THE UNIVERSITY OF THE WEST INDIES, ST. AUGUSTINE CAMPUS

COURSE OUTLINE

COURSE TITLE: Mathematics for Economics II

COURSE CODE: ECON1004

LEVEL: I

SEMESTER: II

CREDITS: 3

PREREQUISITES: ECON1003 **or** PASS in Advanced Level Mathematics or Pass in CAPE Pure Mathematics

DEPARTMENT: ECONOMICS

INSTRUCTOR INFORMATION:

Lecturer: Mr. Martin Franklin
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Office Telephone: 82581

REQUIRED TEXT

Turkington, Darrell, Mathematical Tools for Economics, Second Edition, Blackwell Publishing. 2009. ISBN:978-1-4051-3381 (soft cover) or 978-1-4051-3380-7 (hard cover)

HIGHLY RECOMMENDED READING

Sydsaeter, Knut and Hammond, Peter, Essential Mathematics for Economic Analysis, Third Edition, Prentice Hall. 2008.

Haeussler, E., Paul, R. and Wood, R., Introductory Mathematical Analysis for Business, Economics and the Life and Social Sciences**,** Eleventh Edition Prentice Hall. 2008.

LETTER TO THE STUDENT

Welcome to Mathematics for Economics II.

This course will be delivered with the support of a Myelearning Website. When the website becomes accessible, it should be visited frequently by each student to access Tutorial Registration; The Diagnostic Exercise; Course Slides & Resources; Forum Messages from the Lecturer(s); Coursework Grades; Tutorial Assignments; Online Quizzes; Links to videocasts; Solutions to Coursework Examinations and Course Notices.

You are reminded that courses such as Mathematics require a mix of learning approaches. You will be required to read the lecture materials from the course texts prior to the lecture, participate in the in-class discussion of that material and supplement both these activities with a second reading and group discussion of the course text and related materials provided via links on the course website. Such reading and discussion must be followed by the solving of problems on the tutorial assignments.

Please ensure that you allocate much of your time and effort to developing your problem solving and critical thinking skills.

Remember to apply yourself consistently from the first week.

EXPECTATIONS

As a student enrolled in Mathematics for Economics II, your lecturers expect that you bring to the course, all the Learning Outcomes of ECON1003. In addition, it is expected that you will be fully engaged in the traditional classroom, the cooperative learning activities, office consultations with your Lecturer & Tutor, all online activities and all coursework activities. Research has shown that students learn best through collaboration and interaction; accordingly, you are encouraged to participate in and complete all assignments and classroom activities. The success of such activities depends significantly on the quality of the relationships that you establish and maintain with your Lecturer, Tutor and Peers

COURSE DESCRIPTION:

The course is organized around two (2) areas of Mathematics for Economics namely, Linear Algebra and Calculus.

This course builds on students' understanding of elementary mathematics (as gained at CXC CAPE Pure Mathematics or G.C.E. ‘A’ Level Mathematics or in ECON1003) and exposes them to mathematical concepts that underpin the mathematical models that will be encountered in the Level II/III courses in the B. Sc. Economics Major and Special Programs.

COURSE GOALS

The goals of this course are:

a. To understand and use basic mathematical data, symbols and terminology utilized in Mathematical Economics

b. To utilize the rules of logic in the application of numerical and algebraic concepts and relationships

c. To understand and recognize concepts of Linear Algebra and Calculus relevant to Economics.

d. To solve problems in Economics that require the application of logic, knowledge and solution approaches relevant to Vector Spaces, Linear Algebra and Calculus.

COURSE OBJECTIVES/COMPETENCIES

At the end of this course students will be expected to:

- Perform a range of matrix operations as well as operations within a vector space
- Solve systems of linear equations in Economics using Cramer's Rule and the Gauss-Jordan Method
- Interrogate matrices for definiteness or semi-definiteness
- Investigate a function for continuity
- Compute and interpret the derivative of univariate and multivariate functions and apply same to problems in economics
- Apply Integration to compute areas under curves and solutions to Ordinary Differential Equations of the first order.

Emphasis will be placed during the course on the understanding and application of mathematical concepts rather than just computational skills, the use of algorithms and the mere manipulation of formula.

OUTLINE OF COURSE CONTENT

This course is organized into two (2) sections; these parts cover a total of eight (8) units. The first part of the course focuses on Functions, Differentiation of Functions of One Variable, Integration and Ordinary Differential Equations and is covered in 4 units. The second part focuses on Vector Spaces, Linear Algebra (inclusive of Matrix Algebra) and the Calculus of Functions of More Than One Variable and is covered in Units 5 - 8 inclusive.

The content of the eight (8) units is defined below.

SECTION I

1. FUNCTIONS, LIMITS AND CONTINUITY
Definition of a function; Graph of a function; Bounded function; Monotonic function; Inverse function.

Limits and Continuity: Limits of a function; Right and Left hand limits; Continuity; Right and Left hand continuity.

2. DERIVATIVE OF A FUNCTION OF ONE VARIABLE
Definition of a derivative: Right and left hand derivatives; Differentiability in an interval; Differentials; Implicit differentiation.

L'Hopital's Rule

Applications of the Derivative: Increase and decreasing functions; Concavity and convexity; Relative extrema; Lagrange optimization; Marginal concept in economics.

Mean Value Theorems (*time permitting*): Rolle's Theorem; The theorem of the mean; Cauchy's generalized theorem of the mean; Taylor's theorem of the mean.

3. INTEGRALS
The Definite and Indefinite integrals; The Fundamental Theorem of integral calculus; Improper integrals; Multiple integrals.

Applications of the Integral: Area under a curve

4. DIFFERENTIAL EQUATIONS
Definition of a differential equation; Equations of the First Order and First Degree; Variable Separable equations; Homogeneous equations; Integrating Factors; Linear equations of the first order.

SECTION II

5. VECTOR SPACES

Vector spaces; Subspaces; Addition of vectors; Scalar multiplication of vectors; Scalar product; Orthogonal vectors; Length of a vector; Schwarz inequality; Triangular inequality; Unit vector; Null vector; Normalization of vectors; Orthonormal vectors; Equality of vectors; Linear independence; Vectors in echelon; Subspace; Basis and Dimension.

6. MATRICES

Definition; Equal matrices; Addition of matrices; Product of matrices; Scalar Multiplication of matrices.

Some Types of Matrices: Triangular matrices; Scalar matrices; Diagonal matrices; The Identity matrix; The Inverse matrix; The Transpose of a matrix; Symmetric matrices; Skew-symmetric matrices; Elementary matrices; Elementary transformations.

Determinant of a Square Matrix: Determinants of order 2 and 3. Properties of determinants; Minors and Cofactors; The Cofactor Method for evaluating a determinant.

The Inverse of a Matrix: The Inverse from the Adjoint; The Inverse from Elementary Row Operations; Orthogonal Matrices.

The Rank of a Matrix.

Linear Equations: Homogenous equations; Non-homogenous equations; Solutions using matrices; Cramer's Rule; Gauss-Jordan Method.

The Characteristic Equation of a Matrix: Eigenvalues; Eigenvectors

Similarity: Similar matrices; Reduction to diagonal form; Diagonalization of a symmetric matrix.

7. QUADRATIC FORMS

Matrix representation; Definite and Semi-definite forms; Transformations; Canonical forms.

8. DERIVATIVES OF A FUNCTION OF MORE THAN ONE VARIABLE

Limits; Iterated limits; Continuity; Uniform continuity; Partial derivatives; Total differentials; Differentiation of composite functions; Euler's Theorem on homogenous functions; Implicit differentiation.

COURSE CALENDAR

Week # Start Date	Activity
1 2nd Sep.	Course Orientation **Diagnostic Exercise Part I** utilizing the ECON1003 April/May 2019 (first time students) or ECON1004 April/May 2019 Examination Papers (repeating students);
2 9th Sep.	**Diagnostic Exercise Part II**; Office Hours Consultation on the Diagnostic Exercise; *Lecture on Unit 1* – Functions & Limits;
3 16th Sep	*Lecture on Units 1 & 2* – Continuity & Differentiation; **In-Class Presentations on the Diagnostic**; Office Hours
4 23rd Sep.	*Lecture on Unit 2* - Differentiation; Tutorial based on Unit 1 **In-Class Quiz I;** Office Hours
5 30th Sep.	*Lecture on Unit 3* – Differentiation & More on Derivatives; Tutorial based on Unit 2; **In Class Test I**; Office Hours
6 7th Oct.	*Lecture on Unit 4* - Integration; Tutorial on Unit 3 **In-Class Quiz II;** Office Hours
7 14th Oct.	*Lecture on Unit 4* - Integration; Tutorial on Unit 4 **In Class Exam II**; Office Hours
8 21st Oct.	*Lecture on Unit 5* – Vector Spaces; Tutorial on Unit 4 **In-Class Quiz III ;** Office Hours
9 28th Oct.	*Lecture on Units 5 & 6* – Vector Spaces & Matrices I; **In-Class Test III;** Office Hours; Tutorial on Unit 5
10 4th Nov.	*Lecture on Units 6* – Matrices I & II; **In-Class Quiz IV;** Office Hours; Tutorial on Units 5 & 6

11 11th Nov.	*Lecture on Units 6 & 7* – Eigenvalues/vectors, Quadratic Forms; **In-Class Exam IV**; Office Hours; Tutorial on Unit 6
12 18th Nov.	*Lecture on Unit 8* – Functions of Several Variables; Office Hours; Tutorial on Unit 7
13 25th Nov.	Course Wrap Up Lecture; Tutorial on Unit 8; Office Hours.

TEACHING STRATEGIES

The course will be delivered by way of lectures, in-class problem solving activities, tutorials, pre and post tests, graded activities on Myelearning, and consultations during office hours.

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 did not attend at least 75% of tutorials. The Course Lecturers will be enforcing this **regulation**.

Students will be provided with a minimum of four (4) contact hours weekly; two (2) for lectures on new material; one (1) for in-class problem solving and one (1) for tutorials. Registration for tutorial classes will be **online during Week #1, more specifically September 2nd - 8th 2019.**

In addition, the Course Lecturers will be available for consultations during specified **Office Hours** and at other times by appointment. Remember to check the times posted on the doors to their offices.

Participation in class discussion and problem solving activities is a critical input to the feedback process within a lecture or tutorial. The rules of engagement for these discussions will be defined by the Course Lecturer and/or Tutor at the first lecture and first tutorial respectively.

Pre and post tests will be administered by the Course Lecturer at the start and end of a lecture respectively. These are aimed at assisting the student to focus on and clarify key concepts discussed during the previous lecture or the current lecture.

IN COURSE **ASSIGNMENTS**

Students will be required to register for a **tutorial** class during the first weekend of the semester (i.e. September 8^{th} – 9^{th}). Each **Tutorial** Class will consist of no more than 20 students. The students within each class may be organized into ten (10) pairs. Each pair can be assigned responsibility for leading the class discussion on the solution to problems on the Tutorial Assignment or any assigned question on the topic related to the tutorial sheet during at least one week of the semester

Tutorial assignments are designed to help students flesh out concepts and practice the application of the logic and concepts to a range of problem situations. These are important in this course since they provide the basis for formal practice and assist in reinforcing the concepts introduced in lectures. It is expected that students will also use the texts and recommended references. Every effort should be made to complete each tutorial sheet within the time period indicated on the sheet.

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Students are advised to read through each tutorial assignment to identify the concepts required for its solution prior to revising the concepts so identified; it is only after such revision that you should proceed to attempt the solutions. Some questions in an assignment sheet will be solved in one attempt; others will require more than one attempt. Students are encouraged to adopt co-operative learning approaches (i.e. working with another student or students) to solve the more challenging questions in the tutorial sheet.

Under no condition should a student come to a tutorial class unprepared to contribute to the class proceedings. If after the individual effort and the co-operative learning effort, the student feels challenged by a question(s), he/she owes it to himself/herself to seek out the Course Lecturer or Tutor for guidance and assistance.

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

ASSESSMENT STRATEGY

Assessment Objectives are linked to the Course Objectives. The approach to be adopted for assessment in this course has three (3) objectives:

a. to effectively measure the students' proficiency in interpreting and using the mathematical concepts, symbols and terminology

b. to effectively measure the students' proficiency in recognising the appropriate mix of mathematical concepts and methods that are required for addressing problems in the areas of economics, accounting and management

c. to effectively measure the students' ability to apply the appropriate mix of mathematical methods in a logical manner.

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 Quizzes.

Each student is required to complete a **Diagnostic Activity**: this activity will provide first time students reading the course with an opportunity to revisit key concepts and methods captured in CXC CAPE Pure Mathematics or G.C.E. 'A' Level Mathematics and/or in ECON1003. For repeating students, the Diagnostic Activity will provide an opportunity to review their strengths and weaknesses in the content of ECON1004. There are **two (2) deliverables** for this diagnostic activity:

1. The submission of the solutions to the ECON1003 April/May 2019 Final Examination Paper (for first time students) and/or ECON1004 April/May 2019 Final Examination Paper (for repeating students). **Deadline for submission of the solutions to the Economics Department Office is the Saturday of the first week of the semester.**

2. Students will be provided with a soft copy of the Solutions to the Examination Paper via their UWI Emails the **Tuesday of the second week of the semester**. On receipt of the solutions, students must retrieve their submissions at 1. above from the Economics Department Office, undertake their own evaluation of their solutions, identify their errors and areas of weakness. Students will be required to apply critical thinking to the solutions of all questions on the examination so as to be in a position to make an in-class presentation of the solution of any question (or part of a question) from the examination. These presentations will be scheduled during the **first tutorial class and the lecture within the third week of semester.**

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

Students will be continuously assessed by way of up to four (4) **In-Class Quizzes** which will be administered at **fortnightly** intervals beginning with **Week #4**. The questions that comprise each test will be based on the topics covered in the lectures over the previous two weeks and the related tutorial assignment(s). Solutions to each in-class test will be disseminated online to students within 24 hours of the test.

Students must be prepared for four (4) **In Class Tests** to be done during Week #5, 7, 9 & 11 of the semester. Solutions to each in-class test will be disseminated online to students within 24 hours of the quiz.

Students will be required to engage the Lecturer 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 Linear Algebra and Calculus. Students must be able to demonstrate the Learning Outcomes of the course during the examination. The examination will be of two hour duration.

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:

Coursework	40%
▪ Diagnostic Activity	3%
▪ 4 In-Class Tests	25%
▪ 4 In-Class Quizzes	12%
Final Examination	60%

Final grades will be awarded according to the following descriptors:

Grade	% Range	Grade Point	Grade Definition	Grade Descriptor
A+	90 -100	4.3	Exceptional	Demonstrates exceptional performance and achievement in all aspects of the course. Exceptional application of theoretical and technical knowledge that demonstrates achievement of the learning outcomes. Goes beyond the material in the course and displays exceptional aptitude in solving complex issues identified. Achieves the highest level of critical, compelling, coherent and concise argument or solutions within the course.
A	80 – 89	4.0	Outstanding	Demonstrates outstanding integration of a full range of appropriate principles, theories, evidence and techniques. Displays innovative and/or insightful responses. Goes beyond the material with outstanding conceptualization which is original, innovative and/or insightful. Applies outstanding critical thinking skills
A-	75 – 79	3.7	Excellent	Demonstrates excellent breadth of knowledge, skills and competencies and presents these in appropriate forms using a wide range of resources. Demonstrates excellent evidence of original thought, strong analytical and critical abilities; excellent organizational, rhetorical and presentational skills.
B+	70 – 74	3.3	Very Good	Demonstrates evidence of very good critical and analytical thinking in most aspects of the course. Very good knowledge that is comprehensive, accurate and relevant. Very good insight into the material and very good use of a range of appropriate resources. Consistently applies very good theoretical and technical knowledge to achieve the desired learning outcomes.

Grade	% Range	Grade Point	Grade Definition	Grade Descriptor
B	65 – 69	3.0	Good	Demonstrates good knowledge, rhetorical and organizational skills. Good insight into the material and a good use of a range of appropriate resources. Good integration of a range of principles, techniques, theories and evidence.
B-	60 – 64	2.7	Satisfactory	Displays satisfactory evidence of the application of theoretical and technical knowledge to achieve the desired learning outcomes. Demonstrates sound organisational and rhetorical skills.
C+	55 – 59	2.3	Fair	Demonstrates fair breadth and depth of knowledge of main components of the subject. Fair evidence of being able to assemble some of the appropriate principles, theories, evidence and techniques and to apply some critical thinking.
C	50 – 54	2.0	Acceptable	Demonstrates acceptable application of theoretical and technical knowledge to achieve the minimum learning outcomes required in the course. Displays acceptable evidence of critical thinking and the ability to link theory to application.
F1 & F2	35 – 49	1.3	Unsatisfactory	Demonstrates unsatisfactory application of theoretical and technical knowledge and understanding of the subject. Displays unsatisfactory ability to put theory into practice; weak theoretical and reflective insight. Unsatisfactory critical thinking, organizational and rhetorical skills.
F	0 – 34	0	Poor	Overall poor or minimal evidence of knowledge and understanding of the subject. Displays little ability to put theory into practice; lacks theoretical and reflective insights. Incomplete breadth and depth of knowledge on substantive elements of the subject. Little or no evidence of critical engagement with the material. Responses are affected by irrelevant sources of information, poor organizational and rhetorical skills.

Board for Undergraduate Studies (October 2013)

COURSE EVALUATION

At the end of each unit and at the mid-point of the course, the lecturer will solicit feedback on how the information is being processed and the course in general. The feedback will be used to make improvements, correct errors, and try to address the students' needs. Additionally, at the end of the course, the CETL will evaluate the course, so it is important that you are in attendance during that time.

CLASS ATTENDANCE POLICY

Regular class attendance is essential. A student who misses a class will be held responsible for the class content and for securing material distributed. Attendance is the responsibility of the student and consequently nonattendance will be recorded. Students would be reminded of the implications of non-responsible attendance.

EXAMINATION POLICY

Students are required to submit coursework by the prescribed date. Coursework will only be accepted after the deadline, in extenuating circumstances, with the specific written authority of the course lecturer and in any event, not later than the day before the start of the relevant end of semester examinations of the semester in which the particular course is being offered.
Please review the handbook on *Examination Regulations for First Degrees, Associate Degrees, Diplomas, and Certificates* available via the Intranet.

POLICY REGARDING CHEATING

Academic dishonesty including cheating is not permitted. For more information, read Section V (b) Cheating in the *Examination Regulations for First Degrees, Associate Degrees, Diplomas, and Certificates* online via the Intranet.

STATEMENT ON DISABILITY PROCEDURE

The University of the West Indies at St. Augustine is committed to providing an educational environment that is accessible to all students, while maintaining academic standards. In accordance with this policy, students in need of accommodations due to a disability should contact the Academic Advising/Disabilities Liaison Unit (AADLU) for verification and determination as soon as possible after admission to the University, or at the beginning of each semester.

POLICY REGARDING INCOMPLETE GRADES

Incomplete grades will only be designated in accordance with the University's Incomplete Grade Policy.

OTHER RESOURCES

1. **Hoy, Michael, John Livernois, Chris McKenna, Ray Rees and Thanasis Stengos,** Mathematics for Economics, Third Edition, MIT Press.

2. **Dowling, Edward T**., Calculus for Business, Economics, and the Social Sciences, Schaum's Outline Series, McGraw-Hill.

3. **Hoffman, L. D**. Calculus for Business, Economics, and the Social Sciences, McGraw-Hill.

August 2019