Syllabus

Course coordinator: Asst. Prof. Robert M. Curry (rcurry@usna.edu)

Textbook: *Deterministic Operations Research*, by David Rader.

Course description: This course covers a range of advanced topics in mathematical programming. Topics include integer programming modeling, branch-and-bound methods, integer programming theory and nonlinear optimization theory and algorithms. Students will also learn to use a set-based modeling language for an advanced integer programming solver. Topics may vary with instructor.

Course objectives: By the end of this course, students will be able to

(i) identify, model, and solve (using software) a variety of real-world problems that can be formulated as integer linear programs;

(ii) use Microsoft Excel and Python to develop a spreadsheet interface for a linked optimization model;

(iii) understand and use Python to implement algorithms aimed at network optimization problems that commonly occur in real-world applications;

(iv) understand the theoretical and computational difficulty of integer linear optimization, along with associated theoretical and algorithmic considerations and algorithms.

Approximate weekly course schedule:

Week	Topic
Integer linear programming applications and network algorithms	
1	Mathematical optimization modeling and software review.
2	Network flows: Assignment and minimum-cost flow problems
3	Maximum flow formulation and Ford-Fulkerson Algorithm.
4	Shortest path problem and Bellman-Ford and Dijkstra's Algorithms.
5	Facility location problems.
6	*Exam #1* and Minimum spanning tree (MST) Problem and Prims Algorithm.
7	Set-covering, fixed-charge, and logical constraints.
8	Traveling salesperson problem (TSP) and nearest neighbor algorithm.
9	Vehicle routing problems and subtour-elimination constraints.
10	Integrating Python, Pyomo, and Microsoft Excel.

Integer programming: theory and algorithms

11 *Exam #2* and Improving integer feasible region formulations.

12 Total unimodularity and linear relaxations.

13 Branch and Bound (B&B).

14 Other Integer Programming Solution Techniques.

15 Other Integer Programming Solution Techniques and Project work.

16 Project presentations and Review.