SOIL-650

Advanced Topics: Introduction to Environmental and Ecological Modeling

3 credits (Tue/Thu 9-10:15 am)

New Mexico State University

Spring 2021

Course Description

The *Advanced Topics: Introduction to Environmental and Ecological Modeling* course introduces students to different approaches to conceiving of, and modeling, environmental and ecological processes at local to global scales. Starting with simple analytical models of environmental and biological processes, through spatially explicit simulation of populations and communities, to spatially interactive cellular automata and agent based models. All material is introduced via classic case studies appropriate to each model approach (e.g. population and predator prey literature, regional and global biodiversity, pattern formation in plant communities, and flocking behavior in mammals and birds). Students realize all models using the *R* programming language. The course therefore has dual aims of providing students a broad survey of modeling approaches used in the environmental sciences, with an introduction to implementing such models in *R*. In so doing, students develop confidence in scripting and simulation modeling using a popular and adaptable modeling, analysis and statistical programming environment (i.e. *R*). The class will provide students valuable tools and confidence to use mathematical and simulation models to explore the interactions and feedbacks that characterize environmental systems and the functioning of the biosphere.

Course Goals and Outcomes

Students completing the course will have:

- **An improved understanding and appreciation of complex environmental and ecological issues**
- **Familiarity with diverse modeling approaches used in ecology and environmental sciences**
- **The skills and confidence to use simulation approaches for problem-solving**
- **Familiarity in using 'R' as a tool for data analysis and simulation modeling**

INSTRUCTOR: Dr. Niall Hanan (Office Hours: any time via email)
Plant and Environmental Sciences
Email: nhanan@nmsu.edu

COURSE FORMAT: On-line synchronous default (with face-to-face if feasible). Lecture/discussions will introduce case studies and modeling approaches. Articles from primary literature provide background for each Theme and form the basis for classroom discussions and model development. Labs will develop skills in *R* with students building on instructor-provided examples.

PREREQUISITES: This course is open to graduate students in the natural and environmental sciences. There are no defined prerequisites: prior experience using *R* and coursework in natural resources or ecology will be helpful, but enthusiasm to learn about ecosystem processes and their mathematical representation is more important.

COURSE REQUIREMENTS: Reading materials provided. Students should install *R* on their personal desktop/ laptop computer. Students without access to a laptop or other computer should contact the instructor to discuss alternatives. Students are required to complete designated R-tutorial(s) prior to semester and submit certification.

ATTENDANCE POLICY: Students should attend and participate in ALL lectures and laboratory sessions. Unexcused absences will result in reduced class participation grades. Students will be required to behave appropriately at all times to promote successful learning outcomes for all participants.

EVALUATION: Student assessment will be based on classroom participation (10%), lab assignments (60%), term paper plan (5%) and term-paper (25%). The lowest two grades among the 6 lab assignments can be dropped, thus the 60% will be distributed among the 4 best assignment grades.

SOIL-650 – INTRO TO MODELING – SPRING 2021 SCHEDULE

Week	Week Begins	Hand in Assignments (MONDAYS)	LECTURE & DISCUSSION TUESDAYS 9:00-10:15 AM	LABORATORY THURSDAYS 9:00-10:15 AM
1	January 25		1/26/21: Introductory	1/28/21: Basics of 'R'
2	February 1	'R' Tutorial Certificates	2/2/21: Revision of Basic Growth & Pop-Biology	2/4/21: Basics of 'R'
3	Feb. 8	Basics of 'R' Assignment	2/9/21: Theme 1: Population & Predator-Prey Modeling (Spruce-Budworm & Hare-Lynx Cycles)	2/11/21: Population & Predator-Prey Modeling (PP)
4	Feb. 15		2/16/21: Theme 1	2/18/21: PP
5	Feb. 22	PP Assignment	2/23/21: Theme 2: Multi-Trophic Cascades (Yellowstone Wolves)	2/25/21: Trophic Cascades (TC)
6	March 1		3/2/21: Theme 2	3/4/21: TC
7	March 8	TC Assignment	3/9/21: Theme 3: Gridded Niche Modeling (Global Vegetation)	3/11/21: Gridded Niche Modeling (GM1)
8	March 15		3/16/16: Theme 3	3/18/21: GM
9	March 22		Spring Break	3/25/21: Term Paper Planning Lab
10	March 29		3/30/21: Theme 3 (expansion) – Gridded Competition Modeling	4/1/21: Gridded Competition Modeling (GM2)
11	April 5	GM Assignment	4/6/21: Theme 4: Cellular Automata (Pattern Formation)	4/8/21: Cellular Automata (CA)
12	April 12		4/13/21: Theme 4	4/15/21: CA
13	April 19	CA Assignment	4/20/21: Theme 5: Agent-Based Models (Flocking Behavior)	4/22/21: Individual / Agent Based Models (ABM)
14	April 26	Term Paper Plan	4/27/21: Theme 5	4/29/21: ABM
15	May 3	ABM Assignment	5/4/21: Term Paper Lab	5/6/21: Term Paper Lab
16	May 10	Term Paper Due **Friday 5/14/2020**	5/11/21: Term Paper Lab	5/13/21: Course review & discussion
17	May 17		Note: grades must be finalized Tuesday 5/18– thus no exceptions to 5/14 Term Paper deadline	

Note: Color scheme links modeling approaches with case-studies and associated assignments.

POLICIES

CLASS ATTENDANCE AND PARTICIPATION

Students are required to attend every class period. For Spring 2021, meetings will be available on-line via zoom in CANVAS. Logging in to a zoom conference or sitting in a classroom is not the same as participation in class: active participation is required and considered in grades. Three unexcused absences, late arrivals and/or early departures will result in a letter grade reduction. Six unexcused absences, late arrivals and/or early departures will result in failure of class.

LATE ASSIGNMENTS

Late assignments lose a grade point; assignments not accepted if more than 3 days late.

DISCRIMINATION AND DISABILITY ACCOMMODATION

Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act Amendments Act (ADAAA) covers issues relating to disability and accommodations. If a student has questions or needs an accommodation in the classroom (all medical information is treated confidentially), contact:

Jesse Haas, Interim Director
Student Accessibility Services (SAS)
Corbett Center Student Union, Rm. 208
Phone: (575) 646-6840
Email: sas@nmsu.edu
Website: http://sas.nmsu.edu/

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Laura Castille, Executive Director
Title IX and Section 504 Coordinator
Office of Institutional Equity
P.O. Box 30001, E. 1130 University Avenue
Las Cruces, NM 88003
575.646.3635; 575-646-7802 (TTY)
equity@nmsu.edu

Title IX prohibits sex harassment, sexual assault, intimate partner violence, stalking and retaliation. For more information on discrimination or Title IX, or to file a complaint contact:

Laura Castille, Executive Director and Title IX Coordinator
Office of Institutional Equity (OIE)
O'Loughlin House, 1130 University Avenue
Phone: (575) 646-3635 E-mail: equity@nmsu.edu
Website: http://equity.nmsu.edu/

Other NMSU Resources:

NMSU Police Department:	(575) 646-3311	www.nmsupolice.com
NMSU Police Victim Services:	(575) 646-3424	
NMSU Counseling Center:	(575) 646-2731	
NMSU Dean of Students:	(575) 646-1722	
For Any On-campus Emergencies:	911	

ACADEMIC RESOURCES

NMSU provides students with academic resources such as tutoring, final exam schedules, library and research, and transcript information on the NMSU Current Student webpage.