Dept. of Biological Sciences, University of Toronto Scarborough

BIOD59 / EEB1420 Syllabus, Fall 2021

Models in Ecology, Epidemiology, and Conservation

Prof. Péter Molnár

Prerequisites

BIOB50

MATA29 or MATA30 or MATA31 (or equivalent). These are non-negotiable.

Course description

Modelling is a critical tool for describing the complex dynamics of ecosystems and for addressing urgent management questions in ecology, epidemiology and conservation. In this practical introduction, students learn how to formulate ecological and epidemiological models, link them to data, and implement/analyze them using computer simulations. The course includes approaches for modelling individuals, populations, and communities, with applications in population viability assessments, natural resource management and food security, invasive species and pest control, disease eradication, and climate change mitigation. While not a requirement, some experience with computer programming will be beneficial for this course.

Learning goals

At the end of the course, students will have obtained a broad overview of the many situations in which models can be helpful in ecology, epidemiology, and conservation. They will have learned how to formulate ecological models, parameterize and test them against data, and analyze them both analytically and using simulations. Students will be able to determine in which situations models can be useful and what their limitations are, and will be able to apply these skills to different biological systems and public health and conservation management questions.

The course puts particular emphasis on sensitizing students to the philosophy and rationale behind ecological models, the links to classical hypothesis testing approaches, as well as communicating the strengths and limitations of models to both technical and non-technical audiences. These skills are critical, as most ecologists work in interdisciplinary teams and also need to communicate their results to the broader public, i.e. people that may not understand or value models.

Course information

Instructor:

Dr. Péter Molnár

Office hours: TBA

Email: peter.molnar@utoronto.ca (**please put BIOD59 or EEB1420 in the subject line**)

Teaching Assistant:

Juan Sebastian Vargas Soto, juan.vargassoto@mail.utoronto.ca

Lecture times & location:

Tuesdays, 12-2pm, online.

See below for tentative lecture schedule.

Tutorials:

Thursdays, 1-3pm, online.

Note: this course is running as BIOD59 for undergraduate students and as EEB1420 for graduate students. Occasionally, some time might be aside within the tutorial slot for EEB1420 discussions (graduate students only). Please check the Course Announcements on a regular basis.

Course Website and Online Lectures: All lecture slides will be posted on Quercus (q.utoronto.ca) before the lecture begins. Materials discussed in tutorials (e.g. computer codes) will also be posted on Quercus, either before or after the tutorial. Announcements will be made regularly on the course website, so please check on an ongoing basis.

Communication policy

Students are required to regularly check their UTOR email to receive announcements relating to the course. To inquire about course-related issues, students should solely use their UTOR email, as hotmail and other email providers are spam-filtered on a regular basis. **When emailing the instructor, please begin the subject line with "*BIOD59: <subject>*" (or "*EEB1420: <subject>*" for grad students) to make sure emails are not overlooked.** It is the responsibility of the student to adhere to these instructions and make sure their email reaches the instructor.

Tentative **lecture schedule**

Date	Day	Lecture	Topic	Recommended Readings
Sep 7	TU	1	Course introduction	
Sep 14	TU	2	How to construct a model	Otto Ch. 2
Sep 21	TU	3	Discrete-time population models, density dependence, fisheries management and the butterfly effect	Case, Ch. 1, 5
Sep 28	TU	4	Age- and stage-structured models; population viability analysis	Case Ch. 3
Oct 5	TU	5	Continuous-time population models, ordinary differential equations, the stability of systems, fisheries revisited	Case, Ch. 1, 5
Oct. 11-15	**Reading week**			
Oct 19	TU	6	An introduction to epidemiology: interactions, disease dynamics, SIR models; Time-permitting: other multispecies interactions (e.g. predator-prey, competition, parasitism, metapopulations, food webs)	Keeling Ch. 2 Hastings Ch. 6-9
Oct 26	TU	7	A brief introduction to the philosophy of science; modelling & the scientific approach; linking models to data	Hilborn Ch. 2, Haefner Ch.7
Nov 2	TU	8	Linking models to data (cont.); model discrimination & model validation	Haefner Ch. 8
Nov 9	TU	9	Thermal performance curves, the Metabolic Theory of Ecology, & understanding climate change impacts	TBA
Nov 16	TU	10	Case studies: e.g. harvest management; invasive species control; climate change impacts on parasitism	TBA
Nov 23	TU	11	TBA	TBA
Nov 30	TU	12	**Student presentations (mandatory attendance)**	

Tentative **tutorial schedule**

Date	**Time**	**Tut**	**Topic**	***Tentative*** **homework due dates**	**Attendance**
Sep 9	1-3pm	1	**NO COMPUTER LAB**		
Sep 16	1-3pm	2	Introduction to MATLAB & Homework 1		
Sep 23	1-3pm	3	Discrete-time models (Homework 1)		
Sep 30	1-3pm	4a	Population viability analysis (Homework 2)	HW 1	
	TBA	4b	**Readings:** TBA		EEB1420 only
Oct 7	1-3pm	5a	Continuous-time models (Homework 3); Research projects	HW 2	
Oct 11-15	**Reading week**				
Oct 21	1-3pm	6a	Continuous-time models (Homework 3); Research projects		
	TBA	6b	**Readings:** TBA		EEB1420 only
Oct 28	1-3pm	7a	Epidemiological models (Homework 4); Research projects	HW 3	
	TBA	7b	**Readings:** TBA		EEB1420 only
Nov 4	1-3pm	8	Research projects		
Nov 11	1-3pm	9a	Translating and communicating models to scientists from other fields and/or the general public	HW 4	
	TBA	9b	**Readings:** TBA		EEB1420 only
Nov 18	1-3pm	10	Research projects		
Nov 25	1-3pm	11	Research projects		
	TBA	11	**Readings:** TBA		EEB1420 only
Dec 2	1-3pm	12	**Student presentations (mandatory attendance)**	Research paper & News Summary	Mandatory for everyone

Course readings

No single textbook covers the breadth of topics we will discuss in this class. As such, we will use a combination of chapters from different books as well as readings from the primary literature. The readings outlined above are not required, but highly encouraged to provide additional foundations on the lecture topics discussed. Additional readings may be assigned throughout the course. Scanned copies of all required book chapters will be made available for your convenience on eReserve on the course website to the degree that copyright permits. Copies of each book will also be on hold in the library and/or are available online. We will work with the following:

Otto S. & Day T. 2007. A Biologist's Guide to Mathematical Modeling in Ecology and Evolution. Princeton University Press. **Also available in bookstore and online at UofT library; includes 'Primers' for reviewing calculus concepts**[1]

Keeling M. J. & Rohani P. 2008. Modeling Infectious Diseases in Humans and Animals. **Available online at UofT library**

Haefner J. W. 2005. Modeling Biological Systems: Principles and Applications. Springer. **Available online at UofT library**

Hilborn R. & Mangel M. 1997. The Ecological Detective: Confronting Models with Data. Springer. **Available online at UofT library.**

Case T. 1999. An Illustrated Guide to Theoretical Ecology. Oxford University Press. **Available on course website**

Hastings A. 1997. Population Biology: Concepts and Models. Springer. **Available online at UofT library**

Evaluation

BIOD59 – marks breakdown:

Homework assignments	50%
Research Paper	30%
Presentation of Research Paper	12.5%
Research Paper – News Summary	7.5%

[1] Purchasing a textbook is not necessary for this class. However, if you wish to buy a hard copy for your own library, I recommend getting this one first.

EEB1420 – marks breakdown:

Homework assignments	40%
Research Paper	30%
Presentation of Research Paper	10%
Research Paper – News Summary	5%
Discussion group – Moderation, Participation, Report	15%

Homework assignments:
Homework assignments will be introduced during the tutorials, so it is to your benefit to attend each tutorial. Homework assignments and relevant computer code will be posted on the course website following each tutorial. Homeworks are typically due one or two weeks after their assignment; cf. tentative schedule above and please watch *Class Announcements* for final due dates and details. **Penalty for late submission:** 20% of the maximum homework mark per day that the assignment is received late. Weekend days count as individual days. Unless there are extenuating circumstances (e.g. medical reasons), a mark of zero will be applied to all assignments submitted 5 days late or more. If you know ahead of time that you have a legitimate reason why you cannot hand in the assignment at the due date, let the course instructor know **before** the due date.

Research paper
Over the course of the semester, students will engage in a modelling project that applies the skills learned throughout the course. Students will work in groups of 4-5, which will be assigned in late September. At the end of the course, we will simulate a scientific conference in our classroom: each group will present their research to the class using a PowerPoint presentation and answer questions from the audience about their project. In addition, each student will write an individual, short *News Summary* of their paper intended for non-technical audiences.

By default, all students in the group will receive the same mark for the research paper; however, marks may be deducted from individuals at the discretion of the instructor if that individual is not contributing their fair share to the group's work (cf. separate document *Research Paper Instructions* for details). For their PowerPoint presentation, students will receive a mark that is a weighted average of two parts: (i) the PowerPoint slides themselves, for which all students in the group will receive the same mark, and (ii) the students' ability to present the information, answer questions, and engage in a scientific discussion, for which students will receive individual marks. Students will also receive individual marks for their *News Summary*. **Penalties for late submission:** Research paper, 20% of the maximum mark per day that the assignment is received late. *News Summary*, 20% of the maximum mark per day that the assignment is received late. Weekend days count as individual days. Unless there are extenuating circumstances (e.g. medical reasons), a mark of zero will be applied to all assignments submitted 5

days late or more; in the case of the research paper, this applies to all students in the group. If you know ahead of time that you have a legitimate reason why you cannot hand in an assignment at the due date, let the course instructor know **before** the due date. **More details regarding the Research Paper will be announced in a separate document.**

EEB1420 – Additional Requirement: Discussion groups
EEB1420 students are required to attend additional intended to provide a deeper understanding of the topics discussed in lecture and placing them within the context of current scientific advances. Each meeting, one or more students will lead the discussion on 2-3 assigned readings. At the beginning of the discussion, they will provide a brief summary of the papers and provide guidance for the discussion that follows. Students will prepare a short report on the discussion they led. Moderation and the report combine to 15% of their final mark. Attendance is required at all Discussion Groups, please see Course Announcements for schedule & details.

Attendance policy: lectures and tutorials

Attendance at lectures is not mandatory but strongly encouraged as we will develop many concepts in classroom discussions. The more students participate, the better the course.

Attendance at tutorials is not mandatory but strongly encouraged and to your own benefit, as homework exercises will be based on work begun in the tutorials.

Attendance is mandatory for all students at the last lecture and tutorial where students will present their research projects. Absences without a valid excuse during either of these two presentation days will result in a penalty of up to 50% of your own presentation mark (assuming that other members of your group were able to give the presentation). If you miss any of these events due to illness or other causes beyond your control, submit as soon as possible, and no later than within three days of the missed date, a written request for special consideration to Jennifer Campbell, explaining the reason for missing the event and attaching appropriate documentation (see below). If you know you will miss the research project presentations (with a legitimate reason), let the course instructor and your group members know as soon as possible **before** the presentation day.

Attendance is mandatory for the EEB1420 Discussion Group for graduate students. Absences without a valid excuse during will lead will lead to a 20% decrease of the mark for this

Programming language

We will use MATLAB throughout most of the course. If students wish, they are allowed to complete the exercises and research projects in R or another programming language, but should understand that programming help cannot be provided for languages other than MATLAB. All computers in the computer lab have MATLAB installed. You can also install it on your own computer for free, see here: https://www.mathworks.com/academia/tah-portal/university-of-toronto-676468.html

Submission of Reports to UofT's Plagiarism Detection Tool

Normally, students will be required to submit their course essays (Research Paper and News Summary) to the University's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site https://uoft.me/pdt-faq. The Plagiarism Detection Tool is most effective when it is used by all students; however, if a student objects to its use on principle, the course will offer a reasonable offline alternative. The student will then be asked to meet with the course instructor to outline and discuss the report before its final submission to demonstrate the process of creating the report according to the academic integrity policy. **Note: Please submit only one copy of the Research Paper per group, as otherwise the program will think that you have plagiarized each other and becomes less effective comparing with other sources. Please also note that the Plagiarism Detection Tool will be integrated into Quercus, so you will submit your assignment directly on the course website.**

Academic Integrity

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's *Code of Behaviour on Academic Matters* outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

- using someone else's ideas or words in their own work without appropriate acknowledgment.
- including false, misleading or concocted citations in your work.
- obtaining unauthorized assistance on any assignment.

- providing unauthorized assistance to another student. This includes showing another student completed work.
- submitting your own work for credit in more than one course without the permission of the instructor
- falsifying or altering any documentation required by the University. This includes, but is not limited to, doctor's notes.
- using or possessing an unauthorized aid in any test or exam.

The learning environment is built on mutual trust, and we will assume that all students operate with honesty and integrity. However, in the rare cases where there is evidence that the University of Toronto's *Code of Behaviour on Academic Matters* has been compromised, I will enact the procedures outlined in the *Code of Behaviour on Academic Matters*. First, I will invite you to discuss the possible offence through an email invitation. If our discussion leads me to believe that you have not compromised the code, then the matter will be dropped. If either you fail to respond to two requests for this discussion or new evidence comes to light, then a formal investigation will be initiated, and a penalty according to the U of T's guidelines on sanctions will be put into place.

Missed term work:

If you miss term work due to illness you must **self-declare within 48 hours via Acorn**. **Please note it is mandatory for you to fill in the notes field within the self-declaration tool on Acorn to specify what term work you are missing and applicable due dates to be considered**. For some additional instructions on how to declare illness please review the following resource https://help.acorn.utoronto.ca/blog/ufaqs/how-do-i-declare-an-absence/. If you are missing term work for another reason including: short-term illness under the care of a Physician or someone affiliated with Health and Wellness, disability reasons, a family death, vehicle accident, essential travel that is not vacation related, or varsity activities, you must e-mail the course instructor **and** Jennifer Campbell (jac.campbell@utoronto.ca) in advance or within 48 hours of the term work due date. Please note all documentation will be verified for authenticity by Jennifer Campbell and any accommodations (if applicable) will be determined by the course instructor.

Please note that we understand that life happens and you may miss term work for valid reasons and we will help you navigate through those situations. Please remain in communication with our departmental admin office as well as your course's teaching team.

AccessAbility

Everyone is a welcome member of this class, and we strive to provide an equal playing field for students with diverse learning styles and needs. In particular, if you have a

disability/health consideration that may require accommodations, please contact the AccessAbility office as soon as possible. They will provide confidential services that include flexible, personalized solutions for test-taking, note-taking, and similar issues. The AccessAbility office is located in AA142 and can be reached at: (416) 287-7560 or ability@utsc.utoronto.ca. Please see their website for more information: https://www.utsc.utoronto.ca/ability/welcome-accessability-services

Copyright in Instructional Settings:

All lectures and tutorials will be recorded and made available for later viewing on the course website. Downloading and reproduction of materials provided by instructors, including the lecture, tutorials, quizzes and exams, is an infringement of copyright and therefore prohibited.