

# Econ 172A, Winter 2009

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Department of Economics, UCSD

## Introduction to Operations Research

### Course Objectives

Economics 172A is the first course in the two-quarter Introduction to Operations Research sequence. It covers linear and integer programming, elements of zero-sum, two-person game theory, and specific combinatorial algorithms. Linear and integer programs are types of mathematical optimization problems.

The class will introduce you to the fundamental methods of operations research, train you to formulate economic and business problems as linear or integer programming problems, teach you how to solve the problems, including some specific methods called combinatorial algorithms, and teach you how to interpret the solutions.

Zero-sum, two-person game theory is the theory of how to make optimal decisions in situations of pure conflict, in which the outcome is influenced by another person's decision as well as one's own, and in which the other person is also trying to make an optimal decision. The class will teach you how to formulate situations of pure conflict as games and teach you how to use linear programming to solve for the optimal decision.

### Background Preparation and Course Prerequisites

You should be comfortable with linear algebra, basic microeconomics, and the operation of a spreadsheet computer program such as Microsoft Excel. In order to enroll in the class you must have the prerequisites listed in the UCSD catalog: ECON 100A or 170A; and ECON 120A or ECE 109 or MATH 180A or MATH 183 or MATH 186; and MATH 20F. Note that credit is not allowed for both ECON 172A and MATH 171A.

### Lecture Information

The course meetings include three lectures per week, scheduled for MWF 4:00p – 4:50p in Pepper Canyon Hall 109

### Web Page

The course web page may be accessed at <http://webct.ucsd.edu>. Students are strongly advised to become familiar with accessing the web page early on, as this will be a repository for course lecture notes, problem sets and course information. Please access the course web site regularly in order to keep abreast of any changes. If you have any question regarding grading policy, exam format or any other issues, consult the course web page first. Chances are that you can

find the answer there. If you cannot, please contact one of the TAs or me by e-mail.

The course will utilize teaching materials from previous versions of the course taught by Professors Joel Sobel and Vincent Crawford. You may find it useful to access information and links on Professor Crawford's web site at <http://dss.ucsd.edu/~vcrawfor/econ172A.html>.

## **Textbooks**

The text for this class is Hillier and Lieberman, *Introduction to Operations Research*, 8<sup>th</sup> edition, McGraw-Hill. Supplementary copies of the text have been placed on reserve at the Social Science and Humanities Library in the Geisel Library building. The course will also draw on a set of lecture notes which will be posted on the course web site.

## **Problem Sets**

There will be five assignments (one for each two-week period of the course). Problem sets will be announced in class and posted on the course website. Some problems will involve using standard spreadsheet computer programs, such as Microsoft Excel, to solve linear programming problems. You will need Microsoft Excel (with the "solver" option installed) to do these assignments. The program is available on the computers in Econ 100, but there is no need to go there if you have access elsewhere. The use of Excel is not discussed in lectures, but notes containing information about using Excel to solve linear programming problems are posted to the course web site.

I encourage you to discuss your homework assignments with classmates, but you must write your answers independently. Problem sets should be turned in by the start of lecture on the announced dates, or put in the course mailbox in Economics Undergraduate Student Services Office (245 Sequoyah Hall) by the same time. Except for documented medical excuses, late problem sets will not be accepted.

Each problem set will be worth 1% of the final course grade, with the score assigned primarily on the basis of completeness and evidence of effort. Students should at least attempt all problems in order to get credit. A solution key will be posted to the course web site on the due date of each problem set.

The problem sets should be taken as a good indication of the type of questions that may be asked on exams. Group study and free discussion are encouraged, but you need to develop an independent understanding of how to answer questions in order to prepare for exams.

If you have any question on the problem sets, please ask a TA or me during our office hours. I would prefer to talk to you in person. If you do not have time to come by in person, you may also send your questions by e-mail, but note that e-mail is not an ideal medium for clearing up questions.

## Examinations

There will be a single mid-term exam carrying a weight of 40%. The cumulative final exam will carry a 55% weight. Both exams will be closed book. You do not need to bring a blue book, but you may wish to bring your own paper as a supplement to the writing space provided on the exam.

There will be no make-up exams. If you miss the midterm for reason of a valid emergency and provide verifiable evidence, then the final exam will carry its weight.

## Grading

All grading problems must be addressed within a week from the time a graded exam is returned.

- **Re-grading of exams will only be considered in cases of blatant grading error.** Please address exam re-grading requests to me.
- Re-grading of the exams must be resolved with the TA who graded the answer in dispute.

Course grades will be computed as follows. First, if the mean score of either exam (including the mid-term and the final) is below 75 percentage points, points will be added to all scores to bring the mean score for the exam in question up to 75. Second, a weighted average of numerical scores will be obtained. Suppose you received 4 out of a possible 5 points for homework assignments and your scores on the midterm and final exam are 79 and 95 (after possible adjustment), respectively. Then the final course average is computed as the weighted average rounded to the nearest integer, and the course grade is computed directly off this average:  $4\% + 40\% * 79 + 55\% * 95 = 83.89 = 84$ . The weights on the problem sets, midterm and final exams cannot be changed. Finally, letter grades will be assigned using the following scale:

<b>&gt;=95 A+</b>	<b>[80,85) B+</b>	<b>[65, 70) C+</b>	<b>[50 55) D</b>
<b>[90,95) A</b>	<b>[75,80) B</b>	<b>[60, 65) C</b>	<b>&lt; 50 F</b>
<b>[85,90) A-</b>	<b>[70,75) B-</b>	<b>[55, 60) C-</b>	

Note that the scale is exact, so if your course average is 84, you will get a B+.

I will not assign letter grades on the midterm. However, you can refer to the above table to see how your midterm score will affect your course outcome.

## Policy on Academic Dishonesty

Academic dishonesty is a growing problem on our campus, and will be treated in this course as a serious violation of university rules. The university's policy on academic dishonesty may be found at this web site: <http://www-senate.ucsd.edu/manual/appendices/app2.htm>. Students who

are caught cheating on the exams will have their cases referred to the Dean of Student Affairs of the student's college, which could potentially lead to a formal hearing of the case by the Academic Dishonesty Hearing Board and a failing course grade which remains on the student's permanent record.

An exception to the general policy on academic dishonesty is made for students who wish to work together on their problem sets. If you pursue this option, it is still incumbent on you to have an independent understanding of how to answer the questions, and to submit a version of the answers to the questions in your own words to receive credit.

### **E-mail and Office Hours**

Instructor: Stephen Stohs [sstohs@ucsd.edu](mailto:sstohs@ucsd.edu) (Office time on request immediately after lecture)

TAs: Soojin Jo (50% time) [s1jo@ucsd.edu](mailto:s1jo@ucsd.edu) (Office hour time TBA)

We are additionally supposed to get another TA at 25% time (TBA).

### **COURSE OUTLINE**

Recommended readings in Hillier and Lieberman are shown in parentheses by each topic.

#### **Part I. Linear Programming**

(a) Introduction and Problem Formulation (Ch. 3, Ch. 4 Sections 4.1 - 4.6)

(b) Graphical Solutions (Section 3.2)

(c) Duality and Complementary Slackness (Ch. 6 Sections 6.1 - 6.3)

(d) Sensitivity Analysis (Sections 2.3, 3.3, 4.7 and 6.5 - 6.8)

Midterm Exam: Friday, February 6, 2009 (end of week 5), in class

(e) The Transportation Problem (Ch. 8 Sections 8.1 - 8.2)

#### **Part II. Two-Person Zero-Sum Game Theory (Ch. 14 Sections 14.1 – 14.5)**

#### **Part III. Integer Programming (Ch. 11 Sections 11.1 – 11.7)**

Final Exam: Friday March 20, 2009, 3p-6p, Location TBA