ECON 2125/4413/8013
Mathematical Techniques in Economics I

The foundations of economic theory are based on mathematical models. Thus, a thorough understanding of the economic content of such models is not possible without a clear understanding of the mathematical concepts that underpin the modeling. Together with ECON8014 - Mathematical Techniques in Economics II, this course forms a two-semester sequence, which introduces students to a range of mathematical concepts and techniques that form the basis of advanced economic theory courses, such as the ones required of students enrolled in Honours, Masters and PhD programs. The introduced concepts and techniques will be derived from basic principles and assumptions as thoroughly as possible, and will be illustrated using standard applications from economics.

Due to the strong interdependence between the topics covered in the two courses, students are encouraged to take both courses as a sequence in the same year. In addition, post-graduate students who enrol in this course are expected to be familiar with the material covered in ECON6015 - Optimisation Techniques for Economists.

<table>
<thead>
<tr>
<th>Mode of Delivery</th>
<th>On campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerequisites</td>
<td>None</td>
</tr>
<tr>
<td>Incompatible Courses</td>
<td>None</td>
</tr>
<tr>
<td>Course Convener:</td>
<td>Ruitian Lang</td>
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<td>6125 7325</td>
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<td><a href="mailto:ruitian.lang@anu.edu">ruitian.lang@anu.edu</a></td>
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<tr>
<td>Office hours for student consultation:</td>
<td>Tuesday, 3:00-4:00</td>
</tr>
<tr>
<td>Research Interests</td>
<td>Contract theory</td>
</tr>
<tr>
<td>Relevant administrator if any (optional)</td>
<td>Karissa Carkeet</td>
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<td>Phone:</td>
<td>6125 0384</td>
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</tr>
<tr>
<td>Tutor(s) (optional)</td>
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COURSE OVERVIEW

Course Description

The course introduces mathematical tools essential for intermediate and advanced economic courses. Specifically, it covers topics in linear algebra, multivariate calculus, unconstrained optimization and constrained optimization. The focus is on how to use these tools in solving problems. In addition, precise definitions and exact statements of theorems are given with some proofs to familiarize students with formal languages of mathematics. Due to the time constraint, some important mathematical tools for financial economics and macroeconomics (dynamic optimization and stochastic control theory) will not be covered, so ECON 8014 is recommended for students interested in those techniques.

Learning Outcomes

Upon a successful completion of this course, students should be able to:

1. Understand the mathematical methods that are most widely used in economics, both from a formal, abstract perspective, and an intuitive perspective.
2. Know how to read, understand, and construct mathematical proofs, and appreciate their role in the derivation of mathematical concepts and structures.
3. Apply mathematical methods and techniques that are formulated in abstract settings to concrete economic applications.

Assessment Summary

<table>
<thead>
<tr>
<th>Assessment Task</th>
<th>Value</th>
<th>Due Date</th>
<th>Date for Return of Assessment</th>
<th>Linked Learning Outcomes (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Homework 1</td>
<td>4%</td>
<td>25/02/2016</td>
<td>03/03/2016</td>
<td></td>
</tr>
<tr>
<td>2. Homework 2</td>
<td>4%</td>
<td>10/03/2016</td>
<td>17/03/2016</td>
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<tr>
<td>3. Homework 3</td>
<td>4%</td>
<td>24/03/2016</td>
<td>28/03/2016</td>
<td></td>
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<tr>
<td>4. Mid-semester exam</td>
<td>30%</td>
<td>Week 7</td>
<td></td>
<td></td>
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<tr>
<td>5. Homework 4</td>
<td>4%</td>
<td>28/04/2016</td>
<td>05/05/2016</td>
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<tr>
<td>6. Homework 5</td>
<td>4%</td>
<td>12/05/2016</td>
<td>19/05/2016</td>
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<tr>
<td>7. Final exam</td>
<td>50%</td>
<td>Exam period</td>
<td></td>
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</table>

Research-Led Teaching

Modern economic research involves either developing theoretical models or analyzing empirical data (or both). This course prepares students for the former research approach by introducing them to some major mathematical tools used in microeconomic research.

Feedback

Staff Feedback
Students will receive written feedback on their homework through “Turnitin”.

Student Feedback
ANU is committed to the demonstration of educational excellence and regularly seeks feedback from students. One of the key formal ways students have to provide feedback is through Student Experience of Learning Support (SELS) surveys. The feedback given in these surveys is anonymous and provides the Colleges, University Education Committee and Academic Board with opportunities to recognise excellent teaching, and opportunities for improvement.
For more information on student surveys at ANU and reports on the feedback provided on ANU courses, go to
http://unistats.anu.edu.au/surveys/selt/students/ and
http://unistats.anu.edu.au/surveys/selt/results/learning/

Policies
ANU has educational policies, procedures and guidelines, which are designed to ensure that staff and students are aware of the University’s academic standards, and implement them. You can find the University’s education policies and an explanatory glossary at:
http://policies.anu.edu.au/

Students are expected to have read the Student Academic Integrity Policy before the commencement of their course.

Other key policies include:
- Student Assessment (Coursework)
- Student Surveys and Evaluations

Required Resources
Commonwealth supported students and domestic full-fee paying students generally must be able to complete the requirements of their program of study without the imposition of fees that are additional to the student contribution amount or tuition fees.

Provided that its payment is in accordance with the Act, a fee is of a kind that is into any one or more of the following categories:

(a) It is a charge for a good or service that is not essential to the course of study.
(b) It is a charge for an alternative form, or alternative forms, of access to a good or service that is an essential component of the course of study but is otherwise made readily available at no additional fee by the higher education provider.
(c) It is a charge for an essential good or service that the student has the choice of acquiring from a supplier other than the higher education provider and is for:
   (i) equipment or items which become the physical property of the student and are not consumed during the course of study; or
   (ii) food, transport and accommodation costs associated with the provision of field trips that form part of the course of study.
(d) It is a fine or a penalty provided it is imposed principally as a disincentive and not in order to raise revenue or cover administrative costs.

Field trips (optional)
None.

Additional course costs
None.

Examination material or equipment
One two-sided formula sheet prepared by students themselves and a non-programmable calculator.
Recommended Resources

Essential textbook:

COURSE SCHEDULE

<table>
<thead>
<tr>
<th>Week</th>
<th>Summary of Activities</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Euclidean space</td>
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</tr>
<tr>
<td>2-3</td>
<td>Eigenvalues and quadratic forms</td>
<td>Homework 1</td>
</tr>
<tr>
<td>4-5</td>
<td>Multivariate functions and calculus</td>
<td>Homework 2</td>
</tr>
<tr>
<td>6-7</td>
<td>The implicit function theorem</td>
<td>Homework 3</td>
</tr>
<tr>
<td>8</td>
<td>Unconstrained optimization</td>
<td></td>
</tr>
<tr>
<td>9-10</td>
<td>Convex sets and functions</td>
<td>Homework 4</td>
</tr>
<tr>
<td>11-13</td>
<td>Constrained optimization</td>
<td>Homework 5</td>
</tr>
<tr>
<td></td>
<td>Examination period</td>
<td></td>
</tr>
</tbody>
</table>

ASSESSMENT REQUIREMENTS

The ANU is using Turnitin to enhance student citation and referencing techniques, and to assess assignment submissions as a component of the University's approach to managing Academic Integrity. For additional information regarding Turnitin please visit the ANU Online website.

Students may choose not to submit assessment items through Turnitin. In this instance you will be required to submit, alongside the assessment item itself, copies of all references included in the assessment item.

Assessment Tasks

Participation
Participation will not count toward your final mark.

Assessment Task 1: Homework
Details of task:
Word limit (where applicable): N/A
Value: 4% each, five in total
Presentation requirements: None
Estimated return date: (See assessment summary)

Hurdle Assessment requirements (where applicable):
Individual Assessment in Group Tasks (where applicable):

Examination(s)
A mid-semester examination and a final examination are required.

Assignment submission
Online Submission: Assignments are submitted using Turnitin in the course Wattle site. You will be required to electronically sign a declaration as part of the submission of your assignment. Please keep a copy of the assignment for your records.

Extensions and penalties
Extensions and late submission of assessment pieces are covered by the Student Assessment (Coursework) Policy and Procedure.
The Course Convener may grant extensions for assessment pieces that are not examinations or take-home examinations. If you need an extension, you must request it in writing on or before the due date. If you have documented and appropriate medical evidence that demonstrates you were not able to request an extension on or before the due date, you may be able to request it after the due date.

No submission of assessment tasks without an extension after the due date will be permitted. If an assessment task is not submitted by the due date, a mark of 0 will be awarded.

**Returning assignments**
Marking will be done online through Turnitin.

**Resubmission of assignments**
N/A.

**Referencing requirements**
N/A.

**SUPPORT FOR STUDENTS**
The University offers a number of support services for students. Information on these is available online from [http://students.anu.edu.au/studentlife/](http://students.anu.edu.au/studentlife/)