OIDD 910/ESE 504, Fall 2020, sections 401 and 402

Instructor: Monique Guignard-Spielberg, OID Department, Wharton
syllabus as of August 13, 2020.

AUDIENCE This is a first course in optimization, introducing students in engineering, mathematics and business to Mathematical Programming. It is open to undergraduates with permission and to MS and Ph.D. students.

The goal of sections 401/2 is to make students educated users of optimization, capable of (1) modeling practical optimization problems, (2) solving them with the most appropriate method, (3) correctly interpreting the results and (4) doing sensitivity analysis whenever available. Section 403, taught by another instructor, covers the material in a less applied, more rigorous mathematical way.

There are additional courses that deal in greater details with the topics covered in this course, such as OIDD 914, 915 and 916, offered on alternate spring semesters.

If you have already taken an introductory Mathematical Programming or Optimization course, you must take section 403, or discuss it with the instructors.

TEXTBOOK

The original textbook is out of print. It is an excellent textbook, and the part that the course will cover is available as a special authorized copy at the bookstore.

If you find an original copy in another bookstore, or online, at a reasonable price, feel free to buy it. The references to homework problems and class references however will be based on the pages of the bookstore copy. Chapters and sections not covered in the course are not part of the bookstore version.

The original paper book title is

Introduction to Mathematical Programming: Applications and Algorithms, Volume 1, 4th Edition, by W. L. Winston and M. Venkataramanan, Brooks/Cole Thomson.

Topics (chapter numbers from the original texbook)

- Model Building (11 to 1.5)
- Introduction to Linear Programming – Geometry (3-1, 3-2)
- Introduction to Linear Programming – Models (3-3 to 3-12)
- The Simplex Algorithm - the algorithm (4.1 to 4.8)
- The Simplex Method - special topics (4.9 to 4.15)
- Sensitivity Analysis (6.1 60 6.4)
- Duality (6.5 to 6.7, 6-10)
- Transportation Problem (7.1 to 7.4)
- Assignment Problem (7.5)
- Integer Programming (9.1-9.2)
- Integer Programing: Branch-and-Bound (9.3 to 9.6)
- Integer Programing: cutting plane methods (9.8)
- Nonlinear Programming: differentiability,convexity (12.1 to 12.4)
- Nonlinear Programming: one or many variables (12.4to 12.9)
  Notice: Chapter 11 (on Game Theory) in the original printed textbook is not included in the bookstore version, so Chapter 12 in the textbook, which normally starts on p. 653, is renumbered Chapter 11 in the bookstore version and it starts with p. 610. The remaining original chapters 13 to 16 are not covered in this course.
- The next pages describe in more detail the topics covered and the dates of the class(es) dedicated to them.
- Additional details may be added between now and the start of the semester.

Teaching will be done online.

Class material will be recorded and shown the day before the scheduled class times. Students watching remotely will be able to watch at times convenient for them.

In addition, there will be live sessions during class time. These will be recorded and made available for a few days for students who are not able to attend scheduled classes. More details will be made available before or at the beginning of the semester.

The material covered and the dates are given below.

During the first half of the semester, we will concentrate on Linear Programming. This is the most widely used area in optimization, well understood and well solved. In addition, one can also derive a lot of useful information about the robustness of the solution if some of the data change, that is, one can do a lot of “what if”or sensitivity analysis.

The second half of the semester, we will first study duality, i.e., we will see that one can associate a so-called dual problem with the original linear programming problem. This dual problem might be easier to solve, and one can read from the final tableau the solutions of the both the original problem and the dual problem.

The course material will be covered in the following order.

9/1	Model Building (sections 1.1 to 1.5) p.1 to 11
9/3	Introduction to Linear Programming - Geometry sections (3.1, 3.2) p. 49 to 63
9/8,10,15	Introduction to Linear Programming - Models (sections 3.3 to 3.12) p. 63 to 114
9/17,22,24	The Simplex Algorithm - the algorithm (sections 4.1 to 4.8) p. 127 to 158
9/24,29, 10/1	The Simplex Method - special topics (sections 4.9 to 4.15) p, 158 to 191
10/6,8,13	Sensitivity Analysis sections (6.1 to 6.4) p. 262 to 295

‘‘

10/15	Review session(s) for the midterm exam
10/20	Midterm exam

‘‘

10/22,27	Duality (sections 6.5 to 6.7, 6.10) p. 295 to 329
10/29,11/3,5	Transportation Problem (sections 7.1 to 7.4) p. 360 to 392
11/5	Assignment Problem (section 7.5) p. 393 to 400
11/10,12,17	Integer Programming (sections 9.1 to 9.2) p. 475 to 512
11/17, 19	Integer Programing: Branch-and-Bound (sections 9.3 to 9.6) p. 512 to 540

11/19	Integer Programing: cutting plane methods (sections 9.8) p. 545 to 549
11/24	Nonlinear Programming: differentiability, convexity (sections 12.1 to 12.4)
12/1	Nonlinear Programming: one variable (sections 12.4 to 12.5) p. 680 to 698
12/3	Nonlinear Programming: several variables, unconstrained (sections 12.6 to 12.7) p. 698 to 706
12/8	Nonlinear Programming: several variables, with constraints (sections 12.8 to 12.9) p. 706 to 723

‘‘

12/10.	Review session(s) for the final exam

‘‘