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**APPLICATIONS OF OPTIMIZATION**

**Fall term**

**Professor Kenneth Baker** Assistant**:** Deborah Gibbs

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**Course Description**

This course builds on the optimization coverage in the core and provides the student with advanced modeling and optimization tools that can be useful in a variety of industries and functions. The course emphasizes the use of spreadsheets and expands the student's capabilities in using Solver.

We begin by reviewing the formulation and interpretation of linear programming models using spreadsheets and Solver. The course provides an overview of the major types of linear programs, reviewing the allocation, blending, covering, and network models featured in the core, and proceeding to general network formulations. Next, the course introduces Data Envelopment Analysis (DEA), a sophisticated linear programming approach to evaluating the efficiency of similar businesses or operating units. We look briefly at nonlinear programming for perspective on the other approaches. Then we cover the formulation and solution of integer programs, focusing on the use of binary variables and emphasizing applications in distribution, marketing and logistics. Included in the coverage are location models, traveling salesperson problems, and an optimization approach to cluster analysis. Finally, we examine evolutionary algorithms and their use in finding heuristic solutions to challenging combinatorial problems in scheduling, forecasting, and system design.

**Requirements**

**Homework**. The course schedule contains regular written homework assignments. Preparation for virtually every class, including the first, involves building models and running Solver. Strict due dates for the homework assignments will be observed. Homework assignments may be done in pairs with permission of the instructor.

**Exams**. There is a midterm exam and a final exam. These are open book/open notes exams, each with a time limit.

**Software**. We rely on Risk Solver Platform. This is an advanced Windows version of the Solver packaged with Excel and is part of the student software template for Tuck students. For more information, visit www.solver.com.

**Materials**

The text is *Optimization Modeling with Spreadsheets* (*Second Edition*) by Kenneth Baker, 2011 (John Wiley & Sons).

**Supplementary Readings**

Ronald Rardin, *Optimization in Operations Research*, Prentice-Hall (1998).

Linus Schrage, *Optimization Modeling with LINGO*, Lindo Publishing (2003).

Wayne L. Winston and Munirpallam Venkataramanan, *Introduction to Mathematical Programming*, Brooks/Cole (2003).

Jeffrey H. Moore, Larry R. Weatherford, et al., *Decision Modeling with Microsoft Excel*, Prentice-Hall, 6E (2001).

**Policies**  
  
*Attendance*

The general policies of the Tuck School apply. In part, this means that all students are expected to prepare for and attend class each day. Personal illness or family emergency, but not placement activities, are considered grounds for excused absences. Penalties for unexcused absences will be reflected in the course grade.

*Laptops*

Students are encouraged to bring their laptops to class. Some classroom exercises will involve using individual laptops; on other occasions, the instructor will require laptops to be closed.

**Grading**  
  
*Homework 20%*  
*Midterm 35%*  
*Final 45%*

**Schedule**  
  
**September 16**

Allocation, Covering, and Blending Models  
*Readings*  
Chapter 2   
*Assignments*  
Chapter 2/3, 4, 6   
  
**September 17**

Case: Red Brand Canners  
*Readings*  
Handout   
*Assignments*  
Chapter 2/5

**September 22**  
Special Network Models  
*Readings*  
Chapter 3.1-3.4  
*Assignments*  
Chapter 2/7, 13, 15  
  
**September 23**  
Case: Hollingsworth Paper Company  
*Readings*  
See Chapter 3

*Assignments*  
Chapter 3/1  
  
**September 29**  
General Network Models  
*Readings*  
Chapter 3.5-3.7

*Assignments*  
Chapter 3/2, 4, 5, 6

**September 30**Patterns in linear programming solutions  
*Readings*  
Chapter 4   
*Assignments*  
Chapter 3/10, 11  
  
**October 6**

Data Envelopment Analysis (DEA)  
*Readings*  
Chapter 5   
*Assignments*  
Chapter 4/4, 5, 9, 13  
  
**October 7**  
Case: Nashville National Bank  
*Readings*  
See Chapter 5

*Assignments*  
Chapter 5/5, 8, 10  
  
**October 13**  
Nonlinear Programming  
*Readings*  
Chapter 8.1-8.4

*Assignments*  
Chapter 5/6

**October 14**

Midterm exam  
*Assignments*  
Portfolio model

**October 27**

Linearizations  
*Readings*  
Chapter 8.5

*Assignments*  
Chapter 8/3, 5, 12  
  
**October 28**  
Binary Choice Models  
*Readings*  
Chapter 6

*Assignments*  
Chapter 6/1, 2, 3   
  
**November 3**  
Integer Programming Formulations  
*Readings*  
Chapter 7.1 - 7.3  
*Assignments*  
Chapter 6/6, 7, 9  
  
**November 4**  
Location Models

*Readings*  
Chapter 7.4

*Assignments*  
Chapter 8/1, 3, 4

**November 10**  
Traveling Salesperson Problem  
*Readings*  
Chapter 7.5-7.6

*Assignments*  
Chapter 8/5, 6, 7   
  
**November 11**  
The Evolutionary Solver  
*Readings*  
Chapter 9  
*Assignments*  
Chapter 8/8, 9 SNE

**November 17**  
Cluster Analysis  
*Assignments*  
Chapter 9/1, 2, 3, 4

**November 18**  
Case: Colgate Wave  
*Readings*  
See Chapter 9

*Assignments*  
Chapter 9/11, 12

**November 23**  
Final Exam due