THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Introduction to Decision Analytics (STOR 305, 3 credit hours), Spring 2024
Department of Statistics and Operations Research

Instructor:

- Ali Mohammad Nezhad
- Email: alimn@unc.edu
- Homepage: `https://alimn.stor.unc.edu/index.html`
- Office: Hanes 338

- Office hours (in-person): Tuesday and Thursday 3:00 - 4:30 PM at Hanes 338

Lecture:

- STOR 305-001 (5631): Time: Tuesday and Thursday 05:00 - 06:15 PM Location: Hanes 120

Course homepage: `https://alimn.stor.unc.edu/STOR-305.html`

Canvas: `https://edtech.unc.edu/service/canvas/`

Teaching Assistants:

- Can Er (caner@unc.edu)
  - Office hours and location: Wednesday 3:00 - 5:00 PM and Friday 1:30 - 2:30 PM at Hanes B1
- Ethan Turner (ethantur@email.unc.edu)

Course Description

Lectures

Operations research is an (applied) mathematics field that adopts mathematical (from other mathematics fields)/statistical tools to model and solve a wide variety of decision problems (including but not limited to allocation of resources, minimization of operational costs or maximization of profit in deterministic and stochastic environments). This course is an introduction to operations research and decision-making techniques. We cover two sub-fields of operations research, optimization and data analysis, and make a great use of Excel spreadsheet platform to solve optimization/decision-making problems. On the optimization side, we introduce (but rather concisely) break-even analysis, linear programming, nonlinear programming, integer programming, and goal programming. On the data analysis side, we present descriptive statistics, visualizing data (scatterplots, trends, histograms), discrete and continuous probability distributions, and stochastic

simulation. All these topics are of great practical importance in data science. This course is designed for undergraduate students in Statistics and Analytics, Mathematics, and Computer Sciences. I assume that the students have taken STOR 155 or equivalent.

We proceed with the sections as scheduled, and I teach by writing on the blackboard. The course schedule can be found on the course webpage.

- I will hold a live class on Zoom (although we always meet in person), record the lectures, and also upload the lecture notes to Canvas after each class.
- If we are not able to meet in person (e.g., due to an unprecedented situation or a decision made by the university), then we may continue with the live classes on Zoom, as scheduled. Details will be always announced in Canvas.

Textbook: *Bernard W. Taylor. Introduction to Management Sciences, 13th Edition, Pearson, 2018.*

The following sections will be covered:

- Chapter 1 (Break-even analysis)
- Chapter 2 (Linear programming, model formulation, graphical solution)
- Chapter 3 (Linear programming, computer solution, sensitivity analysis)
- Chapter 4 (Linear programming, modeling examples)
- Chapter 5 (Integer programming)
- Chapter 6 (Transportation, assignment)
- Chapter 7 (Network flow models)
- Chapter 9 (Goal programming)
- Chapter 10 (Nonlinear programming)
- Chapter 11 (Probability and statistics)
- Chapter 14 (Simulation)

Discussion Board

I have created a Piazza forum page which is accessible from here: `https://piazza.com/unc/spring2024/stor305001`. Please feel free to post your course related question(s). You are expected to think about your problems before posting them on Piazza.

Technology

We will frequently use Microsoft Excel and its Solver plugin to solve optimization problems. It would be ideal if you could bring in your own laptop to the class and practice working with the solver at the same time.

Office hours

My TA (Can Er) and I will be available during our office hours to answer your questions on homework or lecture. If there is any overlap between the office hours and your course schedule, please come to talk to me after the lecture or send me an email.

Learning Objectives

By successfully completing this course, you will

- learn the basics of decision-making techniques, mathematical reasoning, decision problems, and their applications (e.g., allocation of resources, minimization of costs, maximization of profit etc). This will be the first step in building a mathematical model of a real world problem;
- understand how to think mathematically, how to formulate a mathematical model using continuous or discrete variables (i.e., using logic and problem information to translate an english sentence into mathematical expressions) and learn how to solve it on Excel. This will be the first step to validate your mathematical model;
- learn basic mathematical optimization structures including linear programming, integer programming, nonlinear programming, and goal programming. Furthermore, you will see many real life applications in the form of transportation, assignment, network, and tree models;
- learn the notion of optimal solution(s) (e.g., for linear or integer programming) and how to find (or count) them graphically. You will understand why nonlinear or integer programming may seem harder to solve than linear programming. Furthermore, you will learn what sensitivity analysis means in the context of optimization;
- learn the notion of an optimization algorithm (e.g., Dijkstra's algorithm for the network problems);
- learn the basic rules and tools of probability and statistics, including random variables, probability mass functions, scatter plots, Venn diagrams, etc;
- learn the basics of stochastic simulation and random generators. You will learn how to build a mathematical model under uncertain conditions (e.g., simulation of a queue).

As a by-product, upon a successful completion of this course, you will enhance your mathematical understanding of decision problems and master your capabilities to formulate and solve real-world problems.

Assignments

You will be given 12 handwritten homework assignments, almost every week, on Thursdays from the problems at the end of each section. The problem numbers will be announced in the Canvas. You need to write down the solution(s) to the specified questions on a paper, create a scanned copy of your solution in PDF format (or you can use MS Word/Latex or any similar interface on your laptop/iPad/Tablet) and then upload the PDF file to Gradescope. An introductory document for Gradescope can be found on the course webpage.

- The deadlines will be always announced to you via Canvas.
- Please make sure to upload your solutions according to the Gradescope instructions.
- I will drop your two lowest scores from the homework assignments, when calculating your overall score at the end of the semester.

Quizzes

There will be 4 in-class quizzes, each 20 minutes long, on the recent homework assignments and examples that we solve in the class. The quizzes will be given at the end of the class, and they will be always on Thursdays. Please see the course webpage for the schedule.

Exams

Midterm Examination: There will be two (2) 75-min in-class midterm examinations and a 3-hour in-class final exam as follows:

Midterm #1:	Date: Thursday 02/22/2024	Time: 05:00 - 06:15 PM	Location: Hanes 120
Midterm #2:	Date: Thursday 04/04/2024	Time: 05:00 - 06:15 PM	Location: Hanes 120
Final Exam:	Date: Friday 05/03/2024	Time: 07:00 - 10:00 PM	Location: Hanes 120

- There will be two review sessions on 02/20 and 04/02 during the normal class time.
- There will be a comprehensive review session during the normal class time on 04/30.
- All the exams will be closed book and closed notes, and electronic devices (cell phone, laptop, iPad etc.) are NOT allowed during the exams.
- The final exam will be comprehensive.

Grading Policy

Grade: Your final grade is calculated based on the following formula:

Homework	27%
Quizzes	8%
Midterms	40%
Final exam	25%

Your total score = Homework $\times$ 0.27 + max{Midterm 1, Midterm 2} $\times$ 0.3 + min{Midterm 1, Midterm 2} $\times$ 0.1 + Quiz $\times$ 0.08 + Final $\times$ 0.25.

Grading Scale A total score of 93% is guaranteed an A, 90% an A-, 87% a B+, 83% a B, 80% a B-, 77% a C+, 73% a C, 70% a C-, 67% a D+, and 60% a D. A student with a total score meaningfully less than 60% gets an F. The boundaries (based on the class average on the final exam scores) might be lowered at the end of the semester. For example, if your total score is 88%, then your B+ is guaranteed, but you may also end up with a higher grade like A-.

How to succeed in this course

You are expected to attend and be actively involved in all classes, take advantage of the office hours, take the homework assignments very seriously and complete them by the deadline, and get prepared well for the quizzes and exams. I strongly encourage you to study the lecture notes and the textbook before starting to work on the assignments.

- You are expected to attend the class on a regular basis and be always on time. You are welcome to raise your hand and ask questions if anything comes to your mind. Please do not talk to the students around you as this could cause distraction.
- I am more than happy to help you with the homework problems, and you are always welcome to come to the office hours to discuss those problems (assuming that you have already thought about those problems).

Course Policy

You are allowed to work on the homework problems together (and of course you can freely use your textbook). However, you must write down your solutions in your own words all by yourself. In case of collaboration, you should explicitly spell out the extent of help and your classmate(s) that you worked with on the problems. No points will be taken off for such disclosures. However, you will get zero on an assignment, if your solution is recognized to be identical to that of another student, or if you provide a solution which is not yours. Please see also the section on Honor Code Statement.

- Please note that a frequent unauthorized use of help will be more a learning issue rather than a cheating issue. If you always get the answers from other sources it will affect your learning.

Deadline: A homework will be assigned to you, always on Thursdays, and it will be due in a week or so at 11:59 PM. Please see the course schedule on the course webpage for details.

- Late submissions are not accepted. If you are not able to meet a deadline (due to illness or an emergency) and you need an extension, please contact me at your earliest convenience before the deadline. I then will decide on a case by case basis.

Use of Electronic Devices You are more than welcome to use your electronic devices during the lectures and recitation sessions, but only for this class purposes (e.g., note taking). Please note that an inappropriate use of your electronic devices will cause distraction for the students around you.

Make-up Exams and Quizzes: There will be no make-up exam or quiz. However, if you missed an exam due to an illness or in the event of an emergency, then I will distribute the weight for that exam/quiz among the remaining exams/quizzes.

- If you miss a single quiz (due to an illness), then 2% will be equally distributed among the remaining quizzes for you.
- If you miss a midterm (due to an illness), then the weight of your midterm will be 30% and the wight of the final exam will be 35%.

Regrade Request You have two weeks from the release date of the grades to submit a regrade request on Gradescope. No further requests will be accepted after this deadline.

Announcements: Please stay tuned for announcements in Canvas. All course related information, including the deadline for all assignments, will be announced in Canvas.

Syllabus Changes

I reserve the right to make changes to the syllabus, including due dates and test dates. These changes will be announced as early as possible.

Honor Code Statement

Students are bound by the Honor Code in taking exams and in written work, that includes issues such as plagiarism, falsification, unauthorized assistance, cheating, and other acts of academic dishonesty (please see also the course policy). The Honor Code of the University is in effect at all times, and the submission of work signifies understanding and acceptance of those requirements. Posting homework assignments, exam problems, or any part of them on the internet, or copying solutions from internet resources is a violation of

the Honor Code. Please consult with me if you have any questions about the Honor Code, or you can read more about the Honor Code at `studentconduct.unc.edu`.

Accessibility Resources and Services

I strive to make learning experiences accessible to all students. If you anticipate or experience physical or academic barriers based on disability or you need any accommodations, you are welcome to let me know so that we can discuss options. Please also be advised that the University of North Carolina at Chapel Hill facilitates the implementation of reasonable accommodations, including resources and services, for students with disabilities, chronic medical conditions, a temporary disability or pregnancy complications resulting in barriers to fully accessing University courses, programs and activities. Accommodations are determined through the Office of Accessibility Resources and Service (ARS) for individuals with documented qualifying disabilities in accordance with applicable state and federal laws. See the ARS website `https://ars.unc.edu`. For contact information email ars@unc.edu.

Tests for ARS students

If you have been certified by ARS as eligible for accommodations, then you should contact me to discuss your accommodations as soon as possible. I will work with you to ensure that accommodations are provided as appropriate. For quizzes, you get extended time at the end of the class (unless the accommodations say that you need a separate room too). You will take the exams at ARS. An exam at ARS must be scheduled at the same time as the regular exam.

Counseling and Psychological Services

UNC-Chapel Hill is strongly committed to addressing the mental health needs of a diverse student body. The Heels Care Network website is a place to access the many mental health resources at Carolina. CAPS is the primary mental health provider for students, offering timely access to consultation and connection to clinically appropriate services. Go to their website or visit their facilities on the third floor of the Campus Health building for an initial evaluation to learn more. Students can also call CAPS 24/7 at 919-966-3658 for immediate assistance.

Title IX Resources

Any student who is impacted by discrimination, harassment, interpersonal (relationship) violence, sexual violence, sexual exploitation, or stalking is encouraged to seek resources on campus or in the community. Reports can be made online to the EOC at `https://eoc.unc.edu/report-an-incident/` or by contacting the University's Title IX Coordinator (Elizabeth Hall, titleixcoordinator@unc.edu) or the Report and Response Coordinators in the Equal Opportunity and Compliance Office (reportandresponse@unc.edu). Confidential resources include Counseling and Psychological Services and the Gender Violence Services Coordinators (gvsc@unc.edu). Additional resources are available at `safe.unc.edu`.

Attendance Policy

As stated in the University's Class Attendance Policy, no right or privilege exists that permits a student to be absent from any class meetings, except for these University Approved Absences:

1. Authorized University activities: University Approved Absence Office (UAAO) website provides information and FAQs for students and FAQs for faculty related to University Approved Absences.

2. Disability/religious observance/pregnancy, as required by law and approved by Accessibility Resources and Service and/or the Equal Opportunity and Compliance Office (EOC).

3. Significant health condition and/or personal/family emergency as approved by the Office of the Dean of Students, Gender Violence Service Coordinators, and/or the Equal Opportunity and Compliance Office (EOC).

I work with students to meet attendance needs that do not fall within University approved absences. For situations when an absence is not University approved (e.g., a job interview, illness/flu, or club activity), I will work directly with you to determine the best approach to missed classes and make-up assessment and assignments.

Acceptable Use Policy

By attending the University of North Carolina at Chapel Hill, you agree to abide by the University of North Carolina at Chapel Hill policies related to the acceptable use of IT systems and services. The Acceptable Use Policy (AUP) sets the expectation that you will use the University's technology resources responsibly, consistent with the University's mission. In the context of a class, it's quite likely you will participate in online activities that could include personal information about you or your peers, and the AUP addresses your obligations to protect the privacy of class participants. In addition, the AUP addresses matters of others' intellectual property, including copyright. These are only a couple of typical examples, so you should consult the full Information Technology Acceptable Use Policy, which covers topics related to using digital resources, such as privacy, confidentiality, and intellectual property.

Additionally, consult the Safe Computing at UNC website for information about data security policies, updates, and tips on keeping your identity, information, and devices safe.

Diversity Statement

I value the perspectives of individuals from all backgrounds reflecting the diversity of our students. I broadly define diversity to include race, gender identity, national origin, ethnicity, religion, social class, age, sexual orientation, political background, and physical and learning ability. I strive to make this classroom an inclusive space for all students. Please let me know if there is anything I can do to improve. I appreciate any suggestions.

Policy on Non-Discrimination

The University is committed to providing an inclusive and welcoming environment for all members of our community and to ensuring that educational and employment decisions are based on individuals' abilities and qualifications. Consistent with this principle and applicable laws, the University's Policy Statement on Non-Discrimination offers access to its educational programs and activities as well as employment terms and conditions without respect to race, color, gender, national origin, age, religion, genetic information, disability, veteran's status, sexual orientation, gender identity or gender expression. Such a policy ensures that only relevant factors are considered, and that equitable and consistent standards of conduct and performance are applied.

If you are experiencing harassment or discrimination, you can seek assistance and file a report through the Report and Response Coordinators (email reportandresponse@unc.edu or see additional contact info at `safe.unc.edu`) or the Equal Opportunity and Compliance Office at `https://eoc.unc.edu/report-an-incident/`.