



THE UNIVERSITY OF THE WEST INDIES
ST. AUGUSTINE, TRINIDAD AND TOBAGO

COURSE TITLE: Mathematics for Economics II
COURSE CODE: ECON1004
COURSE TYPE: Core
LEVEL: I
SEMESTER: II
DEPARTMENT: Economics
FACULTY: Social Sciences
CREDITS: 3
PREREQUISITES: ECON1003 or PASS in Advanced Level Mathematics or Pass in CAPE Pure Mathematics

MODE OF DELIVERY: Face to Face

INSTRUCTOR INFORMATION

Name	Office Address*	Email Address	Office Hours*
Dr. Henry Bailey	FSS Room 107	henry.bailey@sta.uwi.edu	Wed: 9-11am (By appointment)

COURSE DESCRIPTION:

The course is organized around two 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 enhance problem solving skills 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/(EROs)
- ☐ Interrogate matrices for definiteness or semi-definiteness
- ☐ Investigate a function for continuity at a point and/or everywhere in its domain, and, in cases where the function is discontinuous, amend same so that it is continuous.
- ☐ 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.
- ☐ Effectively communicate written and orally: ideas, thoughts, opinions, knowledge, and data, with clarity and purpose.

Emphasis will be placed during the course on the understanding and application of mathematical concepts rather than just mere computational skills, the use of algorithms and the mere manipulation of formula. *Students will be required to justify the logic utilized in their solutions.*

OUTLINE OF COURSE CONTENT

This course is organized into two sections; these parts cover a total of eight 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 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.

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.

REQUIRED TEXTS

Haeussler, E., Paul, R. and Wood, R., Introductory Mathematical Analysis for Business, Economics and the Life and Social Sciences, Eleventh Edition Prentice Hall. 2008. (*Available at the Alma Jordan Library*)

Hoy M., Livernois M., Mc Kenna C et al. Mathematics for Economics, Third Edition, MIT Press. 2011 (*Available via UWI Linc*).

HIGHLY RECOMMENDED READING

Sydsaeter, Knut and Hammond, Peter, Essential Mathematics for Economic Analysis, Third

Edition, Prentice Hall. 2008.

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)

COURSE CALENDAR

Week # Lecture Date	Weekly Activity
1 Sept 6	Course Orientation <i>Lecture on Unit 1</i> – Functions Diagnostic Exercise Part I
2 Sept 13	<i>Lecture on Unit 1</i> – Functions & Limits Diagnostic Exercise Part II for all students
3 Sept 20	<i>Lecture on Units 1 & 2</i> – Continuity & Differentiation Tutorial based on Unit 1
4 Sept 27	<i>Lecture on Units 2 & 3</i> – Differentiation & More on Derivatives Tutorial based on Units 1 & 2
5 Oct 4	<i>Lecture on Unit 4</i> – Integration Assessment I Tutorial based on Units 2 & 3
6 Oct 11	<i>Lecture on Unit 4</i> – Applications of Integration to Producer Surplus & Consumer Surplus and Differential Equations Tutorial on Unit 4 - Integration
7 Oct 18	<i>Lecture on Unit 5</i> – Vector Spaces Tutorial on Unit 4 – Applications of Integration
8 Oct 25	<i>Lecture on Unit 6</i> – Matrices I Tutorial on Unit 5
9 Nov 1	<i>Lecture on Units 5 & 6</i> – Matrices I & II Assessment II Tutorial on Unit 6
10 Nov 15	<i>Lecture on Units 6 & 7</i> – Eigenvalues/vectors and Quadratic Forms Tutorial on Unit 6
11 Nov 22	<i>Lecture on Unit 8</i> – Functions of Several Variables Tutorial on Unit 7
12 Nov 29	Tutorial on Unit 8 Course Wrap Up

TEACHING STRATEGIES

The course will be delivered by way of lectures, in-class problem solving activities, tutorials, Q & A sessions, graded activities on Myelearning, and consultations with Lecturer and Tutors between successive lectures.

Lectures are timetabled for 5pm to 8pm on Wednesdays.

See the myelearning page for scheduling tutorial sessions.

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 of teaching**.

In addition, the Course Lecturer will be available for **Office Hours/Consultations by appointment on Wednesdays 9am-11am**.

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.

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.

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.

Q&A sessions will be administered from time to time by the Course Lecturer during each lecture. These are aimed at assisting the student to focus on and clarify key concepts discussed during the previous lecture or the current lecture.

Overall students should invest a **minimum of seven (7) hours per week** apart from lectures, tutorial classes and online consultation 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 as part of problem solving.

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

The Coursework Component is comprised of a Diagnostic Exercise, and Graded Assessments.

Each student is required to complete a **Diagnostic Exercise**: this activity will provide 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. There are **two (2) deliverables** for this diagnostic activity:

1. The submission of your solutions to the ECON1003 Final Examination Paper: **Deadline for submission of the solutions is on i.e September 20th, 2023 via a dropbox on the myelearning page.** *Note that this activity is **Open Book** and you are encouraged to go back to your lecture notes, tutorials and text books, and revisit the material for each question before attempting to solve the question. In this way, you will benefit from some much needed revision and priming in preparation for the delivery of ECON1004.*
2. Students will be provided with a soft copy of the Solutions to the Examination Paper, posted on myelearning on September 21st 2023. Students must then 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 and to write a 1-page report on their key learnings and what they need to work on based on this exercise. **This must be handed in to the lecturer as a 'hard copy' in class on September 27th, 2023).**

The usual requirements for late submission (medical certificate/police report etc) must accompany any request for extension of the deadline for deliverable 1 or 2.

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

Students will be assessed by way of two (2) **Coursework Assessments** which will be administered as in-class tests in Sessions 5 and 9.

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 (as set out earlier in this document) during the examination.

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	6%
▪ 2 Coursework Assessments	34%

Final Examination	60%
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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,

Grade	% Range	Grade Point	Grade Definition	Grade Descriptor
				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.
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. **Dowling, Edward T.**, Calculus for Business, Economics, and the Social Sciences, Schaum's Outline Series, McGraw-Hill.
2. **Hoffman, L. D.** Calculus for Business, Economics, and the Social Sciences, McGraw-Hill.

LETTER TO THE STUDENT

Welcome to Mathematics for Economics II.

Please use the mylearning page to access Tutorial Registration; The Diagnostic Exercise; Course Slides & Resources; Forum Messages from the Lecturer(s); Coursework Grades; Tutorial Assignments; Online Quizzes; 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 participate in the in-class discussion of the course material and work through the assigned readings and tutorial sheets. Cooperative learning is encouraged for a course such as ECON1004.

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 personal (individual) learning, the classroom activities and the cooperative learning 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.