PPPA 6020: Decision Modeling for Public Policy
Section 10, Spring 2018

Class Meetings: Mondays, 6:10-8:00pm, Bell 109
Instructor: Peter Linquiti, PhD (linquiti@gwu.edu), MPA610
Office Hours: I no longer hold regularly scheduled office hours, having found that complicated lives and schedules often make it easier to schedule an appointment as needed. Please don't interpret the lack of scheduled times as a disinterest in meeting with students. I am on campus at least four days a week and happy to meet whenever it's mutually convenient. If you'd like to meet, please email me with some feasible times. For quick questions, feel free to send an email; in general, I will respond within 24 hours.

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 simply spreadsheet techniques.

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 six core topics are:

- ✓ Policy Modeling in Excel
- ✓ Probability & Decision Analysis
- ✓ Probabilistic Simulation Models
- ✓ Optimization Models
- ✓ Deterministic Simulation Models
- ✓ Multi-Attribute Decision Models

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.

LEARNING OBJECTIVES

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

- ✓ Apply modeling and probability theory in a variety of policy contexts
- ✓ Use Excel to begin modeling of policy problems and recognize when other more powerful tools would be more appropriate
- ✓ Conduct analyses in Excel with probability models and simulation using Monte Carlo techniques
- ✓ Demonstrate the evaluation of a policy issue using appropriate modeling techniques
- ✓ Assess the value of gathering additional information
- ✓ Understand optimization techniques as tools for answering specific policy questions

A NOTE ABOUT SOFTWARE

We will make extensive use of Excel 2016. It can be downloaded free by GW students. See https://it.gwu.edu/office365 for details. Some aspects of Excel differ between the PC and Mac platforms but the basic functionality (at least for this class) is the same. Excel for PC will be used in class, but if you have a Mac, it shouldn't be too hard to figure out how to accomplish the same result.

I assume that you are familiar with basics of Excel: setting up and saving workbooks, entering and copying data and formulas, formatting worksheets and workbooks for printing, and basic charting. If your Excel skills are rusty, there are several excellent tutorials that you can find online. (Excel's structure and functionality have changed over the years; make sure you find information on Excel *2016*.) One site I like is Michael Girvin's Youtube channel (https://www.youtube.com/watch?v=c_ZJLJK5PjM) where he's posted literally hundreds of videos demonstrating Excel features and functions.

Excel skills are best developed at the keyboard, trying to figure out how to execute a specific task. Very little lecture time will be spent in class on the mechanics of Excel. The book, Google, and YouTube will be much more useful to you in figuring out how to get Excel to do what you want it to.

READINGS

There are two required books. The first is by Wayne Winston, "Microsoft Excel 2016: Data Analysis and Modeling." It's a massive tome – 89 chapters and 835 pages. We will only cover about two-thirds of it. If you see yourself as a long-term Excel modeler, it's probably worth buying ($32 on Amazon) as a good reference to have on your shelf. Otherwise, Amazon is renting it for $13 for the semester.

The second "book" is actually an e-book comprised of three chapters from Anderson et al's "An Introduction to Management Science: Quantitative Approaches to Decision Making, 14th Ed." This (expensive) book is a standard text in MBA curricula, but covers many topics that we will not address in this class. Fortunately, the publisher has packaged three chapters into an e-book. It can be ordered at http://www.cengagebrain.com/course/2727130. The e-book is priced at $29 for 180 days of access.

Finally, a few other readings – journal articles and short news items – are on Blackboard.

HOW WILL YOU (AND I) ASSESS YOUR ATTAINMENT OF THE COURSE'S LEARNING OBJECTIVES?

You will work on several assignments over the course of the semester.

- *Homework (20% of grade)*: Every other week (except when Skills Exams are due), there will be a few problems that require you to use Excel to practice and increase your understanding of the skills taught in class. Homework is due electronically at the beginning of class. If you attempt each question, and turn it in on time, you will get an "A" on the homework for that week. Because we will discuss the homework in class, late submission of homework is not allowed.
- *Skills Exam #1 (20% of grade)*: A take-home exam addressing Policy Modeling in Excel, Probability & Decision Analysis, and Probabilistic Simulation Modeling will be assigned on March 19 and is due on March 26.
- *Skills Exam #2 (20% of grade)*: A take-home exam addressing Optimization Models, Deterministic Simulation Models, and Multi-Attribute Decision Models will be assigned on April 23 and is due on May 2.
- *Final Project (35% of grade)*: You should select a policy topic of interest to you that can be addressed in Excel with one of the modeling tools discussed in the first eleven weeks of class. (Because we study Multi-Attribute Decision Models so late in the semester, it may be hard to

use a MADM framework for your project, but if you really want to, we can discuss it.) Submit, by April 2, 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 also give a brief, in-class status report on your project. You should have 2 or 3 slides, and take 5 minutes (enforced by a loud and annoying timer), to describe your project and what remains to be done. A third of the class will each make its presentation on April 16, 23, or 30. The later in the semester you present, the more progress you will be expected to have made.

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, along with the Excel spreadsheets used in your work (as a single workbook) by Friday, May 11 at 5pm.

The grade for the final paper will be based on the clarity of the written report, the effectiveness of your use of modeling as a source of policy insight, the implementation of the model in the spreadsheets, and the credibility of the sensitivity analyses you conduct. The grade will also reflect the quality of your project status presentation.

- *Class Engagement (5% of grade)*: If you show up to class prepared and ready to engage the work, you will get an "A" for class engagement. This is more about attitude and effort than it is about intellectual dexterity. If you routinely miss class, fail to ask questions when key points are unclear, rarely offer a comment, or show up unprepared, your engagement grade will suffer.

WHAT PEDAGOGICAL APPROACH WILL BE USED IN THIS CLASS?

This course is premised on the belief that learning is most effective when it is active. Lectures will be limited, collaborative work will be serous endeavors, and I will act more as a "guide on the side" rather than a "sage on the stage." This will give you the opportunity to shape the course but you should in turn expect to take some responsibility for its success.

There is one pre-requisite: PPPA6002 (Research Methods and Applied Statistics), or the equivalent. The course has a quantitative focus, but only college algebra is required to master the core concepts.

ADDITIONAL POLICIES AND INFORMATION

- ❖ Syllabus: This syllabus is a guide to the course. Sound educational practice requires flexibility and the instructor may revise content and requirements during the semester.
- ❖ Blackboard: Blackboard will be used to communicate with students. Please make sure that you can access the course and that you regularly check whatever email account Blackboard uses for you. If you have problems with Blackboard, contact the Helpdesk at 202-994-5530 or helpdesk.gwu.edu.
- ❖ Late Work: Unless you've made arrangements in advance, late work will be penalized with a one grade step reduction (e.g. from an A- to a B+) per day. Homework may not be turned in late.
- ❖ Grades: No grade changes can be made after the conclusion of semester, except for clerical error.

- Civility: Higher education works best when it is a vigorous and lively marketplace of ideas where all points of view are heard. Free expression is an integral part of this process. Higher education also demands that all of us approach the enterprise with empathy and respect for others, irrespective of their ideology, political views, or identity. Listen to understand others, not to judge them.
- Attendance: I won't take attendance, but try to be in class each week. If you need to miss a class, let me know in advance, get notes from a classmate, and turn in any assignments on time. It's fine to miss a class for a religious holiday, but let me know about such cases at the start of the semester.
- Class Decorum: Texting, side conversations, or using your laptop for anything other than taking notes is an inappropriate use of class time. Those who do these things may think their actions are unobtrusive, but they are actually quite conspicuous. It's distracting both to me and to your classmates, and will result in a significant decrease in your class participation/engagement grade.
- English for Academic Purposes Writing Support Program: If English is not your first language, you may wish to take advantage of GW's Writing Support Program which offers free, one on one service. Visit http://www.gwu.edu/~gwriter for details.
- Academic Honesty: 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. (See http://www.gwu.edu/~ntegrity/code.html).
- Incompletes: A student must consult with the instructor to obtain an "incomplete" before the last day of class. Consult the TSPPPA Student Handbook for the relevant CCAS policy.
- Students with Disabilities: If you need accommodation due to a disability, let the instructor know in first week of the class. You should also contact the Disability Support Services office at 202-994-8250 in the Rome Hall, Suite 102, to establish eligibility and to coordinate reasonable accommodations. For additional information see: http://disabilitysupport.gwu.edu.
- Support: GW Mental Health Services (202-994-5300) offers 24/7 assistance to address students' personal, social, career, and study skills problems, including crisis and emergency mental health consultations, confidential assessment, counseling services, & referrals to other providers. See counselingcenter.gwu.edu for more information.
- Grading: Grades for assignments and for the course as a whole reflect the following philosophy:
  - A Excellent: Exceptional work for a graduate student. Work is unusually thorough, well-reasoned, creative, methodologically sophisticated, and well written. Work is of exceptional, professional quality.
  - A- Very Good: Very strong work for a graduate student. Shows signs of creativity and a strong understanding of appropriate analytical approaches, is thorough and well-reasoned, and meets professional standards.
  - B+ Good: Sound work for a graduate student; well-reasoned and thorough, without serious analytical shortcomings. Indicates the student has fully accomplished the basic objectives of this graduate course.
  - B Adequate: Competent work for a graduate student with some evident weaknesses. Demonstrates competency in the key course objectives but the understanding or application of some important issues is less than complete.
  - B- Borderline: Weak work for a graduate student but meets minimal expectations. Understanding of key issues is incomplete. (A "B-" average in all courses is not sufficient to sustain 'good standing.')
  - C+/ C / C- Deficient: Inadequate work for a graduate student; rarely meets minimal expectations. Work is poorly developed or flawed by numerous errors and misunderstandings of important issues.
  - F Unacceptable: Work fails to meet minimal expectations or course credit for a graduate student. Performance has consistently failed to meet minimum course requirements. Weaknesses and limitations are pervasive.
- Course Effort: Federal regulations and the Middle States Commission on Higher Education requires 112.5 hours of work for a 3-credit course. We will meet 14 times for 2 two hours (28 hours). You should expect to spend at least 4 hours per week preparing for class (56 hours) and at least 28.5 hours outside of class on graded assignments.

WEEK-BY-WEEK PLAN

Week	Date	Topic	Sub-Topics	Reading & Assignments
1	Jan 22	Course Overview	▪ Syllabus ▪ Basic Probability Concepts ▪ Basic Modeling Concepts ▪ Examples of Models Covered in Course	▪ Ensure Excel 2016 working on your ▪ Stokey & Zeckhauser, "Chapter 2 – Discussion," A Primer for Policy An ▪ Saltelli & Funtowicz, "When All Mo in Science & Technology, Winter 20
2	Jan 29	Policy Modeling in Excel	Best Practices ▪ Building models, Validating inherited models ▪ Transparency & Documentation ▪ Useful Excel functions	▪ Winston, study Chapters 1-3, skim 23, study Chapters 24-27 ▪ HW #1 Assigned
3	Feb 5		More on Best Practices ▪ Error Trapping & Formula Auditing ▪ Designing Outputs: Numbers & Charts ▪ Sensitivity Analysis: Goal Seek, Data Tables, Scenario Manager, Break-even analysis	▪ Winston, study Chapters 16-19, 40 41 and 42 ▪ HW #1 Due/Discussed
4	Feb 12	Probability & Decision Analysis	Decision Trees ▪ Conditional Probabilities ▪ Expected Values ▪ Value of Information	▪ Anderson, Chapter 13.1-13.5 (Chap ▪ Winston, study Chapters 66-67 ▪ HW #2 Assigned
5	Feb 26		Decision Analysis ▪ Bayes Theorem ▪ Classification & Eligibility Problems ▪ Utility Functions & Attitudes about Risk	▪ Anderson, Chapter 13.6-13.7 (Chap ▪ HW #2 Due/Discussed
6	Mar 5	Probabilistic Simulation Models	Introduction to Monte Carlo Models ▪ Flowcharting the Algorithms ▪ Selecting Input Distributions ▪ Interpreting Monte Carlo Outputs	▪ Winston, study Chapters 68-75 and ▪ HW #3 Assigned
7	Mar 19		More on Monte Carlo Models ▪ Making Probability Statements from Forecasts ▪ Sensitivity & Breakeven Analyses ▪ Probabilistic Queuing Models	▪ Winston, study Chapter 83 ▪ HW #3 Due/Discussed ▪ Skills Exam #1 Assigned

Week	Date	Topic	Sub-Topics	Reading & Assignments
8	Mar 26	Optimization Models	Linear Programing ▪ Decision Variables, Objective Functions, Constraints ▪ Applications: Resource Allocation, Mixing, Transportation ▪ Sensitivity Analysis: Shadow Prices, Slack Resources	▪ Winston, study Chapters 29-35 ▪ Skills Exam #1 Due/Discussed
9	Apr 2		Other Types of Optimization Models ▪ Integer Linear Programming ▪ Non-Linear Optimization Models ▪ Non-Smooth Optimization: Evolutionary Algorithms	▪ Winston, study Chapters 36-38 ▪ HW #4 Assigned ▪ Project Proposals Due
10	Apr 9	Deterministic Simulation Models	Markov Chains & Processes ▪ State-Change Models ▪ Intermediate-State vs. End-State Conditions ▪ Applications: Disease Patterns, Drug Rehabilitation	▪ Winston, study Chapter 88 ▪ Anderson, Chapter 16 (Chapter 3 i ▪ HW #4 Due/Discussed
11	Apr 16		Difference Equations & Systems Dynamics Models ▪ Causal Loop Diagrams, Feedback Loops ▪ Stocks & Flows ▪ Applications: Transportation, GHG Emissions	▪ Pegasus Systems, "Systems Thinkir ▪ HW #5 Assigned ▪ Project Status Presentations (1st Th
12	Apr 23	Multi-Attribute Decision Models (MADM)	Basic MADM Framework ▪ Scoring Methods & Commensurability ▪ Exclusion of Infeasible & Dominated Alternatives ▪ Weighting (including Analytic Hierarchy Processes)	▪ Anderson, Ch 14.3 (§14.1 & 14.2) – ▪ HW #5 Due/Discussed ▪ Skills Exam #2 Assigned ▪ Project Status Presentations (2nd Th
13	Apr 30		More on MADM ▪ Applications: DOD Base Closure, Vaccine Policy, Transportation Sustainability Rating Systems	▪ Project Status Presentations (3rd Th
14	May 2 (W)	Class Wrap-Up	Policy Models & the Policy Process ▪ What Makes for a "Good" Model? ▪ Weaponization of Model Analysis ▪ Survival Skills for Policy Modelers	▪ Skills Exam #2 Due/Discussed ▪ Aggarwall et al, "Model Risk: Darin Box," British Actuarial Journal, 201 & Section 3, are required; skim the ▪ Tankersly, "Republicans Sought to Analysis of Tax Plan," New York Tir ▪ Montgomery, "CBO Director in the to Put Price on Health Reform," W ▪ Final Project Paper Due: Friday, M