



# MATH604

## Mathematical Modelling

S2 Online 2019

*Dept of Mathematics and Statistics*

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## General Information

Unit convenor and teaching staff

Unit Convenor

The Anh Bui

[the.bui@mq.edu.au](mailto:the.bui@mq.edu.au)

Contact via e-mail

12 Wally's Walk 606

Monday 3 - 4 pm or by appointment

Credit points

4

Prerequisites

Admission to MAppStat or GradDipAppStat or MSc or MDataSc or MSc (Statistics Innovation)

Corequisites

Co-badged status

Unit description

This unit introduces students to a range of mathematical techniques from algebra and calculus. Its focus is on the modern application of these ideas, with a particular emphasis on applications to problems in economics, business and finance, and provides a sound mathematical basis for further study in these areas. A key focus of the unit is the development of a sound grasp of how mathematics is used to provide sophisticated modelling of complex real problems. The algebra content of the course includes topics such as linear systems, matrices, determinants, vector spaces, eigenvalues and eigenvectors. The study of these topics is applied to model various economic problems such as Leontief input-output models and dynamical systems used to predict long-term behaviours. The calculus content includes the development of the techniques of differentiation and integration with applications to constrained and unconstrained optimisation, including multivariable cases, and the development and application of a variety of useful approximation techniques. The techniques studied in the calculus course are used to study and solve a wide variety of economic and financial problems.

## 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, Finance and Statistics

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

Apply a wide range of techniques and ideas from differential and integral calculus to the analysis 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.

## General Assessment Information

**HURDLES:** This unit has no hurdle requirements. This means that there are no second chance assessments if you happen to fail at your first attempt.

**ASSESSMENT SUBMISSION:** Assessment submission will be online through the iLearn page.

Submit assessments online via the appropriate assessment link on the iLearn page. A personalised cover sheet is not required with online submissions. Read the submission statement carefully before accepting it as there are substantial penalties for making a false declaration.

- Assessment submission is via iLearn. You should upload this as a single scanned PDF file.
- Please note the quick guide on how to upload your assessments provided on the iLearn page.
- Please make sure that each page in your uploaded assessment corresponds to only one A4 page (do not upload an A3 page worth of content as an A4 page in landscape). If you are using an app like Clear Scanner, please make sure that the photos you are using are clear and shadow-free.
- It is your responsibility to make sure your assessment submission is legible.
- If there are technical obstructions to your submitting online, please email us to let us know.

You may submit as often as required prior to the due date/time. Please note that each submission will completely replace any previous submissions. It is in your interests to make frequent submissions of your partially completed work as insurance against technical or other problems near the submission deadline.

**LATE SUBMISSION OF WORK:** All assessments must be submitted by the official due date and time. No marks will be given to late work unless an extension has been granted following a successful application for [Special Consideration](#). Please contact the unit convenor for advice as soon as you become aware that you may have difficulty meeting any of the assignment deadlines. It is in your interests to make frequent submissions of your partially completed work. Note that later submissions completely replace any earlier submission, and so only the final submission made before the due date will be marked.

## Assessment Tasks

Name	Weighting	Hurdle	Due
<u>Assessed Coursework</u>	40%	No	See iLearn for schedule
<u>Project</u>	20%	No	29 September, 2019
<u>Final Assessment</u>	40%	No	11am 19th November, 2019

### Assessed Coursework

Due: **See iLearn for schedule**

Weighting: **40%**

There are ten major topics studied in this unit. Nine topics have an associated on-line quiz containing a number of selected exercises to enable students to demonstrate mastery of presented techniques and ideas. These are to be completed by the due date specified in iLearn.

Students who have not submitted an on-line quiz by the due date specified will be awarded a mark of 0 except for cases where 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, Finance and Statistics
- Systematic understanding of linear equations and the properties of linear models applicable to Economics, Finance and Statistics
- 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.

### Project

Due: **29 September, 2019**

Weighting: **20%**

The project is an extended application where students apply the mathematical skills they have learned to model and solve a number of real world problems.

Late submission of the project, without an extension (granted *prior* to the due date) following a successful application for Special Consideration, will incur a penalty of 10% of the project total each day (or part thereof) after the due date.

On successful completion you will be able to:

- Development of a range of algebraic skills and proficiency in algebraic techniques applicable to Economics, Finance and Statistics
- 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 Assessment

Due: **11am 19th November, 2019**

Weighting: **40%**

This is a compulsory time limited final assessment at the end of the course covering the topics studied during the semester.

The assessment questions will be made available in iLearn at **9am on Monday 18th November, 2019**. The 26-hour time frame allows for students who are working or have other commitments that impact their availability during the allocated time period.

On successful completion you will be able to:

- Development of a range of algebraic skills and proficiency in algebraic techniques applicable to Economics, Finance and Statistics
- Systematic understanding of linear equations and the properties of linear models applicable to Economics, Finance and Statistics
- 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

## Delivery and Resources

### Classes

This is an online course - there are no classes. The schedule of material that is to be completed is available in iLearn.

### Required Texts and Materials

There are two textbooks that are required for this course:

- Margaret Lial, Raymond N. Greenwell & Nathan P. Ritchey: "**Calculus with**

**Applications: Pearson Global Edition" (11e) (ISBN: 9781488686368)**

- Howard Anton & Chris Rorres: **"Elementary Linear Algebra: Applications Version"**, 11th Edition (ISBN: 9781118938881)

Access to MyMathLab and WileyPLUS for the two texts is a compulsory requirement. Students will not be able to complete the required assessment tasks without access. Details of access/textbook options are provided in iLearn.

## Technology requirements

Students will require a computer with internet access to enable participation in the course. A calculator with a range of mathematical functions will also be needed. There is no need for a graphing or programmable calculator.

Course material and assessments are provided via the learning management system (iLearn), WileyPlus and Pearson MyMathLab.

## Unit Schedule

The following table gives a list of the topics covered in this unit

Topic	Description
1	The Derivative I
2	The Derivative II
3	Integration
4	Functions of two variables
5	Differential Equations
6	Linear Systems and Matrices I
7	Matrices II and applications of linear systems
8	Determinants and Vectors
9	Vector Spaces
10	Eigenevalues, eigenvectors and more applications

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central \(https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central\)](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and

Teaching:

- [Academic Appeals Policy](#)
- [Academic Integrity Policy](#)
- [Academic Progression Policy](#)
- [Assessment Policy](#)
- [Fitness to Practice Procedure](#)
- [Grade Appeal Policy](#)
- [Complaint Management Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#) (**Note:** *The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.*)

Undergraduate students seeking more policy resources can visit the [Student Policy Gateway](https://students.mq.edu.au/support/study/student-policy-gateway) (<https://students.mq.edu.au/support/study/student-policy-gateway>). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit [Policy Central](http://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central) (<http://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/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/study/getting-started/student-conduct>

## Results

Results published on platform other than [eStudent](#), (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in [eStudent](#). For more information visit [ask.mq.edu.au](http://ask.mq.edu.au) or if you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto:globalmba.support@mq.edu.au)

## 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](http://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](http://ask.mq.edu.au)

If you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto:globalmba.support@mq.edu.au)

## IT Help

For help with University computer systems and technology, visit [http://www.mq.edu.au/about\\_us/offices\\_and\\_units/information\\_technology/help/](http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/).

When using the University's IT, you must adhere to the [Acceptable Use of IT Resources Policy](#). The policy applies to all who connect to the MQ network including students.

## Graduate Capabilities

### Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

### Learning outcomes

- Development of a range of algebraic skills and proficiency in algebraic techniques applicable to Economics, Finance and Statistics
- Systematic understanding of linear equations and the properties of linear models applicable to Economics, Finance and Statistics
- 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

- Assessed Coursework
- Project
- Final Assessment



## Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

### Learning outcomes

- Development of a range of algebraic skills and proficiency in algebraic techniques applicable to Economics, Finance and Statistics
- Systematic understanding of linear equations and the properties of linear models applicable to Economics, Finance and Statistics
- 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

- Assessed Coursework
- Project
- Final Assessment

## Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

### Learning outcomes

- Development of a range of algebraic skills and proficiency in algebraic techniques applicable to Economics, Finance and Statistics
- Systematic understanding of linear equations and the properties of linear models applicable to Economics, Finance and Statistics

- 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**

- Assessed Coursework
- Project
- Final Assessment

## **Problem Solving and Research Capability**

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

## **Learning outcomes**

- Development of a range of algebraic skills and proficiency in algebraic techniques applicable to Economics, Finance and Statistics
- Systematic understanding of linear equations and the properties of linear models applicable to Economics, Finance and Statistics
- 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**

- Assessed Coursework
- Project
- Final Assessment

## **Effective Communication**

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess,

write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

## **Assessment tasks**

- Assessed Coursework
- Project

## **Changes from Previous Offering**

There are changes to the assessment weightings.

## **Readiness for Unit**

This unit aims to make you familiar with concepts in calculus and linear algebra and their applications. These topics are typically covered in first year mathematics courses.

If it has been some time since you last studied mathematics, or you have never studied calculus, it is recommended that you do some preparatory work prior to the commencement of this unit.

There are preparatory and revision exercises in iLearn, available for enrolled students two weeks prior to the commencement of semester.

Students who prepare (and persevere) successfully complete this course even after entry into the unit with a non-calculus mathematics background.

## **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 techniques applied to 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.