ECONOMICS 172B: Introduction to Operations Research (Part B) Winter 2022

Instructor: Herb Newhouse (hnewhouse@ucsd.edu) Course webpage: https://canvas.ucsd.edu/
Lectures: MWF 9:00 – 9:50 am in PCYNH 122 Discussions: F 4:00 – 4:50 pm

TA: Wanchang Zhang (waz024@ucsd.edu)
Grader: Jackson Somers (jsomers@ucsd.edu)
The instructor and TA office hours will be held online. Further information will be posted on Canvas.

This course primarily studies non-linear programming. We will examine optimization problems where the objective function, the constraint, or both are non-linear. We will use computational methods to find approximate solutions and calculus to find exact solutions. The course also studies dynamic programming and search models. Dynamic programming is a method of analyzing optimization problems that exploits the sequential structure of the problem.

Prerequisites:

ECON 172A or Math 171A.

Lectures, Discussion Sections and Review Sessions:

You are responsible for all the material covered in lecture and in the problem sets. Partial notes will be available on the class webpage before each lecture. I recommend that you print these out beforehand and fill in the missing information. I'll do my best to avoid typos but you're responsible for the correct material. I want you to understand the material instead of simply memorizing it. If you miss a lecture, borrow someone's notes. We will schedule a review session for each exam. Discussion sections are optional but recommended.

Lectures will be held on Zoom during the first two weeks of the quarter. I am planning to hold lectures in person as soon as the University allows. Lectures, discussion sections and review sessions will be recorded.

Grading:

My prediction of how I will assess you in this course is:

Your grade will be determined based on two midterm exams and a final exam. Each of your two highest exams will count as 40% of your overall grade; your lowest exam will count as 20% of your overall grade. If you miss an exam for a documented, university approved reason (ie., illness, official university trip), you will need to take a make-up exam. The make-up exam could include written and oral components. If you miss an exam for another reason (ie., oversleep, forget the time), you will receive a zero on the exam.

Midterm 1 will be held during a window that includes our class hours on Monday, January 24th. Midterm 2 will be held during a window that includes our class hours on Friday, February 18th. The final exam will be held on Wednesday, March 16th during a window that overlaps our officially scheduled time between 8:00 am and 11:00 am. I expect that each midterm will last approximately 40 minutes and that the final exam will last approximately 60 minutes. I also expect that most students will need approximately 10-20 minutes for setup and submission. If you know in advance that you cannot make an exam, please let me know as soon as possible.

You are only permitted to use pens and pencils, a straight edge, a **single** note sheet and a calculator during each exam. The note sheet can be any physical size up to 8.5" by 11". It may **only** have handwritten notes on both sides. Typed or mechanically reproduced notes are not permitted. Do **not** attach anything to your note sheet.

While I will do what I can to keep to the predicted assessments for this course, the evolving situation may make it necessary for me to make changes.

Academic dishonesty:

I take academic dishonesty seriously. Any student found guilty of academic dishonesty will most likely earn a failing grade for the course. In addition to this sanction, the Council of Deans of Student Affairs will also impose a disciplinary penalty. For a review of UCSD policy, please see http://www-senate.ucsd.edu/manual/appendices/app2.htm.

We will likely use Zoom for proctoring this quarter. It uses video and audio recording or other personal information capture for the purpose of facilitating the course and/or test environment. UC San Diego does not allow vendors to use this information for other purposes. Recordings will be deleted when no longer necessary. However, if cheating is suspected, the recording may become part of the student's administrative disciplinary record

A TA or I may request a copy of your exam recordings. Failure to provide us with a copy upon request will result in a grade of zero on the corresponding exam. **You must keep a copy of your exam recordings until Friday, June 10th, 2022.** Zoom recordings that are automatically saved to the cloud are deleted after a certain amount of time. If you save any of your exam recordings to the cloud, make sure you download them locally so that you can provide them to us if you are requested to do so.

Finally, I reserve the right to give an oral test if I feel it is necessary to uphold academic integrity.

Regrade requests:

Regrade requests may be submitted via Gradescope during the weeklong regrade period. The regrade period will probably begin a day or two after the exam results are made available to the class. Please do not contact the instructor or any of the TAs regarding the grading of an exam or the grading for the course before the regrade period begins. If your TA agrees with your request, your score for that question will be corrected. If your TA disagrees with your request, you will lose 1 point for each midterm question and 2 points for each final exam question.

Text:

Introduction to Operations Research, 10th Edition, Hillier and Lieberman, McGraw-Hill. I will give references for the 10th edition but other recent editions should also be fine. The material for this course is fairly standard; other Operations Research texts are also likely to be helpful.

Problem Sets:

Problem sets will be available online. We will go over these questions in office hours and in the discussion sections. Your best practice for the exams is to try these questions yourself first.

Preliminary Course Outline:

1. Introduction
    - Ch. 12: Intro.
    - 12.1: Sample Applications.
    - 12.2: Graphical Illustration of Nonlinear Programming Problems.
    - 12.3: Types of Nonlinear Programming Problems.
2. Concavity and Convexity
    - Appendix 2: Convexity.
    - Appendix 3: Classical Optimization Methods.
3. Unconstrained Optimization
    - 12.4: One-variable Unconstrained Optimization.
    - 12.5: Multivariable Unconstrained Optimization.
4. Equality Constrained Optimization

    - Briefly covered in readings for Introduction and Concavity and Convexity.
5. Inequality Constrained Optimization (KKT)
    - 12.6: The Karush-Kuhn-Tucker (KKT) Conditions for Constrained Optimization.
    - 12.7 Quadratic Programming.
    - 12.8 Separable Programming.
    - 12.9: Convex Programming.
    - 12.10: Nonconvex Programming (with Spreadsheets).
6. Dynamic Programming
    - 10.1: A Prototype Example for Dynamic Programming.
    - 10.2: Characteristics of Dynamic Programming Problems.
    - 10.3: Deterministic Dynamic Programming.
    - 10.4: Probabilistic Dynamic Programming.
7. Search Models