COURSE TITLE: Introduction to Mathematics

COURSE CODE: ECON1003

Level: I

SEMESTER: II

No. of Credits: 3

Lecturer(s): Mr. Martin Franklin, Mr. Gregory Wallace and Mr. Rishi Maharaj

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PURPOSE OF THE COURSE:
This course is designed to build on students' understanding of elementary mathematics (as gained at CXC Mathematics (General Proficiency) or G.C.E. ‘O’ Level Mathematics) and to expose them to mathematical concepts that underpin the mathematical models that will be encountered in the Level II/III courses in economics and the management sciences.

COURSE DESCRIPTION:
The course is organized around three (3) areas of Introductory Mathematics for the Social Sciences namely, Functions, Matrices and Calculus. The knowledge of
functions is critical for Calculus; as such there are some significant linkages between the content of these two areas in the course.


This choice of target group is driven by the fact that knowledge of the concepts in functions, matrices and calculus is critical for the mathematical analysis to be encountered in ECON2000, ECON2001, ECON2006, ECON2015, ECON2016, MGMT2012, MGMT2023 and MGMT2032.

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 manipulation of formula.

**Pre-requisite(s):**
A PASS at CXC Mathematics (General Proficiency) and a PASS in the Mathematics Proficiency Test (MPT)

or

A PASS at CXC Mathematics (General Proficiency) and ECON0001.

Note that a PASS at Cambridge GCE O’Level Mathematics will be treated as equivalent to a PASS at CXC Mathematics (General Proficiency).

Each student is required to revise the below mentioned topics prior to the first lecture:
1. Positive and Negative Integers
2. Fractions, Positive and Negative Real numbers
3. Powers and Indices
4. Addition, Subtraction, Multiplication & Division of Integers, Real Numbers, Fractions & Powers
5. Order of Operations – Brackets, Powers, Multiplication, Division, Addition & Subtraction
6. Cross Multiplication of Fractions
7. Inequality Signs
8. Algebraic Expressions
9. Substitution into an algebraic expression
10. Addition, Subtraction, Multiplication and Division of Algebraic Expressions
11. Solution of Simple Equations in one variable
12. Construction of a Graph.
**Goals/Aims**

This course aims to provide students with the knowledge and skills necessary for them to:

- a. Interpret and use basic mathematical data, symbols and terminology at the introductory level in the Social Sciences

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

- c. Recognize the appropriate mix of functions, matrices and/or calculus present in a given situation in Economics, Accounting or Management Studies.

- d. Solve problems in the Social Sciences that require the application of the knowledge, logic and solution approaches relevant to functions, matrices and calculus.

**Advice to Students:**

Learning in courses such as Mathematics requires a mix of learning approaches. Students are required to read the lecture slides and to supplement these with reading from one of the course texts. Such reading must be supplemented by work on the tutorial sheets.

Tutorial Sheets 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 the assignment sheet to identify the concepts required for its solution prior to revising the concepts so identified; it is only after such revision that each student 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 assignment sheet.

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.
Under no condition should a student come to a tutorial class unprepared to contribute to the class proceedings. The student’s contribution must be the result of his/her efforts at the assignment sheet.

Overall students invest a minimum of **seven (7) hours per week** apart from lectures, tutorial classes and online quizzes to this course.  
*Remember to apply yourself consistently from the first week.*

**CONTENT**

This course is organized into three (3) parts; these parts cover a total of ten (10) units. The first part of the course focuses on the pre-requisite Elementary Pre-Calculus Algebra. The second part focuses on functions and is covered in Units 2 – 4 inclusive. The second part focuses on matrices and is covered in Unit 5. The third part focuses on calculus and is covered in Units 6 – 10 inclusive. The content of the ten (10) units as defined below.

**Part I – Diagnostic and Review of Pre-Calculus Algebra**

**Readings:**
*Haeussler, Paul & Wood Chapter 0 pg 02 – 26*
*or*
*Tan Chapter 6 pg 305 – 322; Chapter 9 pg 499 – 525; Appendix A 1069 – 1071*

1. Positive and Negative Integers  
2. Fractions, Positive and Negative Real numbers  
3. Powers and Indices  
4. Addition, Subtraction, Multiplication & Division of Integers, Real Numbers, Fractions & Powers  
5. Order of Operations – Brackets, Powers, Multiplication, Division, Addition & Subtraction  
6. Cross Multiplication of Fractions  
7. Inequality Signs  
8. Algebraic Expressions  
9. Substitution into an algebraic expression  
10. Addition, Subtraction, Multiplication and Division of Algebraic Expressions  
11. Solution of Simple Equations in one variable  
13. Construction of a Graph.
Part II - Functions

2. Functions

Readings:
Haeussler, Paul & Wood Chapter 0 pg 27 – 43; Chapter 2 pg 75 – 102;
Chapter 3 pg 117 – 147
or
Tan Chapter 1 pg 03 – 55; Chapter 10 pg 529 – 556; Chapter 13 pg 810 - 832

- Definition of a Function, Domain and Range
- Inverse Function
- Linear Function – form, graph and range
- Graph of functions: Slope, increasing and decreasing functions, stationary points, turning points, points of inflection, x- and y-intercepts; symmetry concepts.
- Quadratic Function – form, graph and range
- Exponential Function – form, graph and range
- Natural Logarithm Function – form, graph and range
- Special functions – form and graph (constant, polynomial, rational, compound, absolute value)
- Combinations of functions (sum, difference, product, quotient, functions of functions)
- Applications (depreciation, demand and supply curves, production levels)

3. Solution of Equations

Readings:
Haeussler, Paul & Wood Chapter 0 pg 27 – 43; Chapter 4 pg 163 – 193

- Linear equations
- Quadratic equations
- Exponential equations
- Logarithmic equations
- The Remainder Theorem

4. Solution of inequalities

Readings:
Haeussler, Paul & Wood Chapter 1 pg 47 - 60
or
Tan Chapter 3 pg 171 – 179; Chapter 9 pg 520 - 525

- Definition of an Inequality
- Types of Inequalities
- Graph of an Inequality – Linear, Quadratic, Exponential,
Part II – Matrices

5. Matrix Algebra

Readings:
Haeussler, Paul & Wood Chapter 6 pg 227 - 270
or
Tan Chapter 2 pg 73 – 155

- Application of matrices to solution of simultaneous equations with 2 variables
- Minors of a 3 by 3 matrix
- Cofactor of a 3 by 3 matrix
- Determinant of a 3 by 3 matrix
- Matrix of cofactors
- Adjoint of a 3 by 3 matrix
- Inverse of a 3 by 3 matrix
- Solution of simultaneous equation with 3 variables; Substitution, Cramer’s Rule and Elementary Operations
- Matrix polynomials and equations

Part III – Calculus

6. Limits

Readings:
Haeussler, Paul & Wood Chapter 10 pg 449 – 465
or
Tan Chapter 10 pg 576 - 614

- Concept of a limit
- Limit of a sequence as it tends to infinity
- Left hand and right hand limits
- Finding limits of functions
- Limit of a polynomial function

7. Differentiation

Readings:
Haeussler, Paul & Wood Chapter 11 pg 481 – 523
or
Tan Chapter 10 pg 615 – 629; Chapter 11 pg 640 - 700

- Concept of the derivative (derived function)
- Differentiation from first principles
- Rules for differentiation (polynomial, logarithmic and exponential functions, sum, product, quotient, function of a function/chain rule)

8. Applications of Differentiation

Readings:
Haeussler, Paul & Wood Chapter 12 pg 529 – 538;
Chapter 13 pg 567 – 579, 587 – 588 & 599 – 610
or
Tan Chapter 12 pg 729 – 765, pg 781 – 795; Chapter 13 pg 833 - 851
- Increasing and decreasing functions using first derivative
- Determination of the slope of a function using first derivative
- Determining local and global maximum and minimum points of functions using first and second derivative tests
- Using the second derivative to determine the curvature of a function
- Determination of points of inflection of functions

9. Integration

Readings:
Haeussler, Paul & Wood Chapter 14 pg 616 – 650, 664 – 667;
Chapter 15 pg 685 - 688
or
Tan Chapter 14 pg 869 – 924; Chapter 15 pg 958 - 964
- Concept of the Integration as the inverse of Differentiation
- Indefinite Integrals
- Definite Integral
- Linking Definite Integrals to areas under curves

10. Introduction to Multivariate Calculus

Readings:
Haeussler, Paul & Wood Chapter 17 pg 745 – 777
or
Tan Chapter 16 pg 1004 - 1039
- Concept of a Function of more than one Variable
- Concept of a partial derivative
- Partial differentiation of functions with more than one variable
- Finding stationary points
- Finding the Hessian Matrix; evaluating it at a stationary point
**UNIT OBJECTIVES:**

**Unit 1:** At the end of this Unit 1 students must be demonstrate confidence and proficiency in Elementary Pre-Calculus Algebra.

**Unit 2:** At the end of this Unit 2 students must be able to:
- Identify a function
- Evaluate a function
- Manipulate function notation
- Add, subtract, multiply, divide and invert functions
- Form composites of functions
- Distinguish among the special classes of functions
- Solve problems that require the application of the rules of logarithms;
- Sketch graphs of functions and identify special characteristics of the graph
- Solve problems that require the application of the concept of a function to situations such as demand and supply curves, growth rates, depreciation and production levels

**Unit 3:** After studying Unit 3 each student must be able to:
- Solve a linear equation.
- Solve a quadratic equation
- Solve an exponential equation;
- Solve a logarithmic equation;
- Find factors and roots of a polynomial equation by the use of the Remainder Theorem and the Factor Theorem
- Solve problems in the social sciences that require the application of the exponential and logarithmic functions.

**Unit 4:** By the end of Unit 4, each student must be able to:
- Define the term ‘inequality’;
- Distinguish between linear inequalities and quadratic inequalities;
- Solve a set of linear inequalities using an algebraic approach;
- Solve a quadratic inequality using an algebraic approach;
- Plot a graph of the solution set for a linear inequality;
- Plot a graph of the solution set for a quadratic inequality;
- Model a system of linear inequalities from the statement of a word problem;
- Solve a system of linear inequalities by the use of the graphical method;
- Plot a graph of the solution set for an exponential inequality;
- Plot a graph of the solution set for a logarithmic inequality;
- Solve problems in the social sciences that require the application of linear or quadratic inequalities.
Unit 5: By the end of Unit 5, each student must be able to:

- Define a 3x3 matrix from the description of a real life situation;
- Distinguish between the types of matrices;
- Perform matrix operations – Addition, Subtraction, Scalar Multiplication, Transpose and Multiplication;
- Solve a system of simultaneous equations with 2 variables by the use of matrices;
- Identify minors of a 3 x 3 matrix;
- Compute the cofactors of a 3 x 3 matrix;
- Compute the determinant of a 3 x 3 matrix;
- Create the matrix of cofactors;
- Populate the adjoint of a 3 x 3 matrix;
- Compute the inverse for a 3 x 3 matrix;
- Find the solution of simultaneous equations with 3 variables using Substitution, Cramer's Rule and Elementary Row Operations;
- Solve problems in the social sciences that require the application of matrix polynomials and equations.

Unit 6: By the end of Unit 6, each student must be able to:

- Compute the Limit of a function;
- Compute the limit of a function by applying the Properties of Limits;
- Select and correctly apply the appropriate approach to computing the limit for a range of functions;
- Compute Left Hand Limits of composite functions;
- Compute Right Hand Limits of composite functions;

Unit 7: By the end of Unit 7, each student must be able to:

- Derive the derivative of a function;
- Evaluate the derivative of a function at a point in its domain.
- Choose to solve problems involving rates of change and marginal change by the use of derivatives
- Solve a range of problems in the social sciences that require the application of the Rules of Differentiation to a range of functions

Unit 8: By the end of Unit 8, each student must be able to:

- Explain the relationship between a function and its derivative;
- Interpret the sign of the derivative and use the derivative to classify a function as increasing or decreasing;
- Distinguish between global maxima and minima of a function and customize conditions for global maximum/minimum or inflection point;
- Solve a range of problems in the social sciences that require the application of differentiation.
**Unit 9**: By the end of Unit 9, each student must be able to:

- Define Integration as the inverse of the differentiation process;
- Compute an Indefinite Integral
- Compute an Integral by the use of the Rules of Integration
- Compute the area under a curve by using integration.
- Solve a range of problems in the social sciences that require the application of integration.

**Unit 10**: By the end of Unit 10, each student must be able to:

- Define and interpret first order partial derivatives of a multivariate function
- Derive and compute first order partial derivatives of a multivariate function;
- Derive and compute second order partial derivatives and cross partial derivatives of a multivariate function;
- Derive and compute the hessian matrix;
- Compute the coordinates of extreme points for multivariate functions
- Distinguish between situations that require the use of partial derivatives as distinct from the total derivative.

**General Objectives**

On successful completion of this course, students will be able to demonstrate that they have acquired the knowledge and skills of Introductory Mathematics for the Social Sciences and thereby possess one of the pre-requisites for ECON2000, ECON2001, ECON2006, ECON2015, ECON2016, MGMT2012, MGMT2023 and MGMT2032.

**ASSESSMENT**

Assessment Objectives are linked to the Unit Objectives and the Course Objectives. Assessment will take the form of Coursework and a Final Examination.

The Coursework Component is comprised of Revision Quizzes, Tutorial Participation and a Mid Term Examination.

Students must be prepared for a revision online quiz at the end of Units 2 - 10 of the course. All online quizzes will be done on Myelearning. All reports of technical glitches experienced by students during an online quiz must be reported to the Teaching Assistant for the course; the Teaching Assistant will refer each report to CITS for investigation and confirmation. Students are strongly advised to familiarize themselves during Week 1 of the course 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 the online quizzes and/or the mid term examination.

Each Tutorial Group will consist of 22 students. The students within the group will be assigned into eleven (11) pairs. Each pair will be given the responsibility of presenting to the class for 30 minutes the solution of problems selected by the Tutor. Each pair will be assigned one week within the tutorial schedule. The Tutorial Participation Mark for each pair will be based on this presentation.

The Mid Term Examination will be based on the following modules of the course:
  i. Functions
  ii. Solution of Equations
  iii. Solution of Inequalities
  iv. Matrix Algebra.
Time allotted will not exceed two hours.

The Final Examination at the end of the Semester will be based predominantly on Calculus. Notwithstanding, students will be expected to apply their knowledge of Functions, Equations and Inequalities in their solutions to problems in Calculus. The examination will be of two hour duration.

The Overall Mark in the course will therefore be a composite of the marks obtained in these quizzes, tutorial participation and the two examinations; the relative weights being:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Coursework</td>
<td>30%</td>
</tr>
<tr>
<td>Revision Quizzes</td>
<td>10%</td>
</tr>
<tr>
<td>Tutorial Participation</td>
<td>2%</td>
</tr>
<tr>
<td>Mid Term Examination</td>
<td>18%</td>
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<tr>
<td>Final Examination</td>
<td>70%</td>
</tr>
</tbody>
</table>

Information on Solution Approaches will be provided after the deadline of each assessment activity.

**TEACHING STRATEGIES**

The course will be delivered by way of lectures, class discussion, tutorials, pre and post tests, graded activities on Myelearning, consultation during office hours and assistance from Adjuncts drawn from Level III.

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 70% of lectures and tutorials. The Course Lecturers will be enforcing this **regulation**.
Students will be provided with a minimum of four (4) contact hours weekly; three (3) for lectures and one (1) for tutorials. Registration for tutorial classes will be online.

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

It is planned to provide further assistance to students through the use of Adjuncts drawn from the Level III Economics majors. The timetable for such consultations will be published as soon at the start of the semester. No registration is required for these sessions.

Participation in class discussion 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 Tutor at the first lecture and first tutorial respectively.

Pre and post tests will be administered by the Course Lecturer at the start or 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.

**Course Schedule**

<table>
<thead>
<tr>
<th>Week</th>
<th>Activity</th>
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<tbody>
<tr>
<td>1</td>
<td>Diagnostic Class Exercise utilizing the ECON0001 December 2010 Examination Paper; Adjunct Sessions</td>
</tr>
<tr>
<td>2</td>
<td>Unit 2 Lecture; Tutorial; Tutorial Sheet I is issued; Online Quiz; Adjunct Sessions</td>
</tr>
<tr>
<td>3</td>
<td>Unit 3 Lecture; Tutorial; Tutorial Sheet I is due; Tutorial Sheet II is issued; Online Quiz; Adjunct Sessions</td>
</tr>
<tr>
<td>4</td>
<td>Unit 4 Lecture; Tutorial; Tutorial Sheet II is due; Tutorial Sheet III is issued; Online Quiz; Adjunct Sessions</td>
</tr>
<tr>
<td>5</td>
<td>Unit 5 Lecture; Tutorial; Tutorial Sheet III is due; Tutorial Sheet IV is issued; Online Quiz; Adjunct Sessions</td>
</tr>
<tr>
<td>6</td>
<td>Unit 6 Lecture; Tutorial; Tutorial Sheet IV is due; Tutorial Sheet V is issued; Online Quiz; Adjunct Sessions</td>
</tr>
<tr>
<td>7</td>
<td>[No Class on Carnival Tuesday]; Tutorial Sheet IV is revisited; Online Quiz; Adjunct Sessions</td>
</tr>
<tr>
<td>8</td>
<td>Revision; Mid Term Examination; Adjunct Sessions</td>
</tr>
<tr>
<td>9</td>
<td>Unit 7 Lecture; Tutorial; Tutorial Sheet V is due; Tutorial Sheet VI is issued; Online Quiz; Adjunct Sessions</td>
</tr>
<tr>
<td>10</td>
<td>Unit 8 Lecture; Tutorial; Tutorial Sheet VI is due; Tutorial Sheet VII</td>
</tr>
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is issued; Online Quiz; Adjunct Sessions

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<tbody>
<tr>
<td>11</td>
<td>Unit 9 Lecture; Tutorial; Tutorial Sheet VII is due; Tutorial Sheet VIII is issued; Online Quiz; Adjunct Sessions</td>
</tr>
<tr>
<td>12</td>
<td>Unit 10 Lecture; Tutorial; Tutorial Sheet VIII is due; Tutorial Sheet IX is issued; Online Quiz; Adjunct Sessions</td>
</tr>
<tr>
<td>13</td>
<td>Tutorial; Tutorial Sheet IX is due; Course Wrap Up; Adjunct Sessions</td>
</tr>
</tbody>
</table>

**REQUIRED READING**

Students should obtain a copy of *any* of the following texts:


The reference texts are:


4. **Lewis J Parry* *An Introduction to Mathematics for Students of Economics*, Macmillan 1970

**January 2011**