Financial Optimization
ISE 347/447

Preliminaries

Dr. Ted Ralphs
Introductory Stuff

• Welcome!
• Class Meeting Time
• Office Hours TBD
• Surveys
What will this class be about?

• Optimization Modeling and Methods
  – Linear and Nonlinear Programming
  – Integer Programming
  – Dynamic Programming
  – Stochastic Programming

• Financial Applications
  – Asset/Liability Management
  – Option Pricing and Hedging
  – Risk Management
  – Portfolio Optimization

• Modeling Maguages and Software
  – Excel Solver
  – AMPL
  – Python!
What do I expect you to know?

- Undergraduate mathematics
- A little mathematical modeling
- A little probability theory
What are the goals for the course?

After this course, you should be able to:

- Understand the basic optimization methodologies used in financial decision-making.
- Understand how to formulate financial optimization programs using the tools of mathematical programming.
- Understand how to select the optimization technique most appropriate for a given financial optimization problem.
- Understand how to use spreadsheets and modeling languages to interface with optimization software for solving financial optimization problems.
# Approximate Syllabus

<table>
<thead>
<tr>
<th>Category</th>
<th>Topic</th>
<th>Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>Introduction</td>
<td>2</td>
</tr>
<tr>
<td>Models and Methods</td>
<td>Linear Programming</td>
<td>2</td>
</tr>
<tr>
<td>Software</td>
<td>Excel Solver and AMPL</td>
<td>2</td>
</tr>
<tr>
<td>Application</td>
<td>Asset/Liability Management and Asset Pricing</td>
<td>2</td>
</tr>
<tr>
<td>Models and Methods</td>
<td>Quadratic Programming</td>
<td>2</td>
</tr>
<tr>
<td>Software</td>
<td>GAMS and software for nonlinear programming</td>
<td>2</td>
</tr>
<tr>
<td>Application</td>
<td>Portfolio Optimization</td>
<td>2</td>
</tr>
<tr>
<td>Models and Methods</td>
<td>Integer Programming</td>
<td>2</td>
</tr>
<tr>
<td>Application</td>
<td>Constructing an Index Fund</td>
<td>2</td>
</tr>
<tr>
<td>Models and Methods</td>
<td>Dynamic Programming</td>
<td>2</td>
</tr>
<tr>
<td>Application</td>
<td>Options Pricing</td>
<td>2</td>
</tr>
<tr>
<td>Models and Methods</td>
<td>Stochastic Programming</td>
<td>2</td>
</tr>
<tr>
<td>Software</td>
<td>Software for Stochastic Programming</td>
<td>2</td>
</tr>
<tr>
<td>Application</td>
<td>Portfolio Optimization and Option Pricing</td>
<td>2</td>
</tr>
</tbody>
</table>
Course Requirements

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

• There will be approximately 5 problem sets worth 20% of your grade.
• There will also be two mid-terms, a final project, and a final exam, each worth 20% of your grade.
• We will try using Google Classroom for turning in assignments and see how that goes.
• Homework is due at the beginning of Tuesday’s class.
• Lateness policy is in the syllabus.
• 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
  – Modeling
  – Computation
Grading

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

• We will be randomly grading selected problems. Detailed solutions for selected problems will be distributed.

• Weighting
  – 20% Homework
  – 20% Midterm (each)
  – 20% Final Project
  – 20% Final Exam
Class Web Site

• The class Web site will be at

    http://coral.ie.lehigh.edu/~ted/teaching/ie447/

    but this will also be supplemented by the Google Classroom site.

• Slides from the previous time I taught the class are already posted, but they will be updated as I go.

• 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 Cornuejols and Tütüncü.
- 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 is only the second time I have taught this course (and the first was a while back), so I will be adjusting as we proceed.

- The adjustments will be based on your feedback, so please let me know what you like and don’t like.

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

- I take this policy very seriously.
Acknowledgements

• Dr. Raphael Hauser was kind enough to share some of his course materials from a financial optimization course taught at Oxford University:

  http://www.maths.ox.ac.uk/people/raphael.hauser

• Dr. Jeffrey Linderoth was kind enough to share some of his course materials from a course on stochastic optimization taught at Lehigh:

  http://homepages.cae.wisc.edu/~linderot/classes/ie495/
Questions?