# 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

| Topic | #of lectures/date |
|---|---|
| Review of Modeling | 2 |
| Geometry of Linear Models | 3 |
| The Simplex Method | 3 |
| First Quiz | October 3 |
| Modeling Languages | 1 |
| Duality Theory | 3 |
| Sensitivity Analysis | 2 |
| Large-scale Linear Programming | 1 |
| Interior Point Methods | 2 |
| Second Quiz | November 7 |
| Network Flow Models | 3 |
| Integer Programming Models | 2 |
| Mathematical Programming in Practice | 1 |

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?