COMPUTATIONAL OPERATIONS RESEARCH

MATH 4320/8326

Course Description:

Survey of computational methods used in the solution of Operations Research problems. Topics include scripting to guide optimization software, metaheuristics for optimization, and basic machine learning algorithms. **3 credits**

Prerequisites:

MATH 3200 and MATH 4300 each with a grade of C- or better or permission of instructor.

Overview of Content and Purpose of the Course:

Operations Research is the application of advanced analytical methods to enable better decision making. A plethora of problems may be solved using Operations Research; among these are (1) determining the route a delivery truck should take in order to make all deliveries while traveling the fewest number of miles; (2) determining the best location for a new facility such as a fire station; (3) scheduling airline flights and crew; and (4) determining the optimal distribution of bicycles in a bike sharing system. Operations Research includes problem-solving methods such as deterministic and stochastic optimization, machine learning, and simulation. Because of the intense computational nature of these methods, a strong foundation in the implementation and use of relevant software is imperative. The course is designed to provide a broad foundation on which students can operate and subsequently acquire depth in particular areas of interest or need.

Anticipated Audience/Demand:

Graduate and undergraduate Mathematics students seeking a Concentration in Operations Research.

Major Topics:

1) Simulation
- a. Introduction to Discrete Event Simulation
- b. Random Number Generation
- c. Elements of Discrete Event Simulation
- d. Software for Simulation
- e. Simulation of Transportation, Manufacturing, and Inventory Systems

2) Scripting to Guide Optimization Software
- a. Scripting/Modeling Languages (Python, R, AMPL, GAMS)
- b. Interfacing with Solver Software (Gurobi, ILOG)

3) Metaheuristic Algorithms
   a. Local Search
   b. Simulated Annealing
   c. Tabu Search
   d. Genetic Algorithms

4) Mathematical Programming Approaches to Data Analysis
   a. Prediction and Classification via Linear Programming
   b. Clustering via Integer Programming
   c. Data Envelopment Analysis via Linear Programming

Methods:

This course will be presented in a lecture/discussion format with occasional use of a computer lab.

Student Role:

Students must attend and participate in class, in addition to completing course requirements.

Textbook:

Winston, Wayne, and Venkataramanan Munirpallam. *Introduction to Mathematical Programming, 4th ed.* Pacific Grove, CA: Brooks/Cole, 2003.

July 2016