Optimization

MATH 451/551–Fall 2013
MW–MYBK 219

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Office Hours: half hour before and after class

Course Description and Goals

Operations Research (O.R.) is the branch of engineering science that approaches large-scale "operations" problems in design and planning by forming abstract mathematical models of relevant problem phenomena and analyzing the models to evaluate decision alternatives. MATH 451/551 is one of two introductory O.R. courses. It focuses on the optimization (also called deterministic or mathematical programming) part of operations research–models in which decisions are the variables, and we solve or search for the optimal values for these variables. We discuss how to formulate optimization models, how to solve and analyze them, and how to recognize tractable cases. Emphasis is on linear programming and nonlinear programming forms.

During this course you will :

- model phenomena in mathematical terms using algebra, geometry, calculus, and other applied mathematics ideas.
- transform vague open-ended optimization problems into formal mathematical models, classify them, evaluate the tractability of the models, and solve them with the help of software.
- derive correct answers to challenging questions by applying these models using algebra, geometry, calculus and other applied mathematics ideas.
- write complete, grammatically and logically correct arguments to prove their conclusions.
- value the historical trail of prior knowledge by explaining and presenting a report on a key figure, event, or algorithm in optimization.
- analyze the steps of various optimization algorithms, considering factors such as work per iteration, storage, and number of iterations.
- practice working in groups often.
- refine your communication skills through oral presentations and government-style briefings. (Operations Research analysts often serve as consultants for non-OR companies, and thus, communication is a valuable skill.)

These outcomes will be assessed on the final exam.

Course Principles

- A successful course requires students and teachers working together. Thus, you will be called on to help with the class teaching, primarily through homework assignments and oral presentations. More on this below.

- A combination of individual and group work best mimics the real-world. However, in group work, all students will be accountable.
- To truly understand material one must master both calculation and concepts. Most mathematics books emphasize calculation with the chapter problems. In order to inject more concept practice, students will be required to submit example concept questions throughout the semester.

Text

Ronald L. Rardin. *Optimization in Operations Research.* Prentice Hall, 1998.
webpage: `http://www.ecn.purdue.edu/~rardin/oorbook/`
errata: `http://www.ecn.purdue.edu/~rardin/oorbook/errata/first.html/`

Course Requirements and Evaluation

- Course meets: MW 7:00-8:15pm
- Resource for Help with Course: professor's office hours, classmates, web
- Attendance: Attendance correlates strongly with performance. Thus, it is in your best interest to attend every class and participate. Students with good attendance (2 or fewer absences) will be rewarded by dropping your lowest three quiz grades. No distinction will be made between excused and unexcused absences.
- Make-up Tests: Make-up tests will not be given, instead your final exam grade will count as the percentage of weight associated with the missed test. Note that this is not recommended. Students generally struggle on the final exam due to its cumulative nature, so please plan accordingly and do everything possible to make it to every test.
- Grading scale: University plus/minus scale
- Grading breakdown:
  - Journal Paper and Presentation (1;I) 5%
  - Announced HW Quiz (10;I) 15%
  - Exams (3;I) 39%
  - Final (1;I) 16 %
  - History Presentation (1;G) 3%
  - Modeling and Matlab codes (4;G) 16%
  - Government Briefing (1;G) 5%
- Homework Quizzes: As this is an intensive, fast-paced course, homework will be assigned daily but not collected. In order to motivate you to do the problems, however, there will be regular quizzes. Suppose on Tuesday, I assign 15 problems for homework, and announce a quiz on Thursday. You are encouraged to work through these problems, writing steps and solutions in your notebook. On Thursday, class will end with 2 or 3 randomly chosen homework problems from Tuesday's assignment. The quiz will be closed textbook, open notebook. If you have worked out the problem, you may copy the solution onto your quiz. If not, you must work the problem on the spot.
- Computing Software: We will use Matlab throughout the class to learn more about the algorithms described in the text. Many classical optimization routines are built into the Matlab Optimization Toolbox.
- Academic Integrity/Disability Services: University policies on academic integrity and disability services will be strictly enforced.

Course Organization

- **Week 1** (W 8/21) — Ch. 1, Ch. 2
- **Week 2** (MW 8/26, 8/28) — Ch. 2, 3.1-3.3
- **Week 3** (MW 9/2, 9/4) — Matlab, 3.4-3.5
- **Week 4** (MW 9/9, 9/11) — Review, Exam #1 (Ch.1-3)
- **Week 5** (MW 9/16, 9/18) — Ch. 4, 5.1
- **Week 6** (MW 9/23, 9/25) — 5.2-5.3, Matlab
- **Week 7** (MW 9/30, 10/2) — 5.5-5.7
- **Week 8** (MW 10/7, 10/9) — 5.8-5.9, Review
- **Week 9** (W 10/16) —Exam #2 (Ch.4-5)
- **Week 10** (MW 10/21, 10/23) — 6.1-6.3
- **Week 11** (MW 10/28, 10/30) — 7.1-7.3
- **Week 12** (MW 11/4, 11/6) — 7.4-7.6
- **Week 13** (MW 11/11, 11/13) — Review, Exam #3 (Ch.6-7)
- **Week 14** (MW 11/18, 11/20) — 13.1-13.2,
- **Week 15** (M 11/25, 12/3) — 13.3-13.4
- **Week 16** (M 12/2) — 13.4-13.5
- **FINAL:** Wed. Dec. 4 7:30pm