

ORI 390R.17
DECISION ANALYSIS I:
INTRODUCTION TO DECISION ANALYSIS

1. Teaching Team

Instructor

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2. Course Description and Objectives

Principles and application of techniques for the logical illumination of complex decision problems within any context. Topics include utility theory, probability as a statement of belief, risk preference, value of information and control, probability assessment, influence diagrams, risk sharing/scaling, and life and death decision making. Prerequisite: Graduate standing, an introductory course in probability and statistics (e.g., ORI 390R.1), or consent of instructor.

Everyone makes decisions, but few people think about how they do it. Yet, psychological research shows that we are prone to many different errors of thought that degrade our decision making ability. In this course we will discuss the principles and fundamental concepts for the normative theory of decision making under uncertainty. We will develop a language, set of theories, and tools to transform complex decisions into ones where the course of action is clear.

This course is intended to provide students with the ability to:

- Bring engineering principals to bear on decision making
- Appreciate the challenges we face when making decisions, particularly decisions that must be made in the face of uncertainty
- Make better decisions in their personal and professional lives
- Play an active role in helping their employers and society make better decisions
- Communicate their choices and recommendations clearly
- Decide on possible career in decision analysis (industry or academia)

3. Text

There is no text for this class. We will use a manuscript that Prof. Bickel is preparing and lecture notes.

4. Course Website and Handouts

All course material will be posted on Canvas.

5. Coursework

Homework

There will be a weekly homework assignment (approximately 12 in total), which will be distributed on Thursday and will be due at the start of class the following Thursday. If the following Thursday is a University holiday, the assignment will be due the following Tuesday at the start of class. The teaching team will strive to grade your homework and return it during class on Thursday. **Late homework will not be accepted.**

Consideration for University Authorized Absences will be made. Out of respect for your instructor and fellow students, please give advance notice of any absences if possible.

Your homework must be clear and neat. You may work on homework in at most teams of **two to three**. However, any work you submit must be your own (i.e., you must fully understand what you submit).

Weekly Take Home Quizzes

There will be a weekly take home quiz consisting of a single problem, which will be distributed and collected according to the homework schedule above. **You may not work together on the take home quizzes.** Failure to follow these rules will be considered a violation of the Honor Code and will be referred to the University. **Late quizzes will not be accepted.**

These quizzes will consist of a single multiple choice question with four possible answers. They will be graded as described in Handout #02 (Probabilistic Grading Information).

Case Studies

You will work in teams of 2-3 on 2-3 case studies. These case studies will involve the application of decision analysis to a real-world problem. You must form your own teams.

Examinations

There will be a midterm and a final, according to the following schedule:

Midterm

This will be a unique multiple choice exam similar to multiple choice questions on your quizzes (see Handout #02 for scoring).

Final Exam

According to the University Exam Schedule

Early final exams will not be offered. If you cannot take the final exam at the designated time then you should not enroll in the course. **Do not make travel plans that necessitate your leaving campus before the final exam!**

This exam will be a standard “problem solving” type of exam. However, it may include some multiple choice questions similar in format to the quizzes and midterm.

There will be no “pop” quizzes.

Consideration will **only** be made for University Authorized Absences.

Exams will cover material from the manuscript, readings, homework, **and** lecture. Exams will be closed notes.

You may use a calculator on the exams. This includes financial calculators. **However, you must clearly show your work.** Your work needs to be such that someone could reproduce your answer without the use of a financial calculator or spreadsheet. No credit will be given for a problem where this is not the case.

6. Attendance

We will not take attendance. This course is about decision-making. As such, you face a decision on whether or not to attend class. You will have to weigh the benefit of attending class (e.g., deeper understanding, great lectures, etc.) against its cost (e.g., the time you will spend). We are confident you will find the lectures both helpful and entertaining. Choose wisely. If you choose to attend class, we expect you to participate fully and act professionally.

7. Letter Grades

Your exams and homework will be weighted as follows:

Homework: 15%

Quizzes: 10%

Case Studies: 20%

Midterm: 25%

Final Exam: 30%

Your weighted average score for the course will be rounded up to the **nearest integer** using Microsoft Excel's® Roundup function. For example, if your weighted average score for the course was 90.3, it would be rounded to 91. A final score of 89.5 would be rounded to 90. Rounding up will take care of any "close calls" and further adjustments will not be made.

Your scores on individual exams, homework, project and the quizzes not be rounded.

Total points will map to letter grades according to the following schedule:

A = 90% or greater

A- = 85% to < 90%

B+ = 80% to < 85%

B = 75% to < 80%

B- = 70% to < 75%

C = 55% to < 70%

D = 40% to < 55%

F = < 40%

The instructor reserves the right to increase your total score by "curving" or some other method. However, these changes will never lower your grade. It is my hope that everyone will earn an A!

8. A Note to Those Taking this Course for a Letter Grade

You have decided to take this course for a grade. I have agreed to assign you a letter grade. I have done my best to design a grading system that (a) maps your understanding to your letter grade, (b) provides the incentive to master course material in a timely fashion, (c) emphasize the concepts discussed in the class. A key part of this is the probabilistic grading system detailed in Handout #02. **Your decision to take this course for a letter grade signifies your agreement to be graded in this way.**

9. Course Topics

Please note: We may not cover all these topics and the order may be slightly different. We will adjust based on class performance and interest.

- Probability
- Probability as a measure of belief

- Bayes theorem
- Probabilistic relevance
- Axioms of choice under uncertainty
- Utility theory
- Risk preference
- Normative vs descriptive theories of decision making
- Certain equivalents
- Value of perfect information
- Value of imperfect information
- Value of control
- Probabilistic assessment
- Decision diagrams
- Decision trees
- Options
- Probabilistic sensitivity analysis
- Experimentation
- Heuristics and biases in decision making
- Risk Sharing/Scaling
- Life and Death Decision Making

10. Learning Environment

Asking Questions

I want you to do well and am concerned about your performance. This material is important. Really!

It is vital that if, during a discussion, there is something you do not understand or the explanation is poor, PLEASE stop me and ask questions. I would prefer that we have a dialog during class sessions and not simply lectures.

Treating Each other with Respect

In order to develop a safe learning environment, I expect everyone to be treated with respect and dignity. Failure to do so will negate your ability to attend lecture.

11. Honor Code

After you graduate and enter the workforce your boss will expect that you have been educated. In the “real world” there are no make up exams or partial credit. Therefore, cheating will hurt you in the long run. I expect everyone to follow the UT Honor Code, which states:

“The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community.”

All suspected violations of the Honor Code will be referred to the Administration for adjudication.

12. University Electronic Mail Notification Policy (Use of E-mail for Official Correspondence to Students)

All students should become familiar with the University's official e-mail student notification policy. It is the student's responsibility to keep the University informed as to changes in his or her e-mail address. Students are expected to check e-mail on a frequent and regular basis in order to stay current with University-related communications, recognizing that certain communications may be

time-critical. It is recommended that e-mail be checked daily, but at a minimum, twice per week. The complete text of this policy and instructions for updating your e-mail address are available at <http://www.utexas.edu/its/policies/emailnotify.html>.

In this course e-mail will be used as a means of communication with students. You will be responsible for checking your e-mail regularly for class work and announcements. Note: if you are an employee of the University, your e-mail address in Canvas is your employee address.

13. Disability Statement

Students with disabilities who require special accommodations need to get a letter that documents the disability from the Services for Students with Disabilities area of the Office of the Dean of Students (471-6259 voice or 471-4641 TTY for users who are deaf or hard of hearing). This letter should be presented to the instructor in each course at the beginning of the semester and accommodations needed should be discussed at that time. Five business days before an exam the student should remind the instructor of any testing accommodations that will be needed.

See website below for more information:

<http://deanofstudents.utexas.edu/ssd/providing.php>

14. Canvas Use

This course uses Canvas, a Web-based course management system in which a password-protected site is created for each course. (Student enrollments in each course are updated each evening.) Canvas can be used to distribute course materials, to communicate and collaborate online, to post grades, to submit assignments, and to take online quizzes and surveys.

You will be responsible for checking the Canvas course site regularly for class work and announcements. As with all computer systems, there are occasional scheduled downtimes as well as unanticipated disruptions. Notification of these disruptions will be posted on the Canvas login page. Scheduled downtimes are not an excuse for late work. However, if there is an unscheduled downtime for a significant period of time, I will make an adjustment if it occurs close to the due date.

Canvas is available at <http://courses.utexas.edu>. Support is provided by the ITS Help Desk at 475-9400 Monday through Friday 8 am to 6 pm, so plan accordingly.

15. Course Feedback

Feedback is an important part of any kind of learning. Without feedback on how well you understand the material, it is more difficult for you to make significant progress. During this course you will give me feedback on your learning in informal and formal ways, such as assignments or exams. I want you to let me know when something we discuss is not clear. This kind of communication will enable me to provide additional information when needed or to explain a concept in different terms.

In addition to feedback on your learning, I will ask for feedback from you about how my teaching strategies are helping or hindering your learning. This kind of feedback is very important to me as I continually strive to be the best teacher I can be. Some of this feedback will be gathered from online anonymous surveys. I encourage you to respond to these surveys so that together we can create an effective teaching and learning environment.

16. About Your Instructor

Education

I am from Albuquerque, New Mexico. I attended New Mexico State University as an undergraduate and obtained a B.S. in mechanical engineering with a minor in economics (1992). I went to graduate school at Stanford University and hold a M.S and Ph.D. from the Department of Engineering-Economic Systems (1999). The Department of Engineering-Economic Systems recently merged with Industrial Engineering and Operations Research to form the department of Management Science and Engineering. My advisor was Professor Ronald Howard, who coined the term “decision analysis” in 1964. I am President-Elect of the INFORMS Decision Analysis Society.

Work Experience: Public Sector

I have worked for Sandia National Laboratories in Albuquerque, New Mexico, and Livermore, California, where I performed research in robotics and combustion.

I worked as a decision analyst at Pacific Northwest Laboratories in Richland, Washington, where I analyzed processes to treat nuclear waste.

Work Experience: Private Sector

During graduate school and after, I worked for Strategic Decisions Group (www.sdg.com), where I was a senior engagement manager. At SDG, I applied decision analysis techniques to the most important decisions facing some of the world’s largest corporations. I have worked in North America, South America, Europe and Asia. Industries included metals, building services, biotech, commodity and specialty chemicals, energy trading and marketing, insurance, oil and gas, power generation and transmission, printing and publishing, and packaging. In most cases, I worked directly with the CEO/CFO/COO, executive vice president, vice president, or business unit head.

Research Interests

Efficient modeling of dependence

Personal and corporate risk preference

Application of decision analysis to energy policy decisions, especially climate engineering

Applications of maximum entropy

Auditing and scoring of expert forecasts

Discretization

Application of decision analysis to sport, especially baseball