Advanced Operations Research Techniques
IE316

Introduction

Dr. Ted Ralphs
Introductory Stuff

- Welcome Back!
- Class Meeting Time
- Office Hours
  - M 10-11
  - TR 2:30-3:30
What will this class be about?

- Modeling of Optimization Problems (10%)
  - Linear Programming
  - Network Flows
  - Integer Programming
  - Some Advanced Models

- Mathematical Structure of Linear Models (40%)
  - Geometric
  - Algebraic

- Techniques for Solution and Analysis (30%)

- Modeling Languages and Commercial Solvers (20%)
What do I expect you to know?

• Things I expect you to know or pick up “along the way”:
  – Undergraduate mathematics
    * Logic and proof
    * Linear algebra
  – A little modeling

• We will cover these topics in class, but not in much depth.
What are the goals for the course?

After this course, you should be able to:

• Given an optimization problem, formulate an appropriate linear model.
• Use a modeling language and/or commercial solver to solve the model.
• Understand the basic mathematical structure of the model.
• Understand the techniques used to solve the model.
• Analyze the model.
## Approximate Syllabus

<table>
<thead>
<tr>
<th>Topic</th>
<th># of lectures/date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review of Modeling</td>
<td>2</td>
</tr>
<tr>
<td>Geometry of Linear Models</td>
<td>4</td>
</tr>
<tr>
<td>The Simplex Method</td>
<td>4</td>
</tr>
<tr>
<td>First Quiz</td>
<td>October 2</td>
</tr>
<tr>
<td>Using AMPL/CPLEX</td>
<td>1</td>
</tr>
<tr>
<td>Duality Theory</td>
<td>4</td>
</tr>
<tr>
<td>Sensitivity Analysis</td>
<td>2</td>
</tr>
<tr>
<td>Large-scale Linear Programming</td>
<td>2</td>
</tr>
<tr>
<td>Second Quiz</td>
<td>November 8</td>
</tr>
<tr>
<td>Network Flow Models</td>
<td>4</td>
</tr>
<tr>
<td>Integer Programming Models</td>
<td>2</td>
</tr>
<tr>
<td>Advanced Models and Methods</td>
<td>1</td>
</tr>
</tbody>
</table>

Textbook coverage is listed in the syllabus.
Course Requirements

- Attendance
- Participation
- Reading
- Homework
- Exams
Homework

• There will be three homeworks in each third of the course.

• The last homework will be worth twice the normal amount and will be comprehensive.

• Homework is due at the beginning of class.

• Lateness policy is in the handout.

• I encourage working together, but you must write up the homework yourself.

• Please reference the work of others.

• Basic problem types:
  – Mathematical Proofs
  – Modeling
  – Computational
Grading

• Your grade will correspond to your learning and understanding of the course material.

• Some areas to keep in mind
  – Good proof technique
  – Level of detail and rigor
  – Accurate self-assessment
  – Class participation

• Weighting
  – 25% Homework
  – 20% Quizzes (each)
  – 25% Final
  – 10% Class Participation
Class Web Site

- The class Web site will be at

  http://www.lehigh.edu/~tkr2/teaching.ie316/

- I will post lecture slides before class so you can use them to take notes.
- The slides will be in PDF format.
- All handouts for the class will also be available.
- There will also be links to other relevant sites and reference materials.
**Textbook**

- The primary text is *Bertsimas and Tsitsiklis*.
- I will also take material out of some other texts.
- There is an abundance of reference material on the Web.
- Check the Web site for links.
- Please let me know if you want supplementary material.
My Approach to Lectures

- Lectures should be as interactive as possible.
- You will get more out of this course if you ask questions during lecture.
- The pace and structure of the lectures can be adjusted.
- I need feedback from you to adjust appropriately.
Some More Notes

- This course will be more mathematical than previously.
- If you are having trouble, let me know.
- There is plenty of supplementary material.
Questions?