MA 416G: Introduction To Optimization

Instructor

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Required Textbook

A gentle introduction to optimization**, by Guenin, Koenemann, and Tuncel, Cambridge 2014.**

The textbook should be available for purchase in the UK bookstore. You can buy it from the publisher's book website or from Amazon. Also available in eBook.

Complementary textbooks

Linear Programming: Foundations and Extensions, by Robert Vanderbei, 2008. Available through the UK Library as an e-text free of charge.

AMPL: A Modeling Language for Mathematical Programming, by Robert Fourer, David M. Gay, and Brian W. Kernighan, 2002. Chapters of the AMPL book are freely available at www.ampl.com/resources/the-ampl-book/chapter-downloads/.

Topics

This course is an introduction to modern operations research and includes discussion of modeling, linear programming, duality theory, integer programming, nonlinear optimization and their applications.

We will cover most of the seven chapters in our main textbook (we will skip some sections). Our pace will be approximately one chapter every 2 weeks. We will make adjustments to it as we go. I will supplement the main textbook by additional material on dual simplex method and financial applications.

Prerequisite

Calculus (MA 213 or equivalent) and Matrix Algebra (MA 322).

Excellent knowledge of the prerequisites is crucial for succeeding in MA 416. In particular, you need to be comfortable with the following topics: Vector spaces and subspaces; matrix operations; the transpose and the inverse of a matrix; linear independence; bases and dimensions. I strongly recommend to review these topics; please do so before we start Chapter 2 on linear programming.

Grading

Your grade in the course will based on the following.

For undergraduate students:

- **30% Homework**
- **40% Midterm exams**
- **30% Final exam**

Grading scale: 90 – 100% = A; 80 – 89% = B; 70 – 79% = C; 60 – 69% = D; Below 60% = E

For graduate students:

- 25% Homework
- 35% Midterm exams
- 20% Project
- 20% Final exam

If you are an undergraduate student, **you can request to be graded as a graduate student**. However, I need to approve your request before September 15.

Exam Dates (Tentative!)

Midterm 1 (in class): during the week of September 24-28
Midterm 2 (in class): during the week of October 29-November 2
Final exam: **Thursday, December 13**

No make-up exam will be given except in the case of an excused absences on the day of the exam. Senate Rules 5.2.4.2 defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit "reasonable cause for nonattendance" by the professor. Students may be asked to verify their absences in order for them to be considered excused.

Homework

The homework has two equally important components, one graded, the other non-graded.

There will be five graded homework assignments. You can work on these assignments in groups of no more than three students per group, and turn in a single assignment per group. Some assignments will be longer and more difficult than others. Therefore, the assignments will not be weighted equally. Some assignments will contain a computational component. No late homework assignment will be accepted.

In addition to the graded assignments, I will assign required reading from the textbooks and weekly problems that you do not need to turn in. Although these problems will not be graded, working on them will substantially improve your performance in this class.

Software

In this class, we are going to use optimization software to solve problems. For our "operations research" type problems, I recommend to use the "algebraic modeling language" AMPL, which can interface with various top commercial solvers and popular open-source solvers. For those who prefer to work with SCIP, R, Python, SageMath, or any other programming language, feel free to do so. However, most of the examples we will discuss in class will be using AMPL.

You can download the full-featured AMPL + solver packages from Canvas/MA416G-001/Files/ampl_download/. Note that this version has no limitation on problem size, but the software will stop working when the course ends. Alternatively, you can download a free size-limited demo version of AMPL (including popular solvers) from AMPL's download page.

Project (for graduate students only)

As a part of your course grade, you are required to do a project that applies techniques we learn in this class to non-trivial "real world problem". Your project must be typed as a report, and at a minimum you must include:

- a statement of the problem and its relevance in non-mathematical terms,
- sources of data or information about the problem,
- a description of the method used to solve the problem,
- well-documented code,
- a description and an interpretation of the solution,
- bibliography/references for all the sources that you have used.

The project will be due on the last day of class. I can provide you with a few ideas for possible projects. You can also propose your own projects. Of course, you are welcome to discuss your ideas about the project with me at any times during the semester. By November 15 (the very latest), you should know some details of what you want to work on. Please submit a 1 to 2 page description ("project proposal") -- this can be a short summary of what you have learned by reading about the project, and a sketch of your work plan for the remaining weeks of the semester.

Students with Disabilities

If you have a documented disability that requires academic accommodations, please see your instructor as soon as possible. In order to receive accommodations in this course, you must provide your instructor with a Letter of Accommodation from the Disability Resource Center. The Disability Resource Center coordinates campus disability services available to students with disabilities. It is located on the corner of Rose Street and Huguelet Drive in the Multidisciplinary Science Building, Suite 407. You can reach them via phone at (859) 257-2754 and via email at drc@uky.edu. To access their web site click here.

Academic Integrity and Cheating

Please see the University of Kentucky Policy on Academic Integrity and Cheating here.

Recording in the Classroom

Video and audio recordings are not permitted during the class unless the student has received prior permission from the Professors. If permission is granted, recording of other students is prohibited. Any distribution of recordings is also probhibited. Students with specific recording accommodations approved by the Disability Resource Center should present their official documentation to the professor. All content for this course, including handouts, assignments, and powerpoint lectures are the intellectual property of the instructors and cannot be reproduced, sold, or used for any purpose other than educational work in this class without prior permission from the professor.