APM236
Applications of Linear Programming

Lectures: Wed. 6-9 at SS2118

- **Instructor:** Soheil Homayouni, homayoun at math.utoronto.ca

- **office hours:** Tuesdays 9-11, Thursdays 10-11:50 place TBA

Textbook: Elementary linear programming with applications, second edition, by B. Kolman and R. Beck (chapters 1-5) available at the bookstore as well as Robart's library online resources

workbook: The sections of a workbook gradually appear in the blackboard. Each section is basically a lecture note with some missing elements, which serve as questions and exercises. The workbook needs to be studied in conjunction with the textbook.

Prerequisite: math 223 or 240; (Note: Arts and Sciences calendar grants no waiver for this prerequisite, and students without the prerequisite will be automatically dropped out of the course.)

Method of evaluation:

- Diagnostic linear Algebra quiz: 5% Jan. 20 (**Note:** passing this quiz is mandatory for passing the course.)
- test 1: 8% Feb. 3
- test 2: 20% Mar. 2
- Problem sets: 14% (4 PS 3.5% each, due Jan. 27, Feb 24, Mar 23, Apr 7, due before the start of the lecture on the due date)
- Pop quizzes: 11 or more (at 1% each)
- Final exam: 45%.

Tutorials/help hours: There is no tutorials nor any TA help hours built into the structure of the course. Please take advantage of the office hours and the available times after the lectures.

About the evaluation

- Diagnostic quiz reminds us of the Linear Algebra necessary for the course. A poor performance in the diagnostic quiz hints at a less than adequate preparedness for the course. In this case one needs to work on Linear Algebra independently, or retaking the course after having secured adequate knowledge of Linear Algebra. Details of the diagnostic quiz will be posted.

- A warm up test, lightly weighted, in the 4th week of classes is a wake up call to gauge our preparedness and to help us troubleshoot our study methods. Traditionally over half of the class fails this test, this is why it is lightly weighted to minimize the damage. Of this group, usually about half eventually drop the course because they are already too far behind the course material, the other half manage to regroup, and to change their study habits and collect more of the future bonus marks, to actually do well above average.

  Note that the loss as a result of a poor performance in this test can surely be recovered if we are willing to attended all the pop quizzes (one may collect up to 3 bonus marks from pop quizzes.)

  At this time of test 1 we are studying chapter 1 of the textbook. Section 1.5 is the theoretical backbone of the course. Traditionally our students are either not sure what to learn in this section, or they are under the illusion that their understanding is sufficient. If one is not proficient in the the ideas of section 1.5 then the rest of the course becomes confused. So please make sure to be very well prepared for this test.

- The tests and Exam questions will have shorter computational components and deeper theoretical involvements: they are testing deeper understanding of of the methods. Even though the questions rarely ask for a direct proof, they often ask for theoretical justifications based on the existing theory. While we must remember the exact statements of theorems and definitions in the textbook, methods should not be understood. Test questions often interrupt the normal routine of a well known method to present us with exceptions. So we must be prepared to do analysis of the methods and not merely memorizing them.

- Sections of a workbook will be gradually posted as the course progresses. These workbook sections are very close to the textbook, and are parallel to the lectures. One must use the workbook sections to gauge the depth of their understanding of the course material and preparedness in the course.

- It is the nature of an applied mathematics course that problem sets involve tedious computations. So please allocate enough time and patience for the problem sets. No electronic submissions please! Problem sets are due at the beginning of the lectures. deviation from this deadline may disrupt the lectures, so please no late submissions! And for the unavoidable emergencies let's say a late submission penalty (after the start of the lecture during the first break) of 0.5 mark (out of 3.5 marks), and for submissions at the end of the lecture there will be a deduction of 1 mark (out of 3.5 marks). No submission past the day of the lecture please.

- While attendance is not mandatory, the majority of the drop outs, failures or low grades in the course have been co-related with low attendance. Pop quizzes are designed to encourage attendance as well as attention during the lectures. A pop quiz is about 5 min long, it consists of a single question, and it is marked out of 3: a mark of 3 will be given to a complete and correct answer, a 2 will be given to an incorrect with relevant details, an mark of 1 is given to incorrect answer and irrelevant details, while a mark of 0.5 would be assigned to a name on a piece of paper. The pop quiz questions deal with the ideas discussed in the same lecture, or the material discussed in the previous lecture which are necessary for the present lecture. So please make this as a practice for focus and attention during a lecture/presentation. There is no make up for pop quizzes. The past trends suggest that more than 75% of those who wrote quizzes they earned 2 or 3 marks.

- In the case of medical emergency there will be a make up test within a few days of the test

(but no later than the weekend.) Please submit your medical note (electronic submission will be enough and the original copy can be delivered at the time of the make up) by the end of the next day (Thursday) to arrange a make up test to be held on the following Friday, Saturday or Sunday. Beyond this point there will not be any make up, and a mark of 0 will be assigned to the missing work. There is no deferred term work.

About the course: Let's make an important assumption about APM236: this is a second year math credit toward a math degree. As such, this course is an important component of one's mathematics education. To be successful in this course one should fight another, (false) rival assumption about the course; the assumption that suggests this course is designed as an easy credit for finishing a degree. The first assumption facilitates learning from the course, while the second (false) assumption sabotages one's education.

Another problematic attitude is as follows: "as soon as I feel I am doing poorly in the course I make the course CR-NCR and then I don't need to work hard to catch up." This assumption has, in most cases, led to NCR option on the transcripts! So please be aware that as soon as we stop working on the course material we can incredibly fall behind, and it would be hard to catch up for even a passing grade.

We often have illusions about Applied Mathematics. Please note that 'Applied mathematics' does not mean cookbook instructions! instead, the term refers to the way basic mathematical properties become the logical backbone of applied models. As such we should be prepared to undertake an analytical journey through the foundations of Linear Programming. Along the way we will investigate the potentials and limitations of such models. By emphasizing on the analysis, we learn how to use the logical foundations of the models to find shorter answers to an otherwise computationally lengthy problem.

Knowledge of the basic concepts of Linear Algebra such as matrix multiplication, elementary row operations, elementary matrices, inverse of matrices, linear independence, span, basis, solving systems of linear equations, is essential for the course. The theory in the course is limited to basic linear Algebra concepts. The course stresses on the analysis of linear systems instead of merely solving such systems.

In some cases the textbook's exposition may not be as easy to read, or may be less relevant to the directions that we are taking in the course. The lectures and the workbook try to introduce the necessary material: a digested, simplified version of the main ideas in the course. As such, missing a (three-hour) lecture may result in difficulty catching up with the material from the textbook.

APM236 is a small mathematical theory from conception to application. This is a chance for us to see a theory in creation, and to see mathematics in action. Let's begin the course with this perspective in mind, and let's examine every small details in the context of a bigger picture.

Coverage and a rough schedule:

Please note, this schedule will be updated as the course progresses. Please take some time to review chapter 0 of the textbook for the linear algebra quiz on Jan 20.

Jan 13: Introduction to the course, sections 1.1, 1.2

Jan 20: sections 1.3, 1.4, linear algebra quiz

Jan 27: section 1.5, assignment 1 due

Feb 3: section 2.1, test 1

Feb 10: sections 2.3, 3.1

Feb 24: sections 3.2, 3.3, assignment 2 due

Mar 2: section 3.4, test 2

Mar 9: sections 3.5, 3.6

Mar 16: section 4.1, 4.2

Mar 23: section 4.2, 5.1, assignment 3 due

Mar 30: section 5.1, 5.2

Apr 7: section 5.2, assignment 4 due