

# EMET1001

## Foundations of Economic and Financial Models (An Introduction to Mathematical Economics)

The course teaches the mathematical foundations of models in economics, business, and finance, along with its applications. Mathematical topics covered include set theory, functions, series, limits, univariate and multivariate calculus, unconstrained and constrained optimization, and matrix algebra. Applications include production functions, average and marginal cost functions, and profit maximization.

<b>Mode of Delivery</b>	On campus.
<b>Prerequisites</b>	None listed.
<b>Incompatible Courses</b>	STAT1006, EMET7001.
<b>Course Convener:</b>	Dr Damien Eldridge.
Email:	<a href="mailto:Damien.Eldridge@anu.edu.au">Damien.Eldridge@anu.edu.au</a>
Office hours for student consultation:	Times: TBA. Location: Arndt Building, Room 2029.
Research Interests	<ul style="list-style-type: none"> <li>• Microeconomic Theory;</li> <li>• Applied Microeconomics;</li> <li>• Microeconometrics.</li> </ul>
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SEMESTER ONE, 2018

## COURSE OVERVIEW

### Learning Outcomes

By the end of the course students will:

1. Have a sound understanding of mathematical techniques discussed.
2. Formulate economic problems in mathematical terms and apply the tools provided in the module for analyzing them.
3. Demonstrate an understanding of many of the common functional forms used in economics.
4. Apply linear and matrix algebra techniques to simple economic and econometric problems.
5. Apply univariate and multivariate differential calculus techniques to simple economic and econometric problems.
6. Apply univariate integral calculus techniques to simple economic and econometric problems.
7. Apply optimization techniques to economic and econometric problems.

### Assessment Summary

Assessment Task	Potential Value	Due Date	Date for Return of Assessment
1. Online Quiz One (One Hour, Multiple Choice)	5 % (Optional and Redeemable)	TBA (In Week 3)	Results and feedback provided upon conclusion of the period in which the exam may be undertaken.
2. Mid-Semester Exam (Fifteen Minutes Reading, Two Hours Writing)	20 % (Optional and Redeemable)	TBA (In Week 6)	Results announced in Week 7. Exam viewing times TBA.
3. Online Quiz Two (One Hour, Multiple Choice)	5 % (Optional and Redeemable)	TBA (In Week 9)	Results and feedback provided upon conclusion of the period in which the exam may be undertaken.
3. Final Exam (Fifteen Minutes Reading, Three Hours Writing)	70 %	TBA (In the official final exam period)	Exams may be viewed at some point after the final grades have been officially released.

Please note that the mid-semester exam, online quiz 1, and online quiz 2 are all both optional and redeemable. As such, there will be no special examinations for these assessment items under any circumstances. Instead the relevant assessment weighting will be moved to the final exam.

### Research-Led Teaching

The material taught in this course is directly relevant to research and analysis of most topics in microeconomics, macroeconomics, econometrics, statistics, finance, and many business disciplines.

## **Feedback**

### **Staff Feedback**

Students will be given frequent, individual feedback in the form of marked tutorial assignments, as well as detailed feedback after the midterm exam. Students will also have the opportunity to obtain feedback on any topic related to this course during their scheduled tutorial sessions and the regular consultation sessions that are held by the teaching staff in this unit. I highly encourage students to avail themselves of these opportunities.

### **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 Academic Misconduct Rules 2014 before the commencement of their course.

Other key policies include:

- Student Assessment (Coursework)
- Student Surveys and Evaluations

### **Workload Expectations**

The amount of work required for successful completion of this subject may vary between students. As a rough guide, students should expect to devote at least 10 hours a week to this unit. This should include all of the following.

- 3 hours a week: lectures.
- 1 hour a week: tutorials.
- At least 6 hours a week: reading, research, writing, lecture and tutorial preparation.

### **Examination material or equipment**

Other than writing-related equipment (such as pens, pencils, erasers, sharpeners, and rulers), only a non-programmable calculator may be used in either of the exams for this subject.

## Recommended Resources

- Textbook:
  - Sydsaeter, K, P Hammond, A Strom, and A Carvajal (2016), *Essential mathematics for economic analysis (fifth edition)*, Pearson Education, United Kingdom.
- Supplementary References:
  - Asano, A (2013), *An introduction to mathematics for economics*, Cambridge University Press, Great Britain.
  - Bradley, T (2013), *Essential mathematics for economics and business (fourth edition)*, John Wiley and Sons, Great Britain.
  - Haeussler, EF Jr, and RS Paul (1987), *Introductory mathematical analysis for business, economics, and the life and social sciences (fifth edition)*, Prentice-Hall International Edition, Prentice-Hall, USA.
  - Shannon, J (1995), *Mathematics for business, economics and finance*, John Wiley and Sons, Brisbane.

## COURSE SCHEDULE

In the following outline for this course, the expression “*a.b*” means lecture *b* in week *a*. Note that this outline is just a rough guide to the topics that will be covered in this course and the lectures in which they will be covered. If it becomes necessary, the timing and subject matter will vary from that set out below.

Lectures (Rough Guide)	Summary of Activities
1.1 (Part)	Introduction and Administration
1.1 (Part), 1.2	Topic 1: Sets, Numbers, Coordinates, and Distances
1.3, 2.1	Topic 2: Functions and Correspondences
2.2, 2.3	Topic 3: Binary Relations, Equations, and Inequalities
3.1, 3.2, 3.3	Topic 4: Sequences, Series, and Limits (with applications to financial economics)
4.1, 4.2, 4.3, 5.1, 5.2, 5.3	Topic 5: Univariate Differential Calculus
6.1, 6.2	Replaced by the Mid-Semester Exam.
6.3	Review of the Mid-Semester Exam.
7.1, 7.2, 7.3	Topic 6: Univariate Integral Calculus
8.1, 8.2, 8.3, 9.1, 9.2, 9.3	Topic 7: Linear Algebra
10.1, 10.2, 10.3, 11. 1	Topic 8: Multivariate Differential Calculus
11.2, 11.3, 12.1, 12.2, 12.3	Topic 9: Optimisation Theory

## ASSESSMENT REQUIREMENTS

- As an academic integrity control, students may be selected for a fifteen-minute individual oral examination of their written assessment submissions.
- Any student identified, either during the current semester or in retrospect, as having used ghost writing services will be investigated under the University's Academic Misconduct Rule.

### Assessment Task 1

Assessment Task: Online Quiz One

Details of task: This will be a one-hour multiple-choice exam that is administered online during week three of the semester. More details will be announced at a later date.

Estimated return dates: Results and general feedback will be available immediately after the exam period has concluded.

Value: This online quiz is worth (at most) 5 % of your raw mark for this course. However, this component is both optional and redeemable. It will only count towards your raw mark if it exceeds your mark on the final exam. If your mark for this online quiz does not exceed your mark on the final exam, then the five percentage points allocated to this quiz will be reallocated to the final exam.

Purpose: The purpose of this assessment item is to test both your understanding of the material covered in the relevant part of this course and your ability to apply that material to problems from economics, finance, and business studies.

Note: Since this assessment item is both optional and redeemable, no special arrangements will be made for students who do not complete this item, regardless of the reason for not doing so. The weight from this assessment will simply be transferred to the final exam for any such students.

### Assessment Task 2

Assessment Task: Mid-Semester Exam

Details of task: This will be a formal exam consisting of fifteen minutes of reading time and two hours of writing time. It will consist of a number of problems that are related to the material covered in at least one of the following: (i) lectures in weeks one to four, (ii) tutorials in weeks two to five, and (iii) the associated readings. It will be held sometime during week six and will replace the first two hours of lectures for this course in that week.

Estimated return dates:	Marks will be posted on the Wattle site for the unit by the end of week seven. Potential exam viewing times will be announced at that point.
Value:	The mid-semester exam is worth (at most) 20 % of your raw mark for this course. However, this component is both optional and redeemable. It will only count towards your raw mark if it exceeds your mark on the final exam. If your mid-semester exam mark does not exceed your mark on the final exam, then the twenty percentage points allocated to the mid-semester exam will be reallocated to the final exam.
Purpose:	The purpose of this assessment item is to test both your understanding of the material covered in the relevant part of this course and your ability to apply that material to problems from economics, finance, and business studies.
Note:	Since this assessment item is both optional and redeemable, no special arrangements will be made for students who do not complete this item, regardless of the reason for not doing so. The weight from this assessment will simply be transferred to the final exam for any such students.

### **Assessment Task 3**

Assessment Task:	Online Quiz Two
Details of task:	This will be a one-hour multiple-choice exam that is administered online during week three of the semester. More details will be announced at a later date.
Estimated return dates:	Results and general feedback will be available immediately after the exam period has concluded.
Value:	This online quiz is worth (at most) 5 % of your raw mark for this course. However, this component is both optional and redeemable. It will only count towards your raw mark if it exceeds your mark on the final exam. If your mark for this online quiz does not exceed your mark on the final exam, then the five percentage points allocated to this quiz will be reallocated to the final exam.
Purpose:	The purpose of this assessment item is to test both your understanding of the material covered in the relevant part of this course and your ability to apply that material to problems from economics, finance, and business studies.
Note:	Since this assessment item is both optional and redeemable, no special arrangements will be made for students who do not complete this item, regardless of the reason for not doing so. The weight from this assessment will simply be transferred to the final exam for any such students.

## **Assessment Task 4**

Assessment Task:	Final Exam
Details of task:	This will be a formal exam consisting of fifteen minutes of reading time and three hours of writing time. It will consist of a number of problems that are related to any of the material covered in this course. This includes material covered in lectures, material covered in tutorials, and material covered in the suggested reading. It will be held sometime during the official final exam period. The date, time, and location will be determined by the University administration.
Estimated return dates:	The final exam script books will be available for viewing at some point following the release of the official results for Semester One in 2017.
Value:	The final exam is worth (at least) 70 % of your raw mark for this course.
Purpose:	The purpose of this assessment item is to test both your understanding of the material covered in this course and your ability to apply that material to problems from economics, finance, and business studies.

### **Assignment submission**

- Please submit your tutorial assignments by placing a hardcopy of the assignment in the appropriate assignment box on Level One of the H. W. Arndt Building (near the Research School of Economics Enquiries Desk).
- Please ensure that your submitted assignments have a completed and signed assignment cover sheet attached.
- Please keep a copy of your submitted assignments for your own use in tutorial classes and for exam revision.

### **Extensions and penalties**

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 and an extension has not been granted or alternative arrangements have not been authorised, then a mark of 0 will be awarded.

## **Raw Unit Mark**

Your raw final percentage mark for this unit will be determined according to the following formula:

- Raw Mark =  $\max\{A, B, C, D\}$ , where:
  - A = Final exam percentage mark,
  - B =  $(0.1)(\text{Tutorial assignments percentage mark}) + (0.9)(\text{Final exam percentage mark})$ ,
  - C =  $(0.2)(\text{Mid-Semester Exam Percentage Mark}) + (0.8)(\text{Final exam percentage mark})$ , and
  - D =  $(0.1)(\text{Tutorial assignments percentage mark}) + (0.2)(\text{Mid-Semester Exam Percentage Mark}) + (0.7)(\text{Final exam percentage mark})$ .

## **Scaling**

Your final mark for the course will be based on the **raw** marks allocated for each of your assessment items. However, your final mark may not be the same number as produced by that formula, as marks may be **scaled**. Any scaling applied will preserve the rank order of raw marks (i.e. if your raw mark exceeds that of another student, then your scaled mark will exceed the scaled mark of that student), and may be either up or down.

## **Privacy Notice**

The ANU has made a number of third party, online, databases available for students to use. Use of each online database is conditional on student end users first agreeing to the database licensor's terms of service and/or privacy policy. Students should read these carefully.

In some cases student end users will be required to register an account with the database licensor and submit personal information, including their: first name; last name; ANU email address; and other information.

In cases where student end users are asked to submit 'content' to a database, such as an assignment or short answers, the database licensor may only use the student's 'content' in accordance with the terms of service – including any (copyright) licence the student grants to the database licensor.

Any personal information or content a student submits may be stored by the licensor, potentially offshore, and will be used to process the database service in accordance with the licensors terms of service and/or privacy policy.

If any student chooses not to agree to the database licensor's terms of service or privacy policy, the student will not be able to access and use the database. In these circumstances students should contact their lecturer to enquire about alternative arrangements that are available.

## **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/>

### **Other Information**

Building Access Hours

Both CBE and HW ARNDT are:

TEACHING PERIOD = Mon – Fri 07.45 to 21.15 and SAT, SUN and Public Holidays is not accessible by students.

Both CBE and HW ARNDT are:

NON TEACHING PERIOD = Mon – Fri 08.00 to 18.00 and SAT, SUN and Public Holidays is not accessible by students.

RSE has a Frequently Asked Questions page where you can find relevant policies and information on a broad range of topics, the onus is on the student to familiarise themselves with this page and the information available.

<https://www.rse.anu.edu.au/students/students/frequently-asked-questions/>

## READING GUIDE

- Note that books relevant to this course can be found in both the **Chifley Library** (which houses the ANU Library's economics collection) and the **Hancock Library** (which houses the ANU Library's mathematics collection).
- I strongly encourage you to familiarise yourself with, and make use of the resources contained in, both of these libraries.

## Core References

- Textbook:
  - Sydsaeter, K, P Hammond, A Strom, and A Carvajal (2016), *Essential mathematics for economic analysis (fifth edition)*, Pearson Education, United Kingdom.
    - Any edition is fine.
    - I will request that this book be made available on short-loan from the ANU library system.
- Supplementary References (at a similar level to the textbook):
  - Asano, A (2013), *An introduction to mathematics for economics*, Cambridge University Press, Great Britain.
    - There is only one edition of this book, as far as I am aware.
    - Unfortunately, the ANU library system does not appear to have a copy. (I have requested that the library purchase a copy of this book.)
  - Bradley, T (2013), *Essential mathematics for economics and business (fourth edition)*, John Wiley and Sons, Great Britain.
    - Any edition is fine.
    - Unfortunately, the ANU library system does not appear to have a copy. (I have requested that the library purchase a copy of this book.)
  - Haeussler, EF Jr, and RS Paul (1987), *Introductory mathematical analysis for business, economics, and the life and social sciences (fifth edition)*, Prentice-Hall International Edition, Prentice-Hall, USA.
    - Any edition is fine.
    - I will request that this book be made available on short-loan from the ANU library system.
  - Shannon, J (1995), *Mathematics for business, economics and finance*, John Wiley and Sons, Brisbane.
    - There is only one edition of this book, as far as I am aware.
    - I will request that this book be made available on short-loan from the ANU library system.

- More Advanced References:
  - For those who want to pursue some of the material further.
    - Often, but not always, beyond the scope of this course.
    - These are intermediate-level undergraduate references on mathematical economics.
    - In general, when multiple editions of one of following references exist, then any edition of that reference will be fine.
  - Chiang, AC, and K Wainwright (2005), *Fundamental methods of mathematical economics (fourth edition)*, McGraw-Hill/Irwin, Singapore.
  - Dixit, AK (1990), *Optimization in economic theory (second edition)*, Oxford University Press, Great Britain.
  - Intriligator, MD (1971), *Mathematical optimization and economic theory*, Prentice-Hall, USA.
  - Lancaster, K (1968), *Mathematical economics*, The 1987 Dover unabridged republication of the original 1968 Macmillan edition, Dover Publications, USA.
  - Leonard, D, and NV Long (1992), *Optimal control theory and static optimization in economics*, Cambridge University Press, USA.
  - Simon, CP, and L Blume (1994), *Mathematics for economists*, WW Norton and Company, USA.
  - Sydsaeter, K, P Hammond, A Seierstad, and A Strom (2005), *Further mathematics for economic analysis*, Pearson Education (Financial Times/Prentice-Hall), Gosport.
  - Takayama, A (1993), *Analytical methods in economics*, The University of Michigan Press, USA.

## **Topic 1: Sets, Numbers, Coordinates, and Distance**

- Sydsaeter, Hammond, Strom, and Carvajal (2016): Chapters 1 and 2 (pp. 1–66).
- Asano (2013): Chapters 1 and 2 (pp. 1–56).
- Bradley (2013): Chapter 1 (pp. 1–35).
- Haeussler and Paul (1987): Chapter 0 (pp. 1–33).
- Shannon (1995): Chapter 1 (pp. 1–27).

## **Topic 2: Functions and Correspondences**

- Sydsaeter, Hammond, Strom, and Carvajal (2016): Chapters 4, 5, 11.1, 11.4, and 11.5 (pp. 89–167, 407–411, and 424–431).
- Asano (2013): Chapters 1 and 2 (pp. 1–56).
- Bradley (2013): Chapters 2 and 4 (pp. 36–99, 147–207, and 361–366).
- Haeussler and Paul (1987): Chapters 3, 4, 5, and 17.1 (pp. 75–163 and 668–674).
- Shannon (1995): Chapters 2 and 6 (pp. 28–82 and 231–284).

### **Topic 3: Binary Relations, Equations, and Inequalities**

- Sydsaeter, Hammond, Strom, and Carvajal (2016): Chapters 2 and 3 (pp. 19–87).
- Asano (2013): Chapters 1 and 2 (pp. 1–56).
- Bradley (2013): Chapter 1 (pp. 18–21 only).
- Haeussler and Paul (1987): Chapters 1 and 2 (pp. 34–74).
- Shannon (1995): Chapters 1, 2, and 6 (pp. 1–27, 28–82, and 231–284).

### **Topic 4: Sequences, Series, and Limits (with applications to financial economics)**

- Sydsaeter, Hammond, Strom, and Carvajal (2016): Chapters 2.8, 2.9, 2.10, 2.11, 6.5, 7.9, 7.11, and 10 (pp. 52–62, 182–188, 257–266, 270–273, and 375–406).
- Asano (2013): Chapter 3 (pp. 57–89).
- Bradley (2013): Chapters 5 and 6.1 (pp. 209–270).
- Haeussler and Paul (1987): Chapters 6 and 10 (pp. 164–193 and 375–402).
- Shannon (1995): Chapters 1.6, 6.6, and 7 (pp. 19–25, 252–256, and 285–355).

### **Topic 5: Univariate Differential Calculus**

- Sydsaeter, Hammond, Strom, and Carvajal (2016): Chapters 6, 7, and 8 (pp. 169–317).
- Asano (2013): Chapters 4 and 5 (pp. 90–146).
- Bradley (2013): Chapter 6 (pp. 259–360).
- Haeussler and Paul (1987): Chapters 10, 11, 12, and 13 (pp. 375–532).
- Shannon (1995): Chapter 8 (pp. 356–407).

### **Topic 6: Univariate Integral Calculus**

- Sydsaeter, Hammond, Strom, and Carvajal (2016): Chapter 9 (pp. 319–373).
- Asano (2013): Chapter 7 (pp. 184–217).
- Bradley (2013): Chapter 8 (pp. 427–476).
- Haeussler and Paul (1987): Chapters 14 and 15 (pp. 533–645).
- Shannon (1995): Chapter 9 (pp. 408–449).

### **Topic 7: Linear Algebra**

- Sydsaeter, Hammond, Strom, and Carvajal (2016): Chapters 15 and 16 (pp. 581–663).
- Asano (2013): Appendix A (pp. 218–242).
- Bradley (2013): Chapters 3 and 9 (pp. 101–145 and 477–538).
- Haeussler and Paul (1987): Chapter 8 (pp. 238–309).
- Shannon (1995): Chapters 2, 3, 4, and 5 (pp. 28–230).

## **Topic 8: Multivariate Differential Calculus**

- Sydsaeter, Hammond, Strom, and Carvajal (2016): Chapters 11, 12, and 13 (pp. 407–531).
- Asano (2013): Chapter 6 (pp. 147–183).
- Bradley (2013): Chapter 7 (pp. 361–426).
- Haeussler and Paul (1987): Chapter 17 (pp. 668–731).
- Shannon (1995): Chapter 10 (pp. 450–509).

## **Topic 9: Optimisation Theory**

- Sydsaeter, Hammond, Strom, and Carvajal (2016): Chapters 8, 13, and 14 (pp. 283–317 and 495–580).
- Asano (2013): Chapters 4.7, 6.6, 6.7, 6.8, 6.9, 6.10, and Appendix A.3. (pp. 111–121, 164–181, and 234–242).
- Bradley (2013): Chapters 6.3, 6.4, 7.3, and 7.4 (pp. 286–320 and 400–422).
- Haeussler and Paul (1987): Chapters 12, 13, 17.7, 17.8, 17.9, and 17.10 (pp. 473–532 and 697–723).
- Shannon (1995): Chapters 8.6, 8.7, 10.4, 10.5, 10.6, and 10.7 (pp. 383–396 and 462–501).