



ACST604

Mathematical Modelling

S1 Day 2014

Applied Finance and Actuarial Studies

Contents

<u>General Information</u>	2
<u>Learning Outcomes</u>	2
<u>Assessment Tasks</u>	3
<u>Delivery and Resources</u>	5
<u>Unit Schedule</u>	6
<u>Learning and Teaching Activities</u>	7
<u>Policies and Procedures</u>	8
<u>Compulsory requirements</u>	9
<u>Research and Practice</u>	9
<u>Changes since First Published</u>	9

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General Information

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Credit points

4

Prerequisites

Admission to MActPrac or MCom or MAcc(Prof)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

Apply a wide range of techniques and ideas from differential and integral calculus to the analyse business, economic and financial data.

Investigate a range of optimisation problems using the techniques of calculus

Formulate models of a variety of real world situations using techniques from differential equations.

Assessment Tasks

Name	Weighting	Due
<u>Assessed Coursework</u>	30%	Fortnightly - see iLearn site
<u>Class Test</u>	20%	1 May
<u>Creative Production</u>	10%	30 May
<u>Final examination</u>	40%	13 June

Assessed Coursework

Due: **Fortnightly - see iLearn site**

Weighting: **30%**

A selection of exercises related to topics currently being studied. These are to be handed in during class time on the due date. Consult the lecturers for alternative submission arrangements if you are unable to attend on the due date.

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
- Apply a wide range of techniques and ideas from differential and integral calculus to the analyse business, economic and financial data.
- Investigate a range of optimisation problems using the techniques of calculus
- Formulate models of a variety of real world situations using techniques from differential

equations.

Class Test

Due: **1 May**

Weighting: **20%**

1 hour in class exam on topics covered in Weeks 1-6

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
- Apply a wide range of techniques and ideas from differential and integral calculus to the analyse business, economic and financial data.

Creative Production

Due: **30 May**

Weighting: **10%**

Groups of 2-4 students are required to produce a short video (5-10 minutes) in which they demonstrate how some of the ideas and techniques developed in this unit can be applied to provide significant insight into a problem of economic or financial interest. The active participation of all members of the group must be evident in the video.

(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
- Apply a wide range of techniques and ideas from differential and integral calculus to the analyse business, economic and financial data.
- Investigate a range of optimisation problems using the techniques of calculus
- Formulate models of a variety of real world situations using techniques from differential

equations.

Final examination

Due: **13 June**

Weighting: **40%**

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

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
- Apply a wide range of techniques and ideas from differential and integral calculus to the analyse business, economic and financial data.
- Investigate a range of optimisation problems using the techniques of calculus
- Formulate models of a variety of real world situations using techniques from differential equations.

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 creative production task has been added to provide students with an opportunity to demonstrate their ability to communicate mathematical ideas in a way appropriate to their audience.

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.
- Students will require access to a smart phone or similar device to record their video production.
- 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/ACST604s114/>

Unit Schedule

Week	Calculus	Linear Algebra
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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 an overdetermined 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://mq.edu.au/policy/docs/academic_honesty/policy.html

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

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

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

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

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

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

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

Supplementary Exams

Further information regarding supplementary exams, including dates, is available here http://www.businessandconomics.mq.edu.au/current_students/undergraduate/how_do_i/special_consideration

Student Support

Macquarie University provides a range of support services for students. For details, visit <http://students.mq.edu.au/support/>

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- [Workshops](#)
- [StudyWise](#)
- [Academic Integrity Module for Students](#)
- [Ask a Learning Adviser](#)

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

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit <http://informatics.mq.edu.au/help/>.

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.

Compulsory requirements

In order to obtain a passing grade in this unit, students must provide a satisfactory demonstration of the attainment of the learning outcomes in the class test and final examination.

Research and Practice

The development of appropriate mathematical models, and an 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.

Changes since First Published

Date	Description
11/02/2014	The Prerequisites was updated.