Modeling with Spreadsheets
QMETH 551
Spring 2015

Instructor
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Course Description
This course covers modeling with spreadsheets for analyzing quantitative aspects of business problems. Spreadsheet packages now have features that allow managers to perform sophisticated quantitative analysis in the comfortable and intuitive environment of the spreadsheet. This gives managers the power of quantitative analysis tools without forcing them to use unfamiliar mathematical notation. Applications from a variety of business areas will be discussed, including finance, marketing, and operations. Sample applications include cash flow problems, portfolio optimization, pricing models and revenue management, municipal bond underwriting, project management, supply chain management, facility location, shortest path and routing, equipment replacement, advertising media selection, and budget-constrained project selection.

Required Materials
Course Packet includes copies of class slides, problem sets, and case studies. Available at RAMS Copy Center (4144 University Way).

Course Packet
I have prepared extensive course notes that I use as overheads during lecture. These course notes include examples that we will work together in class and other lecture material. The course notes are not intended as material that you use to prepare for class; my intent is for them to make it easier for you to listen, ask questions, and participate in class, rather than take lots of your own notes during the lectures.

Software
Microsoft Excel (including Solver), Solver Table (available on Canvas), and Crystal Ball (Oracle has agreed to provide new temporary Crystal Ball licenses for students in this class—instructions on Canvas). Crystal Ball is also available on the computers in the Paccar Computer Lab.
Laptop Policy
You are welcome to bring a laptop to class to work the models we build in class. Completed spreadsheets as well as spreadsheets with just the data are available for download on Canvas. You are also welcome to just watch, take notes, and participate in discussion. I want to encourage your active involvement in this course. Thus, I subscribe to the School’s policy that expects you will *not* access email, surf the internet, or instant message others during class.

Academic Integrity
By being a student in this course you acknowledge that you are a part of a learning community at the Foster School of Business that is committed to the highest academic standards. As a part of this community, you pledge to uphold the fundamental standards of honesty, respect, and integrity, and accept the responsibility to encourage others to adhere to these standards. Furthermore, as part of the Foster MBA program, we have jointly agreed to conform to and uphold the MBA Honor Code.

Grading Policy
The course grade will be based on class participation, problem sets, two exams, and a student presentation, with the following weights:

- Class Participation: 5%
- Problem Sets: 30%
- Midterm: 25%
- Final Exam: 25%
- Student Project and Presentation: 15%

Study Groups
The problem sets and student projects will be done in groups of three to five. The problem set groups will be self-selected on the first day of class. The groups for the presentation can be chosen later. It is acceptable (and typical) that the student project groups be the same as the problem set groups, but this is not required. At the end of the quarter, each member of the group will also evaluate each of the other members of the group in terms of their relative contribution to the group’s problem sets and/or student project and presentation. The individual evaluations will be confidential, made directly to me through Canvas. Your evaluations from others in your group will be combined and evaluated and individuals that did not make a fair contribution (or made extraordinary contributions) to the group will have their overall problem set or project scores adjusted accordingly.

Problem Sets
There will be six graded problem sets. These are to be done in groups of three to five. It is expected that the group will either work together on all problems, or each member will do all the problems individually, and then the group will compare and compile a single version from the individual versions. Groups should *not* split up the problems, work on separate problems individually, and combine. Discussing problems with others in the class (outside your group) is also acceptable, but information sharing should be in the form of discussion and explanation, and should not include copying of computer files (beyond your group). One member of each group should turn in the solution to each assignment via Canvas no later than the due date and time indicated. If possible, include all spreadsheets in a single workbook on separate tabs.
Exams
The midterm exam and final exam will both be take-home exams. You will be given approximately one week for each. These exams are open book and open notes with no time limit (other than the due date), but must be completed individually, without assistance from any other person.

Student Projects & Presentations
Student projects and presentations will be done in groups of three to five students. You may stay in the same groups as for the problem sets, but this is not required. Presentations will be given at the end of the quarter.

You may choose either of the following for the topic of your presentation:

1. Develop a spreadsheet model that addresses a decision that needs to be made. Present the decision to be made, the spreadsheet model developed to address it, and the results of the model.

2. Research a model that was developed by a business to address a decision that needed to be made. There are many references to “real-world” applications in the textbook. Most make reference to the journal Interfaces (available in the Foster library), which is a good resource for management science models that have been developed and used in business. Present a “case study” of the model, including discussion of the decision to be made, demonstrating a spreadsheet version of the model that was developed, and discussing the results obtained with the model. The model need not have originally been a spreadsheet model (e.g., it may have been an LP solved using an algebraic solver); if it is not, you will need to create a spreadsheet based upon the ideas of their model to show the class how the model works in spreadsheet form.

In either case, the spreadsheet model should build upon or be related to one of the techniques covered during the quarter. The presentations should be approximately 10 minutes after which there will be a short question-and-answer period. The presentation (and spreadsheet submission) will be graded for both content (two-thirds weight) and quality of presentation (one-third weight). Qualities I will be looking for include: (1) does the model build effectively on the modeling techniques discussed in class, (2) how well does the model address the decision being made, (3) is the presentation clear and easy to understand, (4) can you convince the audience that the model is effective and the solution a good one.

Deliverables:
- Wednesday, May 13 (by 10pm), please e-mail me a list of your team members, a brief description of your topic, and a brief description of the model you intend to build or discuss.
- Before 1pm on presentation day, please submit to Canvas (under Assignments>Student Project) the spreadsheet model that your team has built and any other electronic items used in your presentation (e.g., Powerpoint slides).
**Schedule**

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<thead>
<tr>
<th>Day</th>
<th>Session</th>
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<tbody>
<tr>
<td>Monday, March 30</td>
<td>Session #1: Modeling with Spreadsheets</td>
<td>Text, Chapter 1</td>
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<tr>
<td>Wednesday, April 1</td>
<td>Session #2: Applications of Linear Programming</td>
<td>Core Sessions #2-4; Text, Chapters 2-4</td>
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<tr>
<td>Monday, April 6, 1pm</td>
<td>Due: Problem Set #1 (Linear Programming)</td>
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<td>Monday, April 6</td>
<td>Session #3: Transportation &amp; Assignment Models</td>
<td>Text, Chapter 15 (available electronically on Canvas Syllabus)</td>
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<td>Wednesday, April 8</td>
<td>Session #4: Network Models</td>
<td>Text, Chapter 6</td>
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<tr>
<td>Monday, April 13, 1pm</td>
<td>Due: Problem Set #2 (Transportation &amp; Network)</td>
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<td>Monday, April 13</td>
<td>Session #5: Applications of Integer Models</td>
<td>Core Session #6; Text, Chapter 7</td>
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<td>Wednesday, April 15</td>
<td>Session #6: Municipal Bond Underwriting Case Study</td>
<td>Municipal Bond Case Study (back of packet)</td>
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<td>Monday, April 20, 1pm</td>
<td>Due: Problem Set #3 (Integer)</td>
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<td>Monday, April 20</td>
<td>Session #7: Multiple Objectives and Goal Programming</td>
<td>Text, Chapter 17 (available electronically on Canvas Syllabus)</td>
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<td>Wednesday, April 22</td>
<td>Session #8: Nonlinear &amp; Separable Programming</td>
<td>Text, Sections 8.1–8.3</td>
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<td>Monday, April 27, 1pm</td>
<td>Due: Problem Set #4 (Multiple Objective &amp; Nonlinear)</td>
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<td>Monday, April 27</td>
<td>Session #9: Applications of Optimization</td>
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<td>Monday, May 4, 1pm</td>
<td>Due: Midterm Exam (Available Monday, April 27, 5pm)</td>
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<td>Monday, May 4</td>
<td>Session #10: Evolutionary Solver</td>
<td>Text, Sections 8.4–8.5</td>
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<td>Wednesday, May 6</td>
<td>Session #11: Macros, VBA, Analytic Solver Platform</td>
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<td>Monday, May 11</td>
<td>Session #12: Simulation and Crystal Ball</td>
<td>Core Sessions #9-10; Text, Sections 20.1–20.8 (on Canvas Syllabus)</td>
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<td>Wednesday, May 13</td>
<td>Session #13: Mountain Realty Case Study</td>
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<td>Wednesday, May 13, 10pm</td>
<td>Due: Student Project Proposals</td>
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<td>Monday, May 18, 1pm</td>
<td>Due: Problem Set #5 (Evolutionary Solver and Simulation)</td>
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<td>Monday, May 18</td>
<td>Session #14: Optimizing with Simulation</td>
<td>Text, Section 20.9 (available electronically on Canvas Syllabus)</td>
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<td>Wednesday, May 20</td>
<td>Session #15: Models for Analyzing Waiting Lines</td>
<td>Text, Sections 11.1–11.7</td>
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<td>Wednesday, May 27, 1pm</td>
<td>Due: Problem Set #6 (Simulation)</td>
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<td>Wednesday, May 27</td>
<td>Session #16: Analysis of Waiting Lines</td>
<td>Text, Sections 11.8–11.9</td>
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<td>Monday, June 1</td>
<td>Session #17: Student Project Presentations</td>
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<td>Wednesday, June 3</td>
<td>Session #18: Student Project Presentations (if needed)</td>
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<td>Wednesday, June 3, 10pm</td>
<td>Due: Peer Evaluation Form</td>
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<td>Monday, June 8, 1pm</td>
<td>Due: Final Exam (Available Monday, June 1, 5pm)</td>
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Session Summaries

Session #1: Modeling with Spreadsheets
In this session we will discuss the role of models in managerial decision making, including the use of spreadsheets, and provide an overview of the models and techniques to be covered in this quarter. We discuss good and poor spreadsheet modeling, and how proper layout and formatting can produce models that are easier to build, debug, read, and modify.

Session #2: Applications of Linear Programming with Spreadsheets
We discuss applications of linear programming with spreadsheets to problems in finance, marketing, and operations.

Session #3: Transportation and Assignment Problems
In this session we will discuss the use of spreadsheet models to handle transportation, distribution, and assignment problems.

Session #4: Network Models
Transportation and communication networks pervade our daily lives. In this session, we discuss applications of network optimization. We then discover that most network optimization problems are really linear programming problems. We discuss minimum-cost flow, maximum flow, shortest path, and equipment replacement problems.

Session #5: Applications of Integer Models
In this session we address problems where some or all of the decision variables are required to assume integer values and discuss the application of binary variables. We discuss applications in finance, marketing, and operations.

Session #6: Municipal Bond Underwriting Case Study
In this session we discuss the application of binary integer models to a municipal bond underwriting case. We also discuss other advanced applications of integer programming.

Session #7: Multiple Objectives and Goal Programming
In this session we look at problems that have more than one objective. Techniques for addressing all of the objectives are discussed.

Session #8: Nonlinear and Separable Programming
Here we discuss spreadsheet models with a nonlinear objective function and/or nonlinear constraints. What are the ramifications on solvability? We also will discuss the use of separable programming to approximate a nonlinear model with a linear one.
**Session #9: Applications of Optimization**
In this session we combine various optimization techniques to develop advanced optimization models addressing problems in project management and pricing and revenue management.

**Session #10: Evolutionary Solver**
We introduce genetic algorithms and the Evolutionary Solver to address problems that can not be solved using the standard Solver.

**Session #11: Macros, VBA, and Analytic Solver Platform**
In this session we will discuss the use of macros and VBA, how they can aid in modeling, and how they can be used to create a decision support system. Next, the Analytic Solver Platform will be demonstrated.

**Session #12: Simulation and Crystal Ball**
In this session we discuss the use of the Crystal Ball Excel add-in for performing Monte-Carlo simulation, and applications in finance, marketing, and operations.

**Session #13: Mountain Realty Case Study**
In this session we will use Crystal Ball to explore a business decision faced by Mountain Realty.

**Session #14: Optimizing with Simulation**
In this session we discuss how optimization can be performed with a simulation spreadsheet model. The OptQuest add-in for Crystal Ball will be demonstrated.

**Session #15: Models for Analyzing Waiting Lines**
In this session we introduce analytical models and corresponding spreadsheet templates for predicting the effects of congestion in waiting line systems. Single and multiple-server queues, priority queues, and systems with finite queue capacity will all be discussed.

**Session #16: Analysis of Waiting Lines**
In this session, we utilize the queueing templates to make the following kinds of decisions: How many servers should we use? How much space needs to be made available for the waiting line? How many phone lines and representatives should a call center utilize? When should a priority scheme be utilized?

**Sessions #17-18: Student Presentations**
Groups of three to five students will give a 10 minute presentation about a model that they have developed or that a business has used to analyze a problem.