

**Faculty of Science Course Syllabus
Department of Mathematics and Statistics
MATH/STAT 2300
Mathematical Modelling
Winter 2020**

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

Lectures: TR 11:35 – 12:55 LSC C338

Laboratories: One of M 11:35-12:25 / M 14:35 – 15:25 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 (5th edition) by F.R. Giordano, W.P. Fox and S.B. Horton, Brooks/Cole, Belmont, 2014.

Course website: The course website is on Brightspace.

Course Assessment

Component	Weight (% of final grade)	Date
<i>Midterm exam</i>	30%	Tuesday, March 3, 2020
<i>Final exam</i>	50%	(Scheduled by Registrar)
<i>Assignments</i>	15%	

Other course requirements

Tutorial Attendance 5% (calculated as (minimum(#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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University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

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

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness

Statement: <http://www.dal.ca/cultureofrespect.html>

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca).

Information: https://www.dal.ca/campus_life/communities/indigenous.html

Important Dates in the Academic Year (including add/drop dates)

https://www.dal.ca/academics/important_dates.html

University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Missed or Late Academic Requirements due to Student Absence (policy)

https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html

Student Resources and Support

Advising

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: <https://www.dal.ca/faculty/science/current-students/academic-advising.html>

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: <https://libraries.dal.ca/>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Fair Dealing Guidelines <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness/services-support/student-health-and-wellness.html

Student Advocacy: <https://dsu.ca/dsas>

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Biosafety: <https://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>