Introduction to Environmental Modeling

Fall 2017
Andrew Bell

Description

Environmental systems respond to disturbance (human or otherwise) in ways that can be counter-intuitive and difficult to predict. Tipping points, non-linearities, and feedback loops create an important role for formal computer models in the systematic analysis of environmental systems.

However, models must always be used with caution. Models are built to answer particular questions, and represent a set of assumptions about how a system behaves. Understanding the assumptions a model makes, and how those assumptions limit the range of inferences that can be made, is critical for any model output to be treated as knowledge.

This course will provide an introduction to the process of building and using models of environmental systems using a systems dynamics (stock & flow) modeling platform called STELLA. Key concepts include causal modeling and the representation of systems as a set of processes, basic numerical methods, model development in STELLA, and analytical approaches to make inferences from model results. No prior coding experience is necessary, but students should expect to make significant use of algebra and basic statistics.

Prerequisite: ES 100, or approval of instructor

Textbooks (Optional):

There are **no required textbooks** for this course. There are a number of guides online that I will draw on as background reading for basic modeling concepts, many of which are here:

https://thesystemsthinker.com/category/how-to-guides/

There are more advanced guides at the link above that I will not draw on, but which are likely to be of interest to some of you. Time spent looking through these materials would not be wasted.

Relevant topic readings for each module will be made available on NYU Classes. For technical issues with the modeling approach, Google is a great place to look. For those who really get into the topic and wish to have a further guide to refer to, I suggest the following (very expensive) book for further reading:

Business Dynamics (2000). John Sterman

Instructor: Andrew Bell is Assistant Professor of Environmental Studies, with research focusing on coupled natural-human systems.

Office Hours: M,T,W, 4-6pm. Sign up for a slot in advance at goo.gl/3ezETN

Disability Disclosure Statement: Academic accommodations are available to any student with a chronic, psychological, visual, mobility, learning disability, or who is deaf or hard of hearing. Students should please register with the Moses Center for Students with Disabilities at 212-998-4980.

Grading and Student Expectations

Item	% of grade
Module Assignments	40
In-class midterm	25
Final paper abstract and causal model	7.5
Final paper presentation	7.5
Final paper and Presentation	20

Assignments and exams will be given a numeric score from 0-100. Late submissions will be penalized 5 points per whole/partial day late.

It is NYU policy that all work is expected to be your own. Plagiarism of any kind will result in a failing grade for the class, and referral to an academic dean. Plagiarism includes: copying sentences or fragments from any source without quotes or references; not citing every source used in your papers; citing internet information without proper citation; presenting someone else's work as your own; or copying verbatim from any source. You are subject to CAS's guidelines for Academic Integrity:

http://cas.nyu.edu/page/ug.academicintegrity

Module Assignments

Modeling tasks as well as numerical and short-answer problems (~5-10 problems per set) will be posted on the Wednesday after the end of a module, online in NYUClasses, and will be due by the start of the 2nd Monday after (i.e., you will have approximately 12 days for each assignment, with office hours right in the middle of that period). Submission is via the NYUClasses page.

Attendance and active participation in class will be necessary to successfully complete the module assignments. Grading of assignments will be based on demonstrated approach to the problem and demonstrated understanding of the concepts, in addition to a correct response.

There will be a total of 6 assignments over the semester. Your grade will reflect the average of your highest 5 assignment scores.

In-class Midterm

On October 30th there will be an in-class midterm, inclusive of material covered up to Case Study 2

Final Paper

The final paper (15 to 20 pages in length) will be on a topic of the student's choosing and may draw on any or all parts of the course. It may include additional literature review, analytic or empirical content; it may expand on questions raised during the course or pose a new question not addressed in lecture. Importantly, it should include a clear research question that can be addressed using a model, and should include an appropriate model to address that question. The final paper will be graded in three parts, as follows:

Stage	Due Date	Description
Abstract and Causal Model	November 9	300-500 words (plus references). A clear introduction to the topic, sufficient background material (with citation) to lead to and articulate the question that the paper will address, a clear research question, and a causal model representation of your system with the necessary focal processes to address your question
Final Paper Presentation	December 13-14	~15 minutes including time for questions. Presentation should clearly introduce the topic and lead to the question, present sufficient detail of your model to allow audience to interpret your analysis, present key results and analysis, and discuss findings and limiting assumptions in your approach.
Final Paper	December 19	3000-5000 words, inclusive of bibliography with at least 20 sources, and in-text citations. A completed final paper that introduces a clear research question, develops an appropriate model to inform it, and contributes some kind of analysis to addressing it.

I highly recommend using a reference management software such as **Mendeley** or **Zotero** (for those who write in Microsoft Word) or **PaperPile** (for those who write in Google Docs) to manage your documents and citations.

It will change your life.

Re-grade Requests

I am willing to re-visit grades for assignments under very specific conditions. Requests for regrade must:

- Be made no sooner than 24 hours from posting of grade, and no later than 72 hours after posting of grade
- Contain a substantive description of how the originally submitted response merited greater consideration, without adding new or different information to the response
- Be submitted via the Messages function of the NYUClasses page

Etiquette

I do not have rules, but I do have expectations on basic etiquette with respect to student engagement in the class. Specifically,

- Cell phones should not ring audibly during lecture
- Students should not arrive casually late to lecture
- Emails to instructors should include a salutation, a clear statement, and a signature

Approximate Lecture Schedule

Lecture	Date	Topic	Reference Chapters	Additional Notes
1	6-Sep	Introduction and Syllabus	Ford Chapter 1	
2	11-Sep	Modeling Basics 1 – Stella	Richmond, Chapters 2-5 Kim, "Introduction to Systems Thinking" Kim, "Systems Thinking Tools"	
3	13-Sep	Modeling Basics 1 – Causal Models		Modeling Basics 1 Assignment posted
4	18-Sep	Modeling Basics 2 – Lakes		
5	20-Sep	Modeling Basics 2 – Escalators		
6	25-Sep	Modeling Basics 2 – Populations and interactions		
	27-Sep	Case 1 – DDT and the environment	*Additional references in NYU Classes – Case 1	Modeling Basics 2 Assignment posted
7	2-Oct	Case 1 – DDT and the environment		
8	4-Oct	Case 1 – DDT and the environment		
9	9-Oct	**No Class**		
-	11-Oct	Case 1 – DDT and the environment		Case 1 Assignment Posted
10	16-Oct	Case 2 – Fixing Las Vegas	*Additional references in NYU Classes – Case 2	
11	18-Oct	Case 2 – Fixing Las Vegas		
12	23-Oct	Case 2 – Fixing Las Vegas		
13	25-Oct	Case 2 – Fixing Las Vegas		Case 2 Assignment Posted
14	30-Oct	In-class Midterm		
15	1-Nov	Case 3 – Forest Succession	*Additional references in NYU Classes – Case 3	
16	6-Nov	Case 3 – Forest Succession		
17	8-Nov	Case 3 – Forest Succession		Final paper abstract and causal model due
18	13-Nov	Case 3 – Forest Succession		
19	15-Nov	Case 4 – Lotus and rice farming	*Additional references in NYU Classes – Case 4	Case 3 Assignment Posted
20	20-Nov	In-class work – Final Model		
-	22-Nov	**No Class**		
21	27-Nov	Case 4 – Lotus and rice farming		
22	29-Nov	In-class work – Final Model		
23	4-Dec	Case 4 – Lotus and rice farming		
24	6-Dec	Case 4 – Lotus and rice farming		Case 4 Assignment Posted
25	11-Dec	In-class work – Final Model		
26	12-Dec	In-class Presentations		
27	13-Dec	In-class Presentations		
	19-Dec			Final Paper Due