The Mathematics of Life Lab
Biol 224L

SYLLABUS

Course goals:
BIOL 224H and 224HL enrich the foundational material from BIOL 201, 202 and 205 by studying classic applications of math to many of the same topics. By revealing the mathematical underpinnings of much of the material in the majors' core, this course will introduce students to quantitative approaches and research directions across Biology. As is the case in the lecture portion of the class, the lab will use techniques to make the math and programming accessible and keep math anxiety to a minimum.

In the lab we will use the analytical and programming platforms Mathematica and Matlab to further explore the biological models and problems that are introduced in the BIOL 224H lecture. No prior knowledge of either programming language, or programming in general, is required -- we will teach you what you need to know as we go!

This lab is corequisite with BIOL 224H.

Credit hours:
1 credit hour of lab per week (2 meeting hours)

Meeting time and place
Th 2:00-4:00pm, GSB1377

Instructors:
Dr. Maria Servedio
Phone: 843-2692; Email: servedio@email.unc.edu; Office: GSB 2258
Office hours: 1st half of the semester: W 1-2 or by appointment, 2nd half of the semester: by appointment only.
Dr. Servedio has been studying questions in Behavioral Ecology and Evolution since she was an undergraduate (though she completed her undergraduate thesis in a functional morphology lab). In grad school she turned to mathematical models to study mate choice copying, speciation, and the evolution of warning coloration. Her work at UNC has focused on sexual selection and speciation, and the effects of learning on both of these processes.

Dr. Todd Vision
Phone: 962.4479, Email: tjv@bio.unc.edu; Office: GSB 3155;
Office hours: In the 2nd half of the semester, Mon and Tue 2-3pm or by appointment. To ensure availability within regular office hours, book times at https://tjv.youcanbook.me/.
Dr. Vision dipped his toes into programming and statistics while doing ecology research as an undergraduate. He did his graduate work in quantitative and population genetics of natural plant populations and discovered while a postdoc at the beginning of the genomics era that he had inadvertently become a bioinformaticist. At UNC, he has developed methods for studying the evolution of genomes, phenotypes, and the genetic basis of complex traits.

Readings:
When readings relevant to specific topics are assigned, they will be posted to Sakai.

There is no required textbook, but we encourage you to consult the following book for reference: *Introduction to Mathematics for Life Scientists*, by Edward Batschelet (Springer, 3rd edition). If you wish to purchase a paper copy, new and used copies of the relatively inexpensive paperback "Study Edition" are available online from a variety of sources. UNC Libraries also provides online and PDF download access to an electronic copy.

The following non-required texts will be placed on reserve at the House Undergraduate Library (24 hour loan period).

- Alberts B *et al.* (2013) *Essential Cell Biology*, 4th ed. *Covers material in BIOL205.*
- Bergstrom CT, Dugatkin LA (2015) Evolution, 2nd ed. *Covers material in BIOL201*.
- Otto SP, Day T (2007) A Biologist's Guide to Mathematical Modeling in Ecology and Evolution. *Includes excellent primers on mathematical topics.*
- Sanders MF, Bowman JL (2015) Genetic Analysis: An Integrated Approach, 2nd ed. *Covers material in BIOL202.*

Grading:
The lecture and lab contain nine joint homework assignments in which the students will explore biological problems using mathematical and programming techniques. Each assignment includes both 1) a portion that addresses the biological interpretation of these exercises – how these procedures address the particular biological question of interest and how their results should be interpreted – as covered in the lecture portion of the class, and 2) the implementation of mathematical and programming exercises using Mathematica and Matlab, as covered in the lab. The grades from these portions count towards the lecture and lab respectively.

The projects, in which students address large scale, creative biological problems, are similarly broken into model development/interpretation portions (lecture) and coding implementation portions (lab).

9 lab/homework assignments - math/programming portion: 60%
2 Group projects - coding implementation portion: 40%

Final exam period:
The second project will act in lieu of a final exam. As stated above, one goal in making this section accessible and removing math anxiety is removing stressful time constraints during problem solving, which a final exam would introduce. The group project presentations for the second project will take place during the final lab session and the writeup will be due at the time of the final exam.

Homework:
While in lab, you will be using Matlab or Mathematica to work on problems. These problems will be finished as homework assignments and will be due in the following class session. We do not expect the assignments to take an inordinate amount of time. Students can obtain both Mathematica and MATLAB from Software Acquisitions https://sa.unc.edu/shop using your Onyen. Both packages are free for students. You can choose to get the software as a download or order a DVD to pick up

Course Policies:
Homework assignments must be turned in to Sakai by class time on Tuesdays and the key for each assignment will be posted at the same time. Homework turned in late, but before the key posted, will incur a 25% penalty on the final grade. Homework turned in after the key is posted, but before the final exam, will incur a 50% penalty on the final grade.

Students assign an initial grade to their own homework assignment using the key, and can correct any error (explaining the logic of the correction) to earn back up to half of the missed points, at the discretion of the instructor. The initial grading of each assignment by the student is due on Thursdays at the start of the next lab period. Graded files turned in after that will not be eligible to earn back points from corrections. Graded files that are turned in more than one week late (without prior permission) will receive a 50% penalty.

Honor code:
Students are encouraged to work together on homework assignments, but must submit an independent write-up. Students are not allowed to use keys for the homework assignments from previous years. Violations of this policy will have honor code consequences.

Group Projects:
There will be two group projects during the semester on topics of your choosing. Groups will consist of 2-3 students. Each group will submit a brief proposal for approval, and then have approximately one month to complete their project. The project will be presented in-class, evaluated by one instructor with peer input, and each group will then submit their final write-up (see schedule below for specific due dates). The coding implementation portion of the group projects will constitute part of your lab grade.

Note:
The instructors reserve the right to make changes to this syllabus.

Schedule

Week	Date	Activity
1	1/10	Introduction to Mathematica
2	1/17	Assignment 1 - Natural selection
3	1/24	Assignment 2 - Two locus example
4	1/31	Assignment 3 - Sexual selection
5	2/7	Assignment 4 - Logistic growth
6	2/14	Project workday 2
7	2/21	Assignment 5 - Disease model
8	2/28	*Group Project Presentations*
9	3/7	Introduction to Matlab (and Chaos!)
		Break
10	3/21	Assignment 6 – Markov models
11	3/28	Assignment 7 – Pattern formation
12	4/4	Assignment 8 – Cellular automata
13	4/11	Assignment 9 – Flocking
14	4/18	Project workday 4
15	4/25	*Project presentations*
	5/3 8am	*Final papers due*