Introduction to Mathematical Programming
IE406

Preliminaries

Dr. Ted Ralphs
Introductory Stuff

• Welcome!

• Class Meeting Time

• Office Hours **MW 4:00-5:00**

• Surveys
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 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
  – Problem formulation and modeling
  – Basic computer programming

• 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>3</td>
</tr>
<tr>
<td>The Simplex Method</td>
<td>3</td>
</tr>
<tr>
<td>First Quiz</td>
<td>October 3</td>
</tr>
<tr>
<td>Modeling Languages</td>
<td>1</td>
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<tr>
<td>Duality Theory</td>
<td>3</td>
</tr>
<tr>
<td>Sensitivity Analysis</td>
<td>2</td>
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<td>Large-scale Linear Programming</td>
<td>1</td>
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<tr>
<td>Interior Point Methods</td>
<td>2</td>
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<tr>
<td>Second Quiz</td>
<td>November 7</td>
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<tr>
<td>Network Flow Models</td>
<td>3</td>
</tr>
<tr>
<td>Integer Programming Models</td>
<td>2</td>
</tr>
<tr>
<td>Mathematical Programming in Practice</td>
<td>1</td>
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</tbody>
</table>

Textbook coverage is listed in the syllabus.
Course Requirements

- Attendance
- Participation
- Reading
- Homework
- Exams
Homework and Final Project

- There will be approximately 9 problem sets worth 25% of your grade.
- Problem sets should be turned in electronically according to the procedure in the syllabus.
- There will also be a comprehensive final project worth 5% of your grade.
- Homework is due at the beginning of Thursday’s class each week.
- Lateness policy is in the handout.
- I encourage working together, but you must write up the homework yourself (unless it is a group assignment).
- Please reference the work of others.
- Basic problem types:
  - Mathematical Proofs
  - Modeling
  - Computation
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

• I will be randomly grading selected problems, but detailed solutions for ungraded problems will be distributed.

• I encourage you to assess your solutions to all assigned problems.

• Weighting
  – 25% Homework
  – 20% Quizzes (each)
  – 5% Final Project
  – 20% Final Exam
  – 10% Class Participation
Class Web Site

• The class Web site will be at

http://www.lehigh.edu/~tkr2/teaching/ie406/

• 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 additional 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 may be more mathematical than you may be used to.

• If you are having trouble, let me know.

• Please pay attention to the policy regarding citing the work of others in the syllabus.

• I take this policy very seriously.
Questions?