Decision-Support Modeling

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Instructor

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Course web sites: www.utexas.edu/courses/lasdon and http://courses.utexas.edu. The first is my personal website, and has information on all my courses. The second one is on the UT intranet, called Blackboard. They both contain last year's class plans and syllabi, and will be updated as the semester progresses. The Blackboard site will also contain announcements, calendar events, and perhaps a bulletin board for online class discussions.

Course Objectives

A goal hierarchy for this course is shown below:

1. Learn how to use models and data to make better decisions
   - 1.1 Study the modeling process
   - 1.2 Learn how to specify and organize multiple objectives using Value-Focused Thinking
     - 1.2.1 Build a goal hierarchy like this one
     - 1.2.2 Build a means-end hierarchy
     - 1.2.3 Use the above to create new and better alternatives
     - 1.2.4 Learn approaches to evaluating alternatives and choosing the best one
     - 1.2.5 Use Logical Decisions software to help make a good choice
   - 1.3 Learn to structure decision problems involving uncertainty using Decision Analysis
   - 1.4 Improve your ability to construct what-if spreadsheet models of typical business situations
   - 1.5 Build, solve, and analyze optimization models using the Excel Solver
     - 1.5.1 Financial Applications
     - 1.5.2 Supply Chain Management
   - 1.6 Use simulation to make better decisions in problems involving randomness, bottlenecks and multiple time periods
     - 1.6.1 Introduce uncertainty into spreadsheet models
     - 1.6.2 Use discrete event simulation to model problems with waiting lines

2. Learn proven state-of-the-art approaches for managing complexity and uncertainty using systems thinking.

This course is designed for any MBA students who want to improve their modeling abilities, and (secondarily) for any OR/MS students from IE/OR, MSIS, or other students, who want a course on OR applications. Its focus is on adding value to data by using models. These models process the data, and their output is used to help in decision making. Systems composed of databases, models, and user interfaces are called Decision Support Systems. We will cover several important user interfaces associated with the modeling methodologies we consider. However, our focus is on modeling. Formal math skills like calculus and probability/statistics will be used some but not much. You don't have to be a nerd to do this, and this is not a math course. You do need the ability to think logically and systematically, but improving this ability is a course goal.

Instructional Methods

The basic approach is to learn by doing. We will build simple, then more complex models in class, using small learning groups. Problems will span the business spectrum, covering operations, finance, marketing, and information systems. Some problems will come from the text, others from cases. There will be a mixture of lectures and group work in class. Outside speakers will explain how their businesses use model-based Decision Support Systems.

Course Materials

The text is "The Art and Science of Modeling with Spreadsheets" by Stephen Powell and Ken Baker, John Wiley and Suns, 2004. A supplementary text (useful but not required) is "Practical Management Science," second edition, by Winston and Albright, Published by International Thomson Publishing, 2004, with CD for use in academic year 2004 (CD ISBN 0-534-4077-57). Both use Microsoft Excel throughout, and the text comes with Excel add-ins for Optimization, Monte Carlo Simulation (Crystal Ball), and Sensitivity Analysis, plus spreadsheets for all text problems. Both are available the Co-op. The text used in the MBA core course in statistics, BA386T, is also an acceptable (if somewhat less desirable) supplementary text. It is "Data Analysis and Decision Making with Microsoft Excel" (2^{nd} edition) by Albright, Winston, and Zappe.

Course readings on our blackboard website contain materials presenting some course topics, successful Management Science applications, Management Science software, and cases.

Software used: Logical Decisions (software for multi-objective decisions), Microsoft Excel, Excel add-ins for decision trees (Precision Tree) and simulation (Crystal Ball).

Grading

There will be an in-class midterm exam worth 20%. There will be 5 cases, done in teams, worth 50%. In lieu of a final exam we will have a term project, done in teams,

worth 20%. The term project will involve selecting an OR application area, researching it, and writing a survey on it and/or building and solving some prototype models from that area. Finally, graded homework will be 10% of the final grade

Tentative Schedule of Topics

Abbreviations: L = LDW manual
MAC = Multi-Attribute Choice
VFT = Value-Focused Thinking

Class number	Date	Topic	Text chapters	Other book chapters and pages	Readings
1	Jan 16	Introduction, modeling framework	1,2		
2	Jan 18	Craft of modeling	3		
3	Jan 23	Visual modeling tools	4		
4	Jan 25	Spreadsheet engineering, begin case 1	5		
5	Jan 30	Spreadsheet analysis	6		
6	Feb 1	MAC		L: sections 1-4	
7	Feb 6	VFT, MAC		L: sections 5-8	VFT ch1,2
8	Feb 8	VFT, MAC		L: section 9	VFT ch3
9	Feb 15	MAC			
10	Feb 20	MAC			
11	Feb 22	MAC: plutonium disposal application			
12	Feb 27	Decision analysis			Decision making under uncertainty
13	Feb 29	Decision Analysis			Decision making under uncertainty
	Mar 6	Plus trips: informal classes			
	Mar 8	Plus trips: informal classes			
14	Mar 20	Decision Analysis			Decision making under uncertainty
15	Mar 22	Decision analysis			
16	Mar 27	Midterm exam			
17	Mar 29	Optimization	203-223		
18	Apr 3	Optimization	223-242, 77-87		

19	Apr 5	Optimization	242-261			
20	Apr 10	Optimization				
21	Apr 12	Optimization, asset allocation			Portfolio optimization	
22	Apr 17	Optimization, asset allocation			Quadratic programming	
23	Apr 19	Data Envelopment analysis				
24	Apr 24	Data Envelopment Analysis				
25	Apr 26	Monte Carlo Simulation	265-291			
26	May 1	Monte Carlo Simulation	292-316			
27	May 3	Monte Carlo Simulation	316-346			

This is a preliminary list of topics. Detailed class plans will be distributed prior to class. A brief description of the topics follows

1. Value-Focused Thinking and Multi-attribute Choice (approx. 7 classes). This methodology asks you to list your objectives, and break them down into a hierarchy. You list your alternatives, and try to create new ones by referring to the objectives. Then you deal with relative importance of the goals, and with scoring the alternatives on each objective. The result is a ranking of alternatives from best to worst. There are several methodologies for this that we will consider, and many applications. The Logical Decisions software is a state-of-the-art tool that many of you will find useful in your work.
2. Decision analysis (approx. 8 classes). Here we consider problems in which decisions are made over time and where some outcomes are uncertain. Decision trees help to structure these problems. There are many applications, e.g., marketing new products, introducing new technologies, etc. The software we will use to build and analyze decision trees is called Precision Tree.
3. Optimization models (approx. 10 classes). How do you find a best alternative that satisfies all your constraints? We will use the Excel Solver to do this. The instructor is a co-author of this piece of Excel, and will introduce many current applications. Application areas include finance (asset allocation, cash management, asset-liability models), operations (production and inventory planning, distribution, facility location), and marketing (sales force allocation). Some of these examples will draw on ideas covered in your previous courses.
4. Simulation (approx. 5 classes). We will use Crystal Ball, an Excel add-in to introduce uncertainty into spreadsheet models by assigning probability distributions to uncertain inputs, and computing the distributions of key outputs by sampling.

There are many important applications in marketing, finance, and operations. If time allows, we may introduce discrete-event simulation using ARENA.