ECC3860
Integrated economic modelling

Unit Guide

Semester 2, 2010

The information contained in this unit guide is correct at time of publication. The University has the right to change any of the elements contained in this document at any time.

Last updated: 04 Feb 2011
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Chief Examiner:

Simon Angus

Lecturer(s) / Leader(s):

Clayton

Dr Simon Angus

Contact hours: Monday 2-4pm, 11.E962

Dr Brett Parris

Contact hours: Thursday 1.30-3.30 PM, 11.E660

Tutor(s):

Clayton

Mr Behrooz Hassani-M

Contact hours: Monday 2:30 - 3:30 PM, Thursday 1 - 2 PM, 11.E755
**Introduction**

Welcome to ECC/ETC 3860, Integrated Economic Modelling (IEM)!

We are extremely excited to offer this unit jointly between the Department of Economics and the Department of Econometrics and Business Statistics at Monash University, Clayton. To our knowledge, this is one of the first Complex Adaptive Systems (CAS) undergraduate units to be taught in an Economics context in Australia, so we will all be part of a ground-breaking work in this unit!

Why now? A quick look at the newspapers and news bulletins reveals a telling set of problems facing Australia at present: the global financial crisis, the sovereign debt crisis in Europe, the enhanced greenhouse effect, global and national food security problems, and continuing concerns over the shifting global trade balance from the US to China. In IEM this semester, we will be arguing that all of these problems can be, and should be, analysed through the CAS perspective.

What are the commonalities? Take the example of the sovereign debt crisis in Europe, where we have: many economic actors (sovereign nations); drawn into economic transactions via a complicated network of transfers, loans and debts; non-rational biases in these actors’ behaviours (fear, anxiety, herd-behaviour); and consequent outcomes which seem abrupt and unpredictable (credit-flights, stock-market bubbles and crashes, riots and political turmoil) -- in short, we have the elements of a Complex System.

Complex Systems Science (CSS) aims to understand such systems with a view to producing models of their behaviour for analysis and ultimately, prediction. The common tool of CSS is Agent-Based Modelling (ABM), which allows for non-rational, heterogeneous, and asymmetrically interacting agents to come together in a digital universe. Sound familiar? .. If you’ve played Civilization, World of Warcraft, SimCity, or SecondLife, stay tuned -- we’ll show you how games are actually more helpful to economists than just providing entertainment in their spare time!

We hope you enjoy exploring with us the fascinating world of Complex Adaptive Systems and ABMs!

**Unit synopsis**

The aim of this unit is to enable students to understand some of the complexities of interdisciplinary policy problems, particularly in the areas of sustainable development, and to enable them to design and undertake integrated modelling exercises for themselves. A complex systems science perspective will be adopted, introducing Agent-Based Modelling (ABM) as a flexible and powerful tool for exploring solutions to complex real-world problems. The ABM approach will be demonstrated and critically assessed through several interdisciplinary, integrated economy/sustainability models. Additionally, a flexible ABM modelling platform (NetLogo) will be introduced and demonstrated.

**Learning outcomes**

The learning goals associated with this unit are for students to:

- understand some of the complexities of interdisciplinary policy problems, particularly in the areas of sustainable development
- comprehend and critically assess the complex systems perspective
- critically evaluate agent-based models and their outputs
- develop and analyse an agent-based model of an integrated modelling problem
- undertake verification, validation, evaluation and assessment of integrated modelling outputs
- apply integrated modelling approaches to real-world interdisciplinary economic problems.
Contact hours

39 contact hours

Unit relationships

Prerequisites

Students must have passed ETC1000 before undertaking this unit

Co-requisites

It is recommended that students study ECC2800 Prosperity, poverty and sustainability in a globalised world
### Teaching and learning method

### Timetable information

For information on your timetable, including tutorial allocation if required, please refer to:
http://allocate.its.monash.edu.au/

### Unit Schedule

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<th>Lecturer/Speaker</th>
<th>Key Dates</th>
<th>Activity</th>
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<tr>
<td>Intro to IEM [1]</td>
<td>Angus/Parris</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The CAS Perspective [2-3]</td>
<td>Parris</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Tour of Complex Policy Problems [4-5]</td>
<td>Parris</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intro to ABMs [6-7]</td>
<td>Angus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Art of ABMs [8]</td>
<td>Angus</td>
<td>End of week 4 tutorial</td>
<td>Complexity Assignment DUE (10 marks)</td>
</tr>
<tr>
<td>Simulation &amp; Gaming [9]</td>
<td>Parris</td>
<td>Start of week 5 tutorial</td>
<td>Minor Project Topic Announced</td>
</tr>
<tr>
<td>Overview of CAS Modelling [10]</td>
<td>Parris</td>
<td></td>
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</tr>
<tr>
<td>CAS Examples [11-13]</td>
<td>Angus</td>
<td>End of week 6 tutorial</td>
<td>Minor Project DUE (15 marks)</td>
</tr>
<tr>
<td>Data Acquisition [14-15]</td>
<td>Parris</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration, Verification [16-18]</td>
<td>Angus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Examples [19-21]</td>
<td>Parris</td>
<td>In week 10 tutorial</td>
<td>Major Project Presentation (5 marks)</td>
</tr>
<tr>
<td>Analysis &amp; Interpretation of Outputs [22-23]</td>
<td>Angus</td>
<td></td>
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</tr>
<tr>
<td>Review [24]</td>
<td>Angus/Parris</td>
<td>Last day of semester (week 12)</td>
<td>Major Project Due (25 marks)</td>
</tr>
</tbody>
</table>
Introduction to ETC/ECC 3860 Integrated Economic Modelling

[Lecture 1: Simon Angus, Brett Parris & Behrooz-Hassani M.]

Don't be alarmed by the number of readings listed on the following pages - we don't expect you to read them all. Required readings are marked with **. The other readings are ones you may find useful or interesting. Since there's only one unit covering complex systems approaches to integrated economic modelling, we thought it best to give you an idea of the breadth of material being produced and the amazing work being done in this exciting and rapidly expanding field. You won't have to go hunting either - all readings will be provided as pdfs in a zip folder.

Part 1: Introductions to Integrated Modelling (Motivation)

1.1: Economic Conundrums and the Complex Adaptive Systems Perspective

[Lectures 2 & 3: Brett Parris]


1.2: A Tour of Complex Policy Problems: Climate-change, economic development, energy, sustainability, finance, conflict, innovation

[ Lectures 4 & 5: Brett Parris ]


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Part 2: The Agent-Based Modelling Approach (Method)

2.1: Introduction to Agent-Based Modelling

[Lectures 6 & 7: Simon Angus]


2.2 The art of ABMs – designing 'good' models (interplay)

[Lecture 8: Simon Angus]


2.3 What can we learn from the overlap between simulation modelling and gaming?

[Lecture 9: Brett Parris]


Barreteau, O., Bousquet, F. and Attonaty, J.-M., (2001) "Role-Playing Games for Opening the Black Box of Multi-Agent Systems: Method and Lessons of its Application to Senegal River Valley Irrigated


2.4: Overview of ABM Platforms

[Lecture 10: Brett Parris]

NetLogo software, manual & tutorials http://ccl.northwestern.edu/netlogo/
2.5 Examples 1: spatial-interactions, cellular automata, networks, soup-models

[Lectures 11 & 12: Simon Angus]


2.6 Examples 2: Learning, innovation, market design, evolutionary programming, genetic algorithms, simulated annealing

[Lectures 13 & 14: Simon Angus]


Part III: ABMS and the Real World (Verification & Interpretation)

3.1 Data acquisition (e.g. Geographic Information System, GIS)

[Lectures 15 & 16: Brett Parris]


### 3.2 Calibration, scaling, verification, validation

[Lectures 17, 18 & 19: Simon Angus]


http://jasss.soc.surrey.ac.uk/8/4/3.html
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3.3 Examples: economics, energy, development, drugs, epidemics, conflict

[Lectures 20, 21 & 22: Brett Parris]


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3.4 Analysis and interpretation of ABM outputs

[Lectures 23 & 24: Simon Angus]


Reference & further reading


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Unit Resources

Prescribed text(s) and readings

Recommended text(s) and readings

Library resources
The Monash University Library provides a range of services and resources that enable you to save time and be more efficient in your learning and research at URL: http://www.lib.monash.edu.au or via the Library tab in the my.monash portal.

Blackboard (MUSO)

- All unit and lecture materials, plus other information of importance to students, are available through the MUSO (Monash University Studies Online) site. You can access MUSO via the My.Monash Portal: http://my.monash.edu.au

Under “Online Systems” click the MUSO hyperlink

In order for your MUSO unit(s) to function correctly, your computer needs to be set up and certain programs may need to be installed such as a compatible Java version (eg version 1.5.0). This can easily be done by going to http://www.monash.edu.au/muso/support/students/browserset.html to update the relevant software.

You can contact MUSO Support by:

**Jobdesk:** http://jobdesk.monash.edu.au/login/index.cfm?jobdesk_id=14
**Email:** muso.support@calt.monash.edu.au
**Phone:** (+61 3) 9903-1268

Operational hours (Monday – Thursday) – local time
Australia: 8 am to 10 pm (8pm Non Teaching period)
Malaysia: 6 am to 8 pm (6 pm Non Teaching period)
South Africa: 11pm to 1pm (11 am Non Teaching period)

Operational hours (Friday) – local time
Australia: Australia: 8 am to 8 pm
Malaysia: 6 am to 6 pm
South Africa: 11pm to 11 am
Operational hours (Saturday-Sunday) – local time (Teaching and Exam Period Only)

Australia: 1 pm to 5 pm
Malaysia: 11 am to 3 pm
South Africa: 4 am to 8 am

Further information can be obtained from the following site

Required software and/or hardware

Key online resources and websites:

**Software**

- Netlogo [http://ccl.northwestern.edu/netlogo/](http://ccl.northwestern.edu/netlogo/)

**People**

- Simon Angus [http://users.monash.edu.au/~sangus/cgi-bin/moinres.cgi/sangus](http://users.monash.edu.au/~sangus/cgi-bin/moinres.cgi/sangus)
- Andrew Crooks [http://gisagents.blogspot.com/](http://gisagents.blogspot.com/)
- Jose M. Vidal [http://jmvidal.cse.sc.edu/](http://jmvidal.cse.sc.edu/)

**Other**

- Journal of Artificial Societies and Social Simulation [http://jasss.soc.surrey.ac.uk/JASSS.html](http://jasss.soc.surrey.ac.uk/JASSS.html)
- Open Agent-Based Modelling Consortium [http://www.openabm.org/site/](http://www.openabm.org/site/)
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VLab - Virtual Complexity Lab at Monash University http://vlab.infotech.monash.edu.au/
Assessment

Assessment Summary

Within semester assessment: 60%
Examination (2 hours): 40%

Faculty assessment policy

For information regarding assessment policy, please refer to the appendix at the end of this Unit Guide.

Second marking

For information regarding second marking practice, please refer to

Return of final marks

The final mark that a student receives for a unit will be determined by the Board of Examiners on the recommendation of the Chief Examiner taking into account all aspects of assessment. The final mark for this unit will be released by the Board of Examiners on the date nominated in the Faculty Calendar.

Applications for extension of time

For information regarding extensions of time, please refer to

Additional assessment information

Assessment Components

<table>
<thead>
<tr>
<th>Assessment</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discussion Log</td>
<td>5</td>
</tr>
<tr>
<td>Tutorial Assignments</td>
<td>25</td>
</tr>
<tr>
<td>Major Project</td>
<td>30</td>
</tr>
<tr>
<td>Examination (2hr)</td>
<td>40</td>
</tr>
</tbody>
</table>

Discussion Log [5%]

Discussion Logs (online) will be formed to discuss the prescribed readings.

- **Group formation:** You must fill out the Online Group Formation Form (accessible via MUSO > Admin) by the end of week 1 of semester. You will receive notification of your group assignment by the end of week 2.
- **Assessment:** You will be assessed individually on how active you have been in the discussion log. As a guide, each student should aim to summarise at least 1 prescribed reading article for each week, and respond to other group member's posts each week to pass this assessment. Your activity on the Discussion Log should take no more than 30min each week.
Tutorial Assignments (2) [25% total]

1. Complexity Assignment (10%, due in week 4 tutorial)

Part A. Find an example from everyday life that operates as a complex system

- Identify the elements of the system, and the feedbacks between the elements.
- Are the feedbacks non-linear in nature? Why?
- Does the system demonstrate emergence? If so, how?

Part B. Sketch (using UML, pseudo-code) how you might model this system using NetLogo.

- What agents would you need?
- What attributes would each agent need to possess?
- What behaviours would each agent need to be able to exhibit?
- What context (e.g. spatial landscape, network, abstract) would the agents inhabit?

Assessment: Your assignment should be no more than 5 pages (including figures). It should be typed clearly. Text answers should be as concise, clear and informative as possible. The UML/pseudo-code component should follow the guidelines given in the tutorials.

Submission: You should submit your assignment (e.g. .doc, .docx, .pdf file) to MUSO by the end of your week 4 tutorial.

2. 'El Farol' Project (15%, due in week 6 tutorial)

At the beginning of the week 5 tutorial, you will be given a modelling problem. The same problem will be given to all students. You have until the end of the week 6 tutorial to send your NetLogo model of the problem to your Tutor (by email).

Assessment: This is an individual assignment. Of course, we expect some discussion between you and your tutorial members. However, you must turn in your own assignment work. Evidence of plagiarism between your assignment and another will incur severe penalties. You will be rewarded to the extent to which your model and Info tab answer the following questions --

1. Does your model display realistic dynamics?
2. Does your model demonstrate a good grasp of NetLogo? (i.e. use of NetLogo procedures)
3. Does your explanation of your model and its insights show a command of NetLogo and its applications? (in the Info tab)

Submission: You should submit your assignment (.nlogo file) to MUSO by the end of your week 6 tutorial.

Major Project [30% total]

Class Presentation [5%, in tutorial of week 10]

- To be based on major project

  ◆ Emphasis will be on your presentation skills, communication, and how you answer questions etc.;
  ◆ Questions and answers will be taken, giving an opportunity to receive feedback on your approach;
  ◆ Demonstration of code is not necessary in this presentation, but may be helpful.
The Project [25%, due end of semester]

You will be required to design, implement and analyse a model that explores an integrated economic / complex adaptive systems problem from a list of projects given out later in the unit.

Note: This is an individual assignment. Of course, we expect some discussion between you and your tutorial members. However, you must turn in your own assignment work. Evidence of plagiarism between your assignment and another will incur severe penalties.

Project submission:

- Your submission must include your .nlogo file (and any input data attachments), and a report (no more than 5 pages, .doc, .docx, .pdf) file that addresses item 5. in the marking guide below.
- Your project must be submitted to MUSO by 11:59pm on the last day of Semester. Late submissions will attract a 5% (raw) deduction for every day (or part thereof) that it is late.
- Your project will be marked as follows:

  1. [3%] The assumptions of the model (are these realistic/intuitive? do they allow for straight-forward analysis?)
  2. [5%] The behaviour of the model (does it give realistic behaviour? does it shed light on the research question?)
  3. [5%] The coding of the model (in the 'Procedures Tab': is the code easy to follow and commented throughout? does the code make appropriate use of NetLogo procedures? is the code modular?)
  4. [4%] The explanation of the model (in the Info Tab: does the explanation of the model fit with what has been modelled? are there interesting extensions to the model?)
  5. [8%] The analysis and interpretation of your model (what does it show? does it answer the research question? what policy implications (if any) does this analysis suggest?)

End of Semester Examination [40%]

1. Aim: to test overall understanding of integrated modelling problems and tools used to analyse them.
2. Task: 2 hour end-of-semester examination requiring students to answer a number of short-answer and long-answer questions on material from the unit.
3. Assessment: emphasis on comprehension and overall synthesis of ideas and examples presented in the unit.

Special consideration

For information regarding special consideration, please refer to the appendix at the end of this Unit Guide.
## Assessment criteria - grading descriptors table

<table>
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<tr>
<th></th>
<th>High Distinction (80%+)</th>
<th>Distinction (70 - 79%)</th>
<th>Credit (60 - 69%)</th>
<th>Pass (50 - 59%)</th>
<th>Fail (Less than 50%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General description</strong></td>
<td>Outstanding or exceptional work in terms of understanding, interpretation and presentation</td>
<td>A very high standard of work which demonstrates originality and insight</td>
<td>Demonstrates a high level of understanding and presentation and a degree of originality and insight</td>
<td>Satisfies the minimum requirements</td>
<td>Fails to satisfy the minimum requirements</td>
</tr>
<tr>
<td><strong>Reading</strong></td>
<td>Strong evidence of independent reading beyond core texts and materials</td>
<td>Evidence of reading beyond core texts and materials</td>
<td>Thorough understanding of core texts and materials</td>
<td>Evidence of having read core texts and materials</td>
<td>Very little evidence of having read any of the core texts and materials</td>
</tr>
<tr>
<td><strong>Knowledge of topic</strong></td>
<td>Demonstrates insight, awareness and understanding of deeper and more subtle aspects of the topic. Ability to consider topic in the broader context of the discipline</td>
<td>Evidence of an awareness and understanding of deeper and more subtle aspects of the topic</td>
<td>Sound knowledge of principles and concepts</td>
<td>Knowledge of principles and concepts at least adequate to communicate intelligently in the topic and to serve as a basis for further study</td>
<td>Scant knowledge of principles and concepts</td>
</tr>
<tr>
<td><strong>Articulation of argument</strong></td>
<td>Demonstrates imagination or flair. Demonstrates originality and independent thought</td>
<td>Evidence of imagination or flair. Evidence of originality and independent thought</td>
<td>Well-reasoned argument based on broad evidence</td>
<td>Sound argument based on evidence</td>
<td>Very little evidence of ability to construct coherent argument</td>
</tr>
<tr>
<td><strong>Analytical and evaluative skills</strong></td>
<td>Highly developed analytical and evaluative skills</td>
<td>Clear evidence of analytical and evaluative skills</td>
<td>Evidence of analytical and evaluative skills</td>
<td>Some evidence of analytical and evaluative skills</td>
<td>Very little evidence of analytical and evaluative skills</td>
</tr>
<tr>
<td><strong>Problem solving</strong></td>
<td>Ability to solve very challenging problems</td>
<td>Ability to solve non-routine problems</td>
<td>Ability to use and apply fundamental concepts and skills</td>
<td>Adequate problem-solving skills</td>
<td>Very little evidence of problem-solving skills</td>
</tr>
<tr>
<td><strong>Expression and presentation appropriate to the discipline</strong></td>
<td>Highly developed skills in expression and presentation.</td>
<td>Well developed skills in expression and presentation.</td>
<td>Good skills in expression and presentation. Accurate and consistent acknowledgement of sources.</td>
<td>Adequate skills in expression and presentation.</td>
<td>Inadequate skills in expression and presentation. Inaccurate and inconsistent acknowledgement of sources.</td>
</tr>
</tbody>
</table>

*Source: University of Adelaide 2005*
Appendix

Please visit the following URL: http://www.buseco.monash.edu.au/unit-guide/appendix.html for further information about:

- Continuous improvement
- Assessment policy
- Grading Scale policy
- Special consideration
- Plagiarism, cheating and collusion
- Plagiarism register
- Non-discriminatory language
- Students with disabilities
- Using the University’s computer and IT facilities
- Faculty policies
- Related links