APPLMATH 3615A - Course Outline - Fall 2023

1. Course Information

Course Information

Course name: Introduction to Mathematical Biology

Course codes: AM 3615A (undergraduate)/ AM 9576 (graduate)

Delivery: In person. UCC 54A. Tuesdays 10:30-12:30 Thursdays 11:30-12:30

List of Prerequisites

Prerequisite(s): Multivariate calculus and linear algebra. One of Calculus 2302A/B, Calculus 2402A/B, Calculus 2502A/B; plus one of Mathematics 1600A/B or the former Linear Algebra 1600A/B, or Applied Mathematics 1411A/B. Or permission of instructor.

Unless you have either the requisites for this course or written special permission from your Dean's Designate (Department/Program Counsellors and Science Academic Counselling) to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

2. Instructor Information

Instructor: Prof. Jason Bertram
Email: jason.bertram@uwo.ca
Office hours: Tuesdays 12:30-13:30 and Thursdays 12:30-13:30 in UCC 54A or MC 116.

Students must use their Western (`@uwo.ca` or `@ivey.uwo.ca`) email addresses when contacting their instructors.

3. Course Syllabus, Schedule, and Delivery Mode

Course Content

A general overview of the key ideas and mathematical methods used in mathematical biology, particularly mathematical population biology. Single- and multi-type population models. Competition and coexistence. Evolutionary dynamics. Systems of ODEs, stochastic population models, diffusion approximations.

Course Learning Outcomes

1. You will be able to conceptually interpret and mathematically analyze canonical single- and multi-type population growth models using differential equations.
2. You will be able to construct your own population models starting from a general description of the

processes involved.

3. You will be able to apply invasion analysis to determine if different types can displace each other.
4. You will be able to analyze the dynamics of a genetic mutation using differential equations and the Wright-Fisher model of random genetic drift.
5. You will be able to define mutation fixation and calculate fixation probabilities using diffusion theory.
6. You will be able to describe three fundamental processes of evolution – mutation, selection, and drift – and be able express these processes mathematically.

Date	Tuesday	Thursday	Homework
Sep 7		Welcome & Introduction	OWL Survey
Sep 12, 14	Single-type models. Density regulation.	Equilibrium & stability.	
Sep 19, 21	Bifurcations & thresholds.	Multi-type models.	Assignment 1
Sep 26, 28	Predation.	Competition.	Assignment 1 due
Oct 3, 5	Multi-type equilibrium & stability	Multi-type equilibrium & stability	Assignment 2
Oct 10, 12	Invasion & coexistence	Environmental Change	Assignment 2 due
Oct 17, 19	Evolution. Natural selection.	Discreteness & stochasticity	
Oct 24, 26	Mid-term exam	Project overview	
Reading week			
Nov 7, 9	Random genetic drift.	Fixation of neutral mutations.	Assignment 3 open
Nov 14, 16	Diffusion approximations.	Fixation of non-neutral mutations.	Assignment 3 due
Nov 21, 23	Project guidance: the principles of mathematical modelling	Project guidance: how to write a write-up	
Nov 28, 30	Project guidance: Interactive session	Project guidance: presentation tips	
Dec 5, 7	Project presentations	Project presentations	Project write-up due

Key Sessional Dates

Classes begin:	September 7, 2023
Last day to add:	September 15, 2023
No classes:	September 29, 2023
Holiday:	October 9, 2023
Reading Week:	October 30 to November 5, 2023
Last day to drop:	November 13, 2023
Classes end:	December 8, 2023
Exam period:	December 10 to 22, 2023

Although the intent is for this course to be delivered in person, should any university-declared emergency require some or all of the course to be delivered online, either synchronously or asynchronously, the course

will adapt accordingly. The grading scheme will not change. Any assessments affected will be conducted online as determined by the course instructor.

Course Materials

All course content will be provided on OWL and in class. No required text.

Students are responsible for checking the course OWL site (http://owl.uwo.ca) on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class.

Learning Management System (OWL)

If students need assistance with the course OWL site, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

4. Methods of Evaluation

Course Grade

The final course grade will be determined by student performance on

Assignments [27%]: Three assignments weighted at 9% each (approximately 1 per month).

Midterm Test [33%]: Oct 24, in class. Covers all material taught up to this date.

Project: Project may be done in pairs (both the write-up and presentation component).

- Write up [35%]:
  - Clear statement of the problem being addressed. What variables are you treating as known? What variables are you treating as unknown and making predictions about? What is the biological/mathematical motivation for studying these variables? What do you expect/hope to find? [5%]
  - Methods. Any combination of logical reasoning, model development, mathematical analysis, numerical solution or computer simulation that produces mathematical predictions from your assumptions. [20%]
  - Results. Focus on concrete results (figures and equations) rather than verbal descriptions. [10%]
- Presentation [5%]: Explain your project at a level your your classmates can understand.

Note:

- Graduate students will be assigned more advanced problems in assignments and the mid-term examination.
- Late assignments and project write-ups (without and accommodation) will be penalized at a rate of 10% per day.
- Although attendance and classroom participation do not directly contribute to your final grade, they are strongly recommended for succeeding in (and enjoying) this course. In-class active learning and group discussions will be an integral part of course delivery.

Make-up Dates

Make up for mid-term will be sometime in the two weeks after reading week. Details TBA.

5. Student Absences

If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below.

Assessments Worth Less Than 10% of Course Grade

Applies to assignments and project presentation. If an accommodation is granted, the assessment will be reweighted to the following major assessment (mid-term or project-write-up).

Assessments Worth At Least 10% of Course Grade

Applies to the mid-term test (33%) and project write-up (35%).

For work totalling 10% or more of the final course grade, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible. For further information, please consult the University's medical illness policy (click here) and review the Student Medical Certificate (click here). In the event that the links do not work, type either

- https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration.pdf (for policy)
- https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf (for certificate)

into your browser.

Accommodation for the mid-term will be a make-up mid-term. Accommodation for the project write-up will be an extension.

Accommodation and Accessibility

Religious Accommodation

When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least

two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult the University's list of recognized religious holidays (click here), which is updated annually. Alternatively, you may wish to enter

- https://multiculturalcalendar.com/ecal/index.php?s=c-univwo

directly into your browser.

Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. Students can consult the policy on Academic Accommodation for Students with Disabilities (click here). Alternatively, type

- www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf

into a browser.

6. Academic Policies

It is permitted to use generative AI for your project write-up but it is not recommended. The project write-up should be primarily mathematical (equations, figures and logical reasoning), not verbal (sentences, descriptions etc.). Nonsensical text will be penalized as harshly as no text at all.

The website for Registrarial Services is http://www.registrar.uwo.ca (click here).

In accordance with policy (click here), the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner. The policy referenced above can also be accessed by typing

- https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf

into your browser.

Scholastic offences are taken seriously and students are directed to read the appropriate policy (click here), specifically, the definition of what constitutes a Scholastic Offence. This policy can also be accessed by typing

- http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

into your browser.

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers

submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com).

In the event of a health lock-down, tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide personal information (including some biometric data) and the session will be recorded. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western's Remote Proctoring website at https://remoteproctoring.uwo.ca (click here).

7. Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https://www.uwo.ca/sci/counselling/ (click here).

Students who are in emotional/mental distress should refer to Mental Health@Western by visiting their website https://uwo.ca/health/ (click here) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will information about support services for survivors, including emergency contacts is available (click here). If you cannot access the link you can type

- https://www.uwo.ca/health/student_support/survivor_support/get-help.html

into your browser. To connect with a case manager or set up an appointment, please email support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education (click here) if you have any questions regarding accommodations. If the link provided does nto work, type

- http://academicsupport.uwo.ca/accessible_education/index.html

into your browser.

Learning-skills counsellors at the Student Development Centre (click here) are ready to help you improve your learning skills (alternatively, type https://learning.uwo.ca into your browser). They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Additional student-run support services are offered by the USC, https://westernusc.ca/services/ (click here).