Course Outline
Applied Mathematics 1201b
Calculus and Probability with Biological Applications
Winter 2020

Instructor

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Office Hours: Check `tpattend.youcanbook.me` weekly!

Course Summary

This year we will change our focus a little from what has previously been covered or taught in AM1201b. We will switch our focus more heavily on the idea of **modelling** various applications to biology, social science and more. This idea of modelling will allow you, as future biologists, doctors or what have you, to learn fundamental ideas that are applicable to your future career. Our modelling adventure will take us down the following four major routes:

1. *Discrete Models:* difference equations, discrete systems, numerical solutions.
2. *Continuous Models:* differential equations, equilibria, analytical and numerical solutions.
3. *Probabilistic Models:* combinatorics, basic probability theory, random variables, population genetics.
4. *Epidemiological Models:*[1] basic theory, basic reproduction number, vaccination.

In addition to our foray into modelling, we will fill in with some additional concepts that are worthwhile for your future undergraduate career. These topics include,

4. *Basic Linear Algebra Tools:* vectors, matrices, determinants, eigenvalues and eigenvectors.
5. *Descriptive Statistics:* five-number summary, graphical descriptions, linear regression.
6. *Game Theoretical Models:*[2] simple games, Nash equilibrium, evolutionarily stable strategies.

Lectures

MWF – 12:30pm - 1:30pm, NCB101

Help Centre Hours

In lieu of weekly tutorials, this course will feature *drop-in* sessions three days a week. The AM1201 Help Centre will run **Wednesday through Friday** from 4:00pm – 6:00pm in MC204. Help Centre will commence on *Thursday, January 9th, 2020*. In addition to Help Centre, there will be drop-in private TA office hours in MC201 on Mondays and Tuesdays from 4:00pm – 6:00pm. The TAs will rotate through responsibilities for these office hours throughout the term. A schedule will be posted on OWL.

Requirements

Prerequisite(s): One or more of Calculus1000A/B, 1100A/B, 1500A/B or Math1225A/B.
Note: You must have passed Calc1000 to get credit for AM1201b. No exceptions will be made.
Antirequisite(s): The former Calculus1201A/B.

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[1] If time permits.
[2] If time permits.

Textbook

Required: *AM1201 Course Manual (2nd Ed.)* by T. Pattenden.

This textbook was written as a set of *pre-populated notes* and will be used in lectures. We will fill in blanks, examples, and more as we go through the course material. Practice problems are also included in this text, with solutions to be posted on OWL throughout the course. The problems in the textbook will be considered sufficient practice of course material. A **free PDF** of the manual will be available through OWL, however the Bookstore will have hardcopies available for purchase (under $40.00).

Note: The first edition will not be applicable to this course. The second edition is required, and will be used in class each lecture.

Previous Text: *Biocalculus: Calculus, Probability, and Statistics for the Life Sciences (Custom Edition)* by J. Stewart and T. Day.

This book was used previously in the course, and has excellent practice problems and has some supplementary descriptions of topics covered in our course. It is not necessary for you to acquire a copy, but may be helpful as an extra tool for studying for tests and assignments.

Other Texts Used to Develop Course Material: The following is a list of texts used to develop various areas in the course manual. None of these books are required, by any means, but is a helpful list of books that you may want to hang onto for future academic use.

- *Mathematics for the Life Sciences* by E.N. Bodine, S. Lenhart, & L.J. Gross
- *Mathematics for the Life Sciences: Calculus, Modeling, Probability, and Dynamical Systems* by G. Ledder
- *Modeling Life* by A. Garfinkel, J. Shevtsov, & Y. Guo
- *Calculus for the Life Sciences* by M.L. Bittinger, N. Brand, & J. Quintanilla
- *Essential Mathematical Biology* by N.F. Britton
- *Mathematical Biology* by J.D. Murray

Evaluation

Your final grade will be determined via one of the following two grading schemes. The higher of the two grades will be the grade submitted as your final grade.

Scheme 1:

Calculus1000 Proficiency Test	1%
In-class Clicker Questions (Participation)	4%
Written Assignments	15%
Term Test #1 (February 2, 10am - 12pm)	25%
Term Test #2 (March 1, 10am - 12pm)	15%
Final Examination (scheduled by registrar)	40%

Scheme 2:

Calculus1000 Proficiency Test	1%
In-class Clicker Questions (Participation)	4%
Written Assignments	15%
Term Test #1 (February 2, 10am - 12pm)	15%
Term Test #2 (March 1, 10am - 12pm)	25%
Final Examination (scheduled by registrar)	40%

(******) Each term test will have a *make-up examination*. The make-up for Term Test #1 will take place on **Thursday, February 6th** from 7pm - 9pm. The make-up for Term Test #2 will take place on **Thursday, March 5th** from 7pm - 9pm. Room(s) to be determined.

Who Should Take This Course?

This course was designed because many students in the biological sciences at Western take Calculus1000, and then one other half course which is their final course in mathematics. AM1201b pulls together small pieces of four other math courses (Calculus, Linear Algebra, Differential Equations, and Probability) that are especially relevant and useful in biology and medicine. However, AM1201b does not cover enough material in these areas to serve as a prerequisite for further courses in mathematics. **If you might be interested in taking further courses in mathematics, you should not take AM1201b**. Also, if you have already taken a course on Linear Algebra or Differential Equations, you should not take AM1201b.

Assignment Logistics

Assignments will be handwritten this year, for the first time. Assignments will be assigned approximately bi-weekly, and will state which sections of the Course Manual they cover. Each assignment will test your knowledge of the concepts covered in class, and push you to expand that which has been covered. All assignments will be submitted to and graded on Gradescope. Details for uploading assignments are posted on OWL.

All assignments will be completed in **groups**. Odd numbered assignments (1,3,5, etc.) will be completed in groups of your own choosing. Even numbered assignments (2,4,6, etc.) will be completed in groups of the instructors choosing (randomized on OWL). This is to ensure you have the opportunity to meet, and work with a variety of peers. Scientists hardly ever work alone, and it is expected that throughout your undergraduate degree you learn techniques to work with all sorts of individuals. **Groups shall be no less than 4 more members and no greater than 5 members.**

Computers in the "GenLabs" on campus are able to access Gradescope and assignments can be easily uploaded there. You are welcome to use your own computer or smart phone as well, however **computer problems** or **internet problems** will not be accepted as a reasonable excuse for missing a deadline. If you use a non-Western computer, **you do so at your own risk**. Therefore, it is not recommended you leave assignments to the last minute!

Additional Notes

Calculus1000 Proficiency Test: This "test" will be administered through OWL's quiz environment. If you complete the test, you will receive the entire point to your final grade, no matter your score. This is meant to allow you to reflect on your previously learning, and will allow the instructor to see the strengths and weaknesses of the class before the course begins. You will have two (2) attempts to do the test, and will close for submissions on *January 19th, 2020* at 11:59pm.

In-class Clicker Questions: Throughout the course, clicker questions will be posed to the class. These questions will be administered through the iClicker Cloud application. It is expected you have this downloaded (for free!) on your computer or smart phone. These questions will not be for grades, but rather participation and instant feedback on your learning. Most of the time, you will have an opportunity to answer alone first, discuss with peers your understanding, and then answer again. Your grade will be determined through the percentage of participation in these questions. If you participate in 80% or more questions, you will receive all 4% of your grade. Any less, and you will receive that as your grade.

Examination Structure: Examinations will be constructed such that (approx) 50% of the evaluation will be four-option multiple choice problems, where students will answer on instructor provided sheets. The other (approx) 50% of the examination will consist of one or two *hand-written* problems, where students are expected to show their steps and demonstrate their ability to do the mathematics taught in class. Topics for each term test will be announced in lecture and on OWL. Topics will be weighted

appropriately to the amount focused on in lecture. The practice problems at the end of each section of the course manual will be the best guide for your studying. The final examination will be cumulative of all topics taught in the course. All examinations will be marked and released to students via Gradescope (details on OWL). Regrade requests will be handled through Gradescope (details about timing and how this will function will be announced later).

Office Hour Policies: Office hours will be appointment only booked through the above "You Can Book Me" link. Students will be allowed to book a maximum of two (2) 15 minute appointments per office hour. Students that miss three (3) booked appointments without sufficient notice (24 hours will suffice) will be barred from booking office hour appointments for the remainder of the term. Students who fall into this category will still be able to attend drop-in office hours around examinations, and will still be able to attend Help Centre hours.

Practice, practice, practice: The material in this course is really fun and challenging, but it builds quickly. Practice problems will be available at the end of each section of the Course Manual, and it is recommended you complete them all. It is best if you book fixed times in your weekly schedule to work on AM1201b practice problems.

Taking notes: Although the Course Manual is structured in a pre-populated format, completed notes will not be available on OWL. Research shows that taking handwritten notes during class is the best way to "absorb" the material. If you miss a lecture, you can get notes from a friend or colleague in the course.

Working together: Working in pairs or groups, talking about problem solving strategies and studying together is encouraged. Assignments will be a great way to work on your teamwork skills.

Hardware: We will use the standard Faculty of Science policy and standard Faculty of Science calculators for both term tests and the final examination. To quote the Faculty of Science guidelines: "The Sharp EL-510R(B) or Sharp EL-510RN(B) are the only calculator models permitted during exams. All other brands and Sharp models will be confiscated. Proctors and instructors for tests and exams do not lend calculators. It is your responsibility to bring the correct calculator and to ensure that it is in proper working order. Its not a bad idea to bring a spare calculator of the same model! The sharing or exchanging of calculators during tests or exams is strictly forbidden. Aside from the specified calculator, no other electronic devices (phones, iPods, etc.) may be in your possession during exams, even for timekeeping purposes."

Extra help: There will be many hours each week during which you can obtain one-on-one extra help on course material. The drop-in Help Centre will run at regular times each week. A document listing times and locations for this extra help is available under "Resources" on OWL. Private tutors are also available; search for the "Tutor Referral Service" or "Private Tutor List" at Western.

Need to miss the tests or final? There will be make-up examinations for each term test, as outlined above. Course instructors in the Faculty of Science are not allowed to approve accommodation for course requirements that are worth more than 10% of any final grade. **Therefore, permission to miss an exam, for either the term tests or final, must be obtained from the Academic Counsellors in your faculty or through the self-reporting system**. Talk to the counsellors first. After permission is granted, an email will be sent to the instructor. The instructor will then email you to confirm details regarding the make-up examination for each examination. **If you miss the deadline for accommodation**, we cannot administer any extra accommodation during regular exam times. It is your responsibility to ensure you receive your accommodation by the correct deadlines set by Academic Counselling.

University Policies

Support Services: Learning-skills counsellors at the Student Development Centre (`http://www.sdc.uwo.ca`) are ready to help you improve your learning skills. 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. Students who are in emotional/mental distress should refer to Mental Health@Western (`http://www.health.uwo.ca/mental_health`) for a complete list of options about how to obtain help. Additional student-run support services are offered by the USC, `http://westernusc.ca/services`. The website for Registrarial Services is `http://www.registrar.uwo.ca`.

Accessibility: 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 Services for Students with Disabilities (SSD) at 661-2111 ext. 82147 if you have questions regarding accommodation.

Code of Student Conduct: To foster a supportive and enriching academic environment that is conducive to learning and free inquiry, Western has a Code of Student Conduct (`http://www.uwo.ca/univsec/pdf/board/code.pdf`). You can expect your instructor to promote this environment and also respect each students unique views and opinions. Because Western is also a part of your environment, we expect the same from you. Activities that disturb another students right to this environment will not be tolerated; these include talking in class about matters irrelevant to the course and using electronic devices inappropriately. You can also expect your instructor to come prepared, on time, and eager to help you learn. In turn, we expect that you will come prepared, on time, and ready to learn.

Academic Dishonesty: Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at this website: `http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf`. Computer-marked, multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

Illness when writing exams: It is Faculty of Science policy that a student who chooses to write a test or exam deems themselves fit enough to do so, and the student must accept the mark obtained. Claims of medical, physical, or emotional distress after the fact will not be considered. In AM1201b, there is no opportunity for a reweight of the other course components after the test or exam has been written. Arguing "I did not want to write a heavily weighted final is not a valid reason for writing the midterm test while ill. If you are ill, obtain medical documentation (see below) and do not write.

Missed Course Components: If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or supporting documentation **to the Academic Counselling Office of your home faculty** as soon as possible. If you are a science student, the Academic Counselling Office of the Faculty of Science is located in WSC 191, and can be contacted at 519-661-3040 or `scibmsac@uwo.ca`. Their website is `http://www.uwo.ca/sci/undergrad/academic_counselling/index.html`. A student requiring academic accommodation due to illness must use the Student Medical Certificate (`https://studentservices.uwo.ca/secure/medical_document.pdf`) when visiting an off-campus medical facility. For further information, please consult the universitys medical illness policy at `http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf`.

Missed Midterm or Final Exam: If you miss the midterm, and if your facultys Academic Counselling Office has approved your circumstances, then you may write the makeup midterm which will be available during the week after the midterm. If you are unable to write the make-up, the weight of the midterm will be shifted to the Final Exam. There are no other possibilities or re-weightings. In particular, to remain fair to other students, it will not be possible to shift more weight onto the assignment component of the course. If you miss the Final Exam, contact your facultys Academic Counselling Office as soon as possible. They will assess your eligibility to write the Special Exam (the name given by the university to a makeup Final Exam). You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation (see `http://www.registrar.uwo.ca/examinations/exam_schedule.html`).

Equal Opportunity and Evaluation Policy: The university is committed to academic integrity and has high ethical and moral standards. All students will be treated equally and evaluated using the criteria presented in this course outline and their respective weights. The evaluation criteria are based strictly on actual achievement, not on effort. Claims of an excellent academic history, of attendance in the course components, or of personal issues (family, relationship, financial, etc.) cannot be used to justify a higher grade in the course because they are not criteria for evaluation. There is no extra work available for extra credit or to "make up" another grade. We do not offer any extra assignments, essays, problem sets, or other work of any kind to any student. The requirement for a higher grade in order to, for example, maintain a scholarship, enter a program, or obtain a higher GPA for various reasons, is not a justifiable reason for increasing your grade. If we increased or "bumped your grade (i.e. gave you a grade that you did not legitimately earn), it would be unfair to the other students and also a great disservice to the scholarships and programs who are evaluating all students on the basis of their grades. This means, for example, if you receive 58% in the course we will not "bump" your grade to a 60%; you will simply need to take the course again if you need 60%.

Overarching Learning Outcomes

Although a full list of learning objectives is posted to OWL for each section of the Course Manual, below is a list of three overarching learning outcomes that set are the focus of each major section in the course.

1. Use discrete dynamical systems to predict the long-term behaviour of a population.
2. Solve simple differential equations to make predictions for various biological phenomena.
3. Explain various probabilistic and their relationship to biological applications.

The most important outcome that we hope to instil in you by the end of the course is that, "**mathematics is extremely important in the world of medicine, biology and various other fields that may not seem to have an obvious connection**".

Schedule of Topics

A course schedule of topics, due dates, and examinations is posted for your perusal on OWL. Please note that this schedule is tentative and is subject to change. The instructor will also fill in lecture topics, assignment due dates, and other important dates that may occur on the OWL Calendar. Please ensure you check this often!