
Fundamentals of Mathematical Programming

ESI6420 - Section 23H3

Class Periods: Monday and Wednesday, 6-7, 12:50-2:45pm

Location: MCCA 1142

Academic Term : Fall 2016

Instructor:

Jean-Philippe P. Richard

richard@ise.ufl.edu

352-294-7713

<http://www.ise.ufl.edu/richard/>

Office hours: TBA, Weil 372

Teaching Assistants:

Roshanak Mohammadjivan. Office hours: TBA.

Please contact through the Canvas website.

Course Description:

Credits: 3; Introduction to Mathematical Programming, with an emphasis on fundamental mathematical concepts used in optimization, classical optimization theory and applications of optimization in engineering. Focus on convex analysis (convex sets, separation theorems, convex functions), optimality conditions (Fritz-John & Karush-Kuhn-Tucker) and lagrangian duality.

Course Pre-Requisites/Co-Requisites:

Although there is no formal prerequisite for this class, students should have:

- A good mathematical background. In particular, basic concepts in linear algebra and calculus will be used frequently.
- An ability to prove basic mathematical statements.
- An ability to write simple codes with Matlab or C (or the motivation to learn.)

Course Objectives:

In this class, we will cover classical models, tools and results in Mathematical Programming. At the end of the class, we expect students to be able to (1) determine when problems they face can be formulated as nonlinear optimization problems, (2) recognize when these problems are convex, (3) know classical results characterizing optimal solutions to these problems and (4) understand how to use these classical results on application problems. Through the course of the class, we also expect that students will develop an ability to formulate mathematical statements precisely and to prove them rigorously. Finally, we expect students to gain some familiarity with commercial algebraic modeling packages such as GAMS.

Materials and Supply Fees:

NA.

Required Textbooks and Software:

Nonlinear Programming: Theory and Algorithms, *Bazaraa, Sherali and Shetty*, Wiley, 2006, 3rd Edition (ISBN-10 number: 0-471-48600-0).

Recommended Materials:

- Bertsekas, *Nonlinear Programming*, Athena Scientific, 1995.
- Luenberger, *Introduction to Linear and Nonlinear Programming*, Addison-Wesley, 1984.

Course Schedule:

Week 1: Introduction: Engineering Applications of Optimization

Week 2: Introduction: Engineering Applications of Optimization/ Modeling with GAMS

Week 3: Mathematics of Optimization: Algebra Review

Week 4: Mathematics of Optimization: Analysis Review

Week 5: Convex Analysis: Convex Sets & Projection

Week 6: Convex Analysis: Separation Theorems & Inner Representation of Convex Sets

Week 7: Convex Analysis: Convex Functions

Week 8: Convex Optimization: Convex Programs & Engineering Applications

Week 9: Optimality Conditions: Convex Programs and Unconstrained Optimization Models

Week 10: Optimality Conditions: Constrained Optimization Models

Week 11: Optimality Conditions: Constrained Optimization Models

Week 12: Lagrangian Duality: Lagrangian Functions & Properties

Week 13: Lagrangian Duality: Weak and Strong Duality

Week 14: Lagrangian Duality: Solution methods

Week 15: Review

This list of topics and the associated schedule are tentative. Some topics may be added depending on the interest of students and the pace of the class. I encourage you to communicate to me other topics that you would like to see covered in the class. I will do the best I can to accommodate relevant requests.

Attendance Policy, Class Expectations, and Make-Up Policy:

Attendance is mandatory. Students are expected to attend class and to notify the instructor when they are not able to. Repeated unexcused absences might result in a penalty of up to 10% of the class grade. In the event a student is unable to attend the midterm or the final exam because of a valid reason (UF-imposed curriculum requirement, religious holiday, jury duty, or a family/medical emergency), a make-up exam will be organized as soon as feasible for both the instructor and the student, provided that the instructor was given advanced notice of the situation. Students who miss an exam without advanced notice to the instructor (or without a valid reason for which such notice could not be given) will receive a F for the exam and will not be given a make-up exam. Make-up will not be given for homework. The instructor might extend the deadline or forgo homework for a student who has a valid reason (see above), provided that the instructor is given advanced notice.

Evaluation of Grades:

Class grades will be based on: homework average grade (20%), midterm (30%), and final exam grade (50%).

- Homework and problem sets will be assigned during the course of the semester (four to five in total). Some problems will be simple applications of the material covered in class, some problems will require the proof of theorems and some problems will require computer implementations. Most students will find homework to be challenging and time-consuming. Not all problems will be graded.

- Students are required to take an in-class midterm exam. The exact date of the midterm will be communicated later.
- Students are required to take a final exam. The goal is to test the general knowledge and understanding of the class material. The final exam is cumulative. The final covers material described during the class itself but also material studied in the homework.

Grading Policy:

The grading scale for the class is: A (90-100], A- (80-90], B+ (70-80], B (60-70], B- (50-60], C+ (40-50], C (30-40], C- (20-30], D+ (10-20], F [0-10]. Curving might occur in any assignment/exam if the average result is too low. More information on UF grading policy may be found at: <http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

In order to graduate, graduate students must have an overall GPA and an upper-division GPA of 3.0 or better (B or better). Note: a B- average is equivalent to a GPA of 2.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit: <http://gradschool.ufl.edu/catalog/current-catalog/catalog-general-regulations.html#grades>

Students Requiring Accommodations:

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation:

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

University Honesty Policy:

UF students are bound by The Honor Pledge which states, We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: On my honor, I have neither given nor received unauthorized aid in doing this assignment. The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Software Use:

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy:

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>.

Campus Resources:

Health and Wellness

U Matter, We Care: If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS): Student Health Care Center, 392-1161.

University Police Department: at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support: 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

Career Resource Center: Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support: <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center: Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall: 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.