University of Illinois at Chicago
College of Urban Planning & Public Affairs
Public Administration Program

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PA 526 – Public Decision Analysis

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Introduction
Decision making is a basic human activity. Individuals and groups carry out decision making for both personal and organizational purposes. Behavioral scientists from economics, psychology, mathematics and other fields have studied the way in which individuals and groups develop decisions under a variety of conditions. Yet unlike many other scientific fields, interest in decision making is often motivated for pragmatic purposes not simply to enhance our understanding of behavior.

World War II was a major impetus for promoting scientific interest in decision making. As nations mobilized all of their resources towards their survival, the scientific community began to apply their unique skills to solving important problems, such as allocating air defense batteries so as to optimize their ability to protect air fields. After the war, the advent of the electronic computer furthered the academic development of a new field of study known as Decision Science. Unlike other typical scientific disciplines, Decision Science oriented itself around real world problem solving and not simply the acquisition of new knowledge. Due to this orientation, Decision Sciences developed an array of modeling approaches designed to analyze the present solutions to a wide array of operational, managerial and policy problems.

Decision Science is often referred to as System's Analysis, Management Science and Operations Research. Though these terms have slightly different origins and uses, we will use them as synonyms. We will broadly define the field of Decision Science as the scientific method applied to problem solving and decision making. Most real world problems involve uncertain information. Although uncertainty can be often reduced, it can be seldom eliminated and whether we are dealing with scientific, engineering, or personal problems, we are forced to make decisions that are based on incomplete knowledge. Even a deliberation of whether more information should be collected before making an actual decision is itself a decision under uncertainty. Decision making under uncertainty has been addressed in mathematics by probability theory and expected utility theory. These two together are known as decision theory. The discipline that focuses on applying decision theory in practice is known as decision analysis. Decision analysis offers a set of structured procedures that assist decision-makers in

- structuring decision problems and developing creative decision options

- quantifying their uncertainty (this includes combining available statistics with expert judgments, and their own beliefs to arrive at estimates of the probabilities of various outcomes)

- quantifying their preferences (this includes structuring their value tradeoffs and examining their attitude towards risk)

- combining their uncertainty and preferences to arrive at optimal decisions

Objectives

This course provides an introductory treatment of decision analysis, along with elements of human cognition under uncertainty. The intended participants are students who want to learn more about decision making under uncertainty and about tools that can be used to support it. More specifically, the course is designed to:

- Provide students with the ability to structure real decision problems into some formal decision model framework.

- Exploit decision models as tools for extracting information about specific decision problems faced by an organization.

- Understand how to evaluate model parameters (sensitivity).

- Provide an ability to recognize situations where Decision Science could be used and have the ability to communicate with specialists.

- To be able to carry out straightforward applications of decision model analysis.

- To develop an appreciation of the data requirements necessary to perform Decision Science analysis in order to anticipate and collect appropriate data during the normal operations of an organization.

Readings

Texts: Clemen, Robert T. and Terence Reilly. 2001, *Making Hard Decisions with Decision Tools*, Duxbury Press: Pacific Grove, CA.

We will also read a selection of articles and book chapters (to be provided).

Software

The software we will use for all aspects of Decision Analysis is DecisionTools, which is a special decision making software developed by Palisade and integrated into the Clemen and Reilly book. DecisionTools comes with the book and is easily added into MS Excel. Although the software is relatively intuitive and the examples in the book do a good job of taking you step by step through examples along the way, you will need to spend some time learning the package.

Homework / Participation

There will be a few selected problems due each week. There will also be a set of 3-4 larger applied homework assignments throughout the term. Finally, you should all be ready each week to discuss the mini-cases at the end of each chapter.

Grading

Homework / Participation	20%
Project	30%
Mid-Term	25%
Final (take home)	25%

Schedule

I. Introduction to Decision Making (One Week)

Clemen and Reilly, Ch. 1, 2
Kleindorfer et al., Ch. 1,2, and 5

II. Modeling Decisions (5 Weeks)

a. Structuring Decisions (Chapter 3)
    i. Fundamental Objectives and Means Objectives
    ii. Influence Diagrams
    iii. Decision Trees
    iv. Decision Details
b. Making Choices (Chapter 4)
    i. Decision Trees and Expected Monetary Value
    ii. Solving Influence Diagrams
    iii. Risk Profiles
    iv. Dominance
    v. Multiple Objectives
c. Sensitivity Analysis (Chapter 5)
    i. Problem Identification and Structure
    ii. One Way and Two way Sensitivity Analysis
d. Creativity and Decision Making (Chapter 6, supplemental readings)

******MIDTERM EXAM*******

III. Modeling Uncertainty (4 Weeks)

a. Probability (Chapters 7-9, supplemental readings)
    i. Probability Theory
    ii. Venn Diagrams
    iii. Discrete and Continuous Probabilities
b. Using Data (Chapter 10)
    i. Fitting Distributions to Data
    ii. The Regression Approach
c. Value of Information (Chapter 12)
    i. Information Value, Probability and Expected Value
    ii. Sensitivity Analysis
    iii. Structuring

IV. Modeling Preferences (2 Weeks)

a. Risk Attitudes
    i. Utility Function Assessment
    ii. Risk Tolerance
    iii. Modeling Preferences
    iv. Risk Aversion
    i. Utility Axioms, Paradoxes and Implications (Chapter 14)

V. ***Final Exam***