | Course Wrap Up, | |

## ASSESSMENT

Assessment will take the form of Coursework and a Final Examination.

The Coursework Component is comprised of a Diagnostic Exercise, Graded In-Class Tests, and Pre-Lecture Online Quizzes and a class participation component

Each student is required to complete a **Diagnostic Activity**: this activity will provide students with an opportunity to revisit key concepts and methods captured in ECON1004 and ECON1003. There are **two (2) deliverables** for this diagnostic activity:

1. The submission of the solutions to the Linear Algebra component of three Final Examination Papers. **Deadline for submission of the solutions to the Economics Department Office is the Tuesday of the second week of the semester.**

2. Students will be provided with a soft copy of the Solutions to the Examination Paper via the course website on the **Thursday of the second week of the semester**. On receipt of the solutions, students must retrieve their submissions at 1. above from online, undertake their own evaluation of their solutions, identify areas of weakness, develop their own strategies for addressing those weaknesses, and write a concise summary of the weaknesses identified and the corrective strategy. **Deadline for submission of the summary via myElearning only is Sunday Sept 27 of the third week of semester.**

Marks will be awarded only on submission of the two deliverables.

Students will be continuously assessed by way of three (3) **In-Class Tests** which will be administered at roughly **fortnightly** intervals beginning with **Week #5**. The questions that comprise each test will be based on the topics covered in the lectures over the previous two weeks and the tutorial assignment(s). Solutions to each in-class test will be posted on the course website.

Students must be prepared for three (3) **online quizzes** to be posted on Myelearning during Week #4, 7, and 9 of the semester.

Students will be required to engage Lecturers and Tutors by way of Office Hours Consultation consistently over the semester in discussion on concepts and approaches to problem solving. Experience has shown that students, who are so engaged, perform well.

Students are strongly advised to familiarize themselves during Week 1 of the Semester with the University Regulations on Examination Irregularities particularly in so far as these regulations relate to Cheating during coursework assessment activities and/or the final examination. The Lecturers will apply these regulations to students determined to have cheated during any of the coursework activities.

The **Final Examination** at the end of the Semester will be based on the entire course. The examination will be of two hours duration. All questions will be compulsory.

The **Overall Mark** in the course will therefore be a composite of the marks obtained in the coursework and final examination components; the relative weights being:

The **coursework mark** will be allocated as follows:

| | |
|---|---|
| Diagnostic Activity | 3% |
| Pre-Lecture Online Quizzes | 10% |
| Class Participation/Homework | 2% |
| In-Class Tests | 25%. |

The **final examination** at the end of the semester will consist of a two (2) day take home paper, comprising five (5) questions drawn from all units of the course. Students will be required to answer all five (5) questions.

The **overall mark** for each student will be a weighted score of the coursework and final examination marks; the weights being

| | |
|---|---|
| Coursework | 40% |
| Final Examination | 60%. |

## TEACHING STRATEGIES

The course will be delivered by way of an individual diagnostic activity, lectures, class discussion, tutorials, in-tutorial presentations, pre-lecture online quizzes, in-class tests, and consultation during office hours or by appointment.

Self-assessment/diagnosis at the start of the course will be encouraged and should not be underestimated. In this regard, students reading the course for the first time must (a) complete the matrix questions in the diagnostic Examination Papers (b) compare their solutions with the Mark Scheme for the examination paper (c) identify and report on their knowledge/skill gaps and their own plan to close these gaps.

Participation in class discussion is a critical input to the feedback process within a lecture. The rules of engagement for these discussions will be defined by the Course Lecturer at the first lecture.

Pre-Lecture Online Quizzes and In-Class Tests will be administered by the Course Lecturer. These are aimed at assisting the student to (a) become familiar with the key concepts to be discussed in a new unit of the course and (b) measure the extent to which the learning outcomes for a previous unit has been derived.

Students will be provided with four (4) contact hours weekly; two (2) for lectures and two (2) for tutorials.

Registration for tutorial classes will be **online at the end of Week #1.**

In addition, the Course Lecturers will be available for consultations during specified **Office Hours** and at other times by appointment.

Attendance at all Lectures and Tutorial Classes will be treated as **compulsory**. **University Regulation #19** allows for the Course Lecturer to debar from the Final Examination students who do not attend at least 75% of tutorials. The Course Lecturers **will be enforcing this regulation**.

**ADDITIONAL INFORMATION**

19 "Any candidate who has been absent from the University for a prolonged period during the teaching of a particular course for any reason other than illness or whose attendance at prescribed lectures, classes, ... tutorials, ... has been unsatisfactory or who has failed to submit essays or other exercises set by his/her teachers, may be debarred by the relevant Academic Board, on the recommendation of the relevant Faculty Board, from taking any University examinations. The procedures to be used shall be prescribed in Faculty Regulations."

"97. (i) Cheating shall constitute a major offence under these regulations.
(ii) Cheating is any attempt to benefit one's self or another by deceit or fraud.
(iii) Plagiarism is a form of cheating.
(iv) Plagiarism is the unauthorized and/ or unacknowledged use of another person's intellectual effort and creations howsoever recorded, including whether formally published or in manuscript or in typescript or other printed or electronically presented form and includes taking passages, ideas or structures from another work or author without proper and unequivocal attribution of such source(s), using the conventions for attributions or citing used in this University.

103. (i) If any candidate is suspected of cheating, or attempting to cheat, the circumstances shall be reported in writing to the Campus Registrar. The Campus Registrar shall refer the matter to the Chairman of the Campus Committee on Examinations. If the Chairman so decides, the Committee shall invite the candidate for an interview and shall conduct an investigation. If the candidate is found guilty of cheating or attempting to cheat, the Committee shall disqualify the candidate from the examination in the course concerned, and may also disqualify him/her from all examinations taken in that examination session; and may also disqualify him/her from all further examinations of the University, for any period of time, and may impose a fine not exceeding Bds$300.00 or J$5000.00 or TT$900.00 or US$150.00 (according to campus). If the candidate fails to attend and does not offer a satisfactory excuse prior to the hearing, the Committee may hear the case in the candidate's absence."

**How to study for this Course**

Students should keep up-to-date with lectures, and must attend tutorials. It is expected that the student reads the Unit before the lecture so that questions can be raised in the lecture on issues that are still puzzling or where further clarification is required. Tutorial questions are to be attempted prior to the tutorial and ready for presentation during the session.

**Grading System**

**2014/2015 Grading Policy**

| Grade | Quality Points | Mark% |
|---|---|---|
| A+ | 4.3 | 90-100 |
| A | 4.0 | 80-89 |
| A- | 3.7 | 75-79 |
| B+ | 3.3 | 70-74 |
| B | 3.0 | 65-69 |
| B- | 2.7 | 60-64 |
| C+ | 2.3 | 55-59 |
| C | 2.0 | 50-54 |
| F1 | 1.7 | 45-49 |
| F2 | 1.3 | 40-44 |
| F3 | 0.0 | 0-39 |

September 2020