Fundamentals of Ecological and Environmental Modeling

11:216:431/16:215:532 (Spring, 4 credits)

Meeting times and place:
Heldrich Science Building, classroom 204
Tuesdays 10:55am-12:15pm
Fridays 10:55am-1:55pm

Professor: Dr. Juan A. Bonachela
Contact information: ENR 134, juan.bonachela@rutgers.edu
Office hours: Please send an email to schedule a meeting.

Course description:
This course will focus on how to apply simple mathematical language and techniques to gain a deeper understanding of biological systems. We will use basic calculus to study the ecological and evolutionary changes of populations, learn how to represent and interpret such changes, and predict their short- and long-term behavior. We will discuss classic examples covering a wide range of terrestrial and marine systems, from microbial growth to predator-prey interactions, vegetation patterns, and biogeochemical cycles.

Pre-reqs: 01:640:135 (Calculus I)

Learning goals:

- Biological interpretation of figures and mathematical equations.
- Understand how mathematical models are constructed in theoretical biology.
- Understand how to analyze mathematical models to make predictions about biological systems.
- Understand how to choose the right analytical techniques to extract biological information from models.
- Develop critical thinking regarding assumptions and level of detail needed to model specific biological systems.
- Communicate successfully theoretical biology.

Grading:
The final course grade will be calculated using the breakdown below. **Attendance and active participation is mandatory,** and important for learning purposes but also because it will be **considered when calculating the final grade**. Please note that the course material is hierarchical, and therefore it is important that you keep up with every week's concepts and work. The latter will mostly focus on weekly exercise sets, which will include exercises that will count against the final grade. In addition, there will be two exams and a team project that will be presented as a group (plus an individual project report). Your critical review of your peers' presentations and of one individual report will complete your final grade.

Grading breakdown:
Weekly assignment, 20%; Mid-term exam, 20%; Final exam, 20%; Project, 30%; Peer review, 10%

Recommended textbooks:

- Hastings, A: "Population biology: concepts and models" (ISBN-13: 978-0387948539).
- Otto, S and Day, T: "A biologist's guide to mathematical modeling" (ISBN-13: 978-0691123448).
- Murray, J: "Mathematical Biology: I. An Introduction" (ISBN-13: 978-0387952239).

Tentative schedule:

Date	Topic
01/21/2020	Introduction and self-assessment exercise set
01/24/2020	Figures and plots (and 2nd exercise set)
01/28/2020	Pseudo-models
01/31/2020	Units (and 3rd exercise set)
02/04/2020	Assumptions
02/07/2020	Borrowing from other disciplines (and 4th exercise set)
02/11/2020	Discrete models
02/14/2020	Modeling population demography (and 5th exercise set)
02/18/2020	Modeling population demography…and space
02/21/2020	Modeling resource uptake and competition (and 6th exercise set)
02/25/2020	Modeling antagonistic interactions
02/28/2020	Modeling management and conservation
03/03/2020	Midterm preparation session
03/06/2020	Midterm exam
03/10/2020	Age-structured models (and 7th exercise set)
03/13/2020	Modeling biodiversity
03/17/2020 03/19/2020	SPRING BREAK
03/24/2020	Modeling evolution I (and 8th exercise set)
03/27/2020	Modeling evolution II
03/31/2020	Modeling evolution III: game theory 1st part (and 9th exercise set)
04/03/2020	Modeling evolution III: game theory 2st part
04/07/2020	Midterm preparation session
04/10/2020	Midterm exam
04/14/2020	Group project session
04/17/2020	Group project session**s**
04/21/2020	Group project session
04/24/2020	Presentation day I&II
04/28/2020	Presentations day III
05/01/2020	Peer review session

Academic Integrity: Your learning experience depends on your academic integrity. You are expected to adhere to University policies and code of conduct (http://academicintegrity.rutgers.edu). These principles forbid plagiarism and require that every Rutgers University student i) properly acknowledge and cite all use of the ideas, results, or words of others; ii) properly acknowledge all contributors to a given piece of work; iii) make sure that all work submitted as his or her own in a course or other academic activity is produced without the aid of unsanctioned materials or unsanctioned collaboration; iv) treat all other students in an ethical manner, respecting their integrity and right to pursue their educational goals without interference. This requires that a student neither facilitate academic dishonesty by others nor obstruct their academic progress. Violations of academic integrity will be treated in accordance with university policy, and sanctions for violations may range from no credit for the assignment, to a failing course grade to (for the most severe violations) dismissal from the university.

Disclaimer: Please note that this syllabus is flexible, and therefore changes can occur if they improve the student experience and/or help the student achieve the learning goals above.