DUKE UNIVERSITY, PRATT SCHOOL OF ENGINEERING

EGRMGMT 580 — DECISION MODELS
Spring 2022

Instructor:	Sophie Yu
Class Meetings:	8:30 am- 11:15 am, Thursday (Teer 106, In-person)
Office Hours:	1:00pm – 2:00 pm, Friday (Zoom)
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Teaching Assistants:	Minjun Chang, Cleo Yan
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TA Office Hours:	2:00pm -3:00 pm Monday, 2:00pm -3:00 pm, Wednesday (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 (classes 1-4), we discuss the use of decision trees for structuring decision problems under uncertainty. In the second part of the course (classes 5-8), we discuss Monte Carlo simulation, a technique for modeling complex, uncertain systems. In the third part of the course (classes 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 classes 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. I will ask you 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. You will choose your own groups and may change groups during the term.

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

Course Materials. The most important materials are the slides used in class which will be posted in Sakai weekly. Note that there is no textbook for the course. I will post an integrated pdf in Sakai 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. I will assume that you have access to Microsoft Excel. I will augment Excel with add-ins for the different modules of the course. I 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 Sakai 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 Sakai.

- 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 Sakai.
- 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 Sakai platform in this class. Most course materials (cases, lecture notes, software, etc.) will be available on Sakai. 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; 15% of total grade, 5% each). There will be three 50-minutes in-class quizzes throughout the course. Each quiz will test students' understanding on materials in one module and will account for 5% of the final grade. For remote students, quizzes will be made accessible on Sakai for two days. Students can freely decide 50 minutes to complete the quizzes. 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 Sakai. Homework due dates are indicated in the course schedule table. Late submissions will be accepted only in extraordinary circumstances and may be penalized.
- *Final Exam* (30% of total grade). There will be a take-home final exam covering all materials from the course. Students will have two days to 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 group members will get the same grade. At the end of the term, each team member will submit a peer review evaluating other team members' contributions in the group projects. If indicated not working, student's grades may be penalized accordingly. Projects due dates are indicated in the course schedule table. Late submissions will be accepted only in extraordinary circumstances and may be penalized. Each group will be asked to do a 20-minutes consulting presentation for one project. The presentation performance will account for 3%

within the 10% grade for that project. For groups with all remote students, please record your presentation and submit the video by 12 p.m. Sunday, the weekend before the class in which the group is scheduled to present.

- *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. For students who cannot attend a class, please watch the video and submit a one-page notes to earn participation credits for every class. Notes can be a summary of the lecture or any interesting thoughts you develop with respect to the class materials. You need to turn in your notes every 4 weeks, when you submit your quizzes. Late submissions will be accepted only in extraordinary circumstances and may be penalized.

Re-grading Policy: For any re-grading request, I 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 I previously gave you the benefit of the doubt.

Office hour. We will hold office hours through zoom on the scheduled time.

Honor Code. Duke's honor code applies to all academic endeavors in this class (http://www.integrity.duke.edu/ugrad/student.html). 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 2022 Schedule
We will meet every Thursday from 8:30 am to 11:15 am.

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

CLASS DATE	CLASS SCHEDULE	DUE BEFORE CLASS
1. January 6	Introduction and course logistics Elements of a decision problem Decision tree basics; TreePlan	Eyetech case (Ungraded)
2. January 13	Sensitivity analysis Value of information	Homework 1: Ventron Engineering case
3. January 20	Risk profiles Risk attitudes and utility functions	Homework 2: Drilling exercise
4. January 27	Gillette vs. Energizer presentations Thinking about probabilities	Group project 1: Gillette vs. Energizer case

Part II: Monte Carlo Simulation

Relevant reading in coursepack: the "Simulation" chapter from *The Art of Modeling with Spreadsheets* by Powell and Baker.

5. February 3rd	QUIZ Introduction to simulation Using Crystal Ball	
6. February 10th	Review of probability distributions	Homework 3: Retirement planning exercise
7. February 24th	Marsh-McLennan case discussion Identifying important uncertainties	Homework 4: Marsh-McLennan case
8. March 3rd	QUIZ Dependence among random variables	Calambra (A) case (Ungraded)

Part III: Optimization

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

9. March 17th	Calambra (B) case presentations Introduction to optimization Using Solver	Group project 2: Calambra (B) case
10. March 24st	Sensitivity analysis part Transportation problems	Homework 5: foreign-exchange case
11. March 31th	QUIZ Integer and non-linear programming	
12. April 7th	J.P. Molasses case presentations Course wrap-up Discussion of the final	Group project 3: J. P. Molasses case

There will be a 48-hour **Take Home Final Exam** available during reading week/ final exam period (Time - TBD).