

MATH132

Mathematics IA (Advanced)

S1 Day 2019

Dept of Mathematics and Statistics

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Disclaimer

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

General Information

Unit convenor and teaching staff Unit Convenor & Lecturer Christopher Lustri <u>christopher.lustri@mq.edu.au</u> Contact via email 12 Wally's Walk 714 Mondays 10-11am

Christopher Lustri christopher.lustri@mq.edu.au

Credit points 3

Prerequisites

(HSC Mathematics Extension 1 Band E3-E4 or Extension 2) or admission to BSc in Advanced Mathematics or BAdvSc or BActStud or BActStudBSc or BAppFinBActStud or BActStudBProfPrac

Corequisites

Co-badged status

Unit description

This is the first mainstream mathematics unit for students who have entered the university with a strong background in mathematics. It is highly recommended for students with a serious interest in science and technology, and recommended for students in many other areas who wish to develop their mathematical knowledge with attention to the detail required for a rigorous development of the subject. Apart from some brief discussion on complex numbers and congruences, the main topic in the algebra half of this unit concerns linearity and the interplay between algebra and geometry. Plane geometry is first used to motivate the study of systems of linear equations. Algebraic techniques involving matrices and determinants are then developed to study these problems further. The algebraic machinery developed is then used to study geometrical problems in three-dimensional space. The notion of a limit is developed to a more sophisticated level than in secondary school mathematics, and this is used to study the differential and integral calculus involving functions of one real variable to a far greater depth than before. Some numerical techniques for integration are also discussed. Students who do not have the required background for this unit can take MATH135 which studies the same material, but from a less sophisticated standpoint.

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:

Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.

Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.

Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning. In particular, the ability to use limits and other infinite processes correctly.

Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using methods from calculus and linear algebra.

Be able to apply the principles, concepts, and techniques learned in this unit to solve practical and abstract problems.

Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions.

Be able to present reasoning and conclusions informed by analysis involving calculus and linear algebra, in a variety of modes, to diverse audiences (expert and non-expert).

Ethical application of mathematical approaches to solving problems and appropriately reference and acknowledge sources in an mathematical context.

Be able to work effectively, responsibly and safely in an individual or team context.

General Assessment Information

HURDLES: Attendance at, and reasonable engagement in, small group teaching activities in all first year mathematics units is compulsory. Participation will be assessed by tutors via rosters and observation of students' work during classes. Attendance and reasonable engagement in the class activities in, at least 10 out of 12 of the tutorial classes are requirements to pass the unit. This is a hurdle requirement.

ATTENDANCE and PARTICIPATION: Please contact the unit convenor as soon as possible if you have difficulty attending and participating in any classes. There may be alternatives available to make up the work. If there are circumstances that mean you miss a class, you can apply for a special consideration.

LATE SUBMISSION: LATE SUBMISSION OF WORK: All assignments and assessment tasks must be submitted by the official due date and time. No marks will be given for late work unless an extension has been granted following a successful application for <u>Special Consideration</u>. Please contact the unit convenor for advice as soon as you become aware that you may have difficulty meeting any of the assignment deadlines.

Information about the submission process of assessment tasks will be made available on iLearn.

FINAL EXAM POLICY: You are advised that it is Macquarie University policy not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, that is, the final day of the official examination period. The only excuse for not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these special circumstances, you may apply for special consideration via ask.mq.edu.au.

If you receive special consideration for the final exam, a supplementary exam will be scheduled in the interval between the regular exam period and the start of the next session. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. You can check the supplementary exam information page on FSE101 in iLearn (bit.ly/FSESupp) for dates, and approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Name	Weighting	Hurdle	Due
Assignment 1	15%	No	Week 7
Assignment 2	15%	No	Week 12
Mid-semester Test	10%	No	Week 8 (in-tutorial)
Final Exam	60%	No	Exam Period
SGTA	0%	Yes	weekly

Assessment Tasks

Assignment 1

Due: Week 7 Weighting: 15%

Assignment based on all material up to this point.

On successful completion you will be able to:

• Demonstrate knowledge of the principles and concepts of polynomial algebra, linear

algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.

- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning. In particular, the ability to use limits and other infinite processes correctly.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using methods from calculus and linear algebra.
- Be able to apply the principles, concepts, and techniques learned in this unit to solve practical and abstract problems.
- Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions.
- Be able to present reasoning and conclusions informed by analysis involving calculus and linear algebra, in a variety of modes, to diverse audiences (expert and non-expert).
- Ethical application of mathematical approaches to solving problems and appropriately reference and acknowledge sources in an mathematical context.
- Be able to work effectively, responsibly and safely in an individual or team context.

Assignment 2

Due: Week 12 Weighting: 15%

Assignment based on all material up to this point.

On successful completion you will be able to:

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning. In particular, the ability to use limits and other infinite processes correctly.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using methods from calculus and linear algebra.
- Be able to apply the principles, concepts, and techniques learned in this unit to solve

practical and abstract problems.

- Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions.
- Be able to present reasoning and conclusions informed by analysis involving calculus and linear algebra, in a variety of modes, to diverse audiences (expert and non-expert).
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Mid-semester Test

Due: Week 8 (in-tutorial) Weighting: 10%

In-class one-hour test based on first six weeks of material.

On successful completion you will be able to:

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning. In particular, the ability to use limits and other infinite processes correctly.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using methods from calculus and linear algebra.
- Be able to apply the principles, concepts, and techniques learned in this unit to solve practical and abstract problems.
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Final Exam

Due: Exam Period Weighting: 60%

Two hour final exam covering all taught material.

On successful completion you will be able to:

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SGTA

Due: weekly

Weighting: 0%

This is a hurdle assessment task (see <u>assessment policy</u> for more information on hurdle assessment tasks)

Attendance at, and reasonable engagement in, Small Group Teaching Activities (SGTA) in all first year mathematics units is compulsory.

Participation will be assessed by instructors via rosters and observation of students' work during classes.

Attendance and reasonable engagement in the class activities in, at least, 10 out of 12 of the

classes are requirements to pass the unit. This is a hurdle requirement.

On successful completion you will be able to:

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
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- Be able to work effectively, responsibly and safely in an individual or team context.

Delivery and Resources

Classes

Lectures: You should attend all four lectures each week, making a total of four hours.

SGTA: You must attend and participate in at least 10 of the 12 weekly tutorial classes to pass this unit.

Required and Recommended Texts and/or Materials

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.

- Stewart; Calculus
- Lay: Linear Algebra and its Applications

Technology Used and Required

Students are expected to have access to an internet enabled computer with a web browser and .pdf reader software. Several areas of the university provide wireless access for portable computers, and access to internet-enabled computers.

Difficulties with your home computer or internet connection do not constitute a reasonable excuse for lateness of, or failure to submit, assessment tasks.

Unit Schedule

	Topics Covered
Week 1	Algebra: Complex numbers: definitions, basic operations, equations with complex roots, modulus-argument form, De Moivre theorem, regions in the complex plane.
Week 2	Algebra: Polynomials: remainder theorem, factor theorem, rational roots, multiple roots, complex roots, relation between roots and coefficients.
Week 3	Algebra: Linear equations: solving systems of linear equations, applications.
Week 4	Algebra: Matrices: Matrices and basic properties, applications.
Week 5	Algebra: Determinants: definition and basic properties, applications.
Week 6	Algebra: Vectors: Vectors in 2 and 3 dimensions, inner product, cross product
Week 7	Calculus: Number systems
	Mid-semester break
Week 8	Calculus: Functions Mid-term test
Week 9	Calculus: Limits and Continuity
Week 10	Calculus: Derivatives
Week 11	Calculus: Integration
Week 12	Calculus: Differential Equations
Week 13	Revision

Learning and Teaching Activities

Lectures

There will be four one hour lectures per week. During these the content of the unit will be explained and example problems will be solved and applications in other disciplines discussed.

Small Group Teaching Activity

There is a one-hour small group teaching activity each week in which attendance is compulsory. During this time students will discuss problems related to the previous week's lecture content and work through similar problems.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.m q.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-centr al). 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
- <u>Special Consideration Policy</u> (*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 <u>Student Policy Gateway</u> (htt ps://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 s://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/p olicy-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 <u>eStudent</u>, (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 <u>eStudent</u>. For more information visit <u>ask.mq.edu.au</u> or if you are a Global MBA student contact <u>globalmba.support@mq.edu.au</u>

Student Support

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

Learning Skills

Learning Skills (<u>mq.edu.au/learningskills</u>) 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

If you are a Global MBA student contact globalmba.support@mq.edu.au

IT Help

For help with University computer systems and technology, visit <u>http://www.mq.edu.au/about_us/</u>offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the <u>Acceptable Use of IT Resources Policy</u>. 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

• Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in

elementary real analysis.

- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
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- Ethical application of mathematical approaches to solving problems and appropriately reference and acknowledge sources in an mathematical context.
- Be able to work effectively, responsibly and safely in an individual or team context.

Assessment tasks

- Assignment 1
- Assignment 2
- Mid-semester Test
- Final Exam
- SGTA

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
- · Present a broad outline of the scope of linear algebra and calculus, their roles in other

fields, and the way other fields contribute to their development.

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Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
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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:

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
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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:

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
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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:

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning. In particular, the ability to use limits and other infinite processes correctly.
- Demonstrate the ability to formulate and model practical and abstract problems in mathematical terms using methods from calculus and linear algebra.

- Be able to apply the principles, concepts, and techniques learned in this unit to solve practical and abstract problems.
- Demonstrate appropriate interpretation of information communicated in mathematical form. Be able to understand what is being said in mathematical expressions.
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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:

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning. In particular, the ability to use limits and other infinite processes correctly.
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 - Assignment 2
 - Mid-semester Test
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Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
- Demonstrate the ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning. In particular, the ability to use limits and other infinite processes correctly.
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- Demonstrate appropriate interpretation of information communicated in mathematical

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- Be able to present reasoning and conclusions informed by analysis involving calculus and linear algebra, in a variety of modes, to diverse audiences (expert and non-expert).
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Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

- Demonstrate knowledge of the principles and concepts of polynomial algebra, linear algebra, and calculus in one variable. Be competent with the rigour required in elementary real analysis.
- Present a broad outline of the scope of linear algebra and calculus, their roles in other fields, and the way other fields contribute to their development.
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- Be able to present reasoning and conclusions informed by analysis involving calculus

and linear algebra, in a variety of modes, to diverse audiences (expert and non-expert).

- Ethical application of mathematical approaches to solving problems and appropriately reference and acknowledge sources in an mathematical context.
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