University of Cincinnati
QA 751: Optimization Analysis
Winter, 2009

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Office Hours: T 4:00-5:00 PM, W 4:00-5:00 PM, Th 4:00-5:00 PM, and by appointment

Prerequisites: QA 750 or permission of the instructor.

Required Reading

1. *Introduction to Mathematical Programming*, Winston and Venkataramanan, Fourth edition, ISBN 13: 978-0-534-35964-5.

Required Software

1. GAMS – download at `www.gams.com` – I will provide a license. The GAMS corporation is generously providing a license for the quarter to formulate problems of unlimited size.

2. MATLAB – purchase a student version in the bookstore, it is on the Lab PCs but I recommend you buy the software.

Course Objectives

1. This course will emphasize optimization methodology. Unless you have an understanding of **how models are solved** you may formulate a model that has no chance of being solved. When you leave UC we want you to understand what you are doing.

2. Develop and build model implementation/computing skills. We will be learning MATLAB which is an important computing tool in many industries. You will also learn the GAMS modeling language and how to write GAMS scripts.

3. Continue developing your modeling skills – extend and reinforce material learned in QA 750. In this class we will formulate and solve some realistic size problems instead of the standard academic toy problems.

4. Finally, a very pragmatic motivation for taking this course – get a job! Compete and exhibit *superior knowledge over the competition* – you may even be competing with students with a Ph.D.

Topic and Reading Outline

Week 1 (January 8) Chapter 2.

- course introduction, objectives, and policies
- algebraic modeling languages, problem instances, and solvers
- using GAMS
- using MATLAB
- linear algebra review (Gaussian elimination and LU decomposition), conservation of solutions

Week 2 (January 15) Chapter 4 pages 127-162, Chapter 10 pages 593-597, plus handout

- the Simplex algorithm
- Revised Simplex algorithm
- convergence, degeneracy, initial solutions
- MATLAB scripts
- variable upper bounds

Week 3 (January 22) Chapters 5 and 6 plus handout

- dual variables
- the dual problem
- optimality conditions

- Farkas' result
- reading Simplex output

Week 4 (January 29) Handout

- Interior point algorithms for linear programming
- more on optimality conditions
- barrier algorithms
- path following

Week 5 (February 5) Chapter 9

- integer programs
- branch and bound
- tight and loose formulations

Week 6 (February 12) Handout

- preprocessing
- cutting planes
- separation
- branch-and-cut
- midtem

Week 7 (February 19) Chapter 10 and handout

- column generation
- Children's Hospital scheduling
- Lagrangian Techniques
- writing GAMS scripts

Week 8 (February 26) Chapter 12

- nonlinear programs
- convex and concave functions
- unconstrained algorithms
- Lagrange multipliers
- optimality conditions revisited

Week 9 (March 5) Handout

- constrained algorithms
- interior point methods revisited
- global optimization

Week 10 (March 12) Chapters 14 and 15

- Heuristic techniques
- Evolutionary solver

Week 11 (March 19) Final exam

Key Dates

Midterm Exam: February 12

Final Exam: March 19

Grading

Grades are based on problem sets, midterm, final exam, and a final project.

Homework	20%
Midterm Exam	30%
Final Exam	30%
Final Project	20%

If you miss the midterm, your final exam will be weighted 60%. **No midterm makeups will be given.** Please do not ask to have a midterm rescheduled or taken at another time. You may not take the midterm later in the class period. The midterm will be given in Week 6, February 12. The final project is due by 6 PM on March 19.

Your grade is determined using the percentages given above and is final. There is no opportunity for extra credit projects, etc. for raising a grade you do not find satisfactory.

Regrading Policy

If you feel that your exam/homework was not graded correctly and wish to submit your work for regrading the following procedures must be followed.

1. All work must be submitted for regrading within two weeks from the date that it was returned.

2. You must indicate which questions you feel were graded incorrectly and clearly explain why you feel your answer is correct. This must be communicated in writing, not verbally.

3. Your entire exam/homework will be regraded with special emphasis on the questions you feel were not correctly graded. Thus, something that was overlooked before may now be discovered and your new adjusted score could be lower than before.

4. The amount of partial credit awarded on a question is a judgment call. As in baseball, judgment calls cannot be protested. Therefore you may not resubmit your work for the purpose of obtaining more partial credit.

Other Details

Project Background (for the fourth credit hour): This is a four credit-hour class which meets in class for only the traditional amount of time (three credit hours). A final project is required for this class to earn the fourth credit hour. The final project is due by the final exam time. The details of this project will be described later in the quarter.

Late Homework: Homework must be submitted by 5:45 PM on the night it is due. There is a 30% per day penalty for late homework regardless of excuse.

Cell Phone Use: You are kidding me, right? Don't even think about using one in class. Not once, not ever. Don't check your voice mail, don't send or receive text messages, and don't do whatever else you can do with those crazy things! The best place for all cell phones is at the bottom of the Ohio River. Okay, got it, **no ***** cell phones!**

Name Calling: I will address you by your first name, please feel free to address me by my first name. If you do not feel comfortable with that, Professor Martin or Dr. Martin also works.

Optional Reading

1. *MATLAB: An Introduction with Applications*, Gilat, Third Edition, ISBN 13:978-0470108772. Optional.