ROWAN UNIVERSITY
Department of Mathematics

Syllabus

1703.511 Operations Research I

Catalog Description

1703.511Operations Research I **3 s.h.**

(Prerequisites: an undergraduate course in linear algebra and an undergraduate course in multivariate calculus or permission of the instructor.)

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, project planning, network optimization, assignment and transportation problems, dynamic programming and game theory.Solutions will be obtained using theoretical methods and software packages.

Essence of the Course

a)**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.Students will also learn how to determine optimal project scheduling plans and strategies in "games." 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.

b)**Topical Outline(Additional graduate topics denoted by *)**

1.History of Operations Research
2.Operations Research Modeling Approach
- Model Formation
- Solution Derivation
- Model Validation and Implementation

3.Linear Programming
- 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
Polynomial, Non-Polynomial (NP) Complete and NP Hard Algorithms*
Solving Linear Programming Models Using Dynamic Programming*
Curse of Dimensionality*

7.Deterministic Inventory Theory
Continuous-Review Models
Periodic-Review Models
Modeling Corporate "Goodwill"

8.Game Theory*
Two-Player, Zero-Sum Games
Games with Mixed Strategies
Solving Using Linear Programming

9.Network Optimization*
Shortest Path Problems
Minimum Spanning Tree
Minimum Cost Problems
Maximum Flow Problems

10.Project Management Using Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM)*
Project Scheduling
Time-Cost Tradeoffs

c)Evaluation and Grading

Students will be evaluated by traditional methods of homework, which will include analytic and computer-based problems, and written exams.Students will also be required to devise and complete a substantial project.Possible projects can come from applied problems in the student's major, an application from the individual's place of employment, applications in relevant journals, theoretical derivations of solutions, research on a topic not covered in the course, or in the form of annotated bibliographies.A presentation on the project will be required.

d)Course Evaluation

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