OID 910/ESE 504, Fall 2018.

Instructor: Monique Guignard-Spielberg, OID Department, Wharton

Audience

This is a first course in optimization, introducing students in engineering, mathematics and business to Mathematical Programming. It is open to undergraduates with permission and to MS and Ph.D. students.

This is a first course in optimization, introducing students in engineering, mathematics and business to Mathematical Programming, which is part of Operations Research or Management Science. It is open to undergraduates with permission and to MS and Ph.D. students. The goal of sections 401/2 is to make students educated users of OR, capable of modeling problems, solving them with the most appropriate method, correctly interpreting the results and doing sensitivity analysis whenever available. Section 403, taught by another instructor, covers the material in a less applied, more rigorous mathematical way.

There are additional courses that deal in greater details with the topics covered in this course, such as OPIM 913, 914, 915 and 916, offered on alternate spring semesters.

If you have already taken an introductory Mathematical Programming or Optimization course, you must take section 403, or discuss it with the instructors.

Textbook and Background

The course will be based on the required textbook

> Introduction to Mathematical Programming: Applications and Algorithms,
> Volume 1, 4th Edition
> by W. L. Winston and M. Venkataramanan, Brooks/Cole Thomson.

This book is out-of-print, but specially made copies will be available from the bookstore. Details will be available in a few days.

This course assumes elementary background in multivariate differential calculus and in linear algebra, plus familiarity with vector/matrix notation and arithmetic. This material is reviewed in Chapter 2. Students must review this chapter on their own. There will be homework questions based on that chapter.

Some slides will be available on the course canvas site, they are based on those by either J. Orlin from MIT or H. Sarper, and are closely related to the textbook. They are made available by the publisher as complements to the texts by Winston. Students should be aware, however, that occasionally the slides do not follow the book's sign conventions. The convention to follow will always be that of the book.

Topics

- Model Building (Chapter 1)
- Introduction to Linear Programming – Geometry (Chapter 3A)
- Introduction to Linear Programming – Models (Chapter 3)
- The Simplex Algorithm And Goal Programming (Chapter 4)
- Sensitivity Analysis and Duality (Chapter 6)
- Transportation, Assignment and Transshipment Problems (Chapter 7)
- Network Models (Chapter 8)
- Integer Programming (Chapter 9)
- Nonlinear Programming (Chapter 11 or 12)

Schedule

Week	Dates	Topics	Reading	W due date	TA in charge	Project
	8/28-8/30	Class Organization Models.	Ch. 1	none		
	Labor Day Mo 9/3	No classes				
	9/4-9/6	Model Building Linear Programming	Ch. 1 Ch. 3	Hw1, due 9/11, 9pm	FANG	
	9/11-9/13	Some Linear Programming Models Simplex Method-I	Ch. 3 Ch. 4	Hw2 due 9/18	DAFTARY	Project 1. Give topic
	9/18-9/20	Simplex Method-II	Ch. 4	HW3 due 9/25	DU	
	9/25-9/27	Degeneracy and 2-phase simplex method Sensitivity Analysis and Duality-I	Ch. 4 Ch. 6	HW4 due 10/2	PENG	
	10/2-10/9	Duality-II;-III	Ch. 6	HW5 Due 10/11	GUO	
	10/4-10/7	Fall break, no class				
	10/11	Sensitivity Analysis (end)	Ch. 6	HW6 due 10/23	DING	
	10/16	Review for midterm in class				Project 1 due on canvas
MT	10/18	IN CLASS MIDTERM EXAM				Project 2 submit topic 10/23
	10/23-10/25	Nonlinear Programming	Ch. 12	HW7 due 10/30		
	10/30-11/1	KKT conditions in NLP	Ch. 12	HW8 due 11/6		

	11/6-11/8	Transportation problem	Ch. 7	HW9 due 11/13		
	11/13-/11/15	Transportation problem	Ch.7	HW10 due11/20		Update Project 2
	11/21	Assignment problem	Ch. 7	HW11 due 11/29		
	11/22-11/25	No class, Thanksgiving				
	11/27-11/29	Integer Programming	Ch. 9			
	12/4-12/6	Integer Programming	Ch. 9	HW12 due 12/6		Project 2 due

Each homework is based on the material of that week and the previous weeks, and is normally due on the first day of class of the following week. For instance, HW1 is based on the material of all weeks up to, including week 2, and is due on the first day of class of the following week, that is, week 3. Students are expected to be familiar with the readings listed above (column 4, Reading).

The readings follow the chapters in the textbook.

Students must review the material in chapter 2 on their own. This chapter covers most of the mathematical background necessary to understand what follows.

Software used in the course.

In order to solve larger size optimization problems, it is necessary to use optimization software. The software available is highly specialized and uses the latest improvements in solution methods. Specific optimization packages are regularly updated, and each one requires learning its specific rules and language. Starting in the early 80's, a new type of package, generically called algebraic modeling system, has become available, starting with development efforts at the World Bank, with the goal of remaining platform (i.e., machine) independent, programming language (i.e., Fortran, C, C++, etc.) independent, and optimization software independent. A code in one of these systems should normally remain valid indefinitely. GAMS Corp. makes available a free license for the length of the semester to the students enrolled in section 401 and 402. This license will allow free access to a large number of the best solvers currently available, using a single optimization programming language, for solving problems of linear programming, nonlinear programming, network flow optimization and integer programming, which would otherwise require learning specific systems and languages. The GAMS language is easy to learn, and if coded with care and properly documented, GAMS codes are easy to decipher. In addition, an included extension to the GAMS language, called GDX for **G**AMS **D**ATA E**X**CHANGE, allows reading and writing data files written in other languages, such as EXCEL. Finally an extensive MODEL LIBRARY, included with the package, contains hundreds of examples of industrial, as well as academic examples of gams programs. Learning GAMS frees you from learning different systems for linear, nonlinear, network and/or integer optimization problems, while giving you access to the best, most up-to-date, optimization packages.
Students will be required to download GAMS from the GAMS website
http://www.gams.com
There are different versions for Windows, Mac or UNIX machines.

Grades.

There is no absolute rule for determining the final grades, your grade will depend on your average grade and that of every student in the class.
The final grade will be the sum of the grades of the homework, the two projects, the midterm and the final, with equal weights (1/5 each). Be careful about the homework, a lower homework average will place you lower in the final ranking.

This was particularly obvious the last few years.
It is allowed to work with other students on the homework problems, but every student must write his/her final answers. The homework must be submitted on canvas as a single file. It does not have to be typed, but you must scan your handwritten parts as pdf files. The final file type will be specified for each homework. If you must combine separate files into a single file, you must use zip. No tar file will be accepted.
Canvas is very strict about the exact time at which you submit your homework. Make sure you submit it on time, which means that you should give yourself a little slack as it can happen that your file is not uploaded the first time, for no particular reason, so always wait until canvas acknowledges your HW file is indeed uploaded. That will save you some headaches!

Exams/Quizzes/Homework

Two exams will be scheduled, the first in-class in the middle of the semester and the final during the official final exam period. They will be closed book with a single handwritten sheet containing all information you find useful for the exam. The final exam will be comprehensive. The final exam date is TBA, decided by the school.

Class attendance is compulsory. There will be one homework assignment every week, normally returned on Tuesday. HWs will be submitted on canvas. There may be occasional in-class quizzes. One homework = 2 quizzes. Students will be allowed to miss up to one HW-equivalent with no penalty. Beyond this, the score for a missing HW or quiz will be 0. The lowest HW-equivalent score will be ignored for the final grade.

Teaching Assistants

The teaching assistants will be

Sohum DAFTARY	daftarys@seas.upenn.edu
Yanxiang DING	yanxding@seas.upenn.edu
Tianlin DU	dtl1995@seas.upenn.edu
Jinxian FANG	roundlet@seas.upenn.edu
Xin GUO	xinguo@seas.upenn.edu
Zhefu PENG	zfpeng@seas.upenn.edu

Office hours and email addresses:

The TAs and the instructor will each have office hours (normally 1½ hours at least) each week. Office hours will start after the first HW is published.

Students should always write using their Penn email address, not their gmail address. The email address specifically reserved for the course has not been activated by ESE, but might be later.

Instead write to the TA in charge of the HW, or to me at guignard_monique@yahoo.fr.

Students can contact the TAs and the instructor throughout the semester for questions related to the course. If the question is of general interest,

expect that the question and answer will be sent to the whole class, but your name will be hidden.

For the instructor: guignard_monique@yahoo.fr (please do not use the Wharton address).
For the TA's: see above.

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Codes of conduct

Students should be aware that the University requires adherence to several codes of conduct. These are available here:

https://secure.www.upenn.edu/osc/pages/codes.html

The code of academic integrity is particularly important in relation to students' behavior in their studies. It is reproduced here. It is important that you read this, as some requirements may be new to you. Pay particular attention to A, B, C and D, as they are most relevant to course taking.

CODE OF ACADEMIC INTEGRITY

Since the University is an academic community, its fundamental purpose is the pursuit of knowledge. Essential to the success of this educational mission is a commitment to the principles of academic integrity. Every member of the University community is responsible for upholding the highest standards of honesty at all times. Students, as members of the community, are also responsible for adhering to the principles and spirit of the following Code of Academic Integrity.

Academic Dishonesty Definitions

Activities, that have the effect or intention of interfering with education, pursuit of knowledge, or fair evaluation of a student's performance are prohibited. Examples of such activities include but are not limited to the following definitions:

A. Cheating: using or attempting to use unauthorized assistance, material, or study aids in examinations or other academic work or preventing, or attempting to prevent, another from using authorized assistance, material, or study aids. Example: using a cheat sheet in a quiz or exam, altering a graded exam and resubmitting it for a better grade, etc.

B. Plagiarism: using the ideas, data, or language of another without specific or proper acknowledgment. Example: copying another person's paper, article, or computer work and submitting it for an assignment, cloning someone else's ideas without attribution, failing to use quotation marks where appropriate, etc.

C. Fabrication: submitting contrived or altered information in any academic exercise. Example: making up data for an experiment, fudging data, citing nonexistent articles, contriving sources, etc.

D. Multiple submission: submitting, without prior permission, any work submitted to fulfill another academic requirement.

E. Misrepresentation of academic records: misrepresenting or tampering with or attempting to tamper with any portion of a student's transcripts or academic record, either before or after coming to the University of Pennsylvania. Example: forging a change of grade slip, tampering with computer records, falsifying academic information on one's resume, etc.