COURSE TITLE: Introduction to Mathematics

COURSE CODE: ECON1003

Level: I

SEMESTER: II

No. of Credits: 3

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

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Preferred Method of Contact: Office Hours
Preferred Method of Communicating Notices from the Lecturer: My elearning website

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), 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 and develop their problem solving skills.
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 the following Level II courses: ECON2000, ECON2001, ECON2006, ECON2015, ECON2016, MGMT2012, MGMT2023 and MGMT2032.

Emphasis will be placed during the course on (a) the understanding and application of mathematical concepts and (b) problem solving skills development rather than just computational skills and the use of algorithms.

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 and Quadratic Equations in one variable
12. Construction of a Graph
13. The Equation of the Straight Line

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 or Management Studies.

d. Solve problems in Economics or Management Studies 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 materials from one of the course texts prior to the lecture, engage in the in-class discussion of that material and supplement these with a second reading of the course text. Such reading and discussion must be followed 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 as well in developing problem solving skills. It is expected that students will also use the texts and recommended references in completing the tutorial sheets. 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 tutorial sheet 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. Some extent of perseverance is necessary in any
Mathematics course. 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.

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 for guidance or either the Tutor or Adjunct 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 in the tutorial class will always derive from his/her efforts invested in the tutorial sheet.

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

Finally, all official notices for this course will be posted on the course website which is accessible via Myelearning. Please make it a habit to check daily for the forum messages on your mysta student email account. As far as possible, you should also log on to the course website every other day.

Remember to apply yourself consistently from the first week.

CONTENT

This course is organized into four (4) 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; each student must take individual responsibility for the review of the content of this part of the course. The second part focuses on Functions and is covered in Units 2 – 4 inclusive. The third part focuses on Matrices and is covered in Unit 5. The fourth part focuses on Calculus and is covered in Units 6 – 10 inclusive.

The content of the ten (10) units is 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,
- Graphical solution of Systems of Linear inequalities

Part III – 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 IV – Calculus

6. Limits

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

On successful completion of this course, students will be able to demonstrate that they have acquired the knowledge and problem solving skills of Introductory Mathematics for the Social Sciences and thereby possess one of the prerequisites 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 a Diagnostic Activity, Online
Revision Quizzes, Tutorial Participation and a Mid Term Examination. No coursework marks will be allocated to Tutorial Attendance as Regulation #19 is enforced for this course.

Students must be prepared for an online revision quiz at the end of each 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 one of the Teaching Assistants 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 any of the coursework activities including the online quizzes and/or the mid term examination.

Information on Solution Approaches will be provided within 48 hours of the deadline for submission for each assessment activity.

Students will be required to take responsibility for the Tutorials. Accordingly, each Tutorial Group will consist of 22 students organized into eleven (11) pairs. Each pair will be assigned one week within the Tutorial Schedule. During the tutorial for that week, the assigned pair will be responsible for leading the class in the discussion on the solution approaches to problems selected by the Tutor for the week. The remaining 20 students of the Tutorial Group will be required to participate in these discussions. The Tutorial Participation Mark for each student will be based on the quality of the presentation from his/her pair during the assigned week and his/her contribution to the tutorial discussions over the remaining 10 weeks.

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, Inequalities and Matrices as part of their solution of problems in Calculus. The examination will be of two hours duration.

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

<table>
<thead>
<tr>
<th>Coursework</th>
<th>30%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic Activity due 30 January 2012</td>
<td>2%</td>
</tr>
<tr>
<td>Online Revision Quizzes</td>
<td>5%</td>
</tr>
<tr>
<td>Tutorial Participation</td>
<td>8%</td>
</tr>
<tr>
<td>- Group Presentation (5%)</td>
<td></td>
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<tr>
<td>- Contributions to class discussion (3%)</td>
<td></td>
</tr>
<tr>
<td>Mid Term Examination</td>
<td>15%</td>
</tr>
</tbody>
</table>

Final Examination 70%

**TEACHING STRATEGIES**

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

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 fail to 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; 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. Remember to check the times posted on the doors to their offices.

It is planned to provide further assistance to students through the use of **Adjuncts** selected from the Level III Economics Majors. The timetable for such consultations will be published at the start of the semester and amended as necessary. No registration is required for these sessions. You may visit with the Adjuncts for further support in cases where you have difficulty in understanding
a concept from the course text. You may visit with the Adjuncts for further support in cases where you have read the required material, attempted questions and found yourself in some difficulty with completing a logical solution. The Adjuncts would need to see your attempts in order to more ably assist.

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>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Diagnostic Activity utilizing the ECON0001 December 2011 Examination Paper – due 30 January 2012; Introductory Lecture; Unit 1 Lecture; Tutorial Registration</td>
</tr>
<tr>
<td>2</td>
<td>Units 1 &amp; 2 Lecture; Start of Tutorials; Tutorial Sheet I is issued; Adjunct Sessions</td>
</tr>
<tr>
<td>3</td>
<td>Units 2 &amp; 3 Lecture; Tutorial; Tutorial Sheet I is due; Tutorial Sheet II is issued; Online Quiz; Adjunct Sessions</td>
</tr>
<tr>
<td>4</td>
<td>Units 3 &amp; 4 Lecture; Tutorial; Tutorial Sheet II is due; Tutorial Sheet III is issued; Online Quiz; Adjunct Sessions</td>
</tr>
<tr>
<td>5</td>
<td>[CARNIVAL in Trinidad – No Classes on 20 &amp; 21 February]; Units 4 &amp; 5 Lecture; Tutorial; Tutorial Sheet III is due; Online Quiz; Adjunct Sessions</td>
</tr>
<tr>
<td>6</td>
<td>Unit 5 Lecture; Tutorial; Tutorial Sheet III is due; Tutorial Sheet IV is issued; Online Quiz; Adjunct Sessions</td>
</tr>
<tr>
<td>7</td>
<td>Revision; Tutorial; Tutorial Sheet IV is due; Mid Term Examination; Adjunct Sessions</td>
</tr>
<tr>
<td>8</td>
<td>Unit 6 Lecture; Solutions to Mid Term are discussed at Tutorial; Tutorial Sheet V is issued; Online Quiz; 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 is issued; Online Quiz; Adjunct Sessions. [PUBLIC HOLIDAY – 30 MARCH in TRINIDAD]</td>
</tr>
<tr>
<td>11</td>
<td>Unit 9 Lecture; Tutorial; Tutorial Sheet VII is due; Tutorial Sheet</td>
</tr>
</tbody>
</table>
VIII is issued; Online Quiz; Adjunct Sessions. [PUBLIC HOLIDAY – 06 APRIL]

12 Unit 10 Lecture; Tutorial; Tutorial Sheet VIII is due; Tutorial Sheet IX is issued; Online Quiz; Adjunct Sessions

13 Tutorial; Tutorial Sheet IX is due; Course Wrap Up; Adjunct Sessions

REQUIRED READING

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


*Where possible, students should pool and purchase a copy of the text. No course notes will be accessible on the course website.*

The reference texts are:


January 2012