ISE 240: Introduction to Deterministic Models in Operations Research
Spring 2016

Syllabus

Who, When, Where

Instructor: Prof. Larry Snyder

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Class Hours: MWF 10:10–11:00 AM, Mohler 453

Office Hours: M 11:00 AM–12:00 PM, Th 1:00–2:30 PM, and by appointment. If my door is open, you're welcome to drop by, but it is easiest to arrange a meeting time by e-mail in advance.

Teaching Assistant: Afshin OroojlooyJadid, `afo214@lehigh.edu`, office hours T 2:30–3:30 PM, W 11:00 AM–12:00 PM, Th 2:30 PM–3:30 PM, and by appointment. Office Mohler 358, phone 8-5518.

Course Description

This course will introduce you to deterministic models in operations research. You will learn to formulate, analyze, and solve mathematical optimization models that represent real-world problems. We will discuss *deterministic* models, in which no uncertainty exists. The first section of the course will cover linear programming and the simplex algorithm, as well as related analytical topics. We will then discuss other types of optimization models, including transportation, network, integer, and non-linear models.

Course Goals

Upon completion of this course, you will be able to:

1. Formulate a real-world problem as a mathematical optimization model
2. Understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand

3. Understand the relationship between a linear program and its dual, including strong duality and complementary slackness
4. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change
5. Solve specialized linear programming problems like the transportation and assignment problems
6. Solve network models like the shortest path, minimum spanning tree, and maximum flow problems
7. Understand the applications of, basic methods for, and challenges in integer programming
8. Solve single- and multiple-variable unconstrained non-linear optimization problems
9. Recognize the pros and cons of alternate possible formulations for an optimization problem
10. Solve real-world optimization problems with optimization solvers

Textbook

The textbook for the course is:

- Hillier, F. S. and Lieberman, G. J. *Introduction to Operations Research*, 10th ed., New York: McGraw-Hill, 2014.

You are expected to *read the textbook* to prepare for and/or reinforce the lectures. Many homework problems will be assigned from the book.

If you choose to use a different edition of the textbook, you will be responsible for reconciling any discrepancies between your edition and the edition we use in class. Note that section, page, and problem numbers may differ from one edition to the next.

The books below may be useful for further reading and practice material:

- Taha, H. A. *Operations Research: An Introduction*, 8th ed., Prentice-Hall, 2006.
- Winston, W. L. *Operations Research: Applications and Algorithms*, 4th ed., Duxbury Press, 2003.

Course Scope

We will cover Chapters 1–6, 9–10, and 12–13 of the textbook, with additional chapters added as time permits. Unless specified otherwise, you are not responsible for material in the textbook that is not covered in class.

Prerequisite

Math 205.

Software

In this class we will make extensive use of the modeling language AMPL, the computational package MATLAB, and Microsoft Excel and its Solver add-in. You will learn how to use this software in class and/or in additional lab sessions. You should download the demo version of AMPL from `http://ampl.com/try-ampl/download-a-demo-version/`. Information about Lehigh's MATLAB license is at `http://software.lehigh.edu/install/`.

CourseSite

I will use CourseSite to post readings, homework assignments and their solutions, and other information about the course. Please check there regularly for updates.

CrowdMark

This semester, I will be trying out a system called CrowdMark to facilitate creating and grading assignments (homework and exams). Each time I assign a new homework set, you will receive an e-mail from CrowdMark with a URL from which you can download and print the assignment. Once you have completed the assignment, scan it and upload it at the same URL. You must upload the same number of pages (for each problem and total) as are contained in the original file.

I am using this system on a trial basis. Please help me evaluate the system by providing me with any feedback you'd like as the semester progresses.

Exams

You will have two 50-minute in-class exams and a final exam. The final exam will be cumulative. The exams will be closed-book, closed-notes. **No make-up exams will be given,** and no credit will be given for any missed exam.

Homework

You will have regular homework assignments consisting of problems from the book as well as additional problems. The homework assignments are likely to take you a fair amount of time, so get started on them early.

Late Assignments: Homework assignments must be uploaded to CrowdMark by 10 PM on the day the assignment is due. **No credit will be given for any homework assignment turned in late.** If you wish to have a late assignment graded for no credit, we will be happy to oblige. I will drop your lowest homework grade from your average. This means you get one freebie—use it wisely!

Legibility: Homework must be typed or written *neatly* and with problems in the correct order. If we have difficulty reading or following your homework, we will not go to great lengths to decipher it!

Working Together: You may work on the homework assignments individually or with a partner. If you work with a partner, you and your partner may submit a single write-up, or you may submit individual write-ups.

You may discuss the homework with students other than your partner, but you must cite any people or sources (other than Hillier and Lieberman and the lecture slides) that helped you on a particular problem. For example: "Smarty McPants and I worked on this problem together" or "I got help from Smarty McPants about problem #3," or "I consulted *Linear Programming for Dummies*, Section 4.2, by Dopey McBrain when solving question #2." If you work with a partner but submit individual write-ups, make sure you cite your partner. I also encourage you to come to me or the TA for help when you are stuck.

Remember that you are ultimately responsible for mastering the material on your own, and your performance on the exams will depend on your ability to do so. Therefore, you should make sure you fully understand all of the details of the write-up you submit, whether you submit an individual or joint write-up.

Re-grade Requests

If you disagree with the grade you received on a homework or exam problem, you may submit a request for that problem to be re-examined. This request must be turned in **in writing no more than 48 hours after you receive the graded assignment.** It must contain a clear explanation, in no more than one paragraph, of why you feel the grade you received is incorrect. Once we re-examine your work and decide whether to change your grade, our decision will be final.

Class Participation

You are expected to attend class regularly, come to class prepared, participate in the discussions we have in class, and ask questions when you are confused. A portion of your grade will be based on class participation.

Extended Absences

If you believe you will miss two or more consecutive lectures due to illness, family emergencies, etc., please contact me as early as possible so that we can develop a plan for you to make up the missed material. Under no circumstances will I give credit for missed work unless you have discussed your absence with me in advance.

Grading

Your grade will be calculated as follows:

Item	Percentage
Homework assignments	30%
Mid-term exam #1	20%
Mid-term exam #2	20%
Final exam	25%
Class participation	5%

Accommodations for Students with Disabilities

If you have a disability for which you are or may be requesting accommodations, please contact both me and the Office of Academic Support Services, University Center 212 (610-758-4152) as early as possible in the semester. You must have documentation from the Academic Support Services office before accommodations can be granted.

Use of Electronic Devices

The use of computers, smart phones, tablets, and other mobile electronic devices is prohibited in class. I understand that there may be some legitimate reasons to use such devices in class, but please wait until after class ends to perform these functions. Cell phones are a distraction both to the students and to the instructor and may not be used.

Academic Integrity

Please read the material on Academic Integrity available on CourseSite, on the Provost's Academic Integrity site (`http://www.lehigh.edu/~inprv/faculty/academicintegrity.html`), and on the CITL web site (`https://citl.lehigh.edu/academic-integrity-resources`). Examples of behavior that violates Lehigh's academic integrity principles include (but are not limited

to), plagiarism, cheating, copying assignments from previous semesters, creating disruptions, unfairly exploiting the efforts of others, etc.

Perhaps the most misunderstood violation of academic integrity is plagiarism. Plagiarism is defined in the Lehigh student handbook as "the unacknowledged appropriation of another's work, words, or ideas in any themes, outlines, papers, reports, or computer programs." This includes so-called "innocent plagiarism," in which an author essentially quotes another author's work when attempting to paraphrase it. For more information about what plagiarism is and what counts as plagiarism, see `http://library.lehigh.edu/content/avoiding_plagiarism`.

There will be a zero-tolerance approach to academic integrity violations in this class: **Work that violates the academic integrity principles will receive a grade of 0**, and **repeat offenses will be grounds for failure for the course.**

Tentative Course Schedule

Week of	Topic	Chapter(s)	Notes
Jan 25	Introduction; Linear Programming	1–3	
Feb 1	Linear Programming	3	
Feb 8	Linear Programming	3	Lab Session
Feb 15	The Simplex Method	4–5	
Feb 22	The Simplex Method	4–5	
Feb 29	Duality and Sensitivity Analysis	6	Midterm #1
Mar 7	Duality and Sensitivity Analysis	6	
Mar 14	*Spring Break*		
Mar 21	Transportation and Assignment Problems	9	
Mar 28	Network Optimization Models	10	
Apr 4	Network Optimization Models	10	Midterm #2
Apr 11	Integer Programming	12	
Apr 18	Integer Programming	12	Lab Session
Apr 25	Nonlinear Programming	13	
May 2	Additional topics; wrap-up; review		

This syllabus is subject to change.