DETAILED COURSE DESCRIPTION
APM 650 Operations Research

COURSE DEFINITION:
APM 650 Operations Research
Shared Resource: none
Instructor: C. J. Davis
Course format: 3 hour(s) lecture per week
0 hour(s) discussion or seminar per week
0 hour(s) field work/field trip/laboratory/studio per week
0 hour(s) recitation per week
3 credit hours Fall Semester (odd years)
Pre- or co-requisite(s): Prerequisite: Calculus and Probability and Statistics

SCOPE:
Level of Instruction:
The course is designed for graduate students who want a survey course in optimization techniques to support decision making in the management of natural resources.

Content:
Major Concepts or Methodologies:
1. Introduction to linear programming techniques and the Simplex algorithm.
2. Introduction to integer programming techniques and the branch-and-bound approach.
3. Introduction to network analysis, including the shortest path algorithm, the minimum spanning tree algorithm, and the maximum flow algorithm.
4. Introduction to nonlinear unconstrained and constrained optimization techniques.
5. Introduction to the Karush-Kuhn-Tucker conditions for optimality.
6. Introduction to deterministic dynamic programming techniques.

Course emphasis is on exposing students to a broad spectrum of optimization techniques that may be appropriate to support decision making in the management of natural resources. It covers the most commonly used constrained optimization algorithms including the Simplex algorithm for linear programming, the branch-and-bound algorithm for integer programming, and the shortest path and minimum spanning tree algorithms for network analysis. It provides student with the theoretical basis for optimization through the Karush-Kuhn-Tucker conditions for optimality in constrained optimization.

Relation to curriculum or to other ESF or Syracuse University courses:
The course provides a theoretical and computational background in optimization techniques for graduate students in the Resource Policy and Management and the Quantitative Methods in Forest Science and Management study areas. The course has some similarities to ENG 681; however, APM 650 covers nonlinear optimization techniques and ENG 681 does not, and ENG covers simulation models and decision trees while APM 650 does not.

OBJECTIVES:
After completing this course the student should be able to:
1. Formulate and solve linear optimization problems using the simplex algorithm.
2. Formulate and solve integer optimization problems using the branch-and-bound technique.
3. Formulate and solve network optimization problem using the appropriate technique.
4. Formulate and solve nonlinear optimization problems using the appropriate technique.
5. Evaluate algorithm solutions for optimality using the Karush-Kuhn-Tucker conditions.
INSTRUCTIONAL FORMAT AND MATERIALS:

Format: Three hours of lecture per week during the fall semester (odd years).

Materials: Lectures serve as the means for introducing the major topics of the course. Assigned readings in operations research textbooks serve as a supplementary source. Homework exercises serve as the primary means to elaborate upon the lectures and to give "hands-on" experience in the analytical techniques discussed. Course grades are based on homework assignments and three exams.

INSTITUTIONAL RESOURCES REQUIRED (INSTITUTIONAL IMPACT):

Standard classroom space with chalk or dry erase board, overhead projector, and screen is required.

Expected enrollment: 10 students.

Current library holdings are sufficient.

Students will require access to computing facilities, either personal or campus clusters, for approximately 4 hours per week. Word processing and spreadsheets will be the most commonly used software.

Duplication of approximately 50 pages per student.

HEALTH AND SAFETY CONSIDERATIONS:

Health and Safety Considerations to be Specifically Addressed.

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<th>Conditions or situations present in association with the course?</th>
<th>YES</th>
<th>NO</th>
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<td>1. Will substances with any of the following properties be used during instruction: flammability, toxicity, corrosivity, reactivity, registered pesticide, legally controlled, or other characteristics with the potential to cause harm or injury?</td>
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<td>2. Will any physical hazards be present during instruction? (e.g., machines that need safety guards; razor blades or syringes; compressed gases, etc.).</td>
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<td>3. Will any biological hazards be present during instruction? (e.g., handling animals (rabies or hantavirus); cultures or stocks of infectious agents (fungal spores, viruses, bacteria, etc.).)</td>
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<td>4. Will any radiation hazards be present during instruction? (e.g., radioisotopes, X-rays, ultraviolet rays, lasers, etc.).</td>
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<td>✗</td>
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<td>5. Will any electrical equipment that, due to its design, location, or method of use, pose any threat to safety during instruction? (Give considerable thought to electrical use outdoors, or any potentially wet location.).</td>
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<td>6. Will there be any personal safety issues related to the class? (e.g., due to time of day or location, at the end of any organized class exercise, will students be in danger of physical assault, etc.).</td>
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<td>7. Will any students be driving official State or research sponsored land or water vehicles during any class or instructional exercise?</td>
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<td>8. Will any type of personal protective equipment be necessary during class exercises? (e.g., hard-hats, eye/face protection, hearing protection, hand/foot protection, lab coat, visibility clothing, etc.)</td>
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Health and Safety Considerations Narrative: This is an indoor class. No hazardous conditions or health and safety issues are anticipated in the classroom.
CATALOG DESCRIPTION:
APM 650   Operations Research   (3)
A survey of optimization techniques to support decision making in the management of natural resources. Techniques examined include linear programming, integer programming, network analysis, nonlinear programming, dynamic programming, and Markov chains.   Fall (odd years)

Pre- or co-requisite(s): Prerequisite: Calculus and Probability and Statistics

COURSE HISTORY:

Last updated: Wednesday, February 21, 2001