Mathematics (MATH) 481

Mathematical Modeling II (Revision 2)

Status:	Replaced with new revision, see the **course listing** for the current revision
Delivery mode:	**Individualized study online** with **eText**
Credits:	3
Area of study:	Science
Prerequisites:	**MATH 265**, **MATH 266**, **MATH 270**, **MATH 370** and **MATH 376**.
Precluded:	None
Challenge:	MATH 481 is not available for challenge.
Faculty:	**Faculty of Science and Technology**
Notes:	To complete this course successfully, you will require access to Microsoft Excel software (2010 or later) to go through worked examples and to complete several of the assignments. You should have basic Excel skills such as inputting and working with

data and presenting data in charts. If you have any questions, contact the **course coordinator** .

Overview

MATH 481 is designed to provide a foundation in mathematical modeling, with an emphasis on numerical methods and simulation modeling. You will learn a variety of modeling approaches with applications in physical sciences, social sciences, finance, medicine, and business. The course examines both observational and explanatory models, though the emphasis is on the latter. Topics include stochastic modeling approaches such as Monte Carlo simulations and discrete-event simulation, as well as deterministic approaches, focusing on the use of numerical methods to simulate systems modeled using ordinary differential equations and partial differential equations. We will also introduce the concepts of optimization and learn how to pose and solve optimization problems via various modeling approaches.

In this course, you will have the opportunity to build both analytic and simulation models yourself. Each course topic is broken into two sections. The first focuses on the theory behind the modeling approach, including methods for analyzing the model. The second section focuses on numerical methods and development of simulation models. Here, you will use Microsoft Excel to build and implement models.

Outline

- Unit 1: Basic Principles and the Process of Mathematical Modeling Revisited
- Unit 2: Empirical Models
- Unit 3: Deterministic Systems – Simulation and Numerical Methods
- Unit 4: Probabilistic Systems – Simulation Modeling
- Unit 5: Optimization

Learning outcomes

Upon successful completion of this course, you should be able to

- differentiate between types of mathematical models, including
  - empirical versus theoretical models,
  - static versus dynamic models, and
  - stochastic versus deterministic models.
- model deterministic dynamical systems using appropriate techniques (e.g., ordinary differential equations and partial differential equations) and numerical methods (e.g., Euler, Runge–Kutta, and finite difference).
- model stochastic dynamical systems using Markov chains and discrete-event simulation.
- model optimization problems using linear programming models, state and apply the fundamental duality theorem, and analyze the models with and without computer software.

Evaluation

To **receive credit** for MATH 481, you must achieve an overall grade of at least **D (50 percent)**, which is a composite of the grades you achieve on the five assignments.

The weighting of the composite grade is as follows:

Activity	Weight
Assignment 1	10%
Assignment 2	15%
Assignment 3	25%
Assignment 4	25%

Activity	Weight
Assignment 5	25%
Total	**100%**

To learn more about assignments and examinations, please refer to Athabasca University's **online Calendar** .

Materials

Giordano, F. R., Fox, W. P., & Horton, S. B. (2014.) *A first course in mathematical modeling* (5th ed.). Brooks/Cole.  (eText)

eText

Registration in this course includes an electronic textbook. For more information on **electronic textbooks** , please refer to our **eText Initiative site** .

Important links

- **Academic advising**
- **Program planning**
- **Request assistance**
- **Support services**

Opened in Revision 2, June 3, 2022

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View **previous revision**