

HLSC 374 / BSCI 374H / BIOL 667: Mathematical Modeling in Biology

Section 0101
Fall 2016
Last Updated: 12 September 2016

Course Information

Lectures Tu & Th 9:30 - 10:45 AM, [CCC 1111](#)
Lab M 1:00 - 3:50 PM, [CCC 1111](#) (starting 8/29/16)
Required Text Elizabeth S. Allman, John A. Rhodes, [Mathematical Models in Biology: An Introduction](#), Cambridge University Press, 2003, ISBN 9780521525862.

Recommended Text David Quammen [Spillover: Animal Infections and the Next Human Pandemic](#), W. W. Norton, 2013, ISBN 9780393346619.

Required Software MATLAB: [Mac Version](#) or [Windows Version](#) (free for UMCP students)

Required Software Microsoft Excel: [Mac Version](#) or [Windows Version](#) (free for UMCP students)

Prerequisites [Math 130](#) (Calculus for Life Sciences I), or the equivalent, including AP credits
[Math 131](#) (Calculus for Life Sciences II), or the equivalent, including AP credits

Course Description Students develop quantitative reasoning skills through the understanding of mathematically based biological models. Models are chosen from a variety of biological disciplines, including biological population dynamics, infectious disease propagation, molecular evolution, and phylogenetic trees. Mathematical skills developed include: solving non-linear difference equations, eigenvector analysis, multi-dimensional stability analysis, and the use of Excel and Matlab to implement these algorithms as computer models.

Testudo Info <http://www.sis.umd.edu/bin/seats?crs=HLSC374&sec=&term=201608> or
<http://www.sis.umd.edu/bin/seats?crs=BSCI374H&sec=&term=201608> or
<http://www.sis.umd.edu/bin/seats?crs=BIOL667&sec=&term=201608>

Other Course Pages

- [Lab Supporting Files](#)
- [Reference Materials](#)

Instructor Info

Instructor Jonathan Z. Simon, Professor

ECE Office/ Phone [AWW 2145 / 301-405-3645](#)

Bio Office/ Phone [BPS 3227 / 301-405-6812](#)

Email jzsimon@umd.edu

Lab Web Page <http://www.isr.umd.edu/Labs/CSSL/simonlab/>

Teaching Assistant [Nikhil Kandpal](#)

Office Hours

	Day	Time	Location
Simon	Tuesday	2:30 - 4:00 PM	BPS 3227
Kandpal	Monday	6:00 - 7:00 PM	LPA 1124

Outline (subject to change)

Introduction & Basics

Why Mathematical Modeling in Biology?
Math Review

Modeling Biological Populations

Difference Equations
Linear Biological Population Dynamics
Non-linear Biological Population Dynamics
Equilibrium & Stability
Matrix Algebra
Linear Structured-Population Dynamics
Eigenvector Analysis
Non-linear Structured-Population (e.g. Predator-Prey) Dynamics
Phase Plane Analysis
Multivariable Equilibrium & Stability

Epidemiological Models

Infectious Disease Models
Non-linear Infectious Disease Dynamics
Infectious Disease Phase Plane Analysis
Example: Sexually Transmitted Diseases

Mathematical Molecular Evolution

Probability
Modeling DNA Base Substitution
Markov Matrices
Phylogenetic Distances
Phylogenetic Trees

Computer Skills (simultaneously with rest of course)

Numerical Calculation & Modeling with MATLAB and Excel

Homework

Math is a "Learn it By Doing it" subject, making the homeworks critical.

Typically, homework problems will be assigned every week. It is possible that only some of the problems will be graded, but solutions will always be made available. Solution sets will be handed out as soon as reasonably possible after the homework is due. No credit will be given for any homework turned in after the solution set has been made available.

You must show your work—your method is more important than your result. For problems in which you use a calculator or computer, you must still explain your methods. A correct result without showing how you arrived at that result will not receive any credit.

All homework assignments are on [ELMS](#), and all completed homework assignments should be turned in (not uploaded), at the beginning of class on their due date, typically on Thursdays.

Late Policy: 1 weekday late = 25% off, 2 weekdays late = 50% off.

Labs

There is a weekly lab for you to try out newly-learned modeling concepts on your computer. Lab reports should be turned in by uploading them electronically on [ELMS](#) at the end of each lab session. The labs are essentially graded Pass/Fail: 100% for a strong report, 50% for a weak report, 0% for no report.

Laptop Computers

It is required that you bring a computer to all class meetings (including lab), and that you have working versions of *Matlab* and *Microsoft Excel* on that computer. Both software packages are free for UMCP students (see **Required Software** above for links by which you can obtain the software packages).

Office Hours: Resource and Requirement

Due to credit-hours limitations, this course cannot have a separate Discussion meeting, so Office Hours become a critical resource. Professor Simon and the TA each hold separate office hours at non-overlapping times. Please take advantage of them!

Additionally, attending the office hours of Professor Simon, at least once in the *first half of the semester*, is **required**, counting one percentage point of the final grade. If you cannot make the standard office hours above, please make an appointment with Professor Simon for a different time.

Undergraduate Enrichment Reflections

Each **undergraduate student** is required to attend at least two "academic enrichment" seminars. This requirement can be satisfied by

attending any scientific research seminar in the life sciences occurring outside of the normal class period, or at the ILS Faculty Mentor Seminar Series. Students are required to write a short paper (about half a page) summarizing each seminar attended.

Your reflection should include:

- The title of the lecture/seminar
- Who was speaking and where they were from
- Why it was of interest to you
- What you felt you gained from the lecture
- Anything else you found interesting or if it opened you up to new ideas or ways of thinking

The grade value of each paper will be the same as a short homework.

Your Enrichment Reflections should be uploaded on [ELMS](#).

Graduate Project Work

Each **graduate student** is required to undertake a small mathematical modeling in biology project, and present the design and result of the project to Dr. Simon. This is required for graduate credit for the course. The grade value of the project will be the same as two short homeworks.

Exams

- 1st Exam: Tuesday, October 18
- 2nd Exam: Tuesday, November 29 (subject to change)
- **Final Exam:** Thursday, December 15, 8:00 – 10:00 AM

There will be no make-up exams. See **Grading** next for missed exam policies.

Grading

30% Homework, Labs, Office Hours, Reflections/Projects, etc.

20% 1st exam

20% 2nd exam

30% Final exam

In the case of a 1st or 2nd exam missed for a legitimate reason, the other exam and the final will be re-weighted, if you give notice to the professor within 24 hours of the missed exam:

30% 1st or 2nd exam

40% Final exam

Academic Honesty

Discussing homework problems, labs, assignments, and other ideas, with others is *encouraged*,

but,

your final write-up must be *your own work* and cannot be a copy of anyone else's work.

The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is also important to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit <http://shc.umd.edu/SHC/>.

Academic dishonesty includes copying homework answers from another's work, from previously written solution sets, from any book, from the web, or any other related source. Instances of academic dishonesty will be referred to the Office of Judicial Programs.

CourseEvalUM

Your participation in the evaluation of courses through CourseEvalUM is a responsibility you hold as a student member of our academic community. Your feedback is confidential and important to the improvement of teaching and learning at the University as well as to the tenure and promotion process.

CourseEvalUM will be open for you to complete your evaluations for two weeks near the end of the semester. Please go directly to the website <http://www.courseevalum.umd.edu> to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing online, at Testudo, the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.

Learning Assistance Service

If you experience difficulty in keeping up with the academic demands of a course, you should know about the Learning Assistance Service, 2202 Shoemaker Building, 301-314-7613, or <http://www.counseling.umd.edu/LAS>. The educational counselors can help with time management, reading, math learning skills, note-taking and exam preparation skills. All their services are free to UMD students.

University of Maryland Policies for Undergraduate Students

The Office of Undergraduate Studies has a guide developed to provide you with resources and information relevant to your participation in this, and any other, UMD course:

[Course Related Policies—Know Your Rights](#)