Fall 2019

IE 439-HM1: Deterministic Models in Operations Research

Esra Buyuktahtakin Toy

IE 439: Deterministic Models in Operations Research Syllabus

Dr. İ. Esra Büyüktahtakın Toy
Fall 2019

1 General Course Information

Instructor:	Dr. İ. Esra Büyüktahtakın Toy
Office:	MEC 313
E-mail:	esratoy@njit.edu **preferred method of contact**
Phone:	973-596-5705 (office)
Meeting time:	T-Th 10:00am-11:20 am
Meeting place:	GITC 2305
Pre-requisites:	IE 222 or an equivalent linear algebra course
Office Hours:	T 11:20 am-12:00 pm; Th 9:30-10:00 am & 11:20 am-12:00 pm
TA:	Thanapat Leelertkij
TA email:	tl375@njit.edu
TA Office Hours:	TBD
Webpage:	`https://njit2.mrooms.net/course/view.php?id=29754`

2 Course Overview and Objectives

Operations research (OR) has many applications in science, engineering, economics, and industry and thus the ability to solve OR problems is crucial for both researchers and practitioners. Being able to solve the real life problems and obtaining the right solution requires understanding and modeling the problem correctly and applying appropriate optimization tools and skills to solve the mathematical model. The goal of this course is to teach you to formulate, analyze, and solve mathematical models that represent real-world problems. We will also discuss how to use MS EXCEL for solving optimization problems. In particular, we will cover linear programming, network flow problems, integer programs, and nonlinear programs. The course will include a mix of theory and in-class problem solving including multiple case study problems.
Upon completion of this course, you will be able to:

1. Formulate a real-world problem as a mathematical programming model
2. Implement and solve the model in EXCEL
3. Understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand
4. Understand the relationship between a linear program and its dual, including strong duality and complementary slackness
5. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change
6. Solve specialized linear programming problems like the transportation and assignment problems
7. Solve network models using dijkstra's shortest path algorithm, minimum spanning tree, and maximum flow problem algorithms
8. Understand the applications and models in integer programming and non-linear programming
9. Be able to solve case-study problems in linear/integer/non-linear programming using EXCEL solver

3 Course Textbook and Topics

3.1 Prerequisites

Familiarity with linear algebra is required (e.g. IE 222 Linear Algebra or a basic Linear Algebra class)

3.2 Required readings

- Hiller, F.S. and Lieberman, G.J., Introduction to Operations Research (10th ed.), McGraw-Hill, 2015

Note: 9th edition is also acceptable

3.3 Recommended readings

- Winston, W.L., Introduction to Mathematical Programming (4th ed.), Duxbury Press, 2002

3.4 Topics

The following is a tentative outline of the course. I may add or remove some topics depending on the interest of the students and the pace of the class. Please tell me if there are other topics that you would like to see covered in the class, and I will do the best I can to accommodate your requests regarding the course content.

Topic	Time
Introduction	**3 Lectures**
Optimization Models and Examples	3 Lectures
Linear Programming	**12 Lectures**
Linear Programming Models	1 Lecture
Graphical Solution	1 Lecture
Excel Solver	3 Lectures
Simplex Algorithm	3 Lecture
Duality	2 Lectures
Sensitivity Analysis	2 Lectures
Review for Midterm Exam	**1 Lecture**
Transportation Models	**1 Lecture**
Network Models and Algorithms	**3 Lectures**
Integer Programming	**3 Lectures**
Case Study Problems	**3 Lectures**
Review for Final Exam	**1 Lecture** (if time allows)

4 Grade Requirements and Policies

Your grade will be determined on the basis of your performance on the activities identified below. Two midterm exams and a final exam will be given. Students are required to take five in-class quizzes. They are also expected to complete four assignments to get a pass grade from the course.

- No make-ups for exams, projects, or daily work (exercises and quizzes) will be given. No "extra work" will be assigned to individuals as a replacement for, or in addition to, these components.
- Additional quizzes or other assignments may be given to everyone in class with or without notice in advance at the instructor's discretion.

4.1 Grading

Semester grades will be based on the five main scores:

Table 1: Grade Point Distribution

Component	**Percentage**
Midterm Exam I	20%
Midterm Exam II	15%
Final Exam	15%
Excel Solver Assignments (4)	20%
In class-quizzes (5)	25%
Class participation	5%
TOTAL	100%

4.2 Grading Policy

When preparing your assignments pay attention to the content, cleanliness, and organization of the document. They all contribute to your grade. Letter grades will be assigned based on the following criteria as a percentage of total points:

Table 2: Letter Grade Point Distribution

Percent	**Grade**
92.0 % or above	A
85.0 - 91.9 %	B+
80.0 - 84.9 %	B
70.0 - 79.9 %	C+
60.0 - 69.9 %	C
55.0 - 59.9 %	D
Lower than 55.0 %	F

4.3 Exams

There will be two midterm exams and a final exam. The midterm exam I will be held on **Thursday October 17** (class time) in class. The midterm exam II will be held on **Tuesday December 10** (class time) in class. The final exam will be on be on the final exam day determined by the university (TBD). The final exam will be cumulative. Exam time and dates are set, they will not be changed. Please make all your arrangements based on the exam dates. No make-up exams will be given, so missing an exam will result in a zero grade for the exam. However well-documented special circumstances (e.g., severe illness or injury, death of a close family member) could be considered to provide a make-up exam with the Dean of Students Office's and the instructor's prior approval.

4.4 In-class quizzes

There will be a 15-20 minutes quiz which will have a question similar to problems discussed in class or the study problems assigned in the previous week. Quizzes will be given at the beginning of the class. There will be no make-up quiz.

4.5 Software Assignments and Homework Policy

There will be software assignments where EXCEL will be used to solve several OR and case study problems.

- All assignments must be returned through Moodle by the beginning of the class.
- A single excel file should be submitted through Moodle. The answers should be presented in different sheets of the excel file. Each sheet should be appropriately named by the problem and corresponding part name.
- You should attempt to solve the questions yourself. If you stuck, you can discuss problems with me or your class mates. However, you should provide your own solutions and excel file. Plagiarism, i.e. copying somebody else's work without citation will not be tolerated.
- I encourage to submit all homework by the due date specified. Late homework will be accepted for up to four days past the due date, but the late penalty will be as follows:

Table 3: Assignment Late Penalty

Days Late	**Late Penalty %**
1	15%
2	30%
3	50%
4	70%

4.6 Attendance

Participation includes the following: regular attendance, timely arrival (at least 5 minutes before the class time to setup the computer), and participation in in-class problem-solving. Regular attendance is critical to learning the class material and will be therefore a part of your overall grade. Class participation will account for the 5% of the grades. Absences and tardiness may lower your grade.

4.7 Class Protocol

- Cellular phones must be in "vibration" or "silent" mode during the class.
- In quizzes and exams all cellphones must be turned off. You cannot use your cellphone as a calculator.
- All material and notices will be posted on the Moodle.
- No web surfing, e-mailing, texting, or any other activity that divides your attention is allowed.
- There is a Moodle site (`https://njit2.mrooms.net/course/view.php?id=29754`) for this class. Check Moodle for handouts that you might have missed as well as videos/problem sets/grades/data files/assignments for the course.
- Check your Moodle email daily as I will use this as a way to communicate information to you between class sessions.
- Calculators on mobile devices will not be allowed for exams and calculators cannot be shared between students during exam periods.
- You are expected to complete a reading assignment (mostly from the class textbook) before coming to each class

5 Other Policies or Procedures

5.1 Academic Honesty

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member

of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at:

`http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf`.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at `dos@njit.edu`.

More on Cheating:

1. Turning in an item you did not create is cheating.
2. Copying another person's digital item or work is cheating.
3. Allowing (intended or not intended) someone else to copy your work or digital item, is considered cheating and will result in a failing grade for the assignment. This means that you must safeguard your work and computer so that others do not have access to your work or computer.
4. You must do your own work, do not look at other's work, and do not talk with others (to do so is cheating).
5. If the instructor allows a group discussion for an assignment, you still must return your own work and cite the other person you discussed with in your assignment.

5.2 Accommodations for Students with Disabilities

If you have a disability or a special need for which you are or may be requesting accommodations, please contact both me and the Office of Disability Support Services (DSS) as early as possible in the semester. The office website is `http://www.njit.edu/studentsuccess/disability-support-services-0/`. You must submit appropriate documentation to the instructor before accommodations can be granted. DS will review your concerns and determine, with you, what accommodations are necessary and appropriate for you. All information and documentation of your disability is confidential and will not be released by DSS without your written permission.

5.3 Moodle

I will use the web page `https://njit2.mrooms.net/course/view.php?id=29754` to post readings, homework assignments and their solutions, and other information about the course. Please check there regularly for updates. If you haven't done so already, please make sure you forward your moodle email to an email account that you frequently use. Otherwise, you might be missing some important information.