MATH3909

Real and Functional Analysis

Session 2, Special circumstance 2020

Department of Mathematics and Statistics

Contents

Notice

As part of Phase 3 of our return to campus plan, most units will now run tutorials, seminars and ot her small group learning activities on campus for the second half-year, while keeping an online ver sion available for those students unable to return or those who choose to continue their studies onli ne.

To check the availability of face-to-face and onlin e activities for your unit, please go to timetable vi ewer. To check detailed information on unit asses sments visit your unit's iLearn space or consult yo ur unit convenor.

General Information

Unit convenor and teaching staff
Convenor
The Bui
the.bui@mq.edu.au
12WW 606
Please refer to iLearn

Lecturer
Ji Li
ji.li@mq.edu.au
Contact via 98506146
12WW 710
Please refer to iLearn

Credit points
10

Prerequisites
((MATH2010 or MATH235) and (MATH2020 or MATH236)) or MATH3901 or MATH3902 or MATH3905 or MATH3906 or MATH331 or MATH332 or MATH335 or MATH336

Corequisites

Co-badged status

Unit description
This unit is concerned with a review of the limiting processes of real analysis and an introduction to functional analysis. Through the discussion of such abstract notions as metric spaces, normed vector spaces and inner product spaces, we can appreciate an elegant and powerful combination of ideas from analysis and linear algebra.

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:

ULO1: demonstrate a well- developed knowledge of the principles, concepts and techniques of a broad range of areas in analysis and applied mathematics, with

significant depth in analysis and functional analysis.

ULO2: demonstrate an understanding of the breadth of mathematics, the multi-disciplinary role of mathematics and the way it contributes the development in other related fields of study.

ULO3: construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.

ULO4: formulate and model practical and abstract problems in mathematical terms using a variety of methods drawn from analysis and functional analysis.

ULO5: apply mathematical principles, concepts, techniques and technology efficiently to solve practical and abstract problems across a range of areas in analysis and functional analysis.

ULO6: interpret mathematical information communicated in wide range of forms.

General Assessment Information

HURDLES: This unit has no hurdle requirements.

ASSIGNMENT SUBMISSION: Assignment submission will be online through the iLearn page.

Submit assignments online via the appropriate assignment 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.

- Assignment submission is via iLearn. You should upload this as a single scanned PDF file.
- Please note the quick guide on how to upload your assignments provided on the iLearn page.
- Please make sure that each page in your uploaded assignment 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 assignment 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 assignments or 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.

FINAL EXAM POLICY: 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.

SUPPLEMENTARY EXAMINATIONS:

IMPORTANT: 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. If you apply for special consideration, you must give the supplementary examination priority over any other pre-existing commitments, as such commitments will not usually be considered an acceptable basis for a second application for special consideration. 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 (https://bit.ly/FSESupp) for dates, and approved applicants will receive an individual notification sometime in the week prior to the exam with the exact date and time of their supplementary examination.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	15%	No	Week 7
iLearn Test	20%	No	Week 10
Assignment 2	15%	No	Week 12
Final Exam	50%	No	Formal Exam Period

Assignment 1

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 5 hours
Due: **Week 7**
Weighting: **15%**

The assignment will include a set of questions with short answers involving proofs and calculations.

On successful completion you will be able to:

- demonstrate a well- developed knowledge of the principles, concepts and techniques of

a broad range of areas in analysis and applied mathematics, with significant depth in analysis and functional analysis.
- demonstrate an understanding of the breadth of mathematics, the multi-disciplinary role of mathematics and the way it contributes the development in other related fields of study.
- construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.
- formulate and model practical and abstract problems in mathematical terms using a variety of methods drawn from analysis and functional analysis.
- apply mathematical principles, concepts, techniques and technology efficiently to solve practical and abstract problems across a range of areas in analysis and functional analysis.
- interpret mathematical information communicated in wide range of forms.

iLearn Test

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 6 hours
Due: **Week 10**
Weighting: **20%**

The test will cover both the real and functional analysis components of the unit.

On successful completion you will be able to:

- demonstrate a well- developed knowledge of the principles, concepts and techniques of a broad range of areas in analysis and applied mathematics, with significant depth in analysis and functional analysis.
- demonstrate an understanding of the breadth of mathematics, the multi-disciplinary role of mathematics and the way it contributes the development in other related fields of study.
- construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.
- formulate and model practical and abstract problems in mathematical terms using a variety of methods drawn from analysis and functional analysis.
- apply mathematical principles, concepts, techniques and technology efficiently to solve practical and abstract problems across a range of areas in analysis and functional

analysis.
- interpret mathematical information communicated in wide range of forms.

Assignment 2

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 5 hours
Due: **Week 12**
Weighting: **15%**

The assignment will include a set of questions with short answers involving proofs and calculations.

On successful completion you will be able to:
- demonstrate a well- developed knowledge of the principles, concepts and techniques of a broad range of areas in analysis and applied mathematics, with significant depth in analysis and functional analysis.
- demonstrate an understanding of the breadth of mathematics, the multi-disciplinary role of mathematics and the way it contributes the development in other related fields of study.
- construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.
- formulate and model practical and abstract problems in mathematical terms using a variety of methods drawn from analysis and functional analysis.
- apply mathematical principles, concepts, techniques and technology efficiently to solve practical and abstract problems across a range of areas in analysis and functional analysis.
- interpret mathematical information communicated in wide range of forms.

Final Exam

Assessment Type [1]: Examination
Indicative Time on Task [2]: 12 hours
Due: **Formal Exam Period**
Weighting: **50%**

The final exam will cover all topics of the unit

On successful completion you will be able to:

- demonstrate a well- developed knowledge of the principles, concepts and techniques of a broad range of areas in analysis and applied mathematics, with significant depth in analysis and functional analysis.
- demonstrate an understanding of the breadth of mathematics, the multi-disciplinary role of mathematics and the way it contributes the development in other related fields of study.
- construct sustained logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.
- formulate and model practical and abstract problems in mathematical terms using a variety of methods drawn from analysis and functional analysis.
- apply mathematical principles, concepts, techniques and technology efficiently to solve practical and abstract problems across a range of areas in analysis and functional analysis.
- interpret mathematical information communicated in wide range of forms.

---

[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

There are two 2 hour lectures each week.

Lecture notes will be available on the web; student can also use

Chen: Fundamentals of Analysis

Chen: Linear Functional Analysis

The following texts are suggested for reference only, and it is not essential to own copies:

Lay: Analysis with an introduction to proof

Gordon: Real Analysis, A First course

Burkill: A First Course in Mathematical Analysis

Burkill and Burkill: A Second Course in Mathematical Analysis

Young: An Introduction to Hilbert Space

Unit Schedule

- Week 1: The number system, completeness and consequences.
- Week 1: Countability, cardinal numbers, Cantor-Bernstein-Schröder theorem.
- Week 2: Sequences and limits, subsequences, general principle of convergence.
- Week 3 and 4: Series, real series, complex series, power series.
- Week 4: Functions and continuity.
- Week 5 and 6: Derivatives and Integrations
- Week 7: Further limits - Uniform Convergence

Mid Session Break (2 weeks)

- Week 8: Metric spaces, open and closed sets, limits and continuity.
- Week 9: Connectedness, completeness, compactness, continuous functions with compact domains.
- Week 10: Normed vector spaces, Banach spaces.
- Week 11: Inner product spaces, Hilbert spaces.
- Week 11: Orthogonal expansions, orthonormal systems, orthonormal bases.
- Week 12: Isomorphism of Hilbert spaces, splitting up a Hilbert spaces
- Week 12: Linear functionals, dual space.
- Week 13: Revision

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). 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.)*

Students seeking more policy resources can visit the Student Policy Gateway (https://students.m

q.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 (https://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 or if you are a Global MBA student contact 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) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- Getting help with your assignment
- Workshops
- StudyWise
- Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

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 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.