PPPA 6020.10
Decision Modeling for Public Policy
FALL 2020

Professor

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Course Description

A skills course that introduces students to some practical modeling approaches -- simulation, probabilistic sensitivity analysis, and optimization -- used by policy analysts to explain and assess complex problems, to bound a solution space, or to determine what data is needed to support policy decisions. These techniques are often taught as decision analysis or operations research, but this course will include examples of policy problems that used these techniques. A focus of the course will be to show the power of initiating analyses using available spreadsheet capabilities. The course will use Excel as the basis for teaching and assignments. References to more complex software tools, and to the mathematical basis of the techniques, will be provided, but the coursework will be accessible to anyone with spreadsheet skills.

Student Learning Objectives

At the end of this course, students will be able to:

- *Apply modeling & probability theory* in a variety of policy contexts
- *Use Excel* to begin modeling of policy problems, and understand when other more powerful tools would be more appropriate
- *Conduct analyses* with probability models and simulation using Monte Carlo techniques when an Excel based model is sufficient
- *Demonstrate evaluation of a policy issue using modeling*
- *Assess the value of additional information and sensitivity of results*
- *Understand optimization* as a tool for solving problems

COURSE OVERVIEW

This is a "skills" course – as opposed to a theory-heavy course – that introduces students to some practical modeling approaches that are used by policy analysts to characterize complex problems, to explicitly address risk and uncertainty, to identify potentially superior policy choices, and to determine which data are needed to support sound policy decisions. A focus of the course will be to demonstrate how powerful insights can often be gleaned with relatively simple spreadsheet techniques. You should come out of this class comfortable (1) discussing the models others may use in a policy argument, (2) creating a simple model to influence discussion on a policy issue, and (3) exploring more complex models and specialized modeling tools and knowing when they would be useful.

After our first class meeting, which will include a course overview and review of basic probability and modeling concepts, we will move on to six core topics. We will spend two weeks on each topic. Our final class will entail stepping back to think about how policy models fit into the broader policy discourse and how they can be weaponized in the political process. By way of preview, the core topics are

- ✓ Policy Modeling in Excel
- ✓ Decision Analysis
- ✓ Probabilistic Models
- ✓ Optimization Models
- ✓ Simulation

As statistician George Box once put it: *"All models are wrong, but some are useful."* Models – especially in the realm of public policy – are of necessity a simplification of complex realities and of uncertain futures. The ultimate test of such models is not whether they are "right" but rather whether developing and applying them reveals new insights, points us away from poor decisions, and adds structure and clarity to murky policy debates.

Assignments and Due Dates

%	Assignment	Due	Details
20%	Homework	ongoing	p. 4
15%	Assessment of a previous study	To be assigned	p. 5
20%	Skills Exam #1	Mar 5	p. 6
20%	Skills Exam #2	Apr 16	p. 6
25%	Final Paper	May 1	p. 6

There will be no final exam – the Final Paper is the end of grading

Course Schedule

Class #	Date	Topic
1	9/3/20	Class Overview, Basic Probability & Modeling Concepts
2	9/10/20	Decision Analysis Trees and Probability Theory
3	9/17/20	Sensitivity Analysis & Modeling
4	9/24/20	Monte Carlo Approaches
5	10/1/20	Queuing
6	10/8/20	Exam Questions; 1st Exam Assigned
7	10/15/20	Example Studies Presentations A
8	10/22/20	Optimization & Linear Programming
9	10/29/20	Markov Processes
10	11/5/20	Simulation
11	11/12/20	Example Studies Presentations B
12	11/19/20	Short Presentation on Project
	11/25/20	Thanksgiving – No
13	12/3/20	Exam Questions; 2nd Exam Assigned
14	12/10/20	Class 2nd Exam Discussion; Summary Thoughts
	12/15/20	Project Due

Credit Hours

This is a 3-credit hour course. Over 14 weeks, students will spend 1 hour and 50 minutes (110 minutes) per week in class. Homework problems, take-home exams, and the two required papers, including research and writing, are expected to take, on average, 8 hours per week, although that amount will vary over the course. You should expect to spend about twice as much time per week on this class in the second half than you do in the first half (unless you make an admirable early start on your paper). Over the course of the semester, students will spend about 26 hours in instructional time and 112 hours preparing for class, for a total of 138 hours

Assignment Descriptions

Homework (20%)

20% of your grade is based on completing the homework. If you attempt each question, and turn in the homework on time, you will get "100%" on the homework for that week.

Most weeks you will have a few problems that require you to use Excel to practice and increase understanding of the skills taught in that week's class.

Homework is assigned every week, except that no homework is assigned on the week when the Skill Exams are assigned, or for Class 14.

Homework is due electronically by 6 PM on the **Wednesday** before next week's class. You are expected to provide spreadsheets showing your work when appropriate. There is no credit for late homework.

The only way to get less than 100% on the homework is to skip a question, or to turn it in late. The intent of the homework is to give you practice in using Excel on these kind of problems, and to make the discussion of techniques more meaningful than can be provided by just listening to a lecture. And they are intended to make you ready for completing the skill exams confidently.

Assessment of a previous study (15%)

Due electronically by the beginning of the class assigned.

Three topic sets will be randomly assigned in the first class.

Group #	Date Assigned	Topic	Presentation Date
A	9/3/20	Decision Trees; Sensitivity Analysis; Monte Carlo; Queuing	Oct 15
B	9/3/20	Optimization, Markov Chains; Simulation	Nov 12

You should find a published report, a research paper, or another project report that uses the one or more of the specific modeling tools listed under "Topic" to address a public policy problem in any field.

Feel free to send me a proposed study to discuss if it is suitable; email discussions are useful for dealing with any uncertainty. Really, I'd rather confirm something obvious than have an argument about the topic after you've done the work.

Write a short (no more than 4 pages) discussion of the report. You should address
- What problem was addressed
- How the model was used
- What data they used in building the model
- What theory they used in building the model
- Your assessment of why a model was used
- Your assessment of the effectiveness of the paper's approach

Include an electronic reference for where the report can be found.

Shorter papers than 4 pages are allowed. You will be graded on finding an appropriate study, and on the completeness and quality of your assessment. Clarity of writing will be considered in the grade, but not length.

All of your assessment papers will be posted on Blackboard for the entire class to use.

You will also be asked to make a short (~5 minute) presentation to the class on the study you have assessed, on the same date the papers are due. These are short, informal presentations addressing the same points as the paper. You may use graphics or just discuss the study and take questions from the class. You will not be graded on your presentation skills, just on the written paper, but I'd like the entire class to be exposed to the examples you have found.

Skill Exam #1 (20%)

An exam will be assigned at the end of the 8 October class, addressing the major techniques that have been taught in the class through that time: Decision Trees, Sensitivity Analysis, Monte Carlo, and Queuing

Due electronically by the beginning of the October 15 class. No credit if late.

Skill Exam #2 (20%)

An exam will be assigned at the end of the December 3 class. The second exam assumes all the knowledge from the first half of the class as well as the topics of optimization, Markov processes and simulation. Because it can combine topics from the entire class, many students think of this exam as more challenging

Due electronically by the beginning of the December 10 class. No credit if late.

Final Paper (25%)

Topic selection due by the end of class on October 16, either electronically or on paper. Final paper due electronically by 6 PM on December 15

Select a policy or management issue of interest to you that can be addressed in Excel with one of the modeling tools discussed in the first 10 weeks of class.

By October 16, use Blackboard to submit a project proposal of not more than one page – a bulleted list is fine – that includes:

✓ The problem you are addressing,
✓ The source of the theoretical approach and data you will use,   ✓ Your modeling approach,
✓ How you will select key variables of interest,
✓ What you expect to demonstrate with the modeling, and
✓ How you will do sensitivity analysis.

You will give a status report on your project on November 19 to a group of classmates. You'll have 5 minutes to describe your project. A 5-minute Q&A with classmates will then follow. Use the checklist above to create a 1-page handout that can be shared with the class.

The final paper will summarize the results of your project. It can be in any format you like but must address the same six topics listed above for your proposal, *plus* what you think the results mean and what further work (if any) should be done to justify making policy decisions with the model. Submit your paper electronically in a PDF file, as a prose description of your work (between 1500 and 2000 words), along with the Excel spreadsheets used in your work (as a single workbook) by Thursday, April 30 at 6pm.

The grade for the final paper will be based on the clarity of the written report, the effectiveness of your model in providing policy insight, the successful implementation of the model in a spreadsheet, and the credibility of your sensitivity analyses.

Reading Recommendations

There is no required textbook for the class. However, the class will use materials from three books in particular:

- *A Primer for Policy Analysis*, Edith Stokey and Richard Zeckhauser, W.W. Norton & Company, 1978

- *The Science of Decision Making: A Problem-Based Approach to Using Excel*, Eric V. Denardo, Wiley, 2001

- *Microsoft Excel Data Analysis and Business Modeling,* Wayne L. Winston, Microsoft Press, 2014.

Everything I cover in the class will be in one of those 3 books, although you should be able to follow the material from the lectures alone. If you purchase the Denardo or the Winston books, the books come with Excel add-ins that make modeling with Excel either easier to apply or allow more complicated analyses.

If you need help with Excel functions and operations, I suggest the following books:

- Any version of "Excel for Dummies" (the current one is *Excel 2013 for Dummies*, Greg Harvey, 2013) or Excel: The Missing Manual (such as *Excel 2013: The Missing Manual*, Matthew MacDonald, 2013).

- Very good guides to statistics and decision analysis with Excel include *Statistical Analysis with Excel For Dummies*, Joseph Schmuller, 2013, and *Excel Data Analysis for Dummies*, Stephen L. Nelson and E.C. Nelson, 2014.

- *Excel Simulations*, Gerard M. Verschuuren, Holy Macro! Publications, 2013

Most students find answers to most of their Excel questions on the internet, once they can express what their problem is in the most general terms, such as "Monte Carlo analysis in Excel".

Some very useful, but less skills-oriented, discussions of the role of probabilistic modeling in analysis, well worth your time, include

- *The Flaw of Averages: Why We Underestimate Risk in the Face of Uncertainty,* Sam L. Savage, Wiley, 2012

- *How to Measure Anything: Finding the Value of Intangibles in Business* (Second Edition), Douglas W. Hubbard, 2010

Relevant Trachtenberg School Policies

1. <u>Incompletes:</u> A student must consult with the instructor to obtain a grade of "I" (incomplete) no later than the last day of classes in a semester. At that time, the student and instructor will both sign the CCAS contract for incompletes and submit a copy to the School Director. Please consult the TSPPPA Student Handbook or visit the website for the complete CCAS policy on incompletes.

2. <u>Submission of Written Work Products Outside of the Classroom:</u>
It is the responsibility of the student to ensure that an instructor receives each written assignment. Students can submit written work electronically only with the express permission of the instructor.

3. <u>Submission of Written Work Products after Due Date: Policy on Late Work</u>**:** All work must be turned in by the assigned due date in order to receive full credit for that assignment, unless an exception is expressly made by the instructor.

4. <u>Academic Honesty</u>: Please consult the "policies" section of the GW student handbook for the university code of academic integrity. Note especially the definition of plagiarism: "intentionally representing the words, ideas, or sequence of ideas of another as one's own in any academic exercise; failure to attribute any of the following: quotations, paraphrases, or borrowed information." All examinations, papers, and other graded work products and assignments are to be completed in conformance with the George Washington University Code of Academic Integrity.

5. <u>Changing Grades after Completion of the Course</u>: No changes can be made in grades after the conclusion of the semester, other than in cases of clerical error.

6. <u>The Syllabus</u>: This syllabus is a guide to the course for students. Sound educational practice requires flexibility and the instructor may therefore, at her/his discretion, change content and requirements during the semester.

7. <u>Accommodation for Students with Disabilities</u>**:** In order to receive accommodations on the basis of disability, a student must give notice and provide proper documentation from the Office of Disability Support Services, Marvin Center 436 (202-994-8250). Accommodations will be made based upon the recommendations of the DSS Office.