

**Faculty of Science Course Syllabus
Department of Mathematics and Statistics
MATH/STAT 2300
Mathematical Modelling
Winter 2019**

Instructor(s): Jason I. Brown jason.brown@dal.ca Chase 204

Lectures: TR 11:35 – 12:55 Dunn 135

Laboratories: One of M 12:35 – 13:25 / T 9:35 – 10:25, in Rowe 3080

Course Description

By using fundamental calculus concepts in a modelling framework, the student investigates practical problems chosen from common experiences encompassing many academic disciplines, including the mathematical sciences, operations research, engineering and the management and life sciences. A significant part of the course is learning to use MAPLE as a mathematical tool.

Course Prerequisites

A passing grade in MATH 1000.03.

Course Objectives/Learning Outcomes

This course an introduction to mathematical modelling.

Objective: “The student will be able to identify the basic steps in mathematical modelling”

Condition: Given a real-life problem.

Behaviour: The student will be able to traverse the steps required to formulate and solve the problem via mathematical modelling.

Objective: “The student will be able to solve simple dynamical system via difference equations.”

Condition: Given a dynamical system.

Behaviour: The student will be able to solve and analyze the related difference equation.

Objective: “The student will be able to use proportionality to solve real-life problems”

Condition: Given a situation where the appropriate model is one based on proportionality.

Behaviour: The student will be able to determine a reasonable solution.

Objective: “The student will understand geometric similarity.”

Condition: Given a real-life problem.

Behaviour: The students will be able to apply their knowledge of geometric similarity to formulate a model.

Objective: “The student will be able to fit data to a model graphically.”

Condition: Given a set of data points.

Behaviour: The student will be able to determine the appropriate function to use via graphing.

Objective: “The student will be able to apply analytic techniques to fit a model to data.”

Condition: Given data.

Behaviour: The student will be able to use analytic techniques (such as least squares) to fit a variety function to the data.

Objective: “The student will be able to choose the best analytic function to a set of data points.”

Condition: Given data.

Behaviour: The student will be able to determine, among a set of possible functional models, which best fits the trend of the data.

Objective: “The student will be able to carry out experimental modeling.”

Condition: Given a real-life problem involving data.

Behaviour: The student will be able to apply a variety of techniques (high order polynomials, smoothing, splines) to mathematically model the data.

Objective: “The student will be able to create and utilize simulations.”

Condition: Given a real-life complex problem.

Behaviour: The student will be able to provide a solution via a computer simulation.

Objective: “The student will be able to develop discrete probabilistic models.”

Condition: Given a real-life problem involving a random process.

Behaviour: The student will be able to determine the appropriate mathematical model.

Objective: “The student will be able to create models using decision theory.”

Condition: Given a real-life problem.

Behaviour: The student will be able to formulate and solve the associated graph theoretic problem.

Objective: “The student will learn to program in Maple™.”

Condition: Given a mathematical problem.

Behaviour: The student will be able to use Maple™ to assist them in formulating, solving and visualizing solutions

Course Materials

Textbook: A First Course in Mathematical Modeling (4th edition) by F.R. Giordano, W.P. Fox, S.B. Horton and M.D. Weir, Brooks/Cole, Belmont, 2003.

Course website: The course website is on Brightspace, with additional materials at

www.mathstat.dal.ca/~brown/math2300

Course Assessment

Component	Weight (% of final grade)	Date
<i>Midterm exam</i>	30%	Tuesday, March 5, 2019
<i>Final exam</i>	50%	(Scheduled by Registrar)
<i>Assignments</i>	15%	

Other course requirements

Tutorial Attendance 5% (calculated as $(\text{minimum}(\#\text{tutorials attended}, 9)/9) * 5\%$)

Everyone must be enrolled on one of the two tutorials

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D	(50-54)
A (85-89)	B (73-76)	C (60-64)	F	(<50)
A- (80-84)	B- (70-72)	C- (55-59)		

Course Policies

No late assignments will be accepted. If you miss a midterm, assignment or tutorial, you are required to fill out and submit the Student Self-Declaration of Absence form online in Brightspace. In the case of a missed assignment or tutorial attendance, the missed assignment or tutorial attendance score will not be included in the average for that component, if a Student Self-Declaration of Absence form is submitted within six (6) days of the missed due date. In the absence of a Self-Declaration of Absence, the missed assignment/tutorial will receive a grade of zero. For a missed midterm, you must contact the instructor at jason.brown@dal.ca on or before the scheduled date of the midterm, and submit a copy of your academic schedule, so that a make-up midterm can be scheduled. If you are unable to attend the make-up midterm, and submit a second Student Self-Declaration of Absence form, the weight of the midterm will be added to the final exam.

All assignments are to be completed independently; no group assignments are allowed.

Course Content

- 1) Modelling change
 - a) Modelling change with a difference equation
 - b) Approximating change with difference equations
 - c) Solutions to dynamical systems
 - d) Systems of difference equations

- 2) Modelling process, proportionality and geometric similarity
 - a) Modeling using proportionality
 - b) Modeling using geometric similarity
 - c) Examples

- 3) Model fitting
 - a) Fitting models to data graphically
 - b) Analytic methods of model fitting
 - c) Applying the least-squares criterion
 - d) Choosing a best model

 - 4) Experimental modelling
 - a) High-order polynomial models
 - b) Smoothing
 - c) Spline methods

 - 5) Simulations
 - a) Monte Carlo simulations
 - b) Queuing models

 - 5) Discrete Probabilistic Modeling
 - a) Markov chains
 - b) Reliability
 - c) Linear Regression

 - 6) Modeling with Decision Theory
 - a) Probability and expected values
 - b) Decision trees
 - c) Sequential decisions and conditional probability
 - d) Decisions using alternative criteria
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ACCOMMODATION POLICY FOR STUDENTS

Students may request accommodation as a result of barriers related to disability, religious obligation, or any characteristic protected under Canadian Human Rights legislation. The full text of Dalhousie's Student Accommodation Policy can be accessed here:

http://www.dal.ca/dept/university_secretariat/policies/academic/student-accommodation-policy-wef-sep-1--2014.html

Students who require accommodation for classroom participation or the writing of tests and exams should make their request to the **Advising and Access Services Centre (AASC)** prior to or at the outset of the regular academic year. More information and the *Request for Accommodation* form are available at www.dal.ca/access.

ACADEMIC INTEGRITY

Academic integrity, with its embodied values, is seen as a foundation of Dalhousie University. It is the responsibility of all students to be familiar with behaviours and practices associated with academic integrity. Instructors are required to forward any suspected cases of plagiarism or other forms of academic cheating to the Academic Integrity Officer for their Faculty.

The Academic Integrity website (<http://academicintegrity.dal.ca>) provides students and faculty with information on plagiarism and other forms of academic dishonesty, and has resources to help students succeed honestly. The full text of Dalhousie's **Policy on Intellectual Honesty** and **Faculty Discipline Procedures** is available here:

http://www.dal.ca/dept/university_secretariat/academic-integrity/academic-policies.html

STUDENT CODE OF CONDUCT

Dalhousie University has a student code of conduct, and it is expected that students will adhere to the code during their participation in lectures and other activities associated with this course. In general:

“The University treats students as adults free to organize their own personal lives, behaviour and associations subject only to the law, and to University regulations that are necessary to protect

- the integrity and proper functioning of the academic and non – academic programs and activities of the University or its faculties, schools or departments;
- the peaceful and safe enjoyment of University facilities by other members of the University and the public;
- the freedom of members of the University to participate reasonably in the programs of the University and in activities on the University's premises;
- the property of the University or its members.”

The full text of the code can be found here:

http://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

SERVICES AVAILABLE TO STUDENTS

The following campus services are available to help students develop skills in library research, scientific writing, and effective study habits. The services are available to all Dalhousie students and, unless noted otherwise, are free.

Service	Support Provided	Location	Contact
General Academic Advising	Help with - understanding degree requirements and academic regulations - choosing your major - achieving your educational or career goals - dealing with academic or other difficulties	Killam Library Ground floor Rm G28 Bissett Centre for Academic Success	In person: Killam Library Rm G28 By appointment: - e-mail: advising@dal.ca - Phone: (902) 494-3077 - Book online through MyDal
Dalhousie Libraries	Help to find books and articles for assignments Help with citing sources in the text of your paper and preparation of bibliography	Killam Library Ground floor Librarian offices	In person: Service Point (Ground floor) By appointment: Identify your subject librarian (URL below) and contact by email or phone to arrange a time: http://dal.beta.libguides.com/sb.php?subject_id=34328



Studying for Success (SFS)	Help to develop essential study skills through small group workshops or one-on-one coaching sessions Match to a tutor for help in course-specific content (for a reasonable fee)	Killam Library 3rd floor Coordinator Rm 3104 Study Coaches Rm 3103	To make an appointment: - Visit main office (Killam Library main floor, Rm G28) - Call (902) 494-3077 - email Coordinator at: sfs@dal.ca or - Simply drop in to see us during posted office hours All information can be found on our website: www.dal.ca/sfs
Writing Centre	Meet with coach/tutor to discuss writing assignments (e.g., lab report, research paper, thesis, poster) - Learn to integrate source material into your own work appropriately - Learn about disciplinary writing from a peer or staff member in your field	Killam Library Ground floor Learning Commons & Rm G25	To make an appointment: - Visit the Centre (Rm G25) and book an appointment - Call (902) 494-1963 - email writingcentre@dal.ca - Book online through MyDal We are open six days a week See our website: writingcentre.dal.ca