MATH 3510 - Biomathematics

Winter 2018

Department of Mathematics & Statistics
University of Guelph

Calendar Description

This course will convey the fundamentals of applying mathematical modelling techniques to understanding and predicting the dynamics of biological systems. Students will learn the development, analysis, and interpretation of biomathematical models based on discrete-time and continuous-time models. Applications may include examples from population biology, ecology, infectious diseases, microbiology, and genetics.

Course Weight: 0.50
Class Schedule and Location: TTh 11:30-12:50 in MCKN 311

Instructor: Prof. Allan Willms
Email: AWillms@uoguelph.ca
Office Location: MACN 512
Office Hours: Tues. 10:30-11:20; Wed. 14:00-16:00; or by appointment

GTA: Thulasi Jegatheesan
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Learning Outcomes

- Be exposed to a range of mathematical models for various biological processes
- Learn to develop and analyze simple mathematical models of biological processes
- Gain a appreciation for the assumptions behind models and their limitations
- Work in a group to analyze and present, in both oral and written form, a project involving a model in mathematical biology

Lecture Content

- Introduction to Modelling
- Discrete Time Models
  - The discrete Logistic Equation
  - Cobwebbing, fixed points, linear stability analysis
  - Population growth modelling
- Continuous Time, Nonspatial, Models: Ordinary Differential Equations
  - Scalar equations
  - Systems of equations, reaction kinetics, population interactions, epidemic model
  - nondimensionalization
  - phase plane analysis
- Continuous Time, Spatial, Models: Partial Differential Equations
  - Age structured models
  - Reaction-diffusion equations
- Stochastic Models
  - Markov Chains
  - Random Variables
  - Diffusion Processes
  - Branching Processes
  - Birth and Death Processes
- Cellular Automata Models (if time permits)

Evaluation

Assessment	date/time	place	weight
Best 6 of 8 Assignments	Tuesdays Jan. 16 -- Mar. 20 (except Feb. 20 and Feb. 27), 11:30	MCKN 311	20%
Midterm Test	(tentative) Wed. Feb. 28 19:00-21:00	TBD	25%
Group Modelling Project	oral portion: last two weeks of classes written portion: Tues. Apr. 3, 11:30	MCKN 311	25%
Final Exam	Thur. Apr. 19, 8:30 - 10:30	TBD	30%

Texts

Recommended:

- *A Course in Mathematical Biology* by G. de Vries, T. Hillen, M. Lewis, J. Müller, and B. Schöfisch, SIAM 2006.

We will cover much of the material in the first seven chapters of this text. Chapter 8 is a self-guided computer tutorial for investigating models using Maple or other software. Chapters 9 and 10 provide examples of extended projects.

Two other texts that may be helpful:

- *An Introduction to Mathematical Biology*, Linda J.S. Allen. Pearson/Prentice Hall, 2007.
- *Mathematical Models in Biology*, Leah Edelstein-Keshet. SIAM, 2005.

All of these texts have been placed on reserve in the library.

Grading Policies

There are eight assignments that are due in class on Tuesdays starting January 16. No assignment will be due on the week of the midterm test, or for the last two weeks of classes. Since only the best six of these assignments will count toward your final grade, there will normally be no accommodation for failing to hand in an assignment.

Assignments and the midterm will be marked as quickly as possible and returned in class. Marks will be available on courselink. It is the student's responsibility to check that the posted marks are accurate. All requests for reassessment of assignments and/or the midterm test **must** follow the procedures outlined on the course web page.

Group Modelling Project

All students will be randomly paired into groups of three (or two). The modelling project will ask groups to construct, analyze, and interpret a simple model for a biological system. This will be done for the same model in both an oral presentation of 15 minutes (including 2 minutes for questions) given to the rest of the class, and a written presentation of about 3 pages. The oral presentations will be given during the last two weeks of classes. The written presentation is due on Tuesday, April 3 in class.

All students will also peer-assess the other oral presentations, and this peer assessment will be weighted with the instructor's assessment in a 40% - 60% scheme. More details on this project will be handed out later in the course.

University Policies

E-mail Communication

All students are required to check their University of Guelph e-mail account regularly; e-mail is the official route of communication between the University and its students.

Academic Accommodation of Religious Obligations

If you are unable to complete a course requirement due to religious obligations, please let the instructor know within the first two weeks of class. See the academic calendar for more information:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Academic Consideration

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor in writing, with your name, id, and e-mail contact. See the academic calendar for information on regulations and procedures for Academic Consideration:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

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 Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

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 Student Accessibilities Services (SAS) as soon as possible. For more information, contact SAS at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website:
http://www.uoguelph.ca/csd/

Drop date

The last date to drop one-semester courses, without academic penalty, is the 40th day of classes, Friday, March 9, 2018. See the Undergraduate Calendar Schedule of Dates:
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c03/index.shtml
For regulations and procedures for Dropping Courses, see the Academic Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Recording of Materials

Presentations which are made in relation to course work, including lectures, cannot be recorded in any electronic media without the permission of the presenter, whether the instructor, a student, or guest lecturer. When recordings are permitted they are solely for the use of the authorized student and may not be reproduced, or transmitted to others, without the express written consent of the presenter.