95.760: Decision Making Under Uncertainty
Spring 2024, Mini 3 (6 units)

Instructor

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Teaching Assistants

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Meeting Times and Location

Lecture Section A3:	T/Th 3:30–4:50pm	HBH 1005
Lecture Section B3:	T/Th 2–3:20pm	HBH 1204
Recitation Section A3:	F 3:30–4:50pm	HBH 1206
Recitation Section B3:	F 2–3:20pm	HBH 1204

Office Hours and Venues

Instructor office hours: 1-2pm in office HBH 2118E

Course Content

This course provides an introduction to modeling and computational methods used by policy-makers, managers and analysts to support decision-making. The first half of the course focuses on deterministic optimization, and covers linear programming, network optimization and integer programming. The second half of this course introduces risk and uncertainty, and includes methods to characterize uncertainty and methods to optimize decisions under uncertainty. Examples are drawn from a variety of domains where these decision-making methods can provide value for business and policy, such as transportation, energy, health care, logistics, manufacturing, supply chain management, etc.

The readings, lectures, recitations, homework assignments and exams will help you develop modeling skills, computational skills and analytical skills. Modeling skills involve translating a problem into a well-defined mathematical framework, using little more than pen and paper. Computational skills involve solving your model on a computer program. In this course, all applications will be done in Excel. Analytical skills involve critically interpreting a model and translating results into insights for decision-making. All three are important!

Course objectives

1. Become familiar with advanced Excel functions. This helps you get a job.

2. Survey optimization and decision science methods. This helps you hire consultants intelligently, should you need to.

3. Learn some analytical methods. This helps you solve smaller problems yourself and develop intuition for more complex problems.

4. Learn how to develop a mathematical model. This helps you think clearly and precisely, and will give you an edge on the marketplace.

The course moves very quickly, so it is important that you do your best not to fall behind.
– Go through lectures (or recordings)! It will be extremely hard to catch up if you miss any lecture.
– Assigned readings must be read before class. This will help you understand the methods covered better and will lead to more interesting discussions in class.
– Start the homework assignments early. Each question will be annotated with the lecture that covers the relevant materials, so that you can attempt the question any time after that lecture.
– Bring your questions to recitation and office hours to address weak spots.

Textbook

Spreadsheet Modeling and Decision Analysis, by Cliff T. Ragsdale, 7th edition.
The use of the textbook is optional. Most, but not all of the examples covered in class will be inspired from the textbook. Many readings will be taken from the textbook. Any other readings will be posted on Canvas. Copies of the textbook are available at the CMU Bookstore.

Course Web Page

The course web page is available on Canvas. Class announcements, lecture notes and homework assignments will be posted online. Solutions to assigned problems will be posted on Canvas after each submission.

Homework

No late homework will be accepted. If you have a scheduling conflict, submit the homework early.
Homework assignments should be submitted electronically on Canvas. Submit a single PDF file. Many of the problems will require you to construct a spreadsheet. In these cases, you should copy a screenshot of the spreadsheet into the PDF that you submit, and also document the formulas that you used (there will be examples you can follow). If you need to draw a picture, then either scan or take a picture of it, and copy it into the PDF that you submit.
Homework assignments must be submitted individually. You are allowed to work with one (and only one) partner. If you work with a partner, you are still required to develop your own spreadsheet model, write your own analysis, and submit your own report. You need to write the name of your partner as part of your submission. No other collaboration is permitted.

Exams

Exam 1: Week 4, during lecture Time
Exam 2: Week 7, during lecture Time

There will be **no make-up exam**. If you miss an exam you can take a 0 or an incomplete in the course and fill in the score from next year's exam.

The exams will be closed book.

Final Grades

The scores will be combined with the following weights:

Participation: 10%
Homework: 40%
Exam 1:   25%
Exam 2:   25%

(Participation = showing up in lectures and asking thoughtful questions and answering questions).

Grades will be curved to conform to Heinz College standards. Typically, grades end up being roughly evenly divided between A+, A, A-, B+, and B, with a few exceptions (both high and low).

Special needs

If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will be happy to discuss your specific needs privately and to work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at access@andrew.cmu.edu.

Communication

Please bring your questions to the weekly office hours. This is the time where the teaching staff is the most available. You are also welcome to send your questions by email. You should cc all the teaching staff on any communication, especially for questions regarding homework assignments and grading.

The Canvas system has an open forum for discussions. You are encouraged to use this for communications that might be of interest to others.

Academic Integrity

Honesty and transparency are important features of good scholarship. The rules and the academic integrity standards outlined in your student handbook will be strictly enforced. Violations of these rules or standards are considered a fundamental breach of trust and will result in failure of the course.

Collaboration on homework (except with your partner, if you choose work with one) is not permitted in this class. Cheating will be treated very seriously.

The following are acceptable:
– Discussing the requirements of a homework problem as long as no specific solution is discussed
– Discussing general approaches to solving a problem as long as no specific solution is discussed
– Using Excel samples from the textbook and class handouts.

The following are considered cheating:

- Discussing specific math or Excel formulations
- Showing anyone your Excel spreadsheet
- Looking at anyone else's Excel spreadsheet
- Having anyone else produce an Excel spreadsheet for you
- Having anyone else correct your Excel spreadsheet for you
- Copying any Excel spreadsheet you find online
- Using solutions from past courses or the solutions manual

You are not permitted to be in possession of any assignments, exams or exercises from another student either from the current semester or from past semesters whether they are electronic or paper. Possession of or sharing such files constitutes an infraction of the academic integrity policies of this course.

Take Care of Yourself!

Do your best to maintain a healthy lifestyle. In particular, make sure to get enough sleep and take time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is almost always helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

If you have questions about this or your coursework, please let me know. Thank you, and have a great semester.

Expected Course Schedule

Week 1
Lecture 1: Introduction to Operations Research; Linear Programming
Optional reading: OR – A Catalyst for Engineering Grand Challenges
Lecture 2: Linear Programming
Reading: Chapter 2, Chapter 3, 3.0-3.5, 3.7-3.14
HW1 out on Thursday of Week 1 — Linear Programming & Sensitivity Analysis

Week 2
Lecture 1: Sensitivity Analysis
Reading: Chapter 4, 4.0 – 4.6
Lecture 2: Network Flows
Reading: Chapter 5, 5.0 –5.7
HW1 due
HW2 out — Network Flows

Week 3
Lecture 1: Integer Programming (1/2)
Lecture 2: Integer Programming (2/2)
Reading: Chapter 6
HW2 due

Week 4
Lecture 1: TBD
Lecture 2: **Exam 1** (both sections)
Reading: Bertsimas, D. and Freund, R. *Data Models and Decisions*, pages posted on Canvas
HW3 out — Integer Programming

Week 5
Lecture 1: Probability Modeling
Lecture 2: Sampling and Simulation (1/2)
Reading: Chapter 12
HW3 due

Week 6
Lecture 1: Sampling and Simulation (2/2)
Lecture 2: Stochastic Programming
HW4 out — Simulation and Optimization

Week 7
Lecture 1: TBD (Optional)
Lecture 2: **Exam 2**
Reading: Chapter 14
HW4 due