Math 405 / EEB 406
Models in Biology

Spring 2018; TR 8:10-9:25, Tickle Building 402

Instructor
Dr. Paul Armsworth
Email: p.armsworth@utk.edu (sent from your UT email with 405/406 as the start of subject line)
Office: 445 Hesler. Office Hours: T 12.10-1.10, W 9.15-10.15 or by appointment.

Graduate Teaching Assistant
Angela Chuang
Email: achuang1@utk.edu (sent from your UT email with 405/406 as the start of subject line)
Office: 430 Hesler. Office Hours: 3.30-5.30 or by appointment

Resources

Textbook:	Ellner, S.P., Guckenheimer J. 2006. Dynamic Models in Biology. Princeton University Press. Copy will go on reserve in library.
Additional material:	Course materials and information will be available through Canvas.

Prerequisites
Math 142, 148, 152 or by permission of Instructor.

Credit
For EEB undergraduate majors the course qualifies EITHER towards your Quantitative Requirement (enroll under Math 405) or for Senior Credit (enroll under EEB 406).

For EEB postgraduates, the course qualifies as a Toolkit course (enroll under EEB 406).

For IGMCS students, the course qualifies in either the Math area or the EEB area (enroll under Math 405 or EEB 406 respectively).

For Biomedical Engineering or Engineering Science postgraduates, the course qualifies as one of the required 400-level math classes (enroll under Math 405).

If any changes to this syllabus are required as the course evolves and students' interests and learning needs become apparent, we will discuss and agree these together as a class. Any such discussions will take place during scheduled class times and any agreed changes will be announced in class and posted on the class website on Canvas. We will send some whole class announcements to you through the Canvas website; this will email your UT email address.

Learning outcomes
By the end of the course, if you engage fully with the taught material and opportunities for guided independent study and you participate in class activities, then you should

1. be able to review critically why and when you would want to use a model to answer a biological question in your own area of interest
2. develop ideas about how to build a model to answer this question
3. have experience with a range of techniques used to analyze the models you might build.

In addition, the course contributes to the general learning outcomes for Biological Sciences (appended).

Topics
Models will be presented that are designed to answer questions drawn from a wide range of biological topic areas, including biodiversity conservation, fisheries management, epidemiology, molecular genetics, and electrophysiology. When discussing techniques for analyzing these models, we will cover:

1. Linear models with one state variable that are both deterministic and stochastic
2. Linear, structured models that are both deterministic and stochastic
3. Deterministic nonlinear models with one state variable in discrete and continuous time
4. Deterministic nonlinear models with several state variables in continuous time

as well as additional topics chosen based on class interest and time available.

Teaching methodology
Content will be introduced and discussed in class. However, class activities are a small fraction of what I expect of students in a 400-level class. To do well on course assessments, you will be expected also to read extensively outside class time, to contribute actively to discussions, and to engage with the assignments that are set. Importantly, you will also be expected to reflect on the diversity of teaching and learning activities provided to arrive at a synthetic interpretation of the material.

Assessment

1. Tests (20%) – two short tests (exam conditions) using multiple choice and short answer questions during the semester. At least 7 days notice will be given in advance of any test. (~ weeks 6 / 11)
2. Coursework (30%) – 2 x 1000 word writing assignments designed to encourage you to explore the application of modeling to a biological topic area of your choosing (~ week 7 / 12).
3. Group Project (30%) – team-based learning activity for which your individual grade will be based on a single written report for the group, a single group presentation, plus a short individual viva/interview to explore your own contribution to and understanding of the project (weeks 13-15). Peer assessment will be used to inform the viva component of your groupwork assessment.
4. Final Exam (20%) – longer version of the tests that integrates across the material (Tuesday May 8 from 8:00-10:00 in Tickle 402).

All work will be assigned a score on a 100 point scale and the above percentages used to convert that to an overall percentage score for the course. Typically the various A-grades fall approximately in the 90-100% range, the various B-grades in the 80-90% range, and so on with specific cut-offs reflecting the different grade categories used for undergraduate and graduate students. If appropriate, normalization across the different assessment activities will be used to ensure they are of commensurate difficulty (e.g. to allow lower cut-offs to be set on the exams).

Homework assignments will also be provided as formative assessment to help you guide your learning. These will not be taken in and graded. Instead solutions sets will be provided and discussed in office hours or class as required.

Additional details

1. You will be expected to participate in additional class activities that may provide opportunities for formative assessment to enhance your learning but will not count towards your final grade.

2. Class is a shared learning environment and you will be asked to adhere to some "ground-rules" in class to respect other students' learning and to enable the Instructor to use particular teaching methods. These include arriving promptly to class, bringing a scientific calculator or similar, switching cell phones off and refraining from texting during class, not listening to ipods, MP3 players and similar during class, not being online in class unless it is as part of an assigned class activity, and not posting materials provided to you in class on other web-sites.

3. Coursework or group project reports: late submissions will be penalized at 10% per business day if there is no prior arrangement or proof of emergency. Coursework or group project reports should be word processed, spell-checked and presented clearly. Word limits will be specified and work that is overly long may be penalized.

4. Academic Honesty: The course follows UT's Honor Statement. Thus all work taken from another source must be documented and any work that you turn in that is not documented must be your own. By enrolling in the course for credit, you agree that written work can be examined using plagiarism detection software.

5. Disability Services: Any student who feels he or she may need an accommodation based on the impact of a disability should contact the Office of Disability Services (ODS) at 865-974-6087 in 100 Dunford Hall to document their eligibility for services. ODS will work with students and faculty to coordinate accommodations for students with documented disabilities.

General Learning Outcomes for Biological Sciences

Students seeking a degree in Biological Sciences (whether the concentration is in Biochemistry, Cellular, and Molecular Biology, Ecology and Evolutionary Biology, or Microbiology) are expected to be able to do the following by the time they graduate:

Explain and provide examples of each the five big ideas in Biology, using their knowledge of biological concepts gained from their course of study:

- **Evolution**: Populations of organisms and their cellular components have changed over time through both selective and non-selective evolutionary processes.
- **Structure and Function**: All living systems (organisms, ecosystems, etc.) are made of structural components whose arrangement determines the function of the systems.
- **Information Flow and Storage**: Information (DNA, for example) and signals are used and exchanged within and among organisms to direct their functioning.
- **Transformations of Energy and Matter**: All living things acquire, use, and release and cycle matter and energy for cellular / organismal functioning.
- **Systems**: Living systems are interconnected, and they interact and influence each other on multiple levels.

Demonstrate the ability to perform the following five scientific practices:

- Link lecture topics and synthesize information, particularly in reference to the five big ideas
- Develop hypotheses and predictions (ask scientific questions) based on models or data
- Interpret scientific representations, such as graphs, phylogenies, or molecular structures, or data, and come to a conclusion (with evidence)
- Summarize information from scientific articles or other sources
- Predict the consequences of changes to systems or pathways