ROWAN UNIVERSITY
Department of Mathematics

Syllabus

Math 03.411 - Deterministic Models in Operations Research

CATALOG DESCRIPTION:

Math 03.411 Deterministic Models in Operations Research, 3 s.h.
Prerequisites: Math 01.230 (Calculus III) or Math 01.141 (Accelerated Calculus II), and Math 01.210 (Linear Algebra) **or** Math 01.235 (Math for Engineering Analysis I), with a C- or better in all prerequisites.

This course is an introduction to mathematical modeling, analysis, and solution procedures applicable to decision- making problems in deterministic environment. Methodologies covered include the simplex and interior point methods of solving linear programming models, inventory theory, assignment and transportation problems, dynamic programming and sensitivity analysis. Solutions will be obtained using theoretical methods and software packages.

OBJECTIVES IN RELATION TO STUDENT OUTCOMES:

Students in this course will become familiar with the process of Operations Research: learning how to create and validate a mathematical model, as well as the processes and optimization/sub-optimization. They will learn how to determine solutions using linear and dynamic programming. They will also learn how to make an optimal set of assignments, based on a set of costs or demands. They will learn how to determine optimal shipping and inventory policies. All of the types of modeling covered in this course will be deterministic, that is, lacking any uncertainty.

Reliance on the tools in the Calculus and Linear Algebra will be substantial, but we will also examine the reasons why these tools provide us with an optimal solution in each scenario. In addition, we will examine how multiple modeling procedures can be used to arrive at the same result, as well as the benefits and pitfalls of the different techniques. Furthermore, students will learn a procedure called *sensitivity analysis*, which is used to determine what types of changes are necessary for our optimal solution to become sub-optimal. Use of some of the leading software in the field, which is included in the text, will be required.

TOPIC OUTLINE:

1. **History of Operations Research**
2. **Operations Research Modeling Approach**
    - Model Formation
    - Solution Derivation
    - Model Validation and Implementation
3. **Linear Programing**
    - Graphical Methodology
    - Simplex Method
    - Shadow Prices
    - Slack and Surplus Variables

- Post-Optimality Analysis
- Selected Interior-Point Algorithms Duality Theory
- Dual-Primal Simplex Algorithm Sensitivity Analysis
- Computer Implementation

4. **Transportation and Assignment Problems**
    - Using Dummy Variables
    - Big-M Method
    - Linear Programming Representation
    - Computer Implementation
5. **Integer Programming**
    - Binary Integer Programming Problems
    - Mixed Integer Programming Problems
    - Branch-and-Bound Algorithm
    - Computer Implementation
6. **Deterministic Dynamic Programming**
    - Characteristics of Dynamic Programming Problems
    - Development of Algorithms to Solve DP Problems
7. **Deterministic Inventory Theory**
    - Continuous-Review Models
    - Periodic-Review Models
    - Modeling Corporate Goodwill

EVALUATION & GRADING:

Students will be evaluated by traditional methods of homework, which will include analytic and computer-based problems, and written exams. Students will also prepare solutions to class projects and be required to make a brief presentation at the end of the semester. Additional methods, such as journal reviews, may also be used.

COURSE EVALUATION:

The course will be evaluated through customary student evaluations as well as regular departmental review.

Reviewed: 04/2021