SYLLABUS – Math 7593: Advanced Linear Programming

Spring 2007
Professor: Weldon A. Lodwick

Office: CU-Denver Building, Room 643
Telephone: 556-8462 (office - voice mail), 556-8442 (secretary)
E-Mail: Weldon.Lodwick@cudenver.edu
Web Site: http://www-math.cudenver.edu/~wlodwick


Office Hours: M/W 4:00 - 5:30 PM CU-Denver Bldg 643
Tu 10:00 – 11:30 AM CU-Denver Bldg 643
Other times by appointment

Students with Disabilities: If you have a disability that requires accommodation in this course, please see me as soon as possible. I am happy to make appropriate accommodations, provided timely notice is received.

Prerequisites: Math 5593

Below is the proposed outline. The weeks listed are tentative and indicate my best estimate as to the pace of the class. Each set of chapters will (most likely) be supplemented by journal articles and notes.

PROPOSED COURSE OUTLINE

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>Review</td>
<td>Chapters 1 – 5, 9, 10</td>
</tr>
<tr>
<td>3/5</td>
<td>Interior Point Methods</td>
<td>Chapter 16 – 21</td>
</tr>
<tr>
<td>6/10</td>
<td>Topics</td>
<td>NOTES, journal articles</td>
</tr>
<tr>
<td></td>
<td>a. Goal Linear Programming</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Semi-Infinite Linear Programming</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Stochastic Linear programming (if time)</td>
<td></td>
</tr>
<tr>
<td>11/12</td>
<td>Sensitivity, Redundancy, Infeasibility Analysis</td>
<td>Chapter 7</td>
</tr>
<tr>
<td>13/14</td>
<td>Complementarity</td>
<td>Chapter 10, 11, 23</td>
</tr>
</tbody>
</table>

OUTCOMES

By the end of the semester you should be able to read, understand, and apply linear programming theory at the research level. Moreover, you should be able to judge for yourself, the veracity of statements made in linear programming research articles.

EVALUATION

There are four evaluative criteria: (i) two in-class 35 minute presentations (15% each, 30% of your grade). The first is a lecture on one of the proposed course topics given during our regular class periods. The second is the presentation of your project during finals week, (ii) five (or six) problem sets (30% of your grade – 6% (or 5%) for each of the topics – interior point methods, goal
programming, semi-infinite programming, (stochastic linear programming), sensitivity, and complementarity), (iii) project (40% of your grade).

PROJECTS: A project may be (i) theoretical (complexity theory of linear programming, the ellipsoid method, a comparison between simplex, ellipsoid and interior point methods, all the optimality conditions for linear programming), (ii) application (network models in water systems, inventory models, coca cola truck scheduling, Denver Convention Center scheduling, radio-surgery models), (iii) algorithms (interior point methods compared to simplex), (iv) software implementation (write up a problem in GAMS, AMPL, C-Plex and solve it), and (v) survey (the current state of the art of modeling languages, linear optimization under uncertainty). A project must involve current and/or past research articles as a central part.

A project consists of:

1. **Proposal** – A formal written proposal due by the end of February is to be submitted for my approval. A proposal must contain:
   a. **Title**
   b. **Statement of the linear programming project**
   c. **The description of the problem, the data, and research articles**
   d. **The methods (theoretical, algorithmic, software development) you will be using for your project**
   e. **Tasks and subtasks with timelines**

2. **Project**
   a. **A Software Project**– If the project does not have a software component this section does not apply. If your project is a software implementation, the components of the software development are:
      i. **Code (10%)** - the actual computer implementation of the project. Attention must be paid to efficiency, readability and portability.
      ii. **Execution (20%)** - the algorithm as run must correctly perform what it was designed to do.
      iii. **Output (10%)** - relevant, clear display of solution (tables, graphs, images).
      iv. **Report (60%)** – The report contents is listed below
   b. **A Written Project (90%)** – If your project is not software, then the report is the focus of your project. This will be done in MS-Word or Latex. The final report will (subject to modifications we uncover) consist of at least the following:
      i. **Introduction**
      ii. **Theoretical foundations** – theory, application, algorithms
      iii. **Software** – description if you use software
      iv. **Survey or articulation of your research**
      v. **Results** – solutions, limitations and improvements
      vi. **Opportunities for further research**
      vii. **Conclusions**
      viii. **Annotated Bibliography**
      ix. **Appendices (if relevant)**

The evaluative criteria for a report will be my judgment of:

1. **Depth (40%)** – The depth should be at least that of a masters-level class, that is, more than upper level undergraduate projects.
2. Thoroughness (40%) – The thoroughness will depend on the scope of the project that is agreed up in your project proposal and the relative importance of the project in light of the other demands of the class. That is, it’s 20% of your grade so I would expect you to put in at least the equivalent time as would be spent on the four assignments. Your report should have at least the items listed above.

3. Correctness (20%)

DATES
February 28, 2007  Project proposals due
March 19 – 23, 2007  Spring Break
May 7, 2007
May 7, 9, 2007  Project presentations

POLICIES

Adds, drops and incomplete grades: See Schedule of Courses for the relevant dates with respect to adding and dropping this course. You must be registered by the dated specified or you will not get credit. The incomplete policy of the Mathematics Department and the College of Liberal Arts and Sciences is strictly enforced. Incomplete grades are given only in situations in which a student who has been in good standing all semester, is prevented from completing part of the work (for example the final report) due to circumstances beyond her/his control (for example, hospitalization, jury duty, revised job assignments, death in the family).

Legitimate Excuses: Legitimate excuses are for reasons that are beyond your control. You may be required to produce an official, signed excuse. If you are needed in a wedding, for example, you must talk to me prior to the (blessed) event. If you are legally arrested, then this is not a legitimate excuse. For matters that are within your control, the general rule is that it is not excused. However, talk to me prior to the event.

The following distribution of grades is guaranteed. However, the university does not recognize pluses and minuses for graduate students.

A+ 97-100%, A 93-96.9%, A- 90-92.9%
B+ 87-89.9%, B 83-86.9%, B- 80-82.9%
C+ 77-79.9%, C 73-76.9%, C- 70-72.9%
D+ 67-69.9%, D 63-66.9%, D- 60-62.9%

General advice: Keep all materials that I turn back in case you think I have not credited you with the points you earned. I can only correct your score if you have what I have turned back to you. It is a good idea to copy anything that you turn in just in case I lose what you turn in. Please check to make sure that the points you earned are the points I have recorded. Note: The statistics that I have read about correctness of professors in recording grades state that there is a 6% error rate in our recording of your grades. Please make sure that I have correctly recorded your points.

Spring 2007 CLAS Academic Policies

The following policies pertain to all students and are strictly adhered to by the College of Liberal Arts and Sciences (CLAS).
• Every student MUST check and verify their schedule prior to the published drop/add deadlines. Failure to verify a schedule is not sufficient reason to justify a late add or drop later in the semester. It is the student’s responsibility to make sure that their schedule is correct prior to the appropriate deadlines.

• CLAS students must always have an accurate mailing and email address. Email is the official method of communication for all University of Colorado at Denver and Health Sciences Center business. Go to http://www.cudenver.edu/registrar to update and/or change your email address.

• Students are NOT automatically added to a course off a wait list after wait lists are dropped. If a student is told by a faculty member that they will be added off the wait list, it is the responsibility of the student to complete the proper paperwork to add a course. Students are NOT automatically added to a course from the wait list after the 5th day of the semester when wait lists are dropped.

• Students must complete and submit a drop/add form to make any schedule changes. Students are NOT automatically added to a course from the wait list after the 5th day of the semester when wait lists are dropped.

• Students must complete and submit a drop/add form to make any schedule changes. Students are NOT automatically added to a course from the wait list after the 5th day of the semester when wait lists are dropped.

• Students must complete and submit a drop/add form to make any schedule changes. Students are NOT automatically added to a course from the wait list after the 5th day of the semester when wait lists are dropped.

• Late add’s will be approved only when circumstances surrounding the late add are beyond the student’s control and can be documented independently. This will require a petition and documentation from the student. Late add’s will only be approved if the student has not taken any exams, quizzes, or has not completed any other graded assignments. Independent verification of this from the professor of record will be required. Please note that the signature of a faculty member on an add form does not guarantee that a late add petition will be approved.

• Late drops will be approved only when circumstances surrounding the late drop are beyond the student’s control and can be documented independently. This will require a petition and documentation from the student. Please note that the signature of a faculty member does not guarantee that a late drop petition will be approved.

• Students wishing to graduate in spring of 2007 must meet with their academic advisor by the end of the drop/add period to obtain a graduation application. This application must be completed and submitted by 5 PM on January 31, 2007. You can obtain an application ONLY after meeting with your academic advisor. There are no exceptions to this policy or date.

• Students are responsible for completing financial arrangements with financial aid, family, scholarships, etc. to pay their tuition. Students will be responsible for all tuition and fees for courses they do not officially drop using proper drop/add procedures and forms.

• Students who drop after the published drop/add period will not be eligible for a refund of the COF hours or tuition.

Spring 2007 Important Dates

• January 16, 2007; First day of Class
• **January 18, 2007;** Last day to be added to a wait list

• **January 18 – January 31, 2007;** Students are responsible for verifying an accurate spring 2007 course schedule via the SMART registration system. Students are NOT notified of their wait-list status by the university. All students must check their scheduled prior to January 31, 2007 for accuracy.

• **January 19, 2007 at 5PM;** Wait lists are dropped. Any student who was not added to a course automatically from the wait list by this date and time MUST complete a drop/add form to be added to the class. Students are NOT automatically added to the class from the wait list after this date and time.

• **January 22, 2007;** First day an instructor may approve a request to add a student to a course using the Schedule Adjustment Form (drop/add form).

• **January 25, 2007;** Last day to add a course using the SMART Web Registration system. Students MUST check their registration to verify what classes they are enrolled in.

• **January 31, 2007 at 5 PM;** Last day to add structured courses without a written petition for a late add. *This is an absolute deadline and is treated as such.* This deadline does not apply to independent study, internships, and late-starting modular courses.

• **January 31, 2007 at 5 PM;** Last day to drop a spring 2007 course with a full tuition refund and no transcript notation. Drops after this date will appear on your transcript. *This is an absolute deadline and is treated as such.*

• **January 31, 2007 at 5 PM;** Last day to completely withdraw from all spring 2007 courses with a full tuition refund and no transcript notation. Drops after this date will appear on your transcript. *This is an absolute deadline and is treated as such.*

• **January 31, 2007 at 5 PM;** Last day for students to apply for Spring 2007 Graduation. Students MUST see their CLAS advisor to obtain a Graduation Application.

• **January 31, 2007 at 5 PM;** Last day to request pass/fail option for a course.

• **January 31, 2007 at 5 PM;** Last day to request a no credit option for a course.

• **January 31, 2007 at 5 PM;** Last day to register for a Candidate for Degree.

• **January 31, 2007 at 5 PM;** Last day to petition for a reduction in thesis or dissertation hours.

• **April 2, 2007 at 5 PM;** Last day for Non-CLAS students to drop individual classes or withdraw from all classes without a petition and special approval from the student’s academic Dean. *This is treated as an absolute deadline.*

• **April 13, 2007 at 5 PM;** Last day for CLAS students to drop individual classes or withdraw from all classes without a petition and special approval from the student’s academic Dean. *This is treated as an absolute deadline.*

• *No schedule changes will be granted once finals week has started.* There are NO exceptions to this policy.