<u>**Decision-Support Modeling**</u>

MIS 383N - Unique # 03765
TTh 12:30-2P UTC 1.146
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<u>**Instructor**</u>

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Course web sites: http://courses.utexas.edu and www.utexas.edu/courses/lasdon. The first one is on the UT intranet, called Blackboard. The second is my personal website, and has information on all my courses. 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.

<u>**Course Objectives**</u>

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

This course is designed for MBA students who want to improve their modeling abilities, and (secondarily) for any OR/MS student from IE/OR, IROM, or other students who want a course on OR applications. The course is really an introduction to Operations Research (OR), and lots of interesting information on this field can be obtained at www.informs.org. OR adds value to data by using it to build models. These models take some of the data as inputs, and their outputs are 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, linear algebra, 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, in homeworks, and in cases, using small learning groups. Problems will span the business spectrum, covering operations, finance, marketing, and information systems. There will be a mixture of lectures and group work in class. I will try to get 1 or 2 outside speakers, who 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 Sons, ISBN 978-0-470-59350-9. Be SURE to get this ISBN and NO OTHER. This is a "custom version" of this text, that was used at Dartmouth College by its authors in Fall 2009. It uses Microsoft Excel throughout, and comes with the Frontline Systems Risk Solver Platform (an Excel add-in) for Optimization, Monte Carlo Simulation and Decision Tree Analysis. It also provides spreadsheets for all text problems. It is available at the Co-Op on Guadalupe, but is not available online because it has not yet been released for general use.

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, Risk Solver Platform.

Grading

There will be five cases, done in teams, worth 40%, and a midterm worth 30%. In lieu of a final exam we will have a term project, done in teams, worth 30%. The term project will involve selecting an OR application area, researching it, and writing a survey on it, building and solving some prototype models from some application area, or some other topic proposed by students and accepted by the instructor.

Tentative Schedule of Topics

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

Class #	Date	Topic	Text chapters	Other book chapters and pages	Readings	Cases
1	Jan 19	Introduction, modeling framework	1			
2	Jan 21	Craft of modeling, visual modeling tools, spreadsheet topics	3-6			Start case 1
3	Jan 26	Visual modeling tools and spreadsheet topics, MAC	3-6	L:sections 1-4		
4	Jan 28	Racquetball case, MAC	3-6	L: sections 1-4		
5	Feb 2	Case 1 presentations		L: sections 1-4	VFT Ch1,2	Case 1 due
6	Feb 4	MAC		L: section 5-8		Start case 2
7	Feb 9	MAC		L: section 9		
8	Feb 11	MAC;plutonium disposal application			Dyer plutonium disposal	
9	Feb 16	MAC		L: section 9	Assessing weights, smarter method	
10	Feb 18	Case 2 presentations, JSD system, jobeval system in JSD			JSD Excel add-in	Case 2 due
11	Feb 23	Decision Analysis	14			
12	Feb 25	Decision Analysis	14			
13	Mar 2	Decision Analysis:utility functions	14		KeeneyVFTatBCG as.pdf, exputil.xls	Start case 3
14	Mar 4	Midterm				
	March 8-12	Global trips: informal classes				
	Mar 15-19	Spring Break				
15	Mar 23	Decision analysis	6			
16	Mar 25	Optimization				
17	Mar 30	Case 3 presentations	11			Case 3 due
18	Apr 1	Optimization	11,12			Start case 4
19	Apr 6	Optimization	12, 13			
20	Apr 8	Optimization	13			
21	Apr 13	Optimization, asset allocation	10		Portfolio optimization	
22	Apr 15	Case 4 presentations	10		Quadratic programming, E&P portfolio paper 103105	Case 4 due
23	Apr 20	Data Envelopment analysis	10, pp 273-277		Data_envelopment _analysis	Start case 5
24	Apr 22	Data Envelopment Analysis	10, pp 273-277			

25	Apr 27	Monte Carlo Simulation	15		Flaw of averages 1,2,3	
26	Apr 29	Monte Carlo Simulation	15			
27	May 4	Case 5 presentations	15			Case 5 due
28	May 6	Monte Carlo simulation	15			Last class
Term projects due						Term projects due

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

1. Modeling and Spreadsheet Engineering (5 classes)
2. Value-Focused Thinking and Multi-attribute Choice (approx. 6 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.
3. Decision analysis (approx. 4 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 Risk Solver Platform.
4. Optimization models (approx. 6 classes). How do you find a best alternative that satisfies all your constraints? We will use the Excel Solver, as implemented in Risk Solver Platform, to do this. The instructor is a co-author of the Solver included with 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.
5. Data Envelopment Analysis (2 classes) Computes an Efficiency Ranking for organizational units like banks, hospitals, or schools.
6. Simulation (approx. 3 classes). We will use Risk Solver Platform, 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.