Optimization

An introduction to modeling, solving with state-of-the-art software, and interpreting the results for real-world linear, integer, and nonlinear optimization applications. Solution techniques and analyses covered include graphical approaches, the simplex method, duality, and sensitivity for linear optimization; branch-and-bound and cutting plane techniques for integer optimization; and Newton’s method and gradient search for nonlinear optimization.

BANA 7020-001, 3 Graduate Credit Hours
Spring Semester, 2016 – 2017
6:00 P.M. – 8:50 P.M., Mondays, January 9 – April 24, 2017
201 Braunstein Hall

Department of Operations, Business Analytics, and Information Systems
Carl H. Lindner College of Business
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http://business.uc.edu/academics/departments/obais.html

Instructor:  David F. Rogers, MBA, PhD
531 Carl H. Lindner Hall          (513)556-7143        David.Rogers@UC.edu
http://www.business.uc.edu/David-Rogers
Office Hours:  2:00 P.M. – 3:20 P.M., Mondays and Wednesdays

Course Prerequisites: Lindner College of Business students in the MSBA-BA program have the necessary prerequisites. This includes coursework in matrix methods, linear algebra, and calculus. If seats are available, other students in the Lindner College of Business and other colleges may be admitted with permission of the instructor should they have the necessary prerequisite knowledge.

Learning Outcomes

a. Learn skills for identifying and modeling problem settings with linear, integer, and nonlinear optimization techniques.

b. Obtain skills in advanced state-of-the-art software systems for solving large and complex real-world optimization applications including Microsoft EXCEL Solver and GAMS software for optimization modeling will both be examined. MATLAB general purpose software with an optimization solver will be introduced.

c. Survey the basic analytical techniques for solving mathematical optimization models for linear, integer, and nonlinear mathematical programming models.

d. Help you become more competitive for getting a job!
This course aligns with PACE, the Lindner College of Business platform for developing the *total* business professional.

**P – Professionalism**
- Enhance oral & written *communication*, express ideas clearly, logically and persuasively.
- Develop and practice *teamwork* skills through group projects and exercises.
- Practice professional habits of punctuality, preparation, respect and participation.

**A – Academics**
- Develop foundational knowledge of core *business functions* and their interactions within firms.
- Begin applying functional and cross-functional knowledge to *critically analyze business problems*; for example, applying techniques for business plan development.

**C – Character**
- Learn and apply *leadership* techniques for project management (plan, brief, execute, debrief).
- Build an understanding and initial skills of *managing diversity*, including understanding cultural differences, and challenges and opportunities of global business.
- Understand importance of *ethics and social responsibility* in business and personal settings.

**E – Engagement**
- Build understanding of importance and practices of *networking* through interactions with business professionals and guest speakers.
- Develop awareness and appreciation of *involvement* in social organizations, community service, and professional group opportunities.

**Required Texts Available On-Line**

*http://web.mit.edu/15.053/www/

*http://site.ebrary.com/lib/cincinnati/docDetail.action?docID=10483436*
Information Resources

Extensive use of **Blackboard Learning and Community Portal System** will be employed for students to access documents such as PowerPoint slides, the syllabus, or assignments, and for communication such as announcements and postings for office hours. Email communication will be maintained through Blackboard and this requires that you keep a functioning email address registered, a setting you control. You may access Blackboard at [https://canopy.uc.edu/](https://canopy.uc.edu/) and the Contact Support Team at the Help button may assist. The Blackboard site for this course is not to be used for anything other than course-related issues. Blackboard should not be used to solicit classmates for anything such as encouragement to fill out a survey, attend a function, or anything not related to the course.

Emergency Class Cancellation Policy

Emergency closures are posted to UC’s homepage [http://www.uc.edu](http://www.uc.edu). If UC is closed, class is cancelled. If UC does not close, unless you hear otherwise from me via email through Blackboard, assume class will be held as scheduled. For a suspected inclement weather closure, you may wish to scan local television, radio, and websites since they may also receive and release information regarding UC closures. In the rare case of emergency cancellation of a class not due to a UC closure for any other unexpected reason, such cancellation will be communicated to students via email through Blackboard.

Grading Policy

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework, Presentations, Quizzes, &amp; Participation</td>
<td>25%</td>
</tr>
<tr>
<td>Midterm Examination</td>
<td>25%</td>
</tr>
<tr>
<td>Final Examination</td>
<td>25%</td>
</tr>
<tr>
<td>Individual Project</td>
<td>25%</td>
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**Notes:**
1) It is the student's responsibility to keep any graded work. This is important if for any reason your grade is at question.
2) Without mutually agreeable prior arrangements, late work will not be accepted.

Auditing and Pass/Fail Options

For auditors, the only requirement is that you attend and participate in classes. You may take examinations and participate in homework and project assignments but that is not required. Auditors who fail to attend class will be assigned a grade of F. Pass/Fail enrollment is not an option.

Withdrawal Policy

The university policy will be followed regarding the awarding of a W grade, i.e., the W grade will be given only if a student withdraws before the officially stated university deadline. According to UC policy you may withdraw until **5:00 P.M., March 17, 2017**. After this date the W grade is no longer an option.

Grade Improvement

Grades will be earned for the required work only. No additional work will be accepted for "extra credit" or "grade improvement".
Examinations
There are two examinations for the course, a Midterm and a Final. The Final Examination will consist of two portions: 1) A unit examination over the material covered since the Midterm Examination and 2) A comprehensive portion that may include problems and questions from any portion of the class. You may pick up your graded final examination after final grades have been submitted.

Make-Up Examinations
Make-up examinations will not be given under normal circumstances. If you miss the first examination with an excused absence the percentage missed may be added to the final examination percentage. An excused absence is one that meets all of the following conditions: 1) the professor is notified in advance; 2) the professor approves the absence; 3) written verification is provided (and may be followed up). A make-up examination may be given at the discretion of the instructor for an excused absence only. If the examination is a take-home examination, advanced notification must be made prior to the time that the examination is handed out or it will be considered as an absence from the examination. If the examination is a take-home examination, failure to turn in the examination at the appointed time will be considered as an absence from the examination. Unexcused absences from examinations will be recorded with a grade of zero percent.

Electronics
Computer usage is strongly encouraged for class-related activities such as accessing the lecture slides, Microsoft EXCEL Solver, GAMS, OpenSolver, MATLAB, or other business analytics resource. Please do not Snapchat, Facebook, Twitter, LinkedIn, YouTube, Google, eBay, instant messaging, or other such activities unless it is directly related to the course topics. Please either turn off or place on vibrate all cell phones. Please DO NOT TEXT. If you must text or take a call, please do not do so in the classroom. Politely leave the room and return – no problem. During examinations computers must be and turned off and cell phones must be off and placed on your desk. Electronic calculators will be allowed for examinations if they are needed and cell phones may not be used as a calculator.

Notification of Grades
Final grades will be available through UC OneStop and will not be posted nor will they be provided over email, telephone, or personally. Teaching Assistants and administrative staff are not authorized to release any grades.

Incomplete Policy
The university policy will be followed regarding the awarding of an I grade, i.e., the I grade will be given only if a student is unable to complete the course and has an excused absence for any incomplete work. Students receiving an I grade must contact Dr. Rogers during the first week of the immediately following semester to arrange a method for completing the course. If you will not be able to schedule a meeting during the first week of the immediately following semester then prior arrangements should be made regarding when you will be able to meet at the time an I grade is requested. Unless an acceptable reason exists to postpone completing the course during the next academic semester, all work necessary to change an I grade must be finished during the immediately following semester or your grade will be converted to an F.
Project
Each student is required to submit an individual project report detailing the definition and solution of an optimization application. A Project Proposal (no more than two pages double-spaced) will be solicited around midterm. Approval of your general project topic idea is not a guarantee that your development of the project will be deemed as being sufficient and is not a contract that your report will be rewarded with any particular grade. It is up to you to thoroughly, competently, and completely develop and document your project. A few examples of past projects are …

- Optimization of Workload and Travel Time for Insurance Underwriters
- Staffing Model with Inventory and Labor Constraints in a Seasonal Business
- Evaluation of the Processing Rate of an Injection Molding Co.
- Minimizing Overtime in an Automobile Manufacturing Facility
- Least Cost Formulation for Sausage and Hot Dog Manufacturing
- Transportation Optimization for a Ball Bearing Manufacturer
- Bank Staff Scheduling
- A 401K Contribution Optimization Model
- Transportation Network Optimization
- Retirement Planning Risk Model
- Picking a Fantasy Football Team
- Staff Scheduling for a Public Golf Course

Absences
While absences from class are extremely discouraged, sometimes exceptional circumstances arise that require missing a class. If you must miss a class, please do not contact the professor since such an interaction is not needed. There is also a Monday night section of this course and you may attend all or any portion of that also. In the event that you do miss a class, it is your responsibility to determine what you missed and obtain handouts. Please work with fellow students to acquire any additional course policies and procedures, obtain homework assignments, and determine the material that was covered.

Special Needs Policy and Disability Services
If you have any special needs related to your participation in this course, including identified visual impairment, hearing impairment, physical impairment, communication disorder, and/or specific learning disability that may influence your performance in this course, you should meet with the instructor to arrange for reasonable provisions to ensure an equitable opportunity to meet all the requirements of this course. At the discretion of the instructor, some accommodations may require prior approval by Disability Services.

If utilizing Disability Services results in any changes of usual procedures for any examination, project, or homework, please notify the professor and process the required paperwork immediately with the professor in his office. A photocopy of the paperwork must be given to the professor. For all such cases, the end of the second week of the semester is the deadline for processing paperwork from Disability Services. If paperwork from Disability Services is pending, please discuss the situation with the professor before the end of the second week of the semester. Failure to follow these guidelines will result in the usual procedures for any examination, project, or homework being retained. If you are taking any examination with Disability Services, you must schedule the examination so that it overlaps with the time period the class is taking the examination.
Academic Integrity Policy

The University Rules, including the Student Code of Conduct, and other documented policies of the department, college, and university related to academic integrity will be enforced. Any violation of these regulations, including acts of plagiarism or cheating, will be dealt with on an individual basis according to the severity of the misconduct. Please refer to the Student Code of Conduct at http://www.uc.edu/conduct/Code_of_Conduct.html.

It is expected and encouraged that students should discuss readings, homework assignments, and case reports with each other unless otherwise specified. When doing homework and cases, try on your own, ask for help from anyone, and get the work completed. However, getting an exercise or case worked through to a solution is not necessarily learning. Make sure you know what the problem is, what the solution is, and what the solution implies. Merely copying someone's work will not guarantee this.

Classroom examinations will be "closed-book" and, along with any take-home examinations, are to be the sole work of individual students. A grade of F for the course will be assigned to anyone receiving assistance or assisting another during any in-class or take-home examinations. Furthermore, any other academic misconduct during an in-class or take-home examination will result in immediate dismissal and a course grade of F. Academic misconduct for an in-class examination includes, but is not limited to, inappropriate behaviors such as: talking; passing any physical thing(s) such as notes, calculators, or writing devices; scanning the room and your classmates and potentially their work; peering at another individual and/or their work; communication of any type with a classmate; and behavior disruptive to the examination. Further disciplinary action for any academic misconduct may be taken that could result in dismissal from the university.

A grade of F for the course will be given to anyone receiving assistance from or assisting another individual or group for assignments for which the work is to be that of each individual student or group. Integrity of take-home assignments is of paramount importance. Should there be an indication that any take-home assignment or examination is to be performed by an individual or limited number of participants, violating this policy will be determined as academic misconduct and a grade of F will be assigned for the course. Plagiarism or representing someone else’s work as your own will result in a course grade of F. Further disciplinary action for any academic misconduct mentioned in this section may be taken that could result in dismissal from the university.

“Two Strikes Policy”

All academic programs at the Lindner College of Business will apply a “Two Strikes Policy” regarding Academic Integrity. Any student who has been found responsible for two cases of academic misconduct may be dismissed from the College.

The “Two Strikes Policy” supplements the UC Student Code of Conduct at http://www.uc.edu/conduct/Code_of_Conduct.html. All cases of academic misconduct, e.g., cheating, plagiarism, or falsification, will be formally reported by faculty. Students will be afforded due process for allegations, as outlined in the policy. If a student is found guilty of academic misconduct in two instances, the student may be dismissed from the Lindner College of Business.
# Tentative Course Outline

<table>
<thead>
<tr>
<th>Session# – Date</th>
<th>Topics</th>
<th>Text Reading</th>
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| 1 – 1/9         | Course Introduction  
Introduction to Operations Research and Analytics  
Introduction to Mathematical Programming Methodology  
Linear Programming (LP) & Linear Integer Programming (IP) Model Formulation | Syllabus  
AMP 1.1-1.2  
OML 1; AMP 1.5,5  
OML 4.6-11  
AMP 1.3,9.1-9.3 |
| 2 – 1/16        | Class Cancelled – Martin Luther King Holiday |
| 2 – 1/23        | Solving LP Models with *Microsoft Excel Solver*  
LP & Linear IP Model Formulation | OML 1.5,3; AMP 3,4  
OML 4, 6-11; AMP 1.3,9.1-9.3 |
| 3 – 1/30        | Optimization Solvers & *GAMS*  
LP & Linear IP Graphing, Sensitivity, & Insights | On-Line Documentation  
OML 1.2, 1.6-1.8; AMP 1.4 |
| 4 – 2/6         | The Simplex Method for LP |
| 5 – 2/13        | The Simplex Method – Initialization and Convergence  
The Revised Simplex Method | AMP 2  
AMP Appendix B.1-B.3 |
| 6 – 2/20        | Duality and the Dual Simplex Method  
Sensitivity Analysis | OML 3.5; AMP 4, Appendix B.7  
OML 1.5, 3.1-3.4; AMP 3, Appendix B.5 |
| 7 – 2/27        | Sensitivity Analysis  
Multi-Criteria Decision Making and Goal Programming | OML 1.5, 3.1-3.4; AMP 3, Appendix B.5  
OML 14 |
| 8 – 3/6         | Midterm Examination |
| 3/13            | Class Cancelled – Spring Break |
| 9 – 3/20        | IP Solution Methodology  
Branch-and-Bound  
Implicit Enumeration | OML 1.4,11; AMP 9  
AMP 9.5-9.6  
AMP 9.7 |
| 10 – 3/27       | IP Solution Methodology  
Lagrangean Relaxation  
The Cutting Plane Algorithm | OML 1.4,11; AMP 9  
AMP 9.8 |
| 11 – 4/3        | Network Optimization Models  
Transportation, Assignment, & Transshipment Models | OML 8; AMP 8  
OML 8.1,11.6  
AMP 8.1-8.2, 8.6 |
| 12 – 4/10       | Network Optimization Models  
Minimum Spanning Tree Model  
Shortest Path Model  
Maximum Flow Model  
Nonlinear Programming Insights and Models  
Portfolio Optimization Models  
Index Fund Model  
Markowitz Model | OML 8; AMP 8  
OML 8.9.8  
AMP 8.2  
AMP 8.2  
OML 1.9; AMP 13  
OML 13  
OML 13.2-13.4 |
| 13 – 4/17       | Nonlinear Programming Optimization Solution Methodology  
Newton’s Method  
The Gradient Method | AMP 13  
AMP 13.9 |
| 14 – 4/24       | 6:00 P.M. – 8:00 P.M. Monday, Final Examination |

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