ECOL 419/519 Introduction to Modeling in Biology  
Fall 2014

Instructors:

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Time and room: Saguaro Hall 223, MWF 3-4pm

Course description
This course will give an introduction to different modeling methods used in biology research, including differential equations, individual-based simulations, Markov processes, network models, and others. The focus of the course is on understanding the purpose and utility of these techniques, and thus no advanced mathematical or computer skills are required. The course will explore what questions can be answered and what the limitations of each modeling approach are, and we will read scientific papers applying them. Each student will choose one modeling paper from their discipline which we will then work through in detail in class.

Expected learning outcomes
Students will become familiar with different quantitative methods used in biology, and their accompanying terminology. Students will acquire skills to help them read theory papers effectively and critically, including when the paper is challenging and includes unfamiliar mathematical techniques. Students will also learn basics of writing scripts and programming through in-class and homework exercises. This will allow hands-on experience in what modeling can be used for and what is involved. Students will gain enough familiarity with scripts and programming languages to enable students to make further learning progress on their own.

Workload for the course
There are no in-class exams. The main workload will stem from reading required readings, paper summaries, homework exercises, and reproducing a figure from a model. All required readings will be made available on D2L.

(1) Paper work-through
Each student will be asked to find a scientific paper in their own field that applies a modeling technique by September 3rd. Each of these papers will be discussed in detail in class over the course of the semester, with the goal that each student will be able to follow the authors’ argument and judge their evidence. For each paper, students will prepare a written summary after our discussion in class. In particular, the following questions should be answered in approximately 1-5 sentences each: (a) What is the research question? (b) What does the modeling/quantitative technique do to help answer it? (c) Why was this technique chosen, or what are its benefits for this purpose? (d) What assumptions had to be made in this approach, and are they specific or general? (e) Could the same have been achieved with an empirical or other modeling approach, or with a well-formed verbal argument? What would have been the disadvantages or advantages then?

(2) Homework exercises
We will have some homework exercises which will help you get comfortable with Mathematica and practical issues in implementing models. Each homework will directly relate to techniques first demonstrated in class. You will submit your Mathematica notebook file to a Dropbox on D2L.

You will need access to Mathematica to complete the homework. For most people, this means buying a student license for Mathematica for $40 at the UA Bookstore. You can print out your request before you go over there, from http://uabookstore.arizona.edu/downloads/mathmat_reg.pdf
(3) Model work-through and figure
Our goal is to have you comfortable enough with the modeling technique used in ‘your’ paper (the one you selected for class discussion) that you can re-implement at least parts of it in Mathematica (or another language) and reproduce one of the results figures from the paper. The homework exercises are designed to help you get started on the skills for achieving this. We expect that doing this will involve individual meetings with one of the instructors.

If you are more ambitious, you may opt to do an original model rather than reproduce one from a paper. If you choose this option, please consult with an instructor to make sure that your modeling ideas are viable within the timeframe of the course.

Grading
Final grade will be determined from your participation in class (10%), the written summaries of papers (40%), the homework exercises (30%), and the model reproduction (20%). Class participation requires not only presence in class but also active participation in discussions.
A: 90-100%; B: 80-89%; C: 70-79%; D: 60-69%; E (fail): 0-59 %

Undergraduate vs. Graduate student requirements
Undergraduate and graduate students will both be completing the same paper summaries and homeworks. However, undergraduate students will not be expected to choose a paper to work through (although they will write the summaries about each paper as do the graduate students), and will be able to drop either one of the homework grades or one of the paper summary grades from their overall grade calculation (i.e. their worst homework/summary grade will not be counted towards the final grade).

Readings & Course website
You will be able to obtain readings and check the current class schedule at the course website on D2L. Before the semester starts, or if you are not yet enrolled, you will find general information at: http://socialinsectlab.arizona.edu/

Policy on Expected Classroom Behavior
Enrollment in the course signifies that a student will participate to the best of his or her abilities in each class session. No electronic communication devices should be used during the class session. Each student is expected to attend every class session; however, I will not take attendance and should you miss one or two class sessions this will have no effect. All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion, and absences pre-approved by the UA Dean of Students (or Dean's designee) will be honored.

Policy Against Plagiarism
http://deanofstudents.arizona.edu/codeofacademicintegrity

Policy Against Threatening Behavior
http://policy.web.arizona.edu/threatening-behavior-students

Special Needs and Accommodations Statement
It is the University’s goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please let me know immediately so that we can discuss options. You are also welcome to contact Disability Resources (520-621-3268) to establish reasonable accommodations.

Please be aware that any accessible table and chairs in the classroom should remain available for students who find that standard classroom seating is not usable.