Introduces optimization methods with a focus on modeling, solution techniques, and analysis. Covers linear programming, network optimization, integer programming, and nonlinear programming. Applications to logistics, manufacturing, data analysis, transportation, marketing, project management, and finance. Includes a project in which student teams select and solve an optimization problem (possibly a large-scale problem) of practical interest.

J. Orlin

Topics
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Course Staff:
Lecturer: Prof. James B. Orlin  jorlin@mit.edu
Teaching Assistants
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Rajan Udwani  rudwani@mit.edu
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Khizar Qureshi  kqureshi@mit.edu
Stellar website:  https://stellar.mit.edu/S/course/15/sp17/15.053/
MITx website: to be determined

15.053 will be storing some materials on Stellar and others on MITx. The material on MITx will primarily be videos and exercises. Most of the materials on the materials on MITx are excerpted from 15.053x, which covers the material of only the first half of 15.053.

Grading:
- Seven problem sets  15%
  - 2.5% each for the best six. The lowest grade is dropped.
- MITx exercises  10%
- Midterm 1 (March 16)  20%
- Midterm 2 (April 20)  20%
- Quiz (May 11)  10%
- Group project  25%

Classes and recitations.

Attendance for classes, recitations and office hours are optional. Students are responsible for all material covered in class.

Class time will consist of a mixture of lecturing and classroom exercises.
In general, lecture videos will be made available to students through the course website.

Midterms and Quizzes.
- The midterms are on March 16 and April 20. Each midterm is during class time and is 80 minutes long. The first midterm tests the materials from lectures 1 to 8. The second midterm tests the material from lectures 10 to 17.
- The quiz on May 11 will be approximately 45 minutes long. It tests the material from lectures 19 to 21.
- Students who miss a quiz or midterm will be given a 0 unless they have an excused absence. Students with an excused absence may be given a makeup quiz or midterm. An excused absence may be granted provided that an advising dean from S^3 recommends that the absence be excused. Students should see an advising dean from S^3 prior to missing the quiz or midterm.
Problem Sets:
- There are seven problem sets. Problem sets are an important part of the learning experience.
- Problem sets are to be handed in individually; however, students may discuss the problems with others in the class. Copying from another student is not permitted.
- Spreadsheets and JuMP/Julia notebooks should also be individual work. Students may obtain help from other students. But students may not copy and paste parts of spreadsheets or notebooks from other students.¹
- Except when stated otherwise, written problem sets should be handed in at the beginning of class the day on which they are due. Late assignments will not be accepted unless they are late because of the use of a flex day. (See next bullet point)
- Flex days for problem sets. Students may have three flex days for problem sets during the term. For all problem sets except for Problem Set 4, students may use one of their three flex days to give them a 24 hour extension on their problem set. The flex day applies to the whole assignment including spreadsheets and Julia notebooks.
- Excel spreadsheets and Julia notebooks should be submitted on line (on the Stellar subject site) by 2:30 PM on the day in which they are due.
- The problem set due dates for the Spring 2017 subject are: 2/16, 2/23, 3/2, 3/9, 4/6, 4/13, and 5/4. They are all listed on the calendar within the Stellar website.

Class Project.
- The class will have a class project. A description of the type of project as well as the due dates associated with the project are in a separate document.

Laptops and smartphones
- For many classes, laptops will be needed in class for class exercises. Students who do not have a laptop in class can work with another student who has a laptop.
- Courtesy note: any laptops used in class should be used for class exercises or for note taking only; any other use is not permitted. This also applies to smartphones.

Websites, Textbook, and Software
- We will be using Stellar for the class website.
- We will be using MITx, especially for the first six weeks of the course.
  https://lms.mitx.mit.edu/courses/MITx/15.053r_1/2017_Spring/ We will send out announcements for when exercises on when videos on MITx should be viewed and due dates for the exercises.
- The book "Applied Mathematical Programming" by Bradley, Hax and Magnanti is available for free on the web at http://web.mit.edu/15.053/www/". The book is available is primarily used for reference, with some exceptions. The book was written in 1977, and much of the material relating to computer software is quite out of date. However, the parts of the book relating to

¹ Because students are permitted to discuss homework with each other, there may be some legitimate commonalities in homework solutions, possibly including similar errors. But copying is not permitted. Copying results in a grade of 0 on a problem set. Students should use their judgment to ensure that individual work on each problem is their own. For Excel assignments or other computer assignments, students may work with others, but they may not copy and paste from others into their spreadsheets or computer programs, and they may not get an advanced start by beginning with a partially completed spreadsheet or program.
modeling and algorithms are still valid today. For these parts, the book still provides a very useful reference.

- **Microsoft Excel** will be used frequently within 15.053. Students can use the Add-in “Excel Solver,” which is adequate software provided that the optimization problem has at most 200 variables. (Excel Solver is limited to problems with at most 200 variables.) For PC users as well as Mac users with Excel 2011, we recommend the use of the publicly available software OpenSolver, which is much faster than Excel Solver and has no limit on the number of variables that are permitted. For Mac users with Excel 2016, you can use OpenSolver by using it with Google Sheets. In general, the spreadsheets used in 15.053 can be used with Google Sheets.

- **JuMP and Julia.** Julia is a high-level, high-performance dynamic programming language for technical computing that was developed at MIT. Its syntax is similar to that of other technical computing environments. JuMP is a modeling language for optimization problems. It lets you translate the mathematical statement of an optimization problem into a form the computer can work with. It is possible for students to download Julia and JuMP and other relevant software to their own computers. However, we recommend that students use JuliaBox instead, which is available at www.juliabox.org. Tutorials on Julia and JuMP are provided with the course materials. JuliaBox permits one to use Julia (and JuMP) from their browser rather than using the Terminal program on their computer. We provide a tutorial on the use of Julia and JuMP.

- **A knowledge of computer programming is not** a prerequisite for 15.053 this year. (Computer programming will be a prerequisite of 15.053 starting in 2018.) Nevertheless, some knowledge of computer programming will be useful in 15.053, especially when using Julia and JuMP. Any student who has never done any computer programming should send a note to the TAs in the first week. The 15.053 staff will work closely with those students, and provide additional guidance for any assignments that requires Julia or JuMP.

- **Jupyter notebooks.** One can use Julia and JuMP in an interactive manner by entering one line at a time. However, we will be using Jupyter notebooks rather than running Julia one line at a time. A Jupyter notebook can include a written descriptions as well as Julia code that will be executed..

**Class Schedule.** The class schedule is available from the left menu on the course website.

**Professor Orlin office hours:** Mondays\(^2\) (and 4/19) 1 to 3 in E62-570.

**TA Office Hours.** 3:00 to 5:30 in E62-587.

Office hours are on most Wednesdays from 3 to 5:30 PM. An exception is that there are office hours on Monday May 8th, which is the day before the quiz.

Here is a complete list of office hours for the semester.

**All TA office hours are from 3 to 5:30 PM in E62-587.**

- Wednesday, February 15.
- Wednesday, February 22.
- Wednesday, March 1.
- Wednesday, March 8.

\(^2\) Except February 13, February 20, and April 17.
Review Session on March 15.
Wednesday, March 22
Wednesday, April 5
Wednesday, April 12
Review Session on April 19
Wednesday, April 26
Wednesday, May 3
Monday, May 8.

MIT Sloan Policy on Classroom Behavior (available at mysloan.mit.edu)

The following policy applies to all subjects at Sloan.

- Students are expected to arrive promptly on time and to stay for the entire class. Faculty are expected to begin and end class on time.

- Laptops and e-readers may not be open in the classroom except with explicit permission of the faculty (e.g., when used to deliver an e-course pack or otherwise used as part of the instructional program or when required by students because of physical or other challenges)

- Cellphones and PDAs may not be used or permitted to ring in the classroom.

- Please note that in accordance with this policy, MIT Sloan requires that students schedule campus interviews outside of scheduled class times and to make every attempt to schedule second round interviews and site visits outside of class times. Classes missed for such activities are not excused absences and may count against your participation grade.