ACST604

Mathematical Modelling

S1 Day 2013

Applied Finance and Actuarial Studies

Contents

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General Information

Unit convenor and teaching staff
Unit Convenor
Adam Sikora
adam.sikora@mq.edu.au
Contact via adam.sikora@mq.edu.au
E7A 304
see iLearn site

Unit Convenor
Rod Yager
rod.yager@mq.edu.au
Contact via rod.yager@mq.edu.au

Credit points
4

Prerequisites
Admission to MActPrac or MCom or MBioTechMCom

Corequisites

Co-badged status

Unit description
This unit covers algebra and calculus. The algebra content discusses linearity and applications to geometry. Algebraic techniques involving matrices and determinants are developed and used to study geometrical problems. Linearity is then developed via the notion of vector spaces and used to study systems of linear equations. The notion of a limit is developed and used to study the differential and integral calculus involving functions of one real variable. This is then extended to functions of two real variables. The notion of a limit is enhanced by the study of sequences and series. Numerical techniques for integration are also discussed.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

Development of a range of algebraic skills and proficiency in algebraic techniques applicable to Economics and Finance

Systematic understanding of linear equations and the properties of linear models applicable to Economics and Finance

Development of proficiency in the application of a wide range of techniques and ideas from differential and integral calculus

Development of skill in the application of the techniques of calculus to a wide range of optimization problems

Development of proficiency in using techniques from the study of differential equations to model a variety of real world situations.

Assessment Tasks

Name	Weighting	Due
Assignment	10%	3 April
Class Test 1	20%	6 May
Report	40%	11 June
Class Test 2	30%	4 June

Assignment

Due: **3 April**
Weighting: **10%**

Early assignment containing a range of basic exercises targeting common skills and techniques. Some elements of this assignment may have an earlier deadline to allow for feedback to enable students to improve the quality of their final submission. (See iLearn site for further details)

No extensions will be granted. Students who have not submitted the task prior to the deadline for that component will be awarded a mark of 0, except for cases in which an application for special consideration is made and approved.

On successful completion you will be able to:
- Development of a range of algebraic skills and proficiency in algebraic techniques applicable to Economics and Finance
- Systematic understanding of linear equations and the properties of linear models applicable to Economics and Finance
- Development of proficiency in the application of a wide range of techniques and ideas

from differential and integral calculus

Class Test 1

Due: **6 May**
Weighting: **20%**

1 hour in class exam on topics covered in Weeks 1-7

To be eligible for a passing grade in this unit, students must provide a satisfactory demonstration of the attainment of the learning outcomes in the class tests.

On successful completion you will be able to:
- Development of a range of algebraic skills and proficiency in algebraic techniques applicable to Economics and Finance
- Systematic understanding of linear equations and the properties of linear models applicable to Economics and Finance
- Development of proficiency in the application of a wide range of techniques and ideas from differential and integral calculus
- Development of skill in the application of the techniques of calculus to a wide range of optimization problems

Report

Due: **11 June**
Weighting: **40%**

This task will require students to creatively apply a wide range of different techniques in a sophisticated setting to demonstrate the research skills they have developed in building appropriate mathematical models and in applying best professional practise in understanding and applying the results derived from the mathematical model in real world contexts.

Some elements of this task will have earlier deadlines in order to provide timely feedback to ensure that the models developed are sufficiently rich to enable subsequent aspects to be adequately addressed. (see iLearn for further details)

No extensions will be granted. Students who have not submitted the task prior to the deadline for that component will be awarded a mark of 0, except for cases in which an application for special consideration is made and approved.

On successful completion you will be able to:
- Development of a range of algebraic skills and proficiency in algebraic techniques applicable to Economics and Finance

- Systematic understanding of linear equations and the properties of linear models applicable to Economics and Finance
- Development of proficiency in the application of a wide range of techniques and ideas from differential and integral calculus
- Development of skill in the application of the techniques of calculus to a wide range of optimization problems
- Development of proficiency in using techniques from the study of differential equations to model a variety of real world situations.

Class Test 2

Due: **4 June**
Weighting: **30%**

2 hour in class exam with emphasis on topics covered in Weeks 7-12.

To be eligible for a passing grade in this unit, students must provide a satisfactory demonstration of the attainment of the learning outcomes in the class tests.

On successful completion you will be able to:

- Development of a range of algebraic skills and proficiency in algebraic techniques applicable to Economics and Finance
- Systematic understanding of linear equations and the properties of linear models applicable to Economics and Finance
- Development of proficiency in the application of a wide range of techniques and ideas from differential and integral calculus
- Development of skill in the application of the techniques of calculus to a wide range of optimization problems
- Development of proficiency in using techniques from the study of differential equations to model a variety of real world situations.

Delivery and Resources

Classes

• There are 5 hours of face-to-face teaching per week consisting of 1 x 3 hour lectorial on Mondays and 1 x 2 hour lectorial on Tuesdays. These sessions will present material in a mix of lecture and tutorial styles.

• Students are required to attend all classes.

• The timetable for classes can be found on the University web site

at: http://www.timetables.mq.edu.au/

Required and Recommended Texts and/or Materials

Detailed notes for the topics covered in ACST604 can be found in the following online resources

▪ Elementary Mathematics by Chen and Duong

▪ Calculus for MATH123 by C. Cooper

▪ First Year Calculus by W.W.L Chen

▪ Linear Algebra by W.W.L Chen

▪ Miscellaneous Topics in First Year Mathematics by W.W.L Chen

These can be downloaded from the links found at http://maths.science.mq.edu.au/ACST604s113/texts.html

The same material is covered in many texts. You should try several of these, adopting one which suits your personal style of learning. The following texts are recommended for this unit, and are available from the

CO-OP Bookshop on campus, and are in the reference section of the Library.

▪ Jacques; Mathematics for Economics and Business, 6th edition

▪ Stewart, Redlin and Watson; Precalculus: mathematics for calculus, 5th edition

▪ Hughes-Hallett and Gleason; Calculus: single and multivariable, 4th edition

▪ Stewart; Calculus

▪ Trim: Calculus

▪ Anton: Linear Algebra and its Applications

▪ David C. Lay; Linear Algebra and its Applications,

Other similar texts are available in the Library, and for reference in the

Numeracy Centre (C5A 225).

What has changed

The nature and weighting of the assessment tasks has been changed, so that the assessment is more directly aligned to the development of good mathematical modelling practice.

A requirement of satisfactory performance in the class tests has been added to address a concern that arose from a student who did not take the final class test seriously.

Technology requirements

 • Students will require a computer with internet access to obtain copies of assignments and other material. A calculator with a range of mathematical functions will also be needed.

• Course material is available on the learning management system (iLearn)

• All required material for this unit can also be accessed on the unit web-site at

http://maths.science.mq.edu.au/ACST604s113/

Unit Schedule

Week	Calculus	Linear Algebra
1	Functions of a real variable, inverse functions: exponentials and logarithms	Polynomials, degree, polynomial equations, factors and roots, iterative methods for finding roots
2	The derivative; curve sketching, rates of growth in some simple functions, optimization, relative error, linearization, Newton's method	Binomial theorem
3	Applications of the derivative in finance	Linear equations; application to network flow, economics
4	Integrals as areas; Techniques of integration; application to separable differential equations	Gauss-Jordan elimination
5	Application of the integral to modelling in finance; Gamma and Beta functions	Matrices and matrix transformations; application to economics
6	Functions of two variables: partial derivatives, total derivative, linearization of the derivative, tangent planes and normals, stationary points, change of variables, constrained optimization	Determinants
7	Integration of a real valued function of two variables over simple regions of the plane (rectangles mainly); evaluation by Fubini's theorem; change of variables (simple examples e.g. linear transformation)	Vectors; application to geometry in 3-space
	Mid session break	
8	Numerical integration rules: trapezoidal, Simpson	n-dimensional real vector spaces, subspaces, linear combination, linear independence, basis and dimension
9	Real sequences, recurrence relations, series, relationship with integrals, power series, Taylor and Maclaurin series	Row space, column space, nullspace, rank of a matrix
10	Introduction to differential equations; modelling with differential equations	Eigenvalues and eigenvectors, diagonalization of matrices; applications
11	First order ordinary differential equations: separable equations, linear equation; applications	Least squares solution of anoverdetermined system of linear equations
12	Systems of first order differential equations (2 equations only)	Modelling with matrices in finance: stochastic matrices, symmetric matrices
13	Revision and class test	Revision and class test

Learning and Teaching Activities

Lectorials

One three hour lectorial on Monday and one two our lectorial on Tuesdays. These sessions will be presented in a mixed lecture/tutorial mode.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://www.mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://www.mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://www.mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://www.mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Special Consideration Policy http://www.mq.edu.au/policy/docs/special_consideration/policy.html

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Student Support

Macquarie University provides a range of Academic Student Support Services. Details of these services can be accessed at: http://students.mq.edu.au/support/

UniWISE provides:

- Online learning resources and academic skills workshops http://www.students.mq.edu.au/support/learning_skills/
- Personal assistance with your learning & study related questions.
- The Learning Help Desk is located in the Library foyer (level 2).
- Online and on-campus orientation events run by Mentors@Macquarie.

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

Details of these services can be accessed at http://www.student.mq.edu.au/ses/.

IT Help

If you wish to receive IT help, we would be glad to assist you at http://informatics.mq.edu.au/hel

p/.

When using the university's IT, you must adhere to the Acceptable Use Policy. The policy applies to all who connect to the MQ network including students and it outlines what can be done.

Research and Practice

The development of appropriate mathematical models, and and understanding of their properties, together with an appreciation of the underlying assumptions and the impact that any discrepancy between these assumptions and reality may have on the results are key aspects of practice and research in Actuarial science.

This unit focuses on equipping students with these skills and providing opportunities for students to develop and demonstrate these skills through the exploration of a range of case studies. While many of these will be contrived to reduce the complexity to a level that can be analysed with the limited range of tools that can be developed in a one-semester gateway unit, there will be an emphasis on real world problems and the development of good research and professional practice.