This is a preliminary course outline.

University of Guelph
College of Biological Sciences
Department of Integrative Biology

COURSE OUTLINE

IBIO*6000 ADVANCES IN ECOLOGY AND BEHAVIOUR

Specific topic: Foundations in Theoretical Biology

General course description

This is a modular course in which several faculty lecture and/or lead discussion groups in tutorials about advances in their broad areas, or related areas, of ecology and behaviour. Topics may include animal communication, optimal foraging, life-history evolution, mating systems, population dynamics, niche theory and food-web dynamics. The course includes lectures and seminars in which the students participate. Offered annually.

Course description specific to topic

This course will review and introduce basic methods used in theoretical biology, including calculus, differential equations, linear algebra and probability theory. Students will also gain practical experience in symbolic and numeric computing using Scientific Python, or a scientific computing platform of their choice. Some introductory modeling in R will also be provided. Exercises will include examples from ecology, evolution and physiology. The course provides a foundation to understand theoretical biology with greater sophistication and a foundation for students who wish to develop theoretical models of their own. It is assumed students have taken one semester of calculus. For specific content, see the course schedule below.

Instructor

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Learning outcomes

1. Familiarity and basic practice with mathematical approaches in theoretical biology
2. Practice in numeric and symbolic computing
3. Verbal summaries and presentations of solutions to problems
4. Visual and oral summaries that link mathematical approaches to current or classic primary research in ecology, evolution and physiology

Course resources

Textbook: Biocalculus: Calculus, Probability and Statistics for the Life Science by J. Stewart and T. Day, ISBN 978-1-305-11403-6 (Required)
Computer algebra system: Scientific Python (Required)

Scientific Python: We will be using the platform Anaconda (https://www.continuum.io), which is freeware. Students may also use other software, such as Mathematica, Maple, SageMath, Matlab, Octave or R, but they will need to translate instructions from Scientific Python to these other systems. In terms of R, some additional instruction will be given, except when the functionality of R becomes limited.

Inappropriate access and use of licensed computer software is illegal misconduct, which implies academic misconduct.

Course schedule

Week 1: Functions and sequences
Biocalculus: Chapters 1 – 2

A review of functions and sequences, an introduction to Scientific Python with practical experience plotting functions and recursive sequences

Weeks 2 - 3: Derivatives and their applications
Biocalculus: Chapters 3 - 4

Taylor's series approximations, finding maxima and minima, using derivatives to characterize the shape of a graph, applying L'Hospital's rule, optimization, equilibria and stability analysis of discrete-time models

Week 4: Integrals and their applications
Biocalculus: Chapters 5 & 6

Discrete approximations of an integral, evaluating integrals and applying the net change theorem, integral projections – including reproductive values, fluxes and physiological outputs

Weeks 5 – 6: Vectors & matrices
Biocalculus: Chapter 8

Coordinate systems, vectors, the dot product, basic matrix algebra, matrix models, application and interpretation of determinants, eigenvalues and eigenvectors in ecology, evolution and physiology

Week 7: Multivariate calculus

Biocalculus: Chapter 9

Partial derivatives, the chain rule, gradients and directional derivatives, maxima and minima

Weeks 8 – 10: Differential equations
Biocalculus: Chapters 7 & 10

Equilibria and stability, systems of differential equations, phase planes and null clines, nonlinear systems

Weeks 11 – 12: Probability and random variables
Biocalculus: Chapter 12

Probability, conditional probability, discrete and continuous random variables, calculating means and variances, Markov processes

Class format

Monday: 3 hour introduction to and practice with focal topics for the week
Friday: 2 hour presentation of solutions to problems and links to current research

Specific meeting times and locations on Mondays and Fridays will be determined by the end of the first week of classes.

Methods of assessment

Participation, oral communication and professionalism
- Monday classes (20%): Present, have read the assigned readings, able to formulate questions to help understanding, worked on any preliminary problems, generally indicate being prepared at the graduate level
- Friday classes (20%): Present, present solutions, offer feedback on other's solutions, generally indicate being prepared at the graduate level

Learning outcomes: 1, 2, 3

Individual problem sets (40%)
- A graded problem set will be assigned each Monday. The nature of the problem set (number of problems and difficulty) will be such that a student can complete the problem set by Friday. Problem sets will be weighted equally when calculating final grades.

Learning outcomes: 1, 2

Group problems or links to current research (20%)
- About every second week, groups of students will either work as a team on a more challenging problem or give a short presentation that links a topic or topics from the

course to classic or current published research. Group assignments will be weighted equally when calculating final grades.

Learning outcomes: 1, 2, 3, 4

Grading will follow the Graduate Calendar criteria (see below).

Course and University Policies

When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact, and be prepared to provide supporting documentation. See the graduate calendar for information on regulations and procedures for Academic Consideration:

https://www.uoguelph.ca/registrar/calendars/graduate/current/index.shtml

Assignments that are submitted after the deadlines indicated on the assignment **will not be accepted** and the distribution of course marks **will not be altered** for any student unless Academic Consideration for illness or other compassionate grounds has been approved by the course instructor.

Accessibility

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Centre for Students with Disabilities as soon as possible.

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.csd.uoguelph.ca/csd/

Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is detailed in the Graduate Calendar:

https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

E-mail Communication
As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

Drop Date
The last date to drop one-semester courses, without academic penalty, is the 40th class day. To confirm the actual date please see the schedule of dates in the Undergraduate Calendar. For regulations and procedures for Dropping Courses, see the Graduate Calendar:

https://www.uoguelph.ca/registrar/calendars/graduate/current/index.shtml

Copies of out-of-class assignments
Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

Recording of Materials
Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Grading

Grading will follow the criteria outlined by the Graduate Calendar and as follows.

Percentage Grade	**Letter Grade**	**Description**
90-100	A+	**Outstanding.** The student demonstrated a mastery of the course material at a level of performance exceeding that of most scholarship students and warranting consideration for a graduation award.
80-89	A- to A	**Very Good to Excellent.** The student demonstrated a very good understanding of the material at a level of performance warranting scholarship consideration.
70-79	B	**Acceptable to Good.** The student demonstrated an adequate to good understanding of the course material at a level of performance sufficient to complete the program of study.
65-69	C	**Minimally Acceptable.** The student demonstrated an understanding of the material sufficient to pass the course but at a level of performance lower than expected from continuing graduate students.
0-64	F	An inadequate performance.

https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-as-gradeint.shtml

Campus Resources

The Academic Calendar is the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs:
http://www.uoguelph.ca/registrar/calendars/index.cfm?index

If you are concerned about any aspect of your academic program:

- make an appointment with a program counsellor in your degree program.

If you are struggling to succeed academically:

- There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist.
  http://www.learningcommons.uoguelph.ca/

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance.
  https://www.uoguelph.ca/counselling/
- Student Health Services is located on campus and is available to provide medical attention. https://www.uoguelph.ca/studenthealthservices/clinic
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations.
  http://www.uoguelph.ca/~ksomers/

If you have a documented disability or think you may have a disability:

- The Centre for Students with Disabilities (CSD) can provide services and support for students with a documented learning or physical disability. They can also provide information about how to be tested for a learning disability. For more information, including how to register with the centre please see: https://www.uoguelph.ca/csd/