MAT 205 / ES 205
Environmental Modeling
(Spring, 2013)

Classes: Monday and Friday, 1.15–2.30 pm (Hale Laboratory, Brown)

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Office Hours: Mondays 3.30 to to 5.00 pm; Fridays 9.15 to 10.15 am and 3.30 to 5.00 pm; and by appointment.

Course Webpage: Accessible via ConnCourse/Moodle at `http://banyan.conncoll.edu/moodle/`

Textbook: *Basic Populus Models of Ecology*, Don Alstad (Prentice-Hall, 2001). We will also use class handouts, journal articles, and online resources.

Software: Modeling requires using computational software. We will mainly use `Excel`, and the software package `Populus`, an open-source educational tool developed at the University of Minnesota, and available for downloading at `http://cbs.umn.edu/populus`.

Group Work: This course will be run mainly through group work, both in and out of class. Most of the homework projects will be done in groups, which will be assigned randomly for each assignment.

Group Presentations: There will be two in-class group presentations in this course. Your group will present case studies or descriptions of environmental modeling topics of your choice. Group Presentation 1 will be on ***March 1 and 4***, and Group Presentation 2 will be on ***May 3 and 6***. Group presentations will also be evaluated by other students, so attendance is mandatory on these days.

Paper/Project: One paper or project, on an environmental modeling topic of interest to you, will be due by ***Monday, May 13*** (in exams week), with an outline due on ***Friday, April 26***, and title on ***Friday, April 5***.

Course Contributions: Given the importance of group work in this course, fully 20% of your grade for this course will come from a "course contribution" grade. This includes both in-class contributions (class groupwork, contribution to discussions and presentations) and out-of-class work (group assignments with classmates). The instructor will assign 10% of this grade, whereas the remaining 10% will be computed based on a combination of peer and self evaluations.

Final Grades: Your final grade will be based on the following weighting.

In-Class Group Presentations (2):	25 %	Paper/Project:	30 %
Course Contribution (Peer and Self):	10 %	Group Homework:	25 %
Course Contribution (Instructor):	10 %		

Late Assignment Policy: Late assignments will ***not*** be accepted. Any assignment not submitted by the due day *and* time will earn an automatic zero.

Attendance: Students registering for this course do so with a full understanding of the scheduled class times, and so attendance is mandatory in classes in which you have assigned duties or exams/quizzes. You may miss *one* other class over the course of the semester with no penalty, after which you will suffer a letter grade penalty (i.e., A- dropping to a B+) for *each* class missed beyond that. *Emergency* reasons – for which you need to provide documentation – are exempt from this. Travel plans or extra-curricular activities are not considered emergencies. If your circumstances are such that this policy will impact you adversely, please consider choosing a different course.

Honor code: The Connecticut College Honor Code will apply. Its impact on individual assessment tasks will be made specific when those tasks are handed out. Any violations will result in referrals to the Honor Council, with potentially serious consequences. Please note that a minimum penalty of an "F" for the course is likely for guilty verdicts.

Special Accommodations: Students with a physical or mental disability (either hidden or visible) must inform the instructor as soon as possible if they require classroom, test-taking, or other reasonable modifications. Such students *must* register with the Office of Student Disability Services (Crozier Williams Room 221, 439-5428 or 439-5240, `barbara.mcllarky@conncoll.edu` or `lillian.liebenthal@conncoll.edu`), who will provide the instructor with a list of required/permissible special accommodations.

MAT 205 / ES 205
Environmental Modeling

Our environment is complex. *Modeling* is the process in which we attempt to come up with a set of rules (deterministic and/or probabilistic) which govern how things function. The simplest models clearly will not provide the best predictions, whereas the most complicated models are difficult to work with, and usually do not provide much insight into the fundamental interactions. Basically, "all models are wrong, but some are useful" (attributed to George Box, 1919-), and the trick is to balance the level of complexity of the model with the information that we seek.

Many environmental models take into account "rates of change," which means that the concepts of derivatives and differential equations become important. Some models rely on statistics, or use random fluctuations to account for interactions far too complex to understand using simple rules. The developed model is usually run on a computer (using either canned software, or programs written specifically for that particular model) in order to obtain predictions. The validation of these prediction is an important step in evaluating how successful a model is.

"Standard" environmental models are usually from the following two areas.

1. *Biological models*

These usually deal with populations (their growth, spatial spread, interaction with other species, the effect of disease, environmental degradation or harvesting, susceptibility to extinction, natural selection and genetic mutations, etc). The simpler versions of biological models have been surprisingly successful in mimicking real life, and therefore form a good introduction to the modeling process.

2. *Chemical/geophysical models*

Examples of these include pollution in a lake, the carbon cycle and its effect on global temperature, degradation of the ozone layer, sea ice and rising ocean levels, the water cycle and the global fresh water budget, soil erosion, ocean circulation, climate, etc. The more useful of these models (say, on climate) are usually very complicated, and require supercomputers to run.

There are environmental models which fit outside the above categories (such as feebate models in environmental economics). There are also models which describe the *interaction* between the biological and the geo-chemo-physical world, which are combinations of the above two model types.

This course is an *introductory* course in environmental modeling. We will address models from both categories, and also some combined models. We will formulate some simple models, program them (or use software), numerically experiment with different parameter values, and observe the effect of assorted factors on final results. We will study results of more complicated models, run (already programmed) models, and attempt to relate our results to policies. We will read, discuss and critically evaluate many case studies. Along the way, we will gain an introduction to basic modeling ideas, including the *systems modeling* approach, analytical (mathematical) approaches, model formulation, prediction and validation. The basic goal of this course is to give you a foundation of the ideas behind environmental modeling, setting the stage for possible future study or work in the area.