AM 1201B:
Calculus and Probability With Biological Applications
Winter 2012 Course Outline

Instructor: Dr. M. Calder, MC 250, X88787, mcalder9@uwo.ca

Office Hours: Mondays from 1:30pm to 2:00pm, Wednesdays and Thursdays from 4:30pm to 5:15pm, or by appointment

Graduate TA: To be announced

Lectures: Mondays, Wednesdays, and Fridays from 12:30pm to 1:20pm in NCB 114

Tutorials: Wednesdays and Thursdays from 5:30pm to 6:20pm in MC 105B

Prerequisites: The prerequisites for this course are Calculus 1000A/B, 1100A/B, 1500A/B or Mathematics 1225A/B. Fundamentally, you should have experience with basic algebra, analytic geometry, elementary functions, limits, derivatives, and integrals. We will do some review in the lectures.

Course Objectives: This course will provide an overview of common applications of mathematics in the life sciences. In the broad sense, the three primary objectives for this course are: To gain an understanding of differentiation, integration, and linear algebra along with their applications; to develop the ability to write well-organized and readable mathematical solutions in order to communicate mathematical and technical ideas; and to develop the ability to read mathematics books in order to learn and use mathematics. Mathematically, we will cover topics such as applications of derivatives and integrals, linear algebra, ordinary differential equations, difference equations, and probability. Biologically, we will cover topics such as scaling and allometry, population growth, predator-prey dynamics, and age-structured populations.

Textbook: The required textbook, which is available at the university bookstore, is:

Marvin L. Bittinger, Neil Brand, and John Quintanilla. *Calculus for the Life Sciences*. Pearson, Toronto, 2006.

Most of what we will cover in the lectures can be found in the textbook. Furthermore, many of the assignment problems will come from the textbook.

WebCT: All course material (including announcements, the quizzes, the assignments, midterm, and the respective solutions) will be available on WebCT which can be accessed at

webct.uwo.ca.

Quizzes: During most weeks, there will be a **quiz** that will test you on the basic techniques covered in recent lectures. The quiz can be taken at most once **in either of the two tutorials**. The quizzes given in the two tutorials will be similar but differ slightly (for example, different numbers may be used or a different variation of a technique may be required). **The three lowest quiz marks will be dropped**.

Assignments:

- There will be **10 assignments**. Typically, the assignments will be due at the **beginning of Friday lectures**.
- Each assignment will be posted on WebCT roughly one week before the due date and the solution set will be posted a few days after the due date.
- You are encouraged to discuss the assignments with other students in the class. However, your submitted **assignments should be written up independently** and reflect your own understanding of the material.
- Marked assignments will usually be **returned in the tutorials** of the following week.
- Solutions to the assignments should be neat, clear, and fully justified. **Marks will be deducted for poor presentation**.
- **The two lowest assignment marks will be dropped**.

Midterm Examination: Thursday, March 1, 2012 from 7:00pm to 9:00pm

Final Examination: There will be a three-hour final examination that will cover the entire course. The exam will be scheduled by the university and held during the final-examination period.

Marking Scheme: Quizzes 10%, Assignments 15%, Midterm 25%, Final Exam 50%

Bonus Marks: Occasionally, I will give bonus problems. Each problem would have to be done independently and would be worth an additional 1% for your final mark. Also, for any of my posted, typed materials (for example, assignments, solutions, lecture notes) I will give 0.25% bonus marks to the first student to identify any given mistake or typographical error. Bonus marks will be capped at 5%.

Calculators: While the use of programmable and graphing calculators when working on assignments is permitted, only non-programmable and non-graphing calculators will be allowed on quizzes and exams.

Learning Mathematics: In high school, mathematics is often learned by rote, that is by memory, without fully understanding the meaning. The purpose of studying mathematics, however, is to learn how to think logically, how to ask questions, and how to solve problems. Thus, while it is necessary to memorize some facts in mathematics, the emphasis should be on learning by understanding. The point is that someone who understands the basic concepts will be able to apply them in solving problems. For this reason, it is important that you spend time studying your lecture notes and the text before you work on the assignments. That said, it is also true that much of mathematics is a participatory activity, not a game for the passive observer. You will only learn by doing! It is only with practice that you will become proficient.

Writing Mathematics: We often find that many students write mathematical solutions which contain only equations and algebraic manipulations, with no (or very few) words of explanation. In our mathematics courses we require that you write well-organized and readable solutions, using sentence form. By writing a well-organized solution, you will develop a better understanding of the method. There are certain components of a solution which are essential:

- An introductory statement (what you are given and what you have to show or find);
- A concluding statement (summarize the conclusion briefly);
- Justifications of the main steps (refer to definitions, rules, and known properties);
- Some sentences of guidance for the reader (for example how you are going to solve the problem).

Why Students Fail: Students who fail mathematics courses usually do so because they fall behind in their work. In order to avoid falling into this trap, you may want to review material from high school and previous university mathematics courses at the beginning of the term, study your lecture notes after each lecture (this can raise your retention by up to 80%), ask questions about the points that you do not understand, and start working on the problem sets as soon as they are available. Do not get into the habit of skipping lectures.

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Western Ontario community are expected to promote honesty, trust, fairness, respect, and responsibility. A student is expected to know what constitutes academic integrity to avoid committing academic offenses and to take responsibility for his/her actions. For more information, see

www.uwo.ca/univsec/handbook/appeals/scholoff.pdf

and

www.uwo.ca/ombuds/student/cheating.html.

Accommodations: If you are unable to meet a major course requirement due to illness or other serious circumstance, you must provide valid supporting documentation to your faculty's Dean's Office as soon as possible and contact me as soon as possible. It is your responsibility to make alternative arrangements. In the event of a missed final examination, a Recommendation of Special Examination Form must be obtained from your faculty's Deans Office immediately. For further information regarding accommodations for medical reasons, see

www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf

and

www.uwo.ca/univsec/handbook/appeals/medicalform.pdf.

Week	Lecture Dates	Topics	Events
1	January 9, 11, 13	Review of Derivatives (Chapter 2) Optimizing a Function (§3.1,§3.2,§3.4) Optimization Problems (§3.5)	Review Quiz in Tutorial (not for marks)
2	January 16, 18, 20	Review of Integrals (§5.1,§5.2,§5.3,§5.4) Method of Substitution (§5.5) Integration By Parts (§5.6)	Quiz 1 Assignment 1 Due
3	January 23, 25, 27	Numerical Integration (§5.7) Volume (§5.8) Improper Integrals (§5.9)	Quiz 2 Assignment 2 Due
4	January 30 February 1, 3	Differential Equations and Initial Value Problems (§8.1) Linear First-Order Differential Equations (§8.2) Autonomous Differential Equations and Stability (§8.3)	Quiz 3 Assignment 3 Due
5	February 6, 8, 10	Separable Differential Equations (§8.4) Numerical Solutions of Differential Equations (§8.5)	Quiz 4 Assignment 4 Due
6	February 13, 15, 17	Higher-Order Homogeneous Differential Equations (§9.1) Higher-Order Inhomogeneous Differential Equations (§9.2) Difference Equations	Quiz 5 Assignment 5 Due
7			Reading Week
8	February 27, 29 March 2	Matrix Operations (§6.1) Solving Systems of Linear Equations (§6.2) Finding a Matrix Inverse and Determinant (§6.3)	Midterm
9	March 5, 7, 9	Computing Eigenvalues and Eigenvectors (§6.4) Solving Difference Equations with Matrices (§6.5)	Quiz 6 Assignment 6 Due
10	March 12, 14, 16	Systems of Linear Differential Equations (§9.3) Matrices and Trajectories (§9.4)	Quiz 7 Assignment 7 Due
11	March 19, 21, 23	Models of Population Biology (§9.5) Numerical Methods (§9.6) Probability (§10.1)	Quiz 8 Assignment 8 Due
12	March 26, 28, 30	Multiplication Trees and Bayes' Rule (§10.2) The Binomial Distribution (§10.3) Expected Value and Standard Deviation (§10.4)	Quiz 9 Assignment 9 Due
13	April 2, 4	Continuous Random Variables (§10.5) The Poisson Process (§10.6)	Quiz 10 Good Friday April 6
14	April 9, 11	The Normal Distribution (§10.7) Review	Assignment 10 Due No tutorials

Table 1: Tentative Schedule