ECC3860 Integrated economic modelling - Semester 2, 2012

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.

Mode of Delivery
Clayton (Day)

Workload
6 points, SCA Band 3, 0.125 EFTSL

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

Chief Examiner
Dr Simon Angus

Campus Lecturer

Clayton

Dr Simon Angus
Contact hours: Tuesday 10am-12pm, 11.E962

Dr Brett Parris
Contact hours: Thursday 1:30-3:30 PM, 11.E660
ECC3860 Integrated economic modelling - Semester 2, 2012

Tutors

Clayton

Mr Behrooz Hassani-M
Contact hours: Monday 2:30 - 3:30 PM, Thursday 1 - 2 PM, 11.E755
Academic Overview

Learning Objectives

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

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

Graduate Attributes

Monash prepares its graduates to be:

1. responsible and effective global citizens who:
   a. engage in an internationalised world
   b. exhibit cross-cultural competence
   c. demonstrate ethical values
2. critical and creative scholars who:
   a. produce innovative solutions to problems
   b. apply research skills to a range of challenges
   c. communicate perceptively and effectively

Assessment Summary

Second marking

Where an assessment task is given a fail grade by an examiner, that piece of work will be marked again by a second examiner who will independently evaluate the work, and consult with the first marker. No student will be awarded a fail grade for an assessment task or unit without a second examiner confirming the result.

Note: Exceptions to this are individual pieces of assessment contributing 10% or less of the final mark, unless the total of such pieces exceeds 30% of the final mark.

Return of final marks

Faculty policy states that '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. Student results will be accessible through the my.monash portal.
Assessment criteria


<table>
<thead>
<tr>
<th>Assessment Task</th>
<th>Value</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexity Assignment</td>
<td>10%</td>
<td>(To MUSO) 11:59pm, Sunday 19th August (Week 4)</td>
</tr>
<tr>
<td>NetLogo skills tests</td>
<td>Each test will be worth 3% of your grade, 9% in total.</td>
<td>(To MUSO) End of weeks (i.e. Sundays 11.59 PM) week 2 (5 August), week 4 (19 August), and week 6 (2 September) of the Semester, however, you may submit any test early.</td>
</tr>
<tr>
<td>Reading Log</td>
<td>8% total made up of 3% + 5%. NB: the Reading Log will be marked individually.</td>
<td>The log will be available all semester online, but will close to submissions at 11:59pm, Sunday 28th October</td>
</tr>
<tr>
<td>Major Project</td>
<td>Check-in 3%, Final submission 30%, 33% in total</td>
<td>The Check-in Assessment will be due by the end of week 8 (11.59 PM, Sunday 16th September), the final project will be due end of week 12 (11.59 PM Sunday 21st October).</td>
</tr>
<tr>
<td>Examination 1</td>
<td>40%</td>
<td>To be advised</td>
</tr>
</tbody>
</table>

Teaching Approach

- **Lecture and tutorials or problem classes**
  Lectures are used to develop the content of the course, starting with basic building block material in different areas such as core complex systems concepts and real world policy challenges. As the unit progresses, agent-based modelling is introduced and some themes from earlier lectures are revisited in more detail as the threads are woven together. Meanwhile, the free agent-based modelling platform NetLogo is taught in the tutorial stream. There is often not a direct connection between a particular week's lectures and that week's tute. Instead they develop in parallel. But as you will see, it all comes together in the end.

- **Peer assisted learning**
  Online group-based discussion logs are an essential component of the unit. The reading list for this unit is large. Since this is the only unit covering these topics, there is a whole world to introduce you to! You are not expected to read them all by any means - they are provided as a resource for later if particular topics spark your interest. To make these topics more accessible, we provide all readings as pdfs in a separate folder for download. Core readings are noted by a double asterisk in the reading guide. You are expected to divide these up among yourselves within the group and summarise their main points and discuss them.

- **Problem-based learning**
  The assignments, and particularly the major project, require you to take what you have learned in lectures and tutes and apply it to a simplified, but still fairly realistic real-world complex problem.

Feedback
Our feedback to You

Types of feedback you can expect to receive in this unit are:

- Informal feedback on progress in labs/tutes
- Graded assignments with comments
- Test results and feedback
- Quiz results

Your feedback to Us

Monash is committed to excellence in education and regularly seeks feedback from students, employers and staff. One of the key formal ways students have to provide feedback is through SETU, Student Evaluation of Teacher and Unit. The University's student evaluation policy requires that every unit is evaluated each year. Students are strongly encouraged to complete the surveys. The feedback is anonymous and provides the Faculty with evidence of aspects that students are satisfied and areas for improvement.

For more information on Monash's educational strategy, and on student evaluations, see:
http://www.policy.monash.edu/policy-bank/academic/education/quality/student-evaluation-policy.html

Previous Student Evaluations of this unit

If you wish to view how previous students rated this unit, please go to

Required Resources

Prescribed textbook


Recommended books


Recommended Resources

Key online resources and websites:

Software
GraphViz  http://www.graphviz.org/
NetLogo  http://ccl.northwestern.edu/netlogo/
NetLogo R Extension  http://r-ext.sourceforge.net/
Pajek  http://pajek.imfm.si/doku.php?id=pajek
R  http://www.r-project.org/
RStudio  http://rstudio.org/
Visual Paradigm for UML  http://www.visual-paradigm.com/product/vpuml/

People - Monash
Simon Angus  http://users.monash.edu.au/~sangus/cgi-bin/moinres.cgi/sangus
Brett Parris  http://www.brettparris.com

People - Non-Monash
Andrew Crooks  http://gisagents.blogspot.com/
David Earnest  http://www.odu.edu/~dearnest/research_abm.htm
Leigh Tesfatsion’s ABM portal  http://www.econ.iastate.edu/tesfatsi/ace.htm
Jose M. Vidal  http://jmvidal.cse.sc.edu/
Gabriel Wurzer, NetLogo lessons  http://www.youtube.com/user/gabrielwurzer/videos

Other
Agent-based Models  http://www.agent-based-models.com/blog/
Complexity Digest  http://comdig.unam.mx/index.html
Journal of Artificial Societies and Social Simulation  http://jasss.soc.surrey.ac.uk/JASSS.html
NetLogo Modeling Commons  http://modelingcommons.org/
Open Agent-Based Modelling Consortium  http://www.openabm.org/site/
Academic Overview

Santa Fe Institute [http://www.santafe.edu/](http://www.santafe.edu/)


# Unit Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Activities</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No formal assessment or activities are undertaken in week 0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Introduction to Integrated Economic Modelling</td>
<td></td>
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<tr>
<td>2</td>
<td>The Complex Adaptive Systems perspective</td>
<td>NetLogo Quiz 1 due 11:59pm Sunday 5th August</td>
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<tr>
<td>3</td>
<td>A Tour of Complex Policy problems</td>
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<tr>
<td>4</td>
<td>Introduction to Agent-Based Models (ABMs)</td>
<td>Complexity Assignment AND NetLogo Quiz 2 due 11:59pm Sunday 19th August</td>
</tr>
<tr>
<td>5</td>
<td>The Art of ABM</td>
<td>First assessment of Reading Logs on discussion up to 11.59pm Sunday 26th August. 3% allocated.</td>
</tr>
<tr>
<td>6</td>
<td>Simulation &amp; Gaming</td>
<td>NetLogo Quiz 3 due 11:59pm Sunday 2nd September</td>
</tr>
<tr>
<td>7</td>
<td>Overview of CAS Modelling</td>
<td></td>
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<tr>
<td>8</td>
<td>CAS Examples</td>
<td>Major Project ‘check-in’ assessment due 11:59pm Sunday 16th September</td>
</tr>
<tr>
<td>9</td>
<td>Data Acquisition</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Calibration, Verification</td>
<td></td>
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<tr>
<td>11</td>
<td>Research Examples</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Analysis &amp; Interpretation of Outputs</td>
<td>Major Project due 11:59pm Sunday 21st October</td>
</tr>
<tr>
<td></td>
<td>SWOT VAC</td>
<td>Reading Log closes 11:59pm Sunday 28th October. Remaining 5% for the logs allocated.</td>
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</tbody>
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Assessment Requirements

Assessment Tasks

* Assessment task 1

Title: Complexity Assignment

Due date: (To MUSO) 11:59pm, Sunday 19th August (Week 4)

Details of task:
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, feedback network) 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?

Word limit: No more than 5 pages (including figures).

Weighting/Value: 10%

Presentation requirements:
The assignment 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.

Estimated return date:

* Assessment task 2

Title: NetLogo skills tests

Due date: (To MUSO) End of weeks (i.e. Sundays 11.59 PM) week 2 (5 August), week 4 (19 August), and week 6 (2 September) of the Semester, however, you may submit any test early.

Details of task:
You will need to demonstrate your ability in fundamental aspects of NetLogo. Each test will be outlined in your tutorials. You will need to submit a working NetLogo (.nlogo) file in each submission that demonstrates the required skills.

Weighting/Value: Each test will be worth 3% of your grade, 9% in total.

Estimated return date:
Assessment Requirements

• Assessment task 3

Title: Reading Log

Due date: The log will be available all semester online, but will close to submissions at 11:59pm, Sunday 28th October

Details of task: You will be placed in a small Discussion Log (online) group to discuss the prescribed weekly 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.

♦ There will be two phases of assessment: 3 marks allocated at the end of week 5 (Sunday 26 August) and the remaining 5 marks at the close of the logs on Sunday 28 October.

Weighting/Value: 8% total made up of 3% + 5%. NB: the Reading Log will be marked individually.

Estimated return date:

• Assessment task 4

Title: Major Project

Due date: The Check-in Assessment will be due by the end of week 8 (11.59 PM, Sunday 16th September), the final project will be due end of week 12 (11.59 PM Sunday 21st October).

Details of task: You are required to either replicate and extend, or design and build, an agent-based model that explores an integrated economic / complex-adaptive-system 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.

Intermediate ‘Check-in’:

You are required to submit to MUSO a 30 word statement of the ‘research problem’, or the research problem that you think the replicate paper is addressing. You must also outline the key agents and interactions in the model. Your check-in submission should be no longer than 1 A4 page.

Final project submission:

Your final 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. Late submissions will attract a 5% (raw) deduction for every day.
Assessment Requirements

(or part thereof) that it is late.

Your project will be marked as follows:

For a novel project:

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?)

For a replication project:

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 replicate the reported behaviour?);
3. [5%] The **coding** of the model (in the ‘Procedures Tab’: is the code easy to follow and well 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 extensions well motivated and documented?)
5. [8%] The **analysis, interpretation & extensions to the model**: what replication challenges did you encounter? was the model well described and easy to follow in the paper? what extensions did you try? what additional impact/insight did these extensions add to the model?

**Weighting/Value:**
Check-in 3%, Final submission 30%, 33% in total

**Estimated return date:**

**Examinations**

- **Examination 1**

  **Weighting:**
  40%

  **Length:**

  **Type (open/closed book):**

  **Electronic devices allowed in the exam:**
  None

  **Remarks:**
  **Aim:** to test overall understanding of integrated modelling problems and tools used to analyse them.

  **Task:** 2 hour end-of-semester examination requiring students to answer a number of
Assessment Requirements

short-answer and long-answer questions on material from the unit.

**Assessment**: emphasis on comprehension and overall synthesis of ideas and examples presented in the unit.

**Assignment submission**

**Online submission**

If Electronic Submission has been approved for your unit, please submit your work via the VLE site for this unit, which you can access via links in the my.monash portal.
Other Information

Policies

Monash has educational policies, procedures and guidelines, which are designed to ensure that staff and students are aware of the University’s academic standards, and to provide advice on how they might uphold them. You can find Monash's Education Policies at: http://policy.monash.edu.au/policy-bank/academic/education/index.html

Key educational policies include:

- Plagiarism (http://www.policy.monash.edu/policy-bank/academic/education/conduct/plagiarism-policy.html)
- Special Consideration (http://www.policy.monash.edu/policy-bank/academic/education/assessment/special-consideration-policy.html)
- Grading Scale (http://www.policy.monash.edu/policy-bank/academic/education/assessment/grading-scale-policy.html)
- Discipline: Student Policy (http://www.policy.monash.edu/policy-bank/academic/education/conduct/student-discipline-policy.html)
- Academic Calendar and Semesters (http://www.monash.edu.au/students/key-dates/)
- Orientation and Transition (http://www.infotech.monash.edu.au/resources/student/orientation/)

Student services

The University provides many different kinds of support services for you. Contact your tutor if you need advice and see the range of services available at www.monash.edu.au/students

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

Students who have a disability or medical condition are welcome to contact the Disability Liaison Unit to discuss academic support services. Disability Liaison Officers (DLOs) visit all Victorian campuses on a regular basis

- Website: http://adm.monash.edu/sss/equity-diversity/disability-liaison/index.html
- Telephone: 03 9905 5704 to book an appointment with a DLO
- Email: dlu@monash.edu
- Drop In: Equity and Diversity Centre, Level 1 Gallery Building (Building 55), Monash University, Clayton Campus.

Moodle 2

All unit and lecture materials, plus other information of importance to students, are available through the virtual learning environment Moodle site. You can access Moodle via the my.monash portal.
Where to go for help
If you're stuck, confused or simply not sure how to approach Moodle, there are a number of Moodle resources that you can tap into.

Prescribed text(s) and readings

Recommended text(s) and readings


Introduction to ETC/ECC 3860 Integrated Economic Modelling
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 are provided as pdfs in a zip folder under IEM Library on MUSO.

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

Part 1: Introductions to Integrated Modelling (Motivation)

1.1: Economic Conundrums and the Complex Adaptive Systems Perspective

Lectures 2 & 3: Brett Parris


Other Information


1.2: A Tour of Complex Policy Problems: Climate-change, economic development, energy, sustainability, finance, conflict, innovation
Lectures 4 & 5: Brett Parris


Other Information


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

2.1: Introduction to Agent-Based Modelling

Lectures 6 & 7: Simon Angus


Other Information


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


Other Information


### 2.4: Overview of ABM Platforms

**Lecture 10: Brett Parris**

NetLogo software, manual & tutorials http://ccl.northwestern.edu/netlogo/


http://jasss.soc.surrey.ac.uk/15/3/8.html

### 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**

Other Information


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

** Lectures 15 & 16: Brett Parris


Other Information


### 3.2 Calibration, scaling, verification, validation

*Lectures 17, 18 & 19: Simon Angus*


Manson, S.M., (2008) "Does Scale Exist? An Epistemological Scale Continuum for Complex


3.3 Examples: economics, energy, development, drugs, epidemics, conflict

Lectures 20, 21 & 22: Brett Parris


** Smajgl, A., (2010) "Challenging Beliefs through Multi-level Participatory Modelling in Indonesia", Other Information


3.4 Analysis and interpretation of ABM outputs

** Lectures 23 & 24: Simon Angus


Reference & further reading

Other Information


Perez, P. and Batten, D.F. (Eds.),(2006) *Complex Science for a Complex World: Exploring Human


