BUS 358: Decision Tools and Visualization for Modern Management

Instructor: Dr. Elliot Bendoly, PhD
Class: Mondays & Wednesdays 11:30-12:45/1:00-2:15
Room: 421
Office Hours: 3:00-4:30M/W, 9:30-11:00 Tu, 9:00-2:00 Th, or by appointment

Note: Generally speaking I maintain an open door policy, though typically not available for office visits MW from 10am-2:30pm

Course Overview

In most settings individual decisions are not made in isolation. Multiple decisions must be made simultaneously and involve judgments that can be described as inherently limited, interdependent or prone to considerable uncertainty with regard to outcomes (often all three). Question: In an ever more demanding business climate where critical decisions need to be made within shorter and shorter time windows, how do effective managers get a handle on these complex decision environments, let alone come up with good solutions? Answer: They develop or customize analytical tools and frameworks to get the job done.

Increasingly this involves leveraging the capabilities of familiar and accessible technologies. The effectiveness of such leverage critically is dependent on (1) the ability to translate real-world problems into forms that such technologies can assist with, (2) the ability to portray/visualize these translations in ways that enhance the understanding of the dynamics of these problems, (3) the ability to structure mechanisms that derive suggested solutions to these problems, as well as describe the robustness of these solutions to sources of uncertainty, (4) the ability to clearly convey the justification and practicality of final solutions to others. Whereas these skills are often assumed to be distributed among multiple roles in a firm, managers competent in all four are certainly at an advantage in modern firms. The cherry on top of course is (5) an ability to develop tools that are not only useful to the developer but also to the developer’s co-workers and/or clients.

This course is designed with the goal of equipping students with competencies in each of the above skill sets – the intended product being an individual capable of developing analytically rigorous decision support tools, catered to specific managerial environments, which can be easily handed off for robust application by a range of intended users in those environments.

Required Text

Excel Basics to Black Belt: An Accelerated Guide to Decision Support Designs
by Elliot Bendoly –2008, Cambridge University Press

Note: On occasion (for certain in-class lab activities) I will ask you to bring the text to class. I am aware that the text is also available on Kindle (and similar formats) however… Electronic versions or printed-from-electronic version are NOT acceptable for in-class reference (I know as a matter of fact that there are some errors and omissions in the electronic versions and I don’t want to disrupt class flow by having to address these when they come up).

All students are also expected to join the “Excel Blackbelts” group on LinkedIn (see “Participation”)


Grading 35% course project, 20% in-class participation/citizenship, 20% assignments, 25% quizzes (preparation and skill-checks).
Examples of decision support system development and use will focus on the Microsoft Excel environment. This design is based on at least three motivating forces: 1) Unlike other possible platforms Excel has become a commodity among business firms and students are more likely to find it available for use in the workplace than any other foundation for DSS development, 2) Excel has a number of simple yet effective built-in functions (eg. Solver, interactive graphics, macros, etc) which make its use as a flexible and robust platform for DSS development extremely straightforward, and 3) The extensive capability for integration built in across Microsoft products provide the potential for wide-spread ubiquitous Excel based decision structures in the workplace (ie. it can be catered to assist co-workers who use packages like Word or PowerPoint regularly but don’t know the first thing about Excel).

Students enrolled in this course (as well as other ISOM electives) are provided free-access to a host of Microsoft products through the school’s participation in the Microsoft Academic Alliance Program (http://www.bus.emory.edu/software/msdn.html). These products include packages that aren’t otherwise available at GBS terminals, such as MapPoint, Project Professional, Access and Visio Professional. Students are encouraged to make use of any of the additional packages as they apply to course projects in this or other class settings.

In particular we will be making use of Excel2010 in class demonstrations (and in the text readings), however Excel2003 and later version are also compatible for use with the course. This semester we will also be making use of will be RiskOptimizer. In past years GBS has made arrangements to have these packages available in the 4th floor student lab as well as on the laptops available for the course. However student versions of the Palisades Suite (including RiskOptimizer) are available at discounts – http://www.palisade.com/academic/students.asp

**Course Grading in Depth:**

**Homework**

There will be up to 3 homework assignments (due by 5pm on the due date; 5% penalties are automatically incurred for submissions missing that deadline + 1.5% additional penalties per hour late). So please manage your time, and start these as soon as they are distributed. These assignments will come in multiple parts and cover several days’ worth of material. Although I am comfortable with peer-to-peer discussion of the questions, students should NOT share advise on approaches to solution. I expect final work to be independent. I don’t want to see work that looks suspiciously like someone else’s, and I certainly don’t want to see work simply copied from one student and dressed-up differently in another student’s submission; such submissions will be deemed violations of the **Honor Code**.

On occasion, when I feel students have had sufficient in-class time to complete work, I will request submissions (e.g. via e-mail) of work developed in class [such requests will be made very infrequently but will not be announced prior to the in-class work period]. This can help ensure checks on the originality of work and serious participation during these in-class periods.

Aside from this, my office hours are designed to provide opportunities for students to ask for guidance on these HWs. Please don’t come in with “I have no idea” – Instead approach me with some suggestions of your own for tackling the problem with specifics on where you are stuck. We’ll both spend our time better this way. I am always more than happy to help students willing to demonstrate individual effort.
Projects

Groups of 3-4 students may be engaged in a single project for this class. These group projects can either focus on providing guidance in terms of (Route I) specific solutions (eg. as possible through optimization, simulation, etc.) or (Route II) enhanced data navigation and visualization (eg. as possible through sophisticated used of dynamic tables, heuristics, graphics, live feeds, etc.). Group projects that are able to professionally display both capabilities will of course be the most impressive, but at the same time will likely require more effort (and room for greater error). Ultimately “planned scope” by itself cannot and should not be automatically equated with, or lead to an expectation of, a “higher score.”

Project grades are broken into three key deliverables:
(a) Project Outline, (b) Working Application and (b) Presentation.

Project Outlines:
Since groups may chose either Route I or II (above) to focus on, and may decide to shift routes during the course of project completion (which I’m perfectly amenable to), I will want all groups to consider the issues associated with both possibilities at this point. To do so groups will need to select a specific management problem “class” for study (eg. human resource management, financial portfolio assembly, facility location/supply network modification, order/customer scheduling, etc. – whatever students find appealing). For that “class” of problems, groups will be expected to provide a document outlining:
1) The difficulty(ies) associated with developing decisions for their ‘class’ of problem.
2) A real world example of that class of problem (can be drawn from personal experience, from recent news, from group investigation/interview of a local firm – whatever).
3) A sketch of the various relationships assumed between the key performance measures of their problem class, and the factors that might be subject to managerial change.
4) An idea of what limitations exist with regards to the extent to which these factors can be reasonably modified by managers.

To further demonstrate their understanding of the issues associated with developing a working application in their chosen context, the project outline should also include:
5) A concrete ‘model’ for optimizing some key decision in their context (outlining any applicable mathematical notation is encouraged here)
6) A concrete outline for better organizing/visualizing data/results associated with their context

The outline should be no more than 6 pages single-spaced in length (no less than 2 pages), not counting any data or diagram appendices deemed relevant. The format of the outline should be 5 sections outlined descriptions of each of the elements (1-5) listed above.
This outline will be due on March 7th by midnight (without exception).

Working Applications:
The primary project deliverable (the decision support tool) will be due near the end of the semester (April 15th). The technical requirements of the tool will be spelled out specifically in an additional document to be posted to the conference folder. However, in terms of general content and functionality, the tools must make use of at least two decision mechanisms (eg. heuristic, optimization or simulation) to analyze data specific to the example described in the earlier delivered outline. Data used in analysis should be appropriate to the context – some significant portion must have been acquired either through available archives/databases, on-line sources, surveys or real-time observations of activities conducted by the group. The tool should also demonstrate a robustness to use such that variants of the problem dealt with could also be specified by users for subsequent comparative analysis. Outputs (eg. descriptive summaries, notable constraints to decision making and prescriptions for policy) should be clearly depicted – implied is the leveraging of visualization technique covered in the course.

Presentation:
Teams will present their applications in-class during one of the two last weeks of the course. Once feedback on project outlines have been returned to students, I’ll post a sign-up so that teams can specify their preferred final presentation dates. Since these presentations will involve both a justification of the work and a
demonstration of functionality (15 minutes), as well as a Q&A period to follow (5-8 minutes), we will limit the number of presentations per each class session to three. So plan ahead for preferred presentation dates.

Teams will also be expected to create 2 YouTube videos. The 1st will be a walk-through of their DSS. This should predominantly be a screen capture presentation of how their application is intended to be used (between 5 and 10 minutes in length). These should not replicate your entire presentation; they are designed to only showcase the application, not describe the context for which it was designed, and not describe limitations/future prospects. The 2nd video should be an elevator pitch for the application (10-20 seconds). It should quickly introduce the application, state its purpose and functionality, and end with “For more information see [your Application Title] on Excel-Blackbelts.com”. Demos from last spring: www.excel-blackbelt.com

Links to YouTube posts should be e-mail to me NO LATER than the day prior to the scheduled group presentation.

Intermediate and End-of-term Quizzes

We will have 3 intermediate semester quizzes (on the order of 20 minutes each) and a final quiz (30 minutes). The 3 intermediate quizzes will serve as a check to student preparation for class and absorption of prior material (i.e. having done readings, followed along on in-class examples, etc.). The final quiz is designed to check on whether students can identify what tools and techniques in general (from among those taught) may be most appropriate for specific managerial decision support tasks. Quiz dates are found on the course schedule attached. All students must take all 3 intermediate quizzes as well as the final quiz. Make-ups are granted only in rare occasions, with rationale filed and supported by the program office.

Participation & Citizenship

The course is designed to incorporate significant portions of in-class lab-time during which students will be able to work on examples and later on their own projects. While attendance in class is voluntary, participation in lab exercises is expected (a unique issue to lab courses). Furthermore there are benefits to what I refer to as "positive" versus "negative" participation even during non-lab discussions/lectures. Positive participation involves consistently providing insightful contributions to classroom discussion, enthusiasm in class learning activities and a willingness to take responsibility and add-value to student-group projects. This is assessed at the end of the semester based on my classroom observations as well as peer (e.g. project group member and audience) evaluations. Highly positive participation can push students above the boundary of two grades. Similarly, negative participation can have the opposite effect.

This year I also will be requiring all students to join in the “Excel Blackbelts” group on LinkedIn. This is a 15,000+ member discussion forum and job board. A good place to network, get off-topic questions answered, and voice specific questions on your projects (questions about homework problems should NOT be posted – such posts will be viewed as a breach of the ethics contract).

Negative participation involves things like talking about non-class issues during class discussion, doing homework in class, not participating in activities, not contributing to group project work, consistently arriving late or leaving early (without informing me ahead of time), etc. Consistent negative participation (again measured by my own observations and reports of your peers) can bring a student's grade down.

Q: Why is this so important?
A: This is not a class of "1" - What you do affects the learning environment of those around you. I want to give everyone the best opportunity to take lessons away from the time they spend in class, and anything that detracts from those opportunities needs to be discouraged. Having said that, again, you will not be penalized for not attending class. If you feel that on certain days you have other priorities or will have a hard time avoiding negative participation of some kind... just don't come in (That's ok). But if you do come to class, come prepared to listen and work.

A final note on in-class demos with Excel: In class I’ll often ask students to open up files I’ve made available (either on-line access from the Cambridge site or the course conference). BEFORE opening a new file, unless instructed otherwise, PLEASE close down the Excel application first (if already open). The entire application, not just a given workbook. In class we will alternate between different Excel settings, some of which will not work well with certain examples. Closing down Excel prior to opening new examples will help avoid functionality errors.
**Course Content in Depth:**

The course is a mix of decision analysis / management science and information systems content. We will be interweaving a host of topics from these fields as we pursue the course objectives.

**From a decision analysis perspective** we will cover various approaches to framing complex management problems, conducting analysis and deriving multi-faceted recommendations for decision makers. The approaches can be roughly divided into three categories:

1. **Managerial Heuristic Applications**
   Many effective approaches to developing good solutions to management problems are fairly simple. This simplicity allows these methods to remain fairly robust to a variety of assumptions (where more complex models based on stricter assumptions may falter). A sampling of the heuristics we will be discussing includes “recognition” (eg. as may apply to investment choice), “shortest processing time” (eg. as may apply to service discrimination), “nearest-next” (eg. as may apply to routing decisions) and “dominance” (eg. as may apply to simultaneous multi-party decision making in general).

2. **Math-Programming and Optimization**
   Given the existence and complex interplay of constraints to decision making, realistic policy prescriptions derived from automated support systems must incorporate any limitations or requirements in decision settings within highly codified decision frameworks. This begins with being able to spell out specifically what requirements for decision making are in place and translating them into mathematical forms that can be used in analysis. Once such limitations are specified, along with the critical decisions that need to be made towards an objective, various tools can be applied to automate a search for intelligent solutions. Building on discussions of Goldratt's theory of constraints, it is also useful to recognize which constraints are most limiting with regards to suggested policy decisions and their anticipated outcomes, and whether additional cost-effective mechanisms exist to bypass such key constraints. We will discuss the processes by which to structure such decision making methods as well as interpret areas for potential outside-the-box approaches to improving them.

3. **Scenario and System Simulation**
   Accounting for uncertainty in managerial problem solving cannot always be easily accomplished by closed form analytics. Simple Monte Carlo-type scenario analysis is just a starting point for discussion here. Ultimately we cover the merger of such simulation with optimization techniques (such as genetic algorithm applications introduced earlier). We also cover the construction and application of "system simulations" wherein the evolution of a simulated business scenario requires multi-period iteration to provide managers with meaningful foundations for interpretation and analysis. Some of the examples discussed involved simulations of inventory re-ordering policies as well as overbooking policies in revenue management contexts. Various approaches to developing, conducting and considering the results of iterative system simulations are discussed here.

Courses with related content at top BBA programs:

* Wharton’s “Advanced Decision Systems” (OPIM319) and "Management Science" (OPIM321);
* Virginia’s “Decision Models” (SYS321) and “Quantitative Analysis (ISBU325);
* Berkeley's "Intro to Management Science" (140);
* U. Michigan’s “Management Science” (OMS301);
* MIT's "Combinatorial Optimization" (18.433);
* Notre Dame’s “Business Problem Solving” (MGT40490).
From an information systems perspective, it informs on various approaches to acquiring, managing and visualizing data.

[1] Data Cleaning and Organization
Discussion relative to a variety of data sets/sources encountered in raw forms from legacy archives or online. Tactics for handling incomplete data sets: omission, replacement (interpolation, extrapolation and bootstrapping basics), consolidation and grouping/clustering as well as other generalized weighted aggregation approaches.

[2] Graphic vs. Tabular Visualization
An introduction to the critical cognitive and interpretative benefits of graphical visualization, as well as approaches to effectively developing visualizations of data that illustrate data, data relationships, managerial options and limitations (constraints) more effectively than that of tabular formats. A discussion of tactics associated with building dynamic graphical visualization to illustrate change to data, relationships and management constraints over time, as well as the interpretability of such visualizations.

[3] Interface Design and Development
Input and output interface structuring to assist in facilitating decision making processes. Object oriented approaches to interface development. Translating functional and decision policy logic into user-friendly system capabilities. Caveats to overly complex interface development and the art of dash-boarding.

Courses with related content at top BBA programs:
Wharton's "Decision Support Systems" (OPIM410) and "Business Computer Languages" (OPIM311); Virginia’s “Programming concepts” (IT327); U. Michigan's "Decision Support with Excel" (BIT311); MIT’s "Structure and Interpretation of Computer Programs" (6.001); Notre Dame’s “Application Development” (MGTI30610).

A quick note on the development environment:
The fact that “Excel” is used as the primary platform for development in this course is nothing more than a matter of convenience, on a number of levels: (1) Most students have Excel freely available to them {at GBS this access is augmented by access to a host of related MS applications through our participation in the Microsoft Academic Alliance Program http://www.bus.emory.edu/software/msdn.html }, (2) Most corporations have Excel available to their workers and already have a legacy of use, (3) Excel is much more and user-friendly and versatile an environment for managerial support system development than a host of other object-oriented development environments. Simply put, Excel is a much more convenient environment within which to illustrate examples and test student skills than would be a more traditional pen-and-paper environment given the specific goals and content of this course.

DISCLAIMERS:
1) This is not a Finance class. So don’t expect us to spend much time with specific financial models (that’s the job of other courses). However, if you do have specific interests in better automating and leveraging those models for practical purposes (eg. for work), I’m in complete support of that and will welcome projects developed to that end or any questions regarding tactics for doing so.
2) If you already have extensive Excel or VB development experience, this class might not be right for you. I'll be spending a bit of time ramping people up to a skill base at which development can take place. Please consult with me personally if you feel you have considerable experience and are unsure whether to participate in the elective.
3) If you are not willing to dive a little into computer programming (which we'll do only very lightly with Macros at the very end of the semester), this course might not be for you. I want to emphasize that NO past programming experience is expected, and that those students who have learned the few key tricks we'll cover in class on Macros have truly appreciated the power these have given them. Please consult with me personally if you feel uncomfortable with the idea of learning a little about these very powerful tactics.
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<tr>
<th>Week</th>
<th>Date</th>
<th>Topics</th>
<th>Readings</th>
<th>Deliverables</th>
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<tbody>
<tr>
<td>1.</td>
<td>Jan 16th (Wed)</td>
<td>The benefits of DSS; Current student domain knowledge/interests; Overview of course</td>
<td>Chapter 1</td>
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<td>2.</td>
<td>Jan 23rd (Wed)</td>
<td>Data Recognition and organization basics</td>
<td>Chapter 2 &amp; Supplement</td>
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<td></td>
<td>Jan 25th (Fri)</td>
<td>Basics graphs for data/relationships</td>
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<td>3.</td>
<td>Jan 28th (Mon)</td>
<td>Creation, interpretation, integration of logic structures</td>
<td>Chapter 3</td>
<td>Quiz #1 (start of class)</td>
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<td></td>
<td>Jan 30th (Wed)</td>
<td>Data linkage and acquisition</td>
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<td>4.</td>
<td>Feb 4th (Mon)</td>
<td>Data compression, simple inference and caveats</td>
<td>Chapters 6 (start)</td>
<td>HW1 (due Thurs, 5pm Feb 7th)</td>
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<td></td>
<td>Feb 6th (Wed)</td>
<td>Model construction and basis of math-programming</td>
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<td>5.</td>
<td>Feb 11th (Mon)</td>
<td>Sensitivity and robustness of optimal prescriptions</td>
<td>Chapter 8 &amp; 7 (start)</td>
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<td>Feb 13th (Wed)</td>
<td>Dealing with non-linearities &amp; multiple objectives</td>
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<td>6.</td>
<td>Feb 18th (Mon)</td>
<td>Frameworks, analysis and interpretation</td>
<td>Chp 7 &amp; Suppl., Chp 8 (start)</td>
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<td>Feb 20th (Wed)</td>
<td>Randomized multi-scenario structuring and execution</td>
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<td>7.</td>
<td>Feb 25th (Mon)</td>
<td>Decision/performance tests; Tabular tool integration</td>
<td>Chp 8 &amp; Suppl., Chp 9 (start)</td>
<td>Quiz #2 (start of class)</td>
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<td></td>
<td>Feb 27th (Wed)</td>
<td>Use of control forms in managing simulations</td>
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<td>HW2 (due Thurs, 5pm Feb 28th)</td>
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<td>8.</td>
<td>Mar 4th (Mon)</td>
<td>Joint use of simulation tactics &amp; optimization</td>
<td>Chapters 9</td>
<td>Outlines (due Thurs, Mar 7th)</td>
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<td></td>
<td>Mar 6th (Wed)</td>
<td>&quot;Surgery&quot; and bottom-up coding; Basic syntax</td>
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<td><strong>SPRING BREAK (Mar 11-15th)</strong></td>
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<td>9.</td>
<td>Mar 18th (Mon)</td>
<td>Conditional action, loops and user-defined functions</td>
<td>Chapter 11 (Chp 12 ref)</td>
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<td>Mar 20th (Wed)</td>
<td>Error handling, non-standard objects and control</td>
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<td>10.</td>
<td>Mar 25th (Mon)</td>
<td>User front-end interface and protection</td>
<td>Chapter 13</td>
<td>Quiz #3 (start of class)</td>
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<td>Mar 27th (Wed)</td>
<td>Finishing touches on packaging/pitching</td>
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<td>11.</td>
<td>Apr 1st (Mon)</td>
<td>Tools for financial simulation, optimization and support</td>
<td>TBD</td>
<td>HW3 (due Thurs, 5pm Apr 4th)</td>
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<td>Apr 3rd (Wed)</td>
<td>Customer service/consulting sim., optim. and support</td>
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<td>12.</td>
<td>Apr 8th (Mon)</td>
<td>Project Labs</td>
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<td>Apr 10th (Wed)</td>
<td>Project Labs</td>
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<td>13.</td>
<td>Apr 15th (Mon)</td>
<td>Presentations (all Project files due)</td>
<td>Final Projects (due Apr 16th)</td>
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<td>Apr 17th (Wed)</td>
<td>Presentations</td>
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<td>14.</td>
<td>Apr 22nd (Mon)</td>
<td>Presentations</td>
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<td>End-of-term Quiz</td>
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<td></td>
<td>Apr 24th (Wed)</td>
<td>Presentations (and end-of-term quiz)</td>
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