DUKE UNIVERSITY, PRATT SCHOOL OF ENGINEERING

EGRMGMT 580 — DECISION MODELS
Spring 2024

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Lecture Meetings:	1:25 pm - 2:40 pm, Tuesday and Thursday (Wilkinson 136)
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Office Hours:	Monday 6-7pm (on Zoom)

Overview. Successful management requires the ability to recognize a decision situation, understand its essential features, and make a reasoned choice. However, many of these situations involve uncertainty and potentially complex interactions between decisions over time that may be difficult to grasp intuitively. In these cases, we may benefit from using *decision models* – simplified representations of these situations that allow us to consider the different possible scenarios (i.e., ask "what if") and learn more about the problem. This course introduces techniques for formally representing and analyzing decision problems, including spreadsheet modeling, decision trees, simulation, and optimization. The skills learned in this course are applicable in almost all aspects of business and should be helpful in future courses.

The course is divided into three parts. In the first part (lectures 1-4), we discuss the use of decision trees for structuring decision problems under uncertainty. In the second part of the course (lectures 5-8), we discuss Monte Carlo simulation, a technique for modeling complex, uncertain systems. In the third part of the course (lectures 9-12), we discuss optimization. Throughout the course, we will use Microsoft Excel as a modeling environment, using add-in programs as necessary. Familiarity with Excel and basic probability and statistics are important prerequisites for this course.

Learning Objectives. By the end of the course, you should be able to:

- Analyze cases and real-world managerial problems, identifying important decision points and selecting appropriate techniques (e.g., Decision Trees, Monte Carlo Simulation, Optimization) to build a model that captures the essential features of the decision setting.
- Clearly explain the assumptions and insights of decision models that you build to others.
- Use decision models to suggest and justify specific courses of action in different scenarios.
- Construct and compare risk profiles and apply utility theory to examine how risk preferences affect a decision maker's objective and optimal decision strategy.
- Carry out sensitivity and value-of-information analyses to identify important assumptions and uncertainties and guide potential further research and analysis to improve your decision model.
- Based on the results of your decision modeling and analyses, think creatively about new potential alternatives and analyses that have not yet been considered.

Format. The lectures will use a variety of different formats, including lectures, case discussions, computer demonstrations, in-class exercises, as well as tests and quizzes. To effectively master the material in this course, you must "roll up your sleeves" and work on problems, including the examples and end-of-chapter exercises in the text as well as the assignments distributed in class. You will be asked to work in small groups (2 or 3 people) on the assignments, which will give you the opportunity to discuss the material and learn from one another. All members of each group will be expected to contribute and fully participate in any final submission.

Remote Students. All class lectures will be recorded and available for watching on Canvas.

Course Materials. The most important materials are the slides used in class which will be posted on Canvas. Note that there is no textbook for the course. We will post an integrated pdf on Canvas called "EGRMGMT 580 Course Pack" which includes textbook chapter for each of the three sections of the course, and many of the cases.

Software. As indicated earlier, the course emphasizes the use of spreadsheets in modeling. We will assume that you have access to Microsoft Excel. We will augment Excel with add-ins for the different modules of the course. We highly recommend getting access to a PC with Windows operating system if you are a Mac user.

- For the decision tree module, we will use TreePlan, an Excel add-in for building and solving decision trees. The program will be available on Canvas and you will be able to download a copy of this program for use on your home computer. Just save the TREEPLAN.XLA file to a directory on your computer and then use Excel to open it. TreePlan documentation will be available on Canvas.
- For the simulation module, we will use Crystal Ball, an Excel add-in for doing Monte Carlo simulation. Information on how to download Crystal Ball will be available on Canvas.
- For the optimization module, we will use Solver. This program comes with Microsoft Excel. You should be sure that it is installed on your computer. (Check that Solver appears under the Tools menu.)

Communication. We will make extensive use of Duke's Canvas platform in this class. Most course materials (cases, lecture notes, software, etc.) will be available on Canvas. Feel free to submit questions about assignments or course administrative issues by e-mail to the instructor.

Grading. Your grade in this class will be based on the following:

- *Quizzes* (3 quizzes with lowest grade dropped; 15% of total grade, 7.5% each). There will be three in-class quizzes throughout the course. Each quiz will test students' understanding on materials in one module. Quiz dates are indicated in the course schedule table. Late submissions will be accepted only in extraordinary circumstances and may be penalized.
- *Homework* (5 graded cases; 20% of total grade, 4% each). There will be five case exercises throughout the course. You may discuss with your classmates or use references to solve homework cases. However, you must write up the solution and excel analysis on your own and submit through Canvas. Homework due dates are indicated in the course schedule table. Late submissions will be accepted only when the instructors are informed before the deadline and will be penalized by at least 30% of the total points.

- *Final Exam* (30% of total grade). There will be a take-home final exam covering all materials from the course. Students will complete the exam individually. The exam will be open book, open notes, and will require the use of a computer. Exam date will be announced later in the course.
- *Group Projects* (3 graded cases; 30% of total grade, 10% each). There will be three group projects throughout the course. Each project will test students' hands-on capability on materials in one module and will account for 10% of the final grade. Students are asked to form groups of size two or three before the first project and the group will be fixed throughout the semester. Each group is required to hand in one presentation document, and one excel analysis for each project. All in-person groups will present in class. Each group will be evaluated as a whole, reflecting the collective effort and contribution of the group members. All group members will receive the same grade for the project, provided that all members have actively participated and collaborated in the project; individual grades may be affected if a member does not fulfill their responsibilities or contribute to the project. Project due dates are indicated in the course schedule table. Late submissions will be accepted only in extraordinary circumstances and may be penalized.
- *Class Participation* (5% of total grade). Students are expected to attend the class and participate actively. Remote students are expected to watch the lecture recordings.

Re-grading Policy: For any re-grading request, we reserve the right to review the entire quiz/case/exam rather than just one problem in particular. This means that you may lose points in other parts of the exam where we previously gave you the benefit of the doubt.

Honor Code. Duke's honor code applies to all academic endeavors in this class (https://students.duke.edu/get-assistance/community-standard). Specifically, you may not discuss case assignments or share materials with students outside your own group or use materials obtained from students who took similar courses. Quizzes and exams must be completed individually with no discussion between students.

Spring 2024 Schedule

Part I: Decision Trees
Relevant reading in course pack: the "Decision Making under Uncertainty" chapter from *Practical Management Science* by Winston and Albright.

CLASS DATE	CLASS SCHEDULE	DUE BEFORE TUESDAY CLASS
1. 1/11	Introduction and course logistics Elements of a decision problem Decision tree basics and TreePlan	
2. 1/16, 1/18	Ventron Engineering case discussion Sensitivity analysis Value of information	Homework 1: Ventron Engineering case
3. 1/23, 1/25	Drilling exercise discussion Risk profiles Utility theory	Homework 2: Drilling exercise

4. 1/30, 2/1	Gillette vs. Energizer presentations Thinking about probabilities	Group project 1: Gillette vs. Energizer case

Part II: Monte Carlo Simulation
Relevant reading in course pack: the "Simulation" chapter from *The Art of Modeling with Spreadsheets* by Powell and Baker.

5. 2/6, 2/8	QUIZ on Tuesday Introduction to Monte Carlo simulation Using Crystal Ball	
6. 2/13, 2/15	Retirement planning exercise discussion Interpreting simulation outputs Probability distributions	Homework 3: Retirement planning exercise
7. 2/20, 2/22	Marsh-McLennan case discussion Identifying important uncertainties Utilities in simulation	Homework 4: Marsh-McLennan case
8. 2/27, 2/29	QUIZ on Tuesday Modeling probabilistic dependence	Calambra (A) case (Ungraded)

Part III: Optimization
Relevant reading in course pack: the "Optimization" chapter from *The Art of Modeling with Spreadsheets* by Powell and Baker.

9. 3/5, 3/7	Calambra (B) case presentations Introduction to optimization Using Solver	Group project 2: Calambra (B) case
10. 3/19, 3/21	Foreign-exchange case discussion Sensitivity analysis	Homework 5: Foreign-exchange case
11. 3/26, 3/28	QUIZ on Tuesday Integer and nonlinear programming	
12. 4/2, 4/4	J.P. Molasses case presentations Course wrap-up Discussion of the final exam	Group project 3: J. P. Molasses case

There will be a **Take-Home Final Exam.** Details will be discussed during class.