

EBGN452 - Nonlinear Programming

Spring 2013

Lectures	Monday, Wednesday	9:30am - 10:45am	211 Engineering Hall
Instructor	A. M. Newman		
	Office:	319 Engineering Hall	
	Office Hours:	Monday	10:45am-11:15am
		Tuesday	8:00am-9:00am; 5:00pm-8:00pm
		Wednesday	10:45am-11:15am
	email:	newman@mines.edu	
Teaching Assistant (TA)	Timo Lohmann		
	Office:	126 Engineering Hall	
	Office Hour:	Monday	3:00pm-4:00pm

GENERAL INFORMATION

- **Textbooks:** (*recommended*)
 - ★ Optimization of Chemical Processes, Edgar, Himmelblau, Lasdon. (second edition)
 - ★ Optimization in Operations Research, Rardin.
 - ★ Nonlinear Programming: Theory and Algorithms, Bazararaa, Sherali, Shetty. (third edition)
 - ★ AMPL: A Modeling Language For Mathematical Programming, Fourer, Gay, Kernighan. (second edition)
- **Assignments:** There will be a weekly assignment due Wednesday (the following week). The TA will grade the homework, so direct homework grading questions to him. *Do not send email to the TA!!*
- **Project:** There will be an *optional* project involving formulating, solving and analyzing a challenging problem, writing code, and/or performing a literature review. The project group may consist of between one and four students. The project will be due during finals week.

- **Exams:** There will be a midterm and a final examination. Both are open book. You must wait 48 hours after the exam has been handed back to ask (me) any grading questions.

- **Grading:**

- ★ Class Participation: 5%
- ★ Homework Assignments: 20%
- ★ Project: 25%
- ★ Midterm: 20%
- ★ Final: 30%

or

- ★ Class Participation: 5%
- ★ Homework Assignments: 25%
- ★ Midterm: 30%
- ★ Final: 40%

Grading is done on a curve where 90% is sufficient but not necessarily necessary for an A-, 80% is sufficient but not necessarily necessary for a B-, etc.

COURSE OUTLINE

- ★ **I. Nonlinear Programming Formulations**

- Unconstrained problems
- Constrained problems

- ★ **II. Mathematical Structure of Nonlinear Programs**

- Review of linear programming
- Difficulty of finding solutions for nonlinear programs
- Well-behaved nonlinear programs (convex sets, convex functions, convex regions)

- ★ **III. Solution Techniques for Unconstrained Problems**

- Optimality conditions
- Rate of convergence
- Steepest Descent and Line search
- Newton's method

- ★ **IV. Solution Techniques for Constrained Problems**

- Karush-Kuhn-Tucker optimality conditions
- Lagrangian methods
- Penalty and Barrier methods
- Methods of feasible directions, e.g., reduced gradient
- ★ **(V. Mixed Integer Nonlinear Programming)¹**
 - Formulation
 - Solution techniques
- ★ **Computer Implementation**
 - Model implementation will be emphasized throughout the course (using AMPL or GAMS as a modeling language – as in EBG455, 456, and 457). However, as time permits, we will explore how to “fine-tune” state-of-the-art software (e.g., MINOS) to achieve the “best” results (in terms of solution quality or solution time) possible.

- RULES

- ★ Please do not send email regarding homework problems; come to office hours instead.
- ★ Statute of limitations for questions about grading is one week from the student’s receipt of the graded work.
- ★ I do not want to see or hear your cell phone. Ever. This includes during office hours.
- ★ No rudeness of any kind towards anyone in the class will be tolerated.
- ★ Do not talk to your neighbor during class.
- ★ You may confer with others regarding the homework and project, but the work you hand in must be your own. Please ensure it is done neatly.
- ★ Attendance in class is required. Be on time.
- ★ Any alternate arrangements for exams must be submitted in writing at least one week in advance of the exam. Any additional arrangements regarding disabilities must be *formally* and *legally* documented and approved.

A minor infraction of the above rules will result in a warning. A major infraction will result in expulsion from the class.

¹Time permitting