**IEE 498/511 Analysis of Decision Processes**

MW 10:30 – 11:45am, BY 510

Fall 2012

**Instructor:**

Ronald G. Askin, ron.askin@asu.edu

BY 548, 480-965-2567

Office Hours: MW 1:00-2:00pm and by appointment

**Text:**

Clemen, Robert and Terence Reilly, *Making Hard Decisions* with Decision Tools, Duxbury Press, 2001.

**Supplemental Sources:**

Berger, James O., *Statistical Decision Theory and Bayesian Analysis*, Springer, 1985.

Bunn, Derek, *Applied Decision Analysis*, McGraw-Hill, 1984.

Bell, Raiffa, Tversky, *Decision Making: Descriptive, Normative and Prescriptive Interactions*, Cambridge Press, 1988.

Chelst, Kenneth and Y. B. Canbolat, Value-Added Decision Making for Managers”, CRC Press, 2012.

**Readings:**

Supplemental readings from the popular press and professional journals will be assigned.

**Catalog Description:**

Methods of making decisions in complex environments and statistical decision theory, effects of risk, uncertainty, and strategy on engineering and managerial decisions. IEE 380; graduate standing (for 511).

**Objective:**

*Students will understand rational and behavioral processes for defining problems and making decisions in single and multi-attribute decision environments.* Economic concepts such as utility theory and the value of information will be covered. Modeling and tradeoff analysis for multicriteria problems and recent research results in human decision processes will also be covered.

**Grading:**

Midterm Exam (one sheet of notes) 10% to 30%  
Class participation 10% to 20%

Homework (undergraduates only) 10% to 20%

Graduate Student Project/Report 20% to 40%

Final Exam (open book/notes) 20% to 60%

**Graduate Student Project:**

Each graduate student will select a topic for in-depth study. Sample topics include but are not limited to:

* Game Theory (beyond the basic class lecture)
* Auctions (you may choose a specific type or general theory)
* Extensions of Decision Field Theory
* Detailed analysis of a major technical decision, e.g. Challenger launch, Health care insurance plan, Highway route, Investment in hydrogen fuel cells, Deployment of solar array, childhood immunization, Pesticide spraying, Fed’s Quantitative Easing, etc.
* Group Decision Making
* Stochastic Optimization
* Multiobjective Decision Making
* Stochastic analysis of decision trees
* Bayesian Belief Networks
* Medical decision making
* Assessing preferences
* Modeling Consumer Choice Behavior
* Should the Federal Government Subsidize Clean Energy Production
* Should NASA pursue manned or un-manned space exploration

Projects will normally be one of two types – 1) a summary and critical analysis of a technical topic related to the course, or 2) detailed analysis of a case study of a major technological decision that impacts society or major corporate direction. In the first case you should read several research papers and/or conference proceeding chapters on this topic. Explain the model, summarize results, and discuss the strengths and weaknesses. An “A” report would include a good critique of the strengths and weaknesses and an outline of a possible research project that would advance the field. For the second project type, you will need access to a history behind the decision process, the relevant factors, and the outcome. An “A” report would recreate the situation and develop and solve an appropriate decision model that includes all relevant factors – technical and social (political, behavioral). A debriefing of what went right and what was wrong with the process actually used should be included. Other project types are acceptable with instructor approval.

A description of the project selected (one page) must be submitted by October 31 for approval. You must then prepare a written report of at most eight pages (1.5 spacing, 11 point) including references. Note: You are expected to understand and adhere to the norms regarding plagiarism. All wording must be your own except that brief passages may be copied where appropriate with proper citation and quotation marks. Any violations will receive a 0 grade on the assignment and may be reported to the university as violations of Academic Integrity.

Each student will also give a 15 minute oral presentation of their project during the last two weeks of class. Dates will be randomly assigned.

**Policies:**

1. Makeup exams will not be given. Approval for missing an exam must be obtained in advance from Dr. Askin. The final exam grade will replace excused midterm absences.
2. Homework problems will be assigned and collected. Undergraduate students will have their assignments graded. Graduate student assignments will be checked for completeness but probably not graded. Unless otherwise stated, homework assignments are to be done individually, but students may discuss general approaches with each other. Students may even work in groups provided all participants are contributing and calculations are done individually. **Copying is not allowed.** Students who cross this line and submit copies of another student’s work will receive a grade of 0 for that assignment the first time and a failing grade for the course the second time. The internet may be used for supplemental educational material but may not be used to find specific problem solutions unless otherwise indicated by the instructor. **All assignments turned in must list all persons involved in the solution process and any inanimate references used other than those listed on this syllabus**. Students failing to adhere to this rule will receive a failing grade in the course. All assignments are due by 5pm on the due date. Solutions will be posted following the due date. The student is strongly advised to try homework problems independently before consulting the answers. Experience shows a strong positive correlation between course grades, course satisfaction and effort on homework. Homework will not be accepted after solutions are posted.
3. On-campus students are expected to attend class and participate in discussions and other classroom activities. If class attendance at the start of class is less than 50% of those registered, a pop quiz may be given. Pop quizzes will be count the equivalent of one homework assignment.
4. All material listed in the reading assignments, included in homework assignments or discussed in class is fair game for the exams.
5. Academic Integrity and Code of Conduct. The ASU Student Academic Integrity Policy <https://provost.asu.edu/academicintegrity/policy> will be strictly enforced. **All students are responsible for understanding and following the policy**. Violations will be reported to the Dean’s office. Possible penalties include reduced or no credit for submitted work, failing grade in the class (XE), removal from the degree program, suspension or expulsion from the university, or revocation of a degree.

Initial Readings (others may be added)

1. Alagoz, O, L. M. Maillart, A.J. Schaefer, and M. S. Roberts, 2007, “Determining the Acceptance of Cadaveric Livers Using An Implicit Model of the Waiting Cost”, *Operations Research,* 55(1),24-36.
2. Busemeyer, J.R. and J. T. Townsend, 1993, “Decision Field Theory: A Dynamic-Cognitive Approach to Decision Making in an Uncertain Environment”, *Psychological Review*, 100(3), 432-459.
3. Tversky, A. and D. Kahneman, 1981, “The Framing of Decisions and the Psychology of Choice”, *Science*, 211, 453-458.
4. Tversky, A. and D Kahneman, 1992, “Advances in Prospect Theory: Cumulative Representation of Uncertainty”, *Journal of Risk and Uncertainty*, 5, 297-323.

**IEE 511 Syllabus (Subject to Change)**

Date Topic Reading

8/27 I. Introduction and Overview Chs 1, 2

8/29 Review of Probability Ch. 7

9/3 Labor Day Holiday – no class

9/5 II. Decision Making Under Certainty

9/10 ….. Value Functions

9/12 Analytical Hierarchy Process notes

9/17 Class exercise/case study

9/19 III. Decision Trees and Influence Diagrams Ch 3

9/24 …Decision Trees Ch 4

9/26 Evaluation and Sensitivity Ch 5

10/1 Value of Information (EVPI) Ch. 12

10/3 IV. Bayesian Analysis – Distribution Review Ch. 9

10/8 Assessing Subjective Probabilities Ch. 8

10/10 Conjugate Priors and Posterior Distributions Ch. 10 (Nat. Conj. Dist.)

10/15 Fall Break – No class

10/17 INFORMS CONFERENCE

10/22 **MIDTERM**

10/24 Frequentist Risk and Bayesian Expected Loss Notes

10/29 V. Utility Theory – Axioms Ch 14

10/31 Certainty Equivalents, Risk Premiums, Risk Aversion Ch. 13

11/5 Eliciting Preferences; Empirical Failures “

11/7 Multiattribute utility theory and mutual independence Ch. 15, 16

11/12 Veteran’s Day Holiday – no class

11/14 VI. Behavioral Models – anchoring, decomposition

11/19 Prospect Theory; Decision Field Theory reading

11/21 X. Multiobjective Decision Making (Goal Programming, Pareto Optimality)

11/26 XI. Medical Decision Making reading

11/28 XII. Basics of Game Theory, Signal Detection Theory notes

12/3 Project presentations

12/5 Project presentations

12/10 Project presentations and review

Final Exam: Friday Dec. 14th, 7:30-9:20am