University of Pennsylvania

The Wharton School

Department of Operations and Information Management

OPIM 621: *Decision Models & Uncertainty*

Fall 2010

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Course Description

OPIM 621 is a core course in *decision models* and their application to management problems. Its main topics include linear and integer programming, decision making under uncertainty, and simulation. The emphasis is on models that are widely used in diverse industries and functional areas, including operations, finance, accounting, and marketing.

The applicability and use of decision models have increased dramatically in recent years due to the extraordinary improvements in computer, information, and communication technologies. These developments in hardware and user interfaces, such as spreadsheets, have been complemented by the availability of large volumes of previously unavailable data, such as the automatic capture of point-of-sale information, and easy access to large databases (e.g., Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) systems.) Personal computers and friendly interfaces have become effective "delivery vehicles" for powerful decision models that were once the exclusive province of experts. Information has come to be recognized as a critical resource, and models play an increasingly critical role in deploying this resource, in organizing and structuring information so that it can be used more productively.

The course has a twofold purpose. First, it seeks to introduce you to simple models and ideas that provide powerful (and often surprising) *qualitative* insights about a large spectrum of managerial problems. Second, it aims to give you a feeling for the kinds of problems that can be tackled quantitatively, the methods and software available for doing so, and the difficulties involved in gathering the relevant data. Our ultimate ambition is to have an impact on the way you think about the surrounding world—even if you do not explicitly use any mathematical models in the future!

You may find that much of the action in the course has to do with the *mechanics* of the formulation and solution of simple problems. That is *not* the purpose of the course, but we believe that it is the best way of accomplishing the above two goals. The simple exercises are complemented by a case assignment that captures more realistically the complexity of managerial problems. We will also provide articles describing successful applications of decision models.

The homework problems you will do are intended to give you practice in developing models and interpreting results. The feedback from these exercises should help you evaluate your progress and understanding. Much of the material builds on topics covered in previous weeks. To keep abreast, it is important that you try to solve these problems on a regular basis.

The textbook by Ragsdale does a good job explaining various concepts with the help of examples. You will be expected to have carefully read the assigned portion of the book *prior to coming to class*. You are encouraged to discuss this material with classmates or teaching assistants. Most of the class time will be devoted to exploring applications and extensions of the material in the book. Further details about reading assignments are provided in the attached course outline.

Required Texts

(Text) Cliff T. Ragsdale, *Spreadsheet Modeling and Decision Analysis,* Revised 5th Edition, Cincinnati: South-Western College Publishing, 2008, 7 selected chapters. (This is a custom text available at the University Bookstore.)

Computer Software

We will use *Microsoft Excel* spreadsheets quite extensively throughout the course. In the first half of the course we will also use Excel's *Solver* add-in to solve constrained optimization problems, and in the second part of the course, we will use the add-in, *Crystal Ball*, which facilitates Monte Carlo simulation. You will be able to download Crystal Ball via WebCafé.

We will also place several data and program files on the course website. Details of these files will be provided in the notes to be handed out in class.

TA Office Hours

There are several teaching assistants (TAs) for the course and their office hours will be distributed during the first week of class. Since all sections of the course will have the same assignments and examination, you may approach any of the TAs with your questions.

Homework Assignments

Homework assignments are essential to staying abreast of this fast-paced course, and we strongly believe that working on these problems is essential to your mastery of the material. There are ***four* written homework assignments.** We will compute your course grade using the ***three* best grades** you receive. To prepare for the final exam, you will nevertheless need to understand well all four assignments.

Homework assignments may be done **individually or in pairs**. If you do an assignment as part of a pair, **please hand in *one* write-up** with two names on it (*do not* hand in two copies of the same assignment). Also, your **partner must be another student from your cluster**. Please hand in your assignments at the beginning of class and do not forget to include your name(s) and student ID(s).

You are free to discuss all four homework assignments with other students. When thinking of whether to work alone or not, you may consider the following trade-offs. Working alone has the advantage that you get the best insight into how well you are mastering the material. On the other hand, particularly if this material is entirely new to you, you may find that discussing the problem with another person helps in the learning process.

We will also distribute a set of "self-study" problems and their solutions. The self-study questions will be similar to homework sets. Together, the homework and self-study problems will give you a good idea of the kind of questions you can expect on the final exam.

Case

In addition to the four homeworks, there will be one group assignment. This assignment, a written case exercise, *Offshore Drilling Incorporated*, will be handed out in class 7 on November 18th. The write-up is due at the beginning of class 10 on December 2nd.

This assignment is to be completed in groups of **four, five,** or **six**. Learning teams that are depleted due to waivers should coalesce with other teams within the same cohort so that each team has at least four and no more than six members.

Examination

The final examination for the course will be held on Monday, December 20, 2010 from 9am to 11am. A common examination will be used for all sections of the course. The examination will be open-book, open-notes. A practice examination with solutions will be included on the course web site.

Grading

The course grade will be based on a weighted average of homework exercises, case write-up, final examination, and class participation. The weights are as follows:

Homework exercises (3 best)	25%
Case write-up	10%
Final examination	50%
Class participation	15%

Class Preparation

Since there are only 12 class sessions in the course, missing a class can make it extremely difficult to catch up. Likewise, being unprepared for class will make it very difficult to follow the discussion. We keep the reading load reasonable and distinguish between essential and optional readings.

In each class we will hand out detailed lecture notes that are designed to help you focus on the class discussion rather than note taking. It is good practice to review these lecture notes soon after each class to reinforce your learning from the class.

When reading the textbook chapters, you should make a distinction between the mathematical models and their spreadsheet implementation. In the detailed course outline that follows, the readings marked **Text–*m*; *ppp–qqq*** refer to Chapter *m*, pages *ppp–qqq* of the Ragsdale text. It is useful at first reading to focus on the mathematical models and skim through the spreadsheet details.

Course Syllabus

Class	Date	Topics	Read Before Class	Submit
1	Oct 28	• Decisions & models • LP Introduction	**Text–1; 1–13**: Introduction to modeling. Skim through the brief sketches of management science applications. **Text–2; 17–39**: Go through the graphical solution method carefully; the geometric intuition you develop now will serve you well in the coming weeks.	
2	Nov 2	• Geometry of linear programs and graphical solution of LPs • *Fabulous Nuts* problem • LP sensitivity analysis	**Text–3; 45–62**: A systematic explanation of how to formulate an LP and then implement the formulation in a spreadsheet. **Text–4; 136–151**: Sensitivity analysis is used to address a large range of managerial questions. **Lecture Notes from Class #1: *Fabulous Nuts***: We'll discuss this problem in class.	
3	Nov 4	• LP formulations: applications to production, transportation, and multi-period planning.	**Text–3; 63–102**: Starting with today's class, we will cover a number of examples to illustrate LP applications in a variety of managerial problems. **Lecture Notes from Class #2: *GlobChem***: We'll discuss this problem in class.	HW #1
4	Nov 9	• LP formulations: applications to investment planning and term-structure analysis	**Lecture Notes from Class #3: *Real Estate Development Investment***: Please come prepared to discuss the case described at the end of Lecture Notes for Class 3.	
5	Nov 11	• Integer programming • Plant location • Currency Arbitrage	**Text–6; 232—262**: Skim pp. 232—239. Concentrate on pp. 240-262. We will focus primarily on *binary* variables and go through additional examples in class.	HW #2
6	Nov 16	• Assignment problem • Search engine advertising • Review of LP&IP	**Lecture Notes from Class #5: *Assignment Problem***: We'll discuss this problem in class.	

7	Nov 18	• Introduction to simulation	**Text–12; 559–586**: A brief introduction to risk analysis.	HW #3
8	Nov 23	• Applications of simulation: evaluating financial options	**Text–12; 559–586**: Read again carefully to make sure you understand the technical concepts.	
9	Nov 30	• Applications of simulation: investment portfolio		
10	Dec 2	• ODI Case discussion	***Offshore Drilling Incorporated***. Read the *ODI* case and prepare a write-up. We will discuss the case in class.	Case Write-up
11	Dec 7	• Instructor's Choice		HW #4
12	Dec 9	• Applications of simulation: project management • Course wrap-up		