**DS 541 - Agent-based modeling of People, Health, and the Environment**

***Fall 2023; 4 credits***

**Instructors: Andrew Reid Bell**

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**CAS 141H**

**Lectures:** Thursdays 3:30-6:15pm, FLR 123

*Office Hours*

**Bell:** Mondays 1-3pm, by zoom appointment. Sign up for a slot (or two, or however many you need) in advance at [bit.ly/bell\_officehours](https://bit.ly/bell_officehours)

**Description**

Agent-based models are an ideal tool for analyzing systems (cities, economies, road networks, forests) in which the outcomes of interest (illness rates, traffic problems, land use, violence) are shaped strongly by interactions among individual ‘agents’ (drivers, consumers, farmers, spouses) with each other and their environments. This course builds skills in the use of agent-based modeling using the NetLogo platform as a tool for analyzing complex human-environment problems. The course will emphasize the iterative model-building process – forming research questions, building conceptual and then operational models, experimenting, and then refining – to address current research problems. Students should expect to commit time outside of meetings to i) gaining comfort with NetLogo syntax; ii) reading current research in the areas of agent-based modeling and human environment and health problems; and iii) a team based approach to building models.

**Textbooks**

I will not assign any physical or electronic textbooks for you to buy. Instead, I will rely strongly on the scholarly literature, as well as web resources and technical training in ABM using NetLogo. I will curate the links to most resources for you; in some cases, I will encourage you to seek out information or datasets on the web on your own.

The list of resources and readings will be updated along the course, and maintained here:

<https://bit.ly/F23_541_readings>

**Course materials**

Lecture slides and handouts will be made available shortly before the class meeting in which they are to be used, via Blackboard

**Grading and Student Expectations**

There are 10 short written assignments for this course. Your grade will be determined from the highest 9 scores of these assignments, with equal weighting, and with the lowest score being dropped.

***Late assignment submissions****:* We all find ourselves at points where we are being asked for too many things at once. My late grading policy is as follows:

* Late submissions within 2 days of due date - no penalty
* Late submissions more than 1 week late - 10% penalty
* Late submissions more than 2 weeks late - 20% penalty
* Late submissions due to medical or other emergency - no penalty

More importantly, late submissions are unlikely to provide feedback to you in a helpful manner for your progress in the course. Please try to plan accordingly.

**Accommodating illness/emergency-related absences and other extenuating circumstances**

If you will miss more than two classes due to COVID or any other circumstances (including planned absences due to athletics, religious observations, etc.), you will need to notify me as soon as possible. Together we will build a plan for keeping up and engaging with the missed material.

**It is BU 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 BU’s guidelines for Academic Integrity:**

<https://www.bu.edu/academics/policies/academic-conduct-code/>

**Approximate Meeting Schedule**

| Date | Prep Tasks | Topic 1 | Topic 2 | Follow-up Tasks | Deliverable |
| --- | --- | --- | --- | --- | --- |
| **MODULE 1: MODELING SKILLS** | | | | | |
| Sept  7 | None | Introduction to modeling and NetLogo | | Tutorials in Netlogo | None |
| Sept 14 | None | Model and experiment walkthrough - Schelling | Model and experiment walkthrough - Cooperation | Extend Schelling or Cooperation and run experiment | Short report (1-2 pages) describing i) code extension, ii) experiment design, and iii) key findings |
| **(THIS CLASS HELD REMOTELY)** | | |
| Sept 21 | [Read Focal paper for model analysis](https://www.sciencedirect.com/science/article/pii/S0304380021000703) | Critical model analysis 1 | Conceptual modeling - Causal loop diagrams, UML diagrams | Develop conceptual model of own idea (or choose from list) | Short report (1-2 pages) describing i) problem, ii) model question, iii) conceptual model, and iv) explanation of how model informs your question |
| Sept 28 | **\*Likely\* no class - Andrew has conflicting commitment in this time slot** | | | | |
| Oct 5 | [Read Focal paper for model analysis](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0245787) | Critical model analysis 2 | [Blank pages 1 - modeling from scratch](https://docs.google.com/document/d/1Ug07TUGG1dllh8C8Wl8Mk8exeYv5-fKiMlaKCO2MLWg/edit) | Develop 2-3 'steps' of own model and show verification tests | Short report (1-2 pages) describing i) initial steps taken to develop computational model from conceptual model, ii) tests taken to verify modeling steps, and iii) problems identified along the way |
| Oct 12 | [Read Focal paper for model analysis](https://arxiv.org/abs/2304.03442) | Critical model analysis 3 | Blank pages 2 - modeling from scratch | Continue further steps with verification tests, and run experiment | Short report (1-2 pages) describing i) initial steps taken to develop computational model from conceptual model, ii) tests taken to verify modeling steps, and iii) problems identified along the way |
| Oct 19 | [Read paper from ABMer](https://www.pnas.org/doi/abs/10.1073/pnas.1812459116) | Ask an ABMer 1 - Dr. Nicholas Magliocca (U Alabama) | Peer review - own models |  |  |
| **MODULE 2: MODELING IN PRACTICE** | | | | | |
| Oct 26 |  | Module 2 Domain Intro:  **(Fall 23 - Migration and mobility)** | | Background Reading | Short report (1-2 pages) describing i) problem, ii) possible model question, and iii) ideas for key processes for inclusion in model |
| Nov 2 |  | Conceptual modeling | | Elaborate conceptual model | Short report (1-2 pages) describing i) your understanding of conceptual model, and ii) key tests of model elements, based on processes included in conceptual model |
| Nov 9 |  | Domain modeling 1 | | Model environment and unit tests | Short report (1-2 pages) describing two specific tests - i) what is being tested, ii) what is being measured, iii) what the results are, and iv) what this tells us about this aspect of the model |
| Nov 16 |  | Domain modeling 2 | | Agent interactions and unit tests | Short report (1-2 pages) describing two specific tests - i) what is being tested, ii) what is being measured, iii) what the results are, and iv) what this tells us about this aspect of the model |
|  | ***Thanksgiving Recess - no class on Nov 23*** | | | | |
| Nov 30 | Read Focal paper for model analysis | Critical model analysis 4 | Calibration and validation |  | Short report (1-2 pages) describing one dimension of the calibration and validation process - i) what is being tested, ii) what is being measured, iii) what the results are, and iv) what this tells us about the performance of this aspect of the model |
| Dec 7 | Read paper from ABMer | Ask an ABMer 2 - Dr. Kelsea Best (The Ohio State University) | Documentation and experiments | Bring progress update and questions | Short report (1-2 pages) describing one experimental outcome - i) what is being varied, ii) what is being measured, iii) what the results are, and iv) what this tells us about our system |
| Online | Virtual presentation forum: Short recorded presentation submitted to Blackboard, and comments/questions on peers’ presentations | | | | |