

Fundamentals of Ecological and Environmental Modeling

11:216:431 (Spring, 4 credits)

Please see last page for important COVID-19-related information.

Meeting times and place:

Mondays, Thursdays, Fridays 12:10pm-1:30pm, Cook/Douglas Lecture Hall (CDL) 102

Professor: Juan A. Bonachela, juan.bonachela@rutgers.edu

Teaching Assistant: Dylan Simpson, dylan.simpson@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: Calculus (Calculus I 01:640:135, or similar).

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 cumulative, 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 assignments, 25%; Mid-terms, 17% each; Project, 35%; Peer review, 6%

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).

Important: Recording, pictures, or snapshots cannot be taken. Laptops or other digital equipment cannot be used in this class unless you have made special arrangements with the professor.

Tentative schedule:

Date	Topic
01/20/2022	Introduction and self-assessment exercise set
01/21/2022	Figures and plots (2 nd exercise set available)
01/24/2022	Pseudo-models
01/27/2022	Lab session to work on 2 nd exercise set
01/28/2022	Units (2 nd exercise set due; 3 rd exercise set available)
01/31/2022	Assumptions
02/03/2022	Lab session to work on 3 rd exercise set
02/04/2022	Borrowing from other disciplines (3 rd exercise set due; 4 th exercise set available)
02/07/2022	Discrete models
02/10/2022	Lab session to work on 4 th exercise set
02/11/2022	Modeling population demography (4 th exercise set due; 5 th exercise set available)
02/14/2022	Modeling population demography...and space;
02/17/2022	Lab session to work on 5 th exercise set
02/18/2022	Modeling resource uptake and competition (5 th exercise set due; 6 th set available)
02/21/2022	Modeling antagonistic interactions
02/24/2022	Lab session to work on 6 th exercise set
02/25/2022	Modeling management and conservation
02/28/2022	Review/Q&A session
03/03&04/2022	Midterm exam
03/07/2022	Structured models (6 th exercise set due; 7 th exercise set available)
03/10/2022	Modeling biodiversity
03/11/2022	Lab session to work on 7 th exercise set
03/21/2022	Modeling evolution I (8 th exercise set available)
03/24/2022	Modeling evolution II
03/25/2022	Lab session to work on 8 th exercise set
03/28/2022	Modeling evolution III: game theory 1 st part (8 th exercise set due; 9 th set available)
03/31/2022	Modeling evolution III: game theory 2 st part
04/01/2022	Lab session to work on 9 th exercise set
04/04/2022	Review/Q&A session (9 th exercise set due)
04/07&08/2022	Midterm exam
04/11/2022	Group project session
04/14/2022	Group project session
04/15/2022	Group project session
04/18/2022	Group project session
04/21/2022	Group project session
04/22/2022	Group project session
04/25/2022	Presentation sessions I
04/28/2022	Presentations session II
04/29/2022	Presentations session III
05/02/2022	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.

Diversity and Inclusivity Statement: In keeping with Rutgers's mission statement, this class strives to be an inclusive learning community, respecting those of differing backgrounds and beliefs. As a community, we aim to be respectful to everyone in this class, regardless of race, ethnicity, religion, gender, or sexual orientation.

If you go by a different name than what is on the class roster, please let us know. Using correct gender pronouns is important to us, so please do not hesitate to share your pronouns with us.

We are committed to supporting the learning of all students in our class, and recognize that you may experience a range of emotional, physical, and/or psychological issues, both in and out of the classroom, that may distract you from your learning. If you are experiencing such issues, please do not hesitate to let us know so we can make the necessary accommodations and/or come up with a plan to ameliorate the impact on your learning.

If you have or think you have a disability (learning, sensory, physical, chronic health, mental health or attentional), please contact the Office of Disability Services (ODS). If you have already registered with the ODS, please meet with us as soon as possible to discuss your accommodations in the course.

Special COVID19 considerations:

We understand that this is an unusual situation and that unanticipated personal issues may arise. It is important that you communicate with us if any special circumstances make it impossible or risky for you to attend class or complete assigned classwork. We will try to find a solution being both flexible and fair.

Other important information:

- Wear masks while in the classroom: Masks must be worn during class meetings; any student not wearing a mask will be asked to leave.
- Before coming to class: Each day before you arrive on campus, you must complete the brief survey on the **My Campus Pass** symptom checker self-screening app.
- In the classroom: Please make sure you wear your mask at all times. Please arrive only a few minutes before the lecture starts. Occupy seats as you enter, and keep at least one seat of separation with the next student. When the class is dismissed, please exit in order to minimize crossing paths with other students. Clear exits as soon as possible.

Additional resources: <https://success.rutgers.edu/>

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