ROWAN UNIVERSITY
Department of Mathematics

Syllabus Math 01232 Mathematical Modeling

CATALOG DESCRIPTION:

MATH 01232: Mathematical Modeling 3 S.H.
Prerequisite: A grade C- or better in MATH 01231 (Calculus II) and in MATH 01210 (Linear Algebra)

This course provides an introduction to mathematical modeling, including probability models, theoretical and empirical modeling, and modeling with simple differential equations. Students will frequently use technology in solving problems, and all students will complete a group modeling project.

OBJECTIVES:

There are two types of goals for this course, one type focusing on the development of an understanding of modeling and the development of modeling skills, and the other focusing on the development of concepts and skills in specific content areas. A major feature of this course will be the completion and presentation of a group modeling project.

With respect to modeling, students completing this course will be able to:
- Identify variables in a given situation and select those that represent essential features
- Formulate a model by creating and selecting geometric, graphical, tabular, symbolic, or statistical representations that describe relationships between the variables
- Analyze and perform operations on these relationships to draw conclusions
- Interpret the results of the mathematics in terms of the original situation
- Validate conclusions by comparing them with the situation and then either improve the model or, if it is acceptable, report on the conclusions and the reasoning behind them.

With respect to specific topics, students completing this course will be able to:
- Use basic probability concepts and theorems in real-world and mathematical contexts.
- Understand independence and conditional probability and use them to interpret data.
- Calculate expected values and use them to solve problems.
- Use probabilities to evaluate outcomes of decisions.
- Create and use empirical models using functions from prior study of mathematics, including linear, polynomial, rational, radical, exponential, logarithmic, and trigonometric functions.

- Solve simple first- and second-order differential equations and use them in modeling specific situations.

CONTENT:

1. The Modeling Process (1/2 week)

2. Probability Models (4-5 weeks)
2.1. Relative frequency approach
2.2. Theorems, including additive and multiplicative rules
2.3. Conditional probability, Bayes' Theorem
2.4. Discrete probability distributions
2.4.1. Random variables
2.4.2. Expected value
2.4.3. Binomial distribution
2.5. Continuous probability distributions
2.5.1. Uniform distribution
2.5.2. Normal distribution
2.6 Simulation Models

3. Empirical Modeling (Model Fitting and Experimental Modeling) (3-4 weeks)
3.1. Linear models
3.1.1 Independence, correlation, line-fitting
3.1.2 Systems of equations and inequalities (linear programming introduction)
3.2. Curve-fitting with functions – complex applications of modeling with familiar functions (e.g., polynomial, exponential, logarithmic, exponential, and trigonometric functions)
3.3. Optimization

4. Continuous Models – Differential Equations (4-6 weeks)
4.1. First Order Differential Equations and Methods of their Solutions
4.2. Modeling with First Order Differential Equations
4.3. Second Order Linear Differential Equations and Methods of Solutions
4.4. Modeling with Second Order Differential Equations
3.5 Introduction to Systems of Differential Equations and Modeling

5. Further Topics in Differential Equations (Optional)
5.1. Laplace Transform
5.2. Series Solutions

TEXTBOOK:

Mathematical Modeling, Rowan University Custom Edition, Cengage, 2018

Updated: 26 Oct 2020