

Hands-On Teaching of the Optimization Process

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Michigan**Engineering**

Industrial and Operations Engineering

IOE310

- ◆ IOE310 – Introduction to Optimization
 - ◆ Required for all students in IOE
 - ◆ Approximately 100 students (mainly juniors) each semester
 - ◆ Wide range of interest, enthusiasm, talent

Solving Optimization Problems vs Taking Simplex Pivots

- ◆ What we want to teach:
 - ◆ How to solve an optimization problem
- ◆ What we actually teach:
 - ◆ How to take a simplex pivot
- ◆ Typical syllabus
 - ◆ $\frac{1}{2}$ lecture on what an optimization problem is
 - ◆ $1 \frac{1}{2}$ lectures on modeling
 - ◆ 21 lectures on solution techniques

Optimization Process

- ◆ What *is* the process to solving an optimization problem?
 - ◆ Identify problem and define scope
 - ◆ Formulate model
 - ◆ Solve
 - ◆ Analyze solution

Optimization Process

- ◆ Where do we invest our teaching time?
 - ◆ Identify problem and define scope
 - ◆ Formulate model
 - ◆ **Solve**
 - ◆ Analyze solution

Optimization Process

- ◆ Topics other than solving are largely ignored
- ◆ Iterative process is largely ignored
- ◆ Software methods for solving are largely ignored

Introduction of Semester Project

- ◆ Full semester
- ◆ Team-based
- ◆ Student-defined project topics
- ◆ Continual milestones, feedback
- ◆ Focus/evaluation is *not* on “solving” the problem but on identifying and overcoming obstacles
- ◆ Different projects have different levels of difficulty in different parts of the problem

Some Sample Projects

- ◆ A twist on the diet problem – choosing a diet plan (Atkins, Weight Watchers, etc.) and adhering to that diet)
- ◆ How to offer swimming scholarships
- ◆ Fantasy football teams
- ◆ Splitting up a block of basketball season tickets

Pros

- ◆ More realistic portrayal of real-world applications of optimization
- ◆ Personal investment in project topics – sparked enthusiasm for many students
- ◆ Helped identify weaknesses in understanding of class material
- ◆ Course variety, more interaction with students

Cons

- ◆ Time consuming!
- ◆ Disinterested students hate it
- ◆ Grading consistency
- ◆ Computing resources/language complexity

Recommendation

- ◆ Don't do it unless you enjoy it!