IE 439: Deterministic Models in Operations Research Syllabus
Dr. Bo Shen, Fall 2025

1. General Course Information
CRN: 93596 & 93597
Instructor: Dr. Bo Shen
Office: Mechanical Engineering Center (MEC) 327
E-mail: bo.shen@njit.edu **preferred method of contact**
Meeting time & location: Friday 6:00 pm - 8:50 pm, Guttenberg Info Tech Center 2305
Meeting format: Face-to-Face Lecture
Pre-requisites: MATH 112 or an equivalent linear algebra course
Office Hours: Friday 3:00 pm - 4:30 pm
TA: Ziyang Zhang
TA email: zz57@njit.edu
TA Office Hours: Thursday 10:00AM - 11:30 AM, MEC 333F

2. Course Overview and Objectives
What is the optimal number of intensive care units (ICUs) to be established to control COVID-19 and where should we open those ICUs? How should we allocate a limited amount of available vaccines among human population to minimize the number of deaths due to COVID? How should I schedule my class activities and assignments under time constraints to maximize my grades? Such relevant questions could be addressed using Operations research (OR) techniques.

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 programming, and nonlinear programming. The course will include a mix of theory and in-class problem solving including multiple case study problems. The students will have a "hands on," computer-based practice on constructing, modifying, and analyzing mathematical programming models.

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 case-study problems using Excel Solver
7. Understand mathematical models and practical applications of integer programming and non-linear programming

8. Be able to formulate and solve case-study problems in linear/integer/non-linear programming using EXCEL solver

3. Course Textbook and Materials

3.1 Prerequisites

Familiarity with linear algebra is required (e.g. MATH 112 Calculus II or a basic Linear Algebra class)

3.2 Required readings and software

- Hiller, F.S. and Lieberman, G.J., Introduction to Operations Research (10th ed.), McGraw-Hill, 2015. Note: 9th and 11th editions are also acceptable
- Microsoft Excel (versions 2013 or 2016 for Windows, and 2011 for Mac) with the Solver Add-in.
- Using optimization Solver under Office for Mac 2016 can generate errors in models. If you run into issues, you can try downgrading to an earlier version of Office (2011).

3.3 Recommended readings

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

4. Topics

The following is a tentative outline of the course. **I may add or remove or modify 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	Chapter
Introduction	**3 Lectures**	1,2
Optimization Models and Examples	3 Lectures	2
Linear Programming	**14 Lectures**	3-6
Linear Programming Models	2 Lecture	3
Graphical Solution	2 Lecture	3
Excel Solver	3 Lectures	3
Simplex Algorithm	3 Lectures	4,5
Duality	3 Lectures	6
Sensitivity Analysis	1 Lecture	6
Review for Midterm Exam	**1 Lecture**	1-4
Network Modeling	**2 Lectures**	9,10
Integer Programming	**3 Lectures**	12
Case Study Problems	**2 Lectures**	
Review for Final Exam	**2 Lecture**	1-6 & 12

5. Grade Requirement and Policies

Your grade will be determined on the basis of your performance on the activities identified below. **One midterm exam** and **a final exam** will be given. Students are required to take **four in-class quizzes**. They are also expected to complete **five assignments** (majority of which will require Excel Solver) 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

5.1 Grading

Semester grades will be based on the five main scores:

Table 1: Grade Point Distribution

Midterm Exam	25%
Final Exam	25%
Assignments (5)	25%
In class-quizzes (4)	20%
Class participation	5%
BONUS: In-Class problem solving and volunteering to share solutions with the class	+2%
TOTAL	102/100%

- Note that final grades will be calculated using the grading scheme above, and so the Total grade column shown in Canvas, which is automatically calculated, may not reflect your final grade.

5.2 Grading Policy

When preparing your assignments pay attention to the content, cleanliness, and organization of the document. They all contribute to your grade. You may be required to upload digital images of your hand-written work, as well as your Excel spreadsheet to show your work. Letter grades will be assigned based on the following criteria as a percentage of total points:

Table 2: Letter Grade Point Distribution

Score Range	Grade
[92,100]	A
[85,92)	B+
[80,85)	B
[70,80)	C+
[60,70)	C
[55,60)	D
[0,55)	F

5.3 Exams

There will be one midterm exam and a final exam. The midterm exam will be held on (**TBD,** class time). The final exam day will be determined by the university. 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.

5.4 Quizzes

There will be a 15-20 minute proctored 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.

5.5 Software Assignments and Homework Policy

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

- All assignments must be submitted via the Canvas "Assignments" tab by the beginning of class.
- Deadlines are based on Eastern Standard Time; if you are in a different time zone, please adjust your submission times accordingly.
- A single excel file should be submitted through Canvas. 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 will not be tolerated.
- **Lateness Policy.** I encourage you 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 (note even half-an-hour lateness of the due date will be considered as a day late):

Table 3: Assignment Late Penalty

Days Late	Late Penalty
1	15%
2	30%
3	45%
4	60%

5.6 Class Protocol

- The course is organized by weekly modules. Each week students must participate in class, complete the reading (mostly from the class textbook) or other assignments, and work in groups when asked during a class session.
- No web surfing, e-mailing, texting, or any other activity that divides your attention is allowed.
- There is a Canvas class web page for this class. All material and notices will be posted on the Canvas. Check Canvas for handouts that you might have missed as well as problem sets/grades/data files/assignments for the course.
- Check your NJIT email daily as the instructor will use this as a way to communicate information to you between class sessions.
- The students are encouraged to attend office hours with the instructor.

5.7 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.

6. Other Policies or Procedures

6.1 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:

https://www5.njit.edu/policies/sites/policies/files/NJIT-University-Policy-on-Academic-Integrity.pdf

Plagiarism is taken seriously and will be dealt with according to university policy. Students must adhere at all times to the NJIT's Code of Academic Integrity.

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.

6.2 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 Accessibility Resources and Services as early as possible in the semester. You must submit appropriate documentation to the instructor before accommodations can be granted. The office 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 the office without your written permission.

6.3 Software/Technical Requirements

The software/technical requirements for this course include:

- Internet connection. You can check you internet speed here.
- Microsoft Excel with Solver Add In
- Windows or Apple Operating System
- Scanner or Camera with the capability to upload digital images of hand-written work.

NOTE: This course has NOT been designed for use with mobile devices, but you should be able to access most of the digital teaching materials using your cell phones.

6.4 Canvas

I will use the Canvas class web page to post readings, homework assignments and their solutions, and other information about the course. Please check there regularly for updates. Please check your NJIT email address regularly. Otherwise, you might be missing some important information.

6.5 Course Evaluation

Students will be provided an opportunity to evaluate instruction in this course through Canvas using the University's standard procedures, which are administered by the Office of Institutional Effectiveness.

Instructor may also provide additional informal surveys within the course to receive students' feedback and comments regarding the class. Feel free to provide your constructive feedback to the instructor regarding the class.

6.6 NJIT's Perspective on AI Usage in Teaching/Learning

This course expects students to work without artificial intelligence (AI) assistance in order to better develop their skills in this content area. As such, AI usage is not permitted throughout this course under any circumstance.

6.7 Special Note

We are going through unprecedented times due to COVID-19. If the class instructor is asked to make a change in the teaching mode of the class (e.g., hybrid or synchronous online) due to new COVID-19 procedures or regulations, he may update the syllabus to provide clear guidelines to students under new circumstances.