Prefix, Number and Name of Course: ACM 620 Optimization of Discrete Models

Credit Hours: 1
In Class Instructional Hours: 1 Labs: 0 **Field Work:** 0

Catalog Description:

Prerequisite: MAT 202 or equivalent
Real-world problems which optimize linear objective functions subject to systems of linear inequalities are formulated mathematically and solved by the two-phase revised simplex method. Applications are given in diverse areas such as business management, industry, economics, finance, and game theory.

Reasons for Addition or Revision:

To create a one-semester-hour core module for the graduate Professional Applied and Computational Mathematics program where students will formulate and solve mathematical models for optimization problems encountered in a variety of business and industrial settings.

Student Learning Outcomes: Students will:	**Course Content References:**	**Assessment:**
1. formulate optimization problems mathematically as linear programming (LP) problems.	I	1. Group work in class, individual homework assignments, exams.
2. solve LP problems by hand and (for larger problems) by use of technology.	II	2. Group work in class, individual homework assignments, exams, and computer projects.
3. analyze and interpret the solutions to the primal and dual LP problems.	III	3. Individual homework assignments, exams and computer projects.
4. construct solutions to applied problems from diverse settings using methods from operations research.	IV	4. Group work in class, individual homework assignments, computer projects, exams.

Course Content:

I. Mathematical modeling
- A. Formulating real-world problems as linear programs
- B. Graphical solutions of two-variable problems
- C. Pathological cases

II. Operations research
- A. Simplex method: algebraic derivation
- B. Avoiding pitfalls: Bland's theorem
- C. Revised simplex method: matricial formulation
- D. Implicit prices

E. Programming the simplex method

III. Duality
- A. Formulating the dual LP problem
- B. Relationship between the primal and dual problems
- C. Checking optimal solutions
- D. Complementary slackness
- E. Sensitivity analysis

IV. Selected applications
- A. Allocation of resources
- B. Scheduling production and inventory
- C. The cutting-stock problem
- D. Approximating data by linear functions
- E. Matrix games: minimax theorem

Resources:

Scholarships in the Field:

Albers, D. J., and Reid, C. *An interview with George B. Dantzig: The father of linear programming*. The College Mathematics Journal, V. 17, no. 4, 1986.

Beck, E., and Kolman, B. *Elementary Linear Programming with Applications*. New York: Academic Press, 1980.

Bard, J. F. and Jenson, P. A. *Operations Research Models and Methods*, 2002.

Carter, M. W. *Operations Research: A Practical Introduction*, 2000.

Chvatal, V. *Linear Programming*. New York: W. H. Freeman and Co., 1983.

Dantzig, G. B. *Linear Programming and Extensions*. Princeton, NJ: Princeton University Press, 1963.

Giordano, F. R., Fox, W. P., Horton, S. B. and Weir, M. D. *A First course in Mathematical Modeling*, 4th ed. Belmont, CA: Brooks/Cole, 2009.

Heyman, D. P. and Sobel, M. J. *Stochastic Models in Operations Research, Vol. I: Stochastic Processes and Operating Characteristics*. Mineola, NY: Dover Publications, Inc., 2004.

Hillier, F. S. and Lieberman, G. J. *Introduction to Operations Research.* Oakland, Calif.: Holden-Day, Inc., 2002.

Kimball, G. E. and Morse, P. M. *Methods of Operations Research*. Mineola, NY: Dover Publications, Inc., 2003.

Marlow, W. H. *Mathematics for Operations Research*. New York: Dover Publications Inc., 1993.

Phillips, D. T., Ravindran, A. and Solberg, J. L. *Operations Research: Principles and Practice*, 2nd ed. New York: Wiley, 1987.

Rao, S. S. *Engineering Optimization: Theory and Practise*, 3rd ed. New York: Wiley, 1996.

Ray, S. C. *Data Envelopment Analysis: Theory and Techniques for Economics and Operations Research*, 2004.

Simmons, D. M. *Linear Programming for Operations Research*. San Francisco: Holden-Day, Inc., 1972.

Taha, H. A. *Operations Research: An Introduction*, 7th ed. New York: Macmillan Co., 2002.

Wagner, H. M. *Principles of Operations Research: with Applications to Managerial decisions*, 2nd ed. Englewood Cliffs, NY: Prentice-Hall, 1975.

Winston, W. L. *Operations Research: Applications and Algorithms*. Boston: Duxbury Press, 2003.

Periodicals:

Advanced Modeling and Optimization
Computational Optimization and Applications
Journal of Computational Mathematics and Optimization
Journal of Optimization Theory and Applications
Optimization Methods and Software
Optimization – A Journal of Mathematical Programming and Operations Research
SIAM Journal of Optimization

Electronic and/or Audiovisual Resources:

Interdisciplinary Lively Applications Projects. Consortium for Mathematics and Its Applications, Inc., COMAP (800-772-6627, www.comap.com).

Journal of the Operations Research Society of America, JSTOR.

Operations Research Letters, Elsevier (http://www.sciencedirect.com/science/Journal/01676377).

Undergraduate Applications in Mathematics Modules, COMAP.