PPP 6085-12
Quantitative Modeling for Public Policy
Spring 2016

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
- Understand optimization as a tool for solving problems

Assignments and Due Dates

<table>
<thead>
<tr>
<th>%</th>
<th>Assignment</th>
<th>Due</th>
<th>Details</th>
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<tbody>
<tr>
<td>20%</td>
<td>Homework</td>
<td>ongoing</td>
<td>p. 3</td>
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<tr>
<td>15%</td>
<td>Assessment of a previous study</td>
<td>To be assigned</td>
<td>p. 4</td>
</tr>
<tr>
<td>20%</td>
<td>Skills Exam #1</td>
<td>Mar 3</td>
<td>p. 4</td>
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<tr>
<td>20%</td>
<td>Skills Exam #2</td>
<td>Apr 14</td>
<td>p. 5</td>
</tr>
<tr>
<td>25%</td>
<td>Final Paper</td>
<td>Apr 21</td>
<td>p. 5</td>
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</table>

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

<table>
<thead>
<tr>
<th>Class #</th>
<th>Date</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/12/16</td>
<td>Class Overview, Basic Probability &amp; Modeling Concepts</td>
</tr>
<tr>
<td>2</td>
<td>1/19/16</td>
<td>Probability Trees &amp; Decision Analysis</td>
</tr>
<tr>
<td>3</td>
<td>1/26/16</td>
<td>Probability Distributions &amp; Intro to Monte Carlo</td>
</tr>
<tr>
<td>4</td>
<td>2/2/16</td>
<td>Monte Carlo Analysis in Models</td>
</tr>
<tr>
<td>5</td>
<td>2/9/16</td>
<td>Example Studies Presentations A; Expanded Monte Carlo</td>
</tr>
<tr>
<td>6</td>
<td>2/16/16</td>
<td>Queuing Theory without Simulation</td>
</tr>
<tr>
<td>7</td>
<td>2/23/16</td>
<td>Markov Chains</td>
</tr>
<tr>
<td>8</td>
<td>3/1/16</td>
<td>Introduction to Simulation; 1st Exam Assigned</td>
</tr>
<tr>
<td>9</td>
<td>3/8/16</td>
<td>1st Exam Discussion; Example Studies Presentations B; Queuing &amp; Simulation Continued</td>
</tr>
<tr>
<td>10</td>
<td>3/15/16</td>
<td>Spring Break</td>
</tr>
<tr>
<td>11</td>
<td>3/22/16</td>
<td>Sensitivity Analysis</td>
</tr>
<tr>
<td>12</td>
<td>4/5/15</td>
<td>Uncertainty, Probability &amp; Risk; 2nd Exam Assigned</td>
</tr>
<tr>
<td>13</td>
<td>4/12/15</td>
<td>Example Studies Presentations C; 2nd Exam Discussion</td>
</tr>
<tr>
<td>14</td>
<td>4/19/15</td>
<td>Summary Lecture and Final Paper Turn-in</td>
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Assignment Descriptions

Homework (20%)

Assigned every week, except that no homework is assigned on the week when the Skills exams are assigned. Due electronically by the beginning of next week’s class.

Each week you will have a few problems that required you to use Excel to practice and increase understanding of the skills taught in that week’s class.

You are expected to provide the spreadsheets showing your answers.

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 an “A” on the homework for that week.

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 this
kind of problems, and to make the discussion of techniques more meaningful that just listening to lecture can provide.

**Assessment of a previous study (20%)**

Due electronically by the beginning of the class assigned.

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

<table>
<thead>
<tr>
<th>Group #</th>
<th>Assignment Date</th>
<th>Topic</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1/12/15</td>
<td>Probability models, decision analysis, Monte Carlo</td>
<td>Feb 2</td>
</tr>
<tr>
<td>B</td>
<td>1/12/15</td>
<td>Queuing, Markov chains</td>
<td>Mar 1</td>
</tr>
<tr>
<td>C</td>
<td>1/12/15</td>
<td>Discrete Event Simulation, sensitivity analysis</td>
<td>Apr 5</td>
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You should find a published report, a research paper, or another project report that uses the one or more of the specific set of these modeling tools listed under “Topic” to address a public policy problem in any field.

Write a short (no more than 4 pages) discussion of the report you find addressing

- 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 the papers will be posted on Blackboard for the entire class to use.

4 papers will be selected for presentation by the student to the class on the next week after the papers are turned in. These are short, informal presentations addressing the same points as the paper.

**Skill Exam #1 (20%)**

An exam will be assigned at the end of the 1 March class, addressing probability and decision analysis, queuing theory, Markov Chains and Monte Carlo methods.

Due electronically by the beginning of the March 8 class
**Skill Exam #2 (20%)**

An exam will be assigned at the end of the 5 April class, addressing simulation, sensitivity analysis, and optimization. The second exam assumes all the knowledge from the first half of the class, and so the problems are a bit more difficult.

Due electronically by the beginning of the April 12 class.

**Final Paper (25%)**

Topic selection due by the end of class on 8 March, either electronically or on paper.

Final paper due electronically or in paper form at the beginning of the April 19 class (the last class).

*Topic selection:* You should select a policy topic of interest to you that you believe can be addressed with one of the modeling approaches in this class using Excel. The modeling approach should include either a probabilistic modeling approach or a linear optimization analysis. The topic selection should be documented in a short (no more than 1 page) description that should include:

- the problem you are addressing;
- the source of the theoretical approach and data you will use;
- your modeling approach;
- how you will select the parameters of your model;
- what you expect to demonstrate with the modeling; and
- how you will do sensitivity analysis.

I strongly encourage you to generate this proposal earlier than 8 March and send it to me. I will respond within 48 hours, by email, to any proposal or questions about the topic and approach you suggest.

Once the topic is agreed to, feel free to continue discussion of the approach with me. This should be a learning experience, not a pure test of your understanding.

Any delay in providing the topic selection after 8 March will result in a loss of 5% of the total course grade per week of delay.

*Final Paper:* Complete the analysis of the problem agreed to in the topic selection, write a short paper documenting your approach and your results. The final paper can be in any format you choose, but should include:

- the problem you addressed;
- how the problem matters to a policy issue;
- the source of the theoretical approach and data you used;
- your modeling approach;
• how you selected the parameters of your model;
• your results;
• how you did sensitivity analysis on the results;
• what you think the results mean; and
• what further work (modeling, data gathering, or practical tests) should be done to justify making policy decisions with the model.

Submit your final paper, as a prose description of your work, by the beginning of the April 19 class. Submit electronically the Excel spreadsheets used in your work, as a single workbook, by April 21 at 5 PM. Any delay in delivering these products will result in a loss of 5% of the total course grade per day of delay.

Beyond meeting the deadlines, the grade for the final paper will be based on the clarity of the written report, the effectiveness of the use of modeling as a source of policy insight, the evaluation you make of the insights from your own approach, the implementation of the model in the spreadsheets, and the sensitivity analysis of the results.
Reading Recommendations

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


Everything I cover in the class will be in one of those 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:


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

Relevant Trachtenberg School Policies

1. **Incompletes**: 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. **Submission of Written Work Products Outside of the Classroom**: 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. **Submission of Written Work Products after Due Date: Policy on Late Work**: 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. **Academic Honesty**: 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. **Changing Grades after Completion of the Course**: No changes can be made in grades after the conclusion of the semester, other than in cases of clerical error.

6. **The Syllabus**: 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. **Accommodation for Students with Disabilities**: 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.