

Syllabus & Course Policies

Time & Location:

Lectures: MWF 2:00-2:50 PM, CB 347

Instructor:

Lecturer: [David Murrugarra](#), POT 771, (859) 257-4734, murrugarra@uky.edu
Office hours: MWF 3-4 pm and by appointment.

Course Overview:

This course is intended for students with interests in mathematics and applications in the life sciences. This class will count towards the math major or minor requirements. It is an introduction to mathematical modeling in biology. The interface between mathematics and biology is an extremely exciting area. It spans all areas of biology, from genomics to ecosystems. Bioinformatics, systems biology, cell biology, infectious disease modeling, and cancer modeling are just a few examples of areas where mathematical models are vitally important. My objectives for the course are threefold: 1) to learn how models are constructed and analyzed, in a way which contributes biological understanding of the process being studied, 2) to gain expertise with the mathematical tools used in the construction and analysis of these models, and 3) to have you engage in the creative process involved in mathematical modeling. This last point is particularly important, and perhaps different than previous math courses you've taken. One thing you will rapidly discover is that there isn't a single way to solve a problem (or even to set-up a problem!), and that there often isn't a single correct answer. Of course, you need mathematical tools to know how to model a biological process, and to have ways to understand the resulting models, so a good chunk of our time will be devoted to developing these techniques. However, part of our time will also be devoted to the modeling process itself. This is messier and more open ended, perhaps, than you might be used to in a mathematics class. Part of this entails thinking critically about what constitutes a reasonable model, and

what types of questions can be addressed using a model. This involves discussion. Having an open environment for honest discussion of these topics is one of my goals for the course.

Course Outline:

1. Part I: Continuous Dynamical Systems

Modeling with differential equations.
Exponential and logistic growth.
Direction fields of differential equations.
Equilibria and their stability.
Graphical approach to Stability.
Systems of differential equations.
Vector fields.
Linear stability analysis.
The Lotka-Volterra Model for Competition.
Predator-prey models.
The Kermack-Mckendrick Model.
Software tutorial: Python and Matlab/Octave.

2. Part II: Discrete Dynamical Systems

Leslie Matrices.
Stable Age Distribution in Demographic Models.
The Perron-Frobenius Theorem
Markov Chains
The Markov property.
Stationary distributions.

3. Part III: Boolean Networks

Wiring diagrams.
Attractors.
Polynomial representation.
Network reduction techniques
Software tutorial: Cyclone.

4. Part IV: Probabilistic Boolean Networks

State transition probabilities.

Long-term dynamical properties.

Applications.

Student Learning Outcomes:

Students will compute fluently. Students will write correct justifications for their solutions to problems. Students will apply the methods of calculus in new contexts to solve unfamiliar problems.

Grading:

You will be able to obtain a maximum of 500 points in this class, divided as follows:

	Points	Percentage of final grade
Exam 1	100 points	20%
Exam 2	100 points	20%
Final Project	100 points	20%
Homework	150 points	30%
Class Participation/Attendance	50 points	10%

Your final grade for the course will be based on the total points you have earned as follows:

	Points	Percentage
A	450 - 500 points	90 - 100 %
B	400 - 449 points	80 - 89.9 %
C	350 - 399 points	70 - 79.9 %
D	300 - 349 points	60 - 69.9 %
E	0 - 299 points	0 - 59.9 %

The grading scale might be adjusted at the end of the semester. You will be guaranteed the above letter grade if your score falls within the given range, but the minimum score for each letter grade might be lowered.

Mid-term grades will be posted in myUK by the deadline established in the [Academic Calendar](#).

Policies:

Attendance and excused absences in MA/BIO 337 is mandatory. Be on time and remain until dismissed. Do not leave in the middle of class. Whenever possible, please notify your instructor of absences prior to class.

S.R. 5.2.4.2 defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit "reasonable cause for nonattendance" by the professor.

You may be asked to verify absences in order for them to be considered excused. Senate Rule 5.2.4.2 states that faculty have the right to request *appropriate verification* when students claim an excused absence because of illness or death in the family. Appropriate notification of absences due to university-related trips is required prior to the absence. If you anticipate an absence for a major religious holiday please notify your instructor (in writing) of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class. Two weeks prior to the absence is reasonable, but should not be given any later. Information regarding major religious holidays may be obtained through the Ombud (859) 257-3737, http://www.uky.edu/Ombud/ForStudents_ExcusedAbsences.php.

Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused or unexcused) per university policy.

Classroom behavior:

Electronic devices such as mobile phones, laptops and tablets should be put away or used only as part of class activities during lectures and recitations. Mobile phones, laptops, and computers may not be used during exams.

Recording in the Classroom:

Video and audio recordings are not permitted during the class unless the student has received prior permission from the Professors. If permission is granted, recording of other students is prohibited. Any distribution of recordings is also prohibited. Students with specific recording accommodations approved by the Disability Resource Center should present their official documentation to the professor. All content for this course, including handouts, assignments, and powerpoint lectures are the intellectual property of the instructors and cannot be reproduced, sold, or used for any purpose other than educational work in this class without prior permission from the professor.

Make-up policies:

Per Senate Rule 5.2.4.2, if you are missing any graded work due to an excused absence you are responsible for informing the Instructor about your excused absence within one week following the period of the excused absence (except where prior notification is required); and for making up the missed work. The instructor will give you an opportunity to make up the work and/or the exams missed due to an excused absence, and shall do so, if feasible,

during the semester in which the absence occurred. In particular, if you have university excused absences or have university-scheduled class conflicts with uniform examinations you may arrange with their instructor to take the exam at an alternate time. Generally these make-up exams will be scheduled on the day of or on the day after the regularly scheduled exam. Work-related conflicts are neither university excused absences nor university-scheduled absences.

Students needing accommodations.

If you have a documented disability that requires academic accommodations, please see your instructor as soon as possible. In order to receive accommodations in this course, you must provide your instructor with a Letter of Accommodation from the Disability Resource Center (DRC). The DRC coordinates campus disability services available to students with disabilities. It is located on the corner of Rose Street and Huguelet Drive in the Multidisciplinary Science Building, Suite 407. You can reach them via phone at (859) 257-2754 and via email at drc@uky.edu. Their web address is <http://www.uky.edu/StudentAffairs/DisabilityResourceCenter/>.

Accommodations for victims of violence:

By federal law, any student who is a victim of dating violence, domestic/intimate partner violence, sexual assault, or stalking (whether on or off campus) is entitled to appropriate accommodations for his or her coursework. To get help getting accommodations and other support, students who are assaulted can do any of the following:

1. Tell your instructor who can assist you in accessing resources appropriate to your situation;
2. Call the UK VIP Center (Violence Intervention and Prevention Center) at 257-3574 or vipcenter@uky.edu or http://www.uky.edu/StudentAffairs/VIPCenter/about_contact.php; or walk in to the Center in Frazee Hall, lower level, between 8:30 and 5:00;
3. Call the University Counseling Center at 257-8701; 2nd floor, Frazee Hall;
4. Call Ms. Patty Bender from the UK Institutional Equity and Equal Opportunity at 257-8927 or patty.bender@uky.edu;
5. In the case of an emergency, contact the UK Police Department at 911.

6. Students may also contact community resources 24-hours a day, including:
 - a. Bluegrass Rape Crisis Center at 800.656.4673 or <http://bluegrassrapecrisis.org/>.
 - b. Greenhouse17 (formerly Bluegrass Domestic Violence Program) at 800.544.2022 or <http://greenhouse17.org/>.

Academic Honesty:

Cheating or plagiarism is a serious offense and will not be tolerated. It will be thoroughly investigated, and might lead to failure in the course or even to expulsion from the university. See

<http://www.uky.edu/StudentAffairs/Code/part2.html>

(Sections 6.3.1 and 6.3.2) for information on cheating, plagiarism, and penalties.

A summary of recent changes to rules on cheating can be found at the Academic Ombud website:

<http://www.uky.edu/Ombud>