



ROBERT H. SMITH  
SCHOOL OF BUSINESS

## BUDT732: Decision Analytics Syllabus

### COURSE OBJECTIVES

A good *decision* is not the same as a good *outcome*. The latter can sometimes be a matter of dumb luck. Conversely, a bad outcome is not necessarily proof of a bad decision. So, how can we characterize a good decision? This question is especially pertinent for business managers since managers encounter new decision problems on an ongoing basis.

In this course, we will explore basic analytical principles that can guide a manager in making complex decisions. Optimization deals with design and operating decisions for complex systems. Simulation deals with the analysis of operating decisions of complex systems in an uncertain environment to assess risk or to deal with uncertainty. This course provides the student with a collection of optimization and simulation modeling and solution tools that can be useful in a variety of industries and functions. The main topics covered are linear, integer, and nonlinear optimization applications in a wide variety of industry segments, and Monte-Carlo Simulation and risk assessment. Extensive use of application oriented cases will be used 1) for develop modeling and analytical skills, and 2) to simulate decision making in a real-world environment.

### Learning Objectives:

- Identify an underlying analytical *structure* in a seemingly complex and amorphous decision problem.
- Translate a verbal description of a decision problem into a valid optimization or simulation model.
- Interpret the meaning and assess the validity of a particular optimization model.
- Express a given optimization model in an Excel spreadsheet, and find solutions to these problems using the most appropriate algorithm and settings in Solver.
- Perform sensitivity analysis by tracing the effects of varying a parameter on the optimal decision variables and the objective function.
- Understand the role of *uncertainty* and *risk* in the decision-making process.
- Use of Simulation models to assess risk.
- Build and run Monte-Carlo Simulation using @RISK.

### COURSE PRE-REQUISITES

It will be assumed that you have mastered the following skills that are necessary for this course:

- You are expected to be familiar with Excel. Further, it will be assumed you have rudimentary exposure to Solver at the level of the pre-requisite course BUSI630.

### **COURSE MATERIALS**

- There are two required texts. The first text deals with the analytic component of the course. The second text deals with the use of optimization models in the real world. I believe understanding of both is critical to be a successful analytic manager.
  - *Optimization Modeling with Spreadsheets Microsoft Excel* (2<sup>nd</sup> edition), by Kenneth Baker, Wiley.
  - *The Optimization Edge* by Steve Sashihara, McGraw-Hill.
- *Additional handouts will be provided in each class and online.* These include a chapter on simulation modeling, as well as case assignments. These will be posted on canvas.
- @RISK Software from Palisade Decision Tools Software (see instructions at end of Syllabus).

### **SOFTWARE**

An explicit goal of this course is to develop your ability to implement analytical techniques using contemporary computing technology. We will achieve this goal with the following strategy:

- The course will use Excel Solver, SolverTable (an add-in introduced to you in BUSI630), and @RISK (part of the Palisade Decision Tools Suite that you used in BUSI630). Students wishing to use Risk Solver Platform (the upgraded version of Excel's Solver that can also build and run simulation models) will be allowed to do so. However, the in class discussion will be based on Solver and @RISK.
- **Class time will *not* be used to learn software skills.** Given the availability of the textbook and online manual for @RISK as a comprehensive reference on software issues, attempting to learn software skills in class is an inexcusably inefficient use of class time. Class time will be reserved for learning analytical principles and for discussing managerial implications of the analysis that is conducted.
- Mastery of the software is eventually accomplished not by simply reading the textbook or by watching a demonstration in class, but by actually using the software in the assignments, using the textbook as a handy reference.

### **ATTENDANCE**

You are expected to attend **ALL SESSIONS**. If you have to miss a class for an unavoidable please let the instructor know ahead of time. If you miss a class you are responsible for catching up on all of the materials including completing homework assignments in a timely fashion.

### **GRADING & DELIVERABLES**

Your overall grade for the course will be determined on the following basis:

- |                        |     |
|------------------------|-----|
| • Class participation  | 10% |
| • Homework Assignments | 50% |
| • Take home final exam | 40% |

Class participation includes not only preparation for the problem/case, analysis, but also the demonstration of an ability to ask questions, provide comments and engage in constructive class discussion.

There will be regular homework assignments. Their scope and intent is varied.

- Discussion assignments. Starting week 2 we will spend some of the class time discussing chapters in Sashihara. Each week a subset of the class will be assigned to lead a discussion of the material. When it is your turn to lead the discussion you should also turn in a 2 page summary and discussion of your reading of the appropriate chapter of Sashihara. You will play this role once during the term.
- Individual assignments. Will be provided weekly. These should be submitted electronically.
- Team assignments. There will be 2 team assignments, consisting of somewhat larger cases.

A comprehensive final exam will be provided at the end of the course.

### **ACADEMIC INTEGRITY**

The University's Code of Academic Integrity is designed to ensure that the principles of academic honesty and integrity are upheld. All students are expected to adhere to this Code. The Robert H. Smith School does not tolerate academic dishonesty. All acts of academic dishonesty will be dealt with in accordance with the provisions of this code. Please visit the following website for more information on the University's Code of Academic Integrity: <http://www.studenthonorcouncil.umd.edu/code.html>. On each exam or assignment you will be asked to write out and sign the following pledge. "I pledge on my honor that I have not given or received any unauthorized assistance on this exam/assignment."

### **COURSE WEBSITE**

The course website is located at <http://elms.umd.edu>.

The course website has multiple purposes to facilitate your learning in this course. First, it will be a repository for the course handouts. Additionally, course homeworks, solutions, etc. will be posted on the website. Use the course website to post questions/communicate. This will be the easiest and *fastest* way for me to respond to your questions.

The course website must be used to submit homework assignments (unless otherwise stated on the assignment). Please type up your homework assignments using Microsoft Word or whatever other package you use for word processing. You should design your spreadsheets so that they are easy to follow. It is easy to annotate spreadsheets by adding text boxes. When you submit your homework, if it is a single file, name your file your

loginname under the course website system followed by HW1.xlsx or HW1.docx. For example if my login name were raghavan, I would submit the homework as raghavanhw1.xlsx. If you have more than 1 file, use a program like 7Zip to create a single zip or rar file containing all your files. In this case when you submit the assignment, call your file yourloginname followed by the assignment number and the extension .zip. For example if I were submitting multiple files, I would use the file name raghavanhw1.zip.

### **SPECIAL NEEDS**

Any student with special needs should bring this to the attention of the instructor as soon as possible, but not later than the end of the first class.

### **INSTRUCTOR**

S. “Raghu” Raghavan is Professor of Management Science & Operations Management at the Robert H. Smith School of Business, University of Maryland, with a joint appointment with the Institute for Systems Research. He joined the Smith School in 1998 after several years in the telecommunications industry. He enjoys teaching decision modeling oriented courses, and has been awarded top 15% teaching awards and the Legg-Mason Teaching Innovation award at the Smith School. He has published on a wide variety of topics (including telecommunications, electronic markets, and data mining) and numerous academic outlets such as Management Science, Operations Research, Decision Support Systems, and the INFORMS Journal on Computing. He holds two patents, and has won numerous awards for his work. These include (i) the Dantzig award for the best doctoral dissertation, (ii) the INFORMS Computing Society Prize (twice); once for innovative contributions to the field of data mining, and a second time for his contributions to public sector auction design, (iii) the Management Science Strategic Innovation Prize from the European Operations Research Society for his research contributions applying optimization techniques to telecommunications problems (iv) the Glover-Klingman Prize for the best paper in the journal Networks, (v) 2<sup>nd</sup> Prize in the INFORMS Junior Faculty Paper Competition, (vi) Finalist for the European Operations Research Society Excellence in Practice Award, and (vii) Finalist for the Wagner Prize for Excellence in Operations Research Practice. He has edited six books titled *Telecommunications Network Design and Management* (Kluwer Academic Press 2003), *Telecommunications Planning: Innovations in Pricing, Network Design, and Management* (Springer 2006), *The Next Wave in Computing, Optimization, and Decision Technologies* (Springer 2005), *Telecommunications Modeling, Policy, and Technology* (Springer 2008), *The Vehicle Routing Problem: Latest Advances and New Challenges* (Springer 2008), and *Tutorials in Operations Research* (INFORMS 2008). Dr. Raghavan obtained his Ph.D. in Operations Research from the Massachusetts Institute of Technology.

- Contact info: [raghavan@rhsmith.umd.edu](mailto:raghavan@rhsmith.umd.edu) (e-mail).
- Website: <http://www.terpconnect.umd.edu/~raghavan>
- Office hours: Tuesdays from: 4:00 – 6:00 pm. (DC Classroom).

# TENTATIVE

# SCHEDULE

## Legend for Readings:

BA: Baker text

BF: Simulation Chapter from Bertsimas Freund (Canvas).

RI: *User's Guide @RISK*, posted on Canvas

RN: Professor Raghavan's online materials posted on Canvas.

Note: **Schedule is tentative and subject to change.**

| <i>Date</i> |     | <i>Topics</i>                                                                                        | <i>Readings</i>                                                                          |
|-------------|-----|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 20-Jan      | Tue | Introduction to Optimization, Linear Optimization, Sensitivity Analysis, Solver Table.               | BA: Ch 1, Ch 2 Sections 2.1, 2.2, 2.3, 2.4, and 2.5.                                     |
| 27-Jan      | Tue | DEC Case.<br>Network Models<br>Supply Chain Optimization & Logistics                                 | DEC Case<br>Sashihara: Chapter 2 (Class Discussion)<br>BA: Ch 3, Sections 3.1 to 3.7.    |
| 3-Feb       | Tue | Integer Optimization 1                                                                               | Sashihara: Chapter 3 (Class Discussion)<br>BA: Ch 6 & 7, Sections 6.1-6.4, 6.8, 7.1-7.4. |
| 10-Feb      | Tue | Integer Optimization Cases. Integer Optimization and Auctions, Social Media/Paid Search/Health Care. | Sashihara: Chapter 4 (class discussion)<br>International Industries Case<br>RN: Handout  |
| 17-Feb      | Tue | Nonlinear Optimization                                                                               | Sashihara: Chapter 5 (Class Discussion)<br>BA: Ch 8, Sections 8.1 to 8.5.                |

|        |     |                                                         |                                                                                                            |
|--------|-----|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| 24-Feb | Tue | Simulation 1<br>@RISK Software<br>Digitron Hedging Case | Sashihara: Chapter 6 (Class Discussion)<br>BF: Sections 5.1 to 5.10.<br>BF: Digitron Hedging Case Page 223 |
| 3-Mar  | Tue | Simulation 2<br>Ontario Gateway Case<br>Review          | Sashihara: Chapter 7 (Class Discussion)<br>BF: Ontario Gateway Case Page 228.                              |
| 10-Mar | Tue | <b>Final Examination Due</b>                            |                                                                                                            |

## SOFTWARE INSTALLATION

Palisade Decision Tools Software was used in BUSI630. We will use the Simulation Component called @RISK (in weeks 6 and 7). The license is good thru May 31, 2015. You can download it from:

<https://umd.box.com/s/xccnoetio9i7px7bqr3m>

*Computer requirements:* The software is supported on native **Windows** machines. The software works with Windows XP, Vista, Windows 7 and 8, both 32-bit and 64-bit versions. The software requires Excel 2003–2013 for Windows (not Excel for Macintosh).

*Mac users:* If you have a Mac, you can try running the Palisade software in Windows under Bootcamp, Parallels, and VMWare, but if they don't work for you then neither our help desk nor Palisade can provide any assistance. As an alternative for Mac users, they can always use SmithApps or the lab computers. The University also provides Mac users licenses to install VMWare Fusion and Windows at no cost from [Terpware.umd.edu](http://Terpware.umd.edu) if they have the appropriate equipment and drive space. See <https://terpware.umd.edu/Mac/Package/2326> for more information about installing this. The DivIT Helpdesk in McKeldin library is staffed to help them configure this on a walk-in basis if they have any trouble with it.

The formal (or the “rules”) part of the syllabus concludes here. What follows are informal paragraphs to help you understand the philosophy behind this course and my teaching style, and some suggestions on mastering the various components of this course.

## WHO CAN DO WELL IN DECISION ANALYTICS?

*Decision Analytics* is not a math course. It is a business course. If you have done well in math courses in the past, you may possibly find it easy to understand much of the material. However, good performance in prior math courses is absolutely no guarantee of doing as well in this course. Conversely, if you have not done well in math courses in the past, there is no reason to believe that you will not do well in this course.

The fundamental difference between *Decision Analytics* and most of your prior math courses is that here problems will be “word problems.” This calls for two distinctly different skills, both of which are absolutely essential for a successful performance in this course. On one hand, you will need **verbal** skills in order to quickly comprehend a situation from a short paragraph and in order to justify your calculations using a few short sentences. On the other hand, you will also need strong **analytical** skills in figuring out which particular technique to apply to the problem, as you understand it.

## MY TEACHING METHOD

The different components of the course—assigned readings, lecture segments, assignments, class discussions, etc.—are designed to be **complementary**. They will not duplicate each other. Each component has a distinct pedagogic goal (e.g., mastery of analytical principles, mastery of software, ability to infer managerial implications, etc.) and is chosen for its efficacy and efficiency in accomplishing that goal.

Further, I like the flexibility to speed up or slow down the material depending upon the audience. The syllabus is a rough guideline, and we may deviate from it as necessary. My ultimate goal is for all of you to be educated consumers of business analytics.

## TIPS ON STUDYING FOR THIS COURSE

### • Attendance

Try not to miss class meetings – given the cumulative nature of most sessions, it is usually impossible to adequately make up a missed session.

### • Reading

Complete the assigned reading for class. Otherwise, the pace of the class will seem too fast.

### • Solving Problems

Reading the textbook is necessary but not sufficient. To truly master the concepts (and software) it is essential to solve as many problems as possible – the textbook has many problems at the end of each chapter.