BUS 657: Data Analytics and Visualization
Fall 2013 **for Modern Management**

Instructor: Dr. Elliot Bendoly, PhD
Class: Mondays *6:30-9:15* Room: 400
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. The end of semester projects – catered specifically for real-world practice – are intended to demonstrate these competencies.

Required Text

2nd Edition - Excel Basics to Black Belt: An Accelerated Guide to Decision Support Designs
by Elliot Bendoly –2013, 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) and that copies of the 2008 text are floating around however… *Electronic versions, printed-from-electronic version and the 2008 text are **NOT** interchangeable references* (I know as a matter of fact that there are some errors and omissions in the electronic and earlier versions - I don't want to disrupt class flow by having to address these when they come up, so please make sure to get the bound version of the **2013 2nd edition**).

Associated Forums

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

Grading 40% course project, 20% in-class participation/citizenship,
20% assignments, 20% quizzes (*preparation and skill-checks*).

Course Technology

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 all later versions 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

We will also make use of screen capturing technology for the development of project videos (part of the project requirements). Camtasia is available on specific computers in the 4th floor lab, however there may be alternate available packages for free download:

eg. Jing: http://www.techsmith.com/jing.html?gclid=CI2wxaCGhrQCFQixnQodDQkABw
Tipcam: http://download.cnet.com/TipCam/3000-13633_4-10796452.html

Details of Course Grading

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.

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.

Group Projects

Each student will be required to contribute to one group project spanning the duration of the semester**. In contrast to homeworks and quizes, students are expected to collaborate**; ideally groups of 3-4 students per group project.

These group projects can either focus on providing guidance in terms of (***Route-1***) specific solutions (eg. as possible through optimization, simulation, etc.) or (***Route-2***) enhanced data navigation and visualization (eg. as possible through sophisticated used of dynamic tables, heuristics, graphics, live feeds, etc.). Students will also have the choice of focusing on the development of either (***Format-A***) a traditional workbook-based dashboard (w/ embedded tables and graphs), or (***Format-B***) a workbook-independent Excel add-in (see *Expectations on User Interface Development* for examples of each). Group projects that are able to professionally display a combination of these features may 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 can't/shouldn't be automatically equated with, or lead to an expectation of a "higher score".

Regardless of focus, all groups must demonstrate the role of 'variability' in their support system. For projects with a focus on **Route-1**, this might mean incorporating variance/uncertainty in either an optimization search mechanism, a post-analysis robustness comparison or in terms of general descriptive both with numbers and graphics. The latter could also be used in projects focusing on ***Route-2***, as can a demonstration of robust fool-proofing against tool misuse, and built-in customizability of data depicted and graphics displayed.

Project grades are broken into four key deliverables:

(a) Project Outline, (b) Working Application, (c) In-class Presentation, (d) YouTube Videos

Project Outlines

Decisions on the specific format of the project (workbook or add-in) won't likely be possible until students gain sufficient exposure to course material. However, I want groups to think about the general theme of their projects early on. To motivate that, all groups will first develop a project outline. To get groups started, it will be useful for students to select a specific management problem *"class"* for study (eg. human resource management, facility location/supply network modification, order/customer scheduling, strategic/tactical opportunity/threat identification, performance and performance-trajectory monitoring etc. – whatever students find appealing). In selecting a project, I encourage students to leverage work experiences and/or Emory club experience, where available. I also encourage students to build on GBS course work and other class projects they have been involved with.

For that "class" of problems, your group will be expected to provide a document with the following elements:

1) OVERVIEW: Briefly describe your intended tool (a few sentences), including your intended focus on either Route-1 or -2, and intended Format-A or –B. Make sure to pinpoint what you see as the primary difficulty(ies) associated with developing decisions for this 'class' of problem, and hence the value of the proposed tool.
2) INTENDED USE: Provide a "story" of how you envision you tool being used (paragraph).
3) KEY FACTORS & DEPENDENCIES: Provide a conceptual sketch of the various relationships assumed between the intended key outputs of your tool, and the factors that might be subject to change by users (or solution search engines).
4) LIMITATIONS: Provide some thoughts on what limitations exist with regards to the extent to which these factors can be reasonably modified by users (or as part of searches).

To further demonstrate your group's understanding of the issues you'll be facing in development, provide at least one of the following items:

5a) DRAFT OF ANALYTICS: A concrete 'model' for optimizing some key decision, or summarizing data, in their context (outlining any applicable mathematical notation is strongly encouraged here).
5b) DRAFT OF VISUALIZATION: A concrete outline for how you intend to better organize/visualize data/results (a computer-drawn sketch of a draft interface is encouraged here).

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. It should include a tentative TITLE for their proposed application (3 words max). The format of the outline should be 5 sections outlined descriptions of each of the elements (1-6) listed above.
This outline will be due on Oct 10th at the start of class or before (without exception).

***** Projects that are OFF LIMITS ***** (ie. DON'T do these):

1) Projects that involve any of the following genres: Dietary/meal planning, Sports team or Fantasy league management, Personal finance management, personal trip or event/dining planning, College search.
2) The development of one-shot consulting solutions – These are intended to be 'repeated use' tools, not one-point-in-time solutions to an existing problem. Make sure your design is for multiple practical use.
3) The development of nothing more than a forecast – Forecasts can help form the basis of decision support but I do not want forecasting to be the main part of the deliverable (take a forecasting class).

Working Applications

The primary project deliverable (the decision support tool submitted on a CD (or via email IF < 5 MB)- *please make sure it runs as expected off of another computer!*) will be due near the end of the semester (Dec 2nd). The evaluation criteria listed on the next page should be taken into consideration when designing and developing your tool. In terms of general content and functionality, the tools must make use of at least two data manipulations (eg. heuristic, optimization, simulation, query, data cleaning, drill down, etc.). 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 other 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.

With your submission, please also feel free to include soft-copies of any additional documentation you feel would be helpful in clarifying your application's use. The quantity and form of such paper-work is all up to your own discretion. If you don't feel any documentation is needed aside from what is embedded in your system, ie. that your tool is sufficiently straightforward for a user new to it, that's great – ultimately it's your call.

In-Class Presentation

Teams will present their applications in-class during one of the two designated presentation dates of the course (see last page of syllabus). 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 (15minutes), 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.

Video Walkthroughs and Pitches

Teams will also be expected to create 2 YouTube videos. The 1st will be a **walk-through** of their tool. This should predominantly be a screen capture presentation of how their application is intended to be used (between 4 and 8 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 (20-40 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".

In the 4th floor lab, Camtasia software is available on select computers. Possible alternatives may include:
Jing: http://www.techsmith.com/jing.html?gclid=CI2wxaCGhrQCFQixnQodDQkABw
Tipcam: http://download.cnet.com/TipCam/3000-13633_4-10796452.html
Such software allows for continuous screen capture capabilities with voice-over recording, as well as editing to create video files that can be posted to YouTube for my viewing (if you wish to share with others, that's your option). These videos serve several purposes: 1) Creating them gives you practice for your in-class presentations; 2) They serve as back-up presentations to me (and others perhaps) in case of technical difficulties during your "live" presentations; 3) They can be used as a virtual component of your personal vitas.

YouTube links should be e-mailed to me *NO LATER than 5pm on the Friday of the first week of presentations*

How your group's working application and presentation will be evaluated:

Both your final tool and presentation will be evaluated by the following criteria. Your peers and professional sitting as guest judges in the audience will use these factors in providing their ratings of your work. I will take those ratings into

consideration, but ultimately I will be making my own assessment. Nevertheless, it the following criteria should be used as a check-list when developing your tool and presentation:

Problem Characteristics

- Is the problem a difficult one to deal with in the absence of a computerized tool?
- Is the problem realistically depicted (w.r.t. what is specified in the functionality of the tool)?

Output Characteristics

- Can the outputs provided be generally viewed as applicable in practice?
- Are the outputs provided likely to encourage repeated subsequent use by the target user(s)?
- Is any uncertainty/variability regarding the data/assumptions taken into account by the tool?
- Is any error/robustness/sensitivity associated with potential outputs described?

System Components

- Are at least 2 separate graphical displays (eg. charts and graphs) of data used? (*Note: Pivot tables don't count here, though graphs based on their summary contents do count*)
- Are at least 2 types of data manipulations used (eg. a heuristic, Solver, query, data clean, data redux via pivot-table filters, simulation comparisons, MapPoint's router, other optimization methods, etc.)?
- Is there a direct (and clear) way for users to change specifics/parameters/constants assumed in the problem's depiction?
- Are at least 2 types of controls/forms present to assist users in the main interface (eg. pull-downs, click boxes, etc.)?

Organization Issues

- Is there a clear presentation of recommendations or data summaries made by the system?
- Does the use of any controls, pop-ups and dialogue windows appear intuitive from a user's perspective?
- Is there a clear effort to make use of cell labels, object labels, graph axis titles, activation buttons and controls, macro and VB variable labels (if such are obviously used)?

Group Knowledge

- Understanding of the Problem targeted
- Understanding of the Outputs generated
- Understanding of the System "components" (eg. how the components work together)
- Understanding of the Limitations of the system

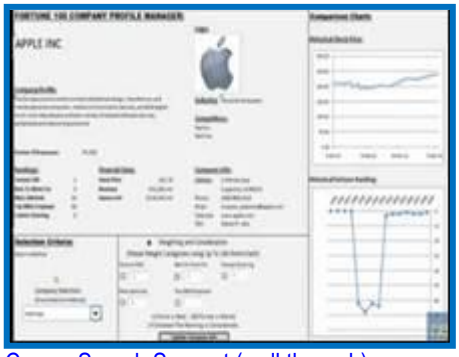
Expectations on interface development:

Although the aesthetics of the interface are not a direct concern of mine, the interface should be user-friendly and to that extent will require some conscious effort on the part of the group to ensure that controls and results are easy to locate and view in a logical and easily interpretable manner. *On the following pages* are some screen shots of past projects that were able to provide both the level of rigor in back-end data-management, calculations and automation while still providing what would be expected of a professional front-end interface.

Route-1 Examples: Workbook-based Applications *(others at http://experimental-instruments.com/Gallery.htm)*

Physician Patient Support (walkthrough)

Channel Management Support (walkthrough)



Career Search Support (walkthrough)

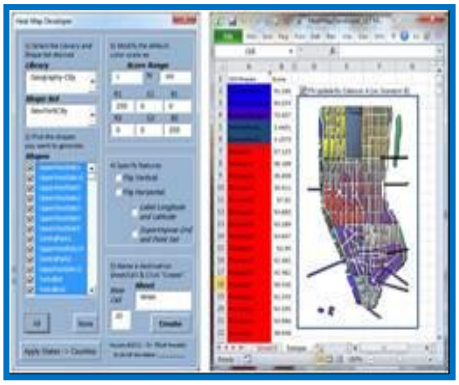
Production Planning Support (pitch)

Facility Location Support (walkthrough)

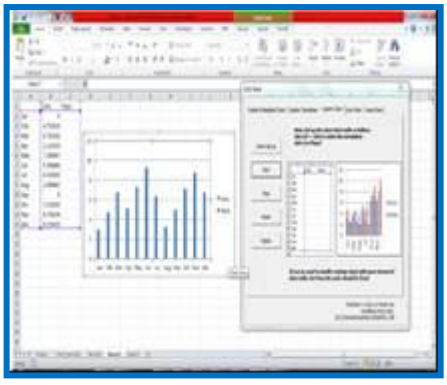
Exercise Routine Support (pitch)

Route-2 Examples: Workbook-independent Add-ins *(others at https://sites.google.com/site/exceladdinsdirectory/home/main-directory)*

BiNCIP: Bivariate Normal Confidence Interval Plotter



Heatmap Developer Add-in



ClickPlot Add-in

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 20,000+ 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.

To that end, all students are required to sign the class's Ethics Contract (provided by email or online conference) and submit a signed copy to me within the first week of class (preferably the first day). Without a signed contract I will not be able to assign any points to assignments (ie. scores on quizzes and homeworks will be "0"). Signing of the ethics contact is also part of the total participation grade in this course.

Q: Why is this so important?
A: This is not a class of "1" - ***What you do effects 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.

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 on-line. 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.

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.

Week	Calendar Date	Topics	Readings	Deliverables
0 - Foundations for Decision Support and the Development Environment	*Following a survey of the general skill set of the students, I'll offer a "ramp" session on the aftenoon of Friday, Sep 6th (also listed below : 4-5pm room TBD for those needing it). We'll discuss some necessary basics on reference & tools in spreadsheet environments*		Chapter 1 & Chapter 2	
1 - Basic Logic & Data Acquisition	Aug 28th (Wed)	Overview of course; Creation, interpretation & use of logic structures; Data linkage and acquisition	Chapter 2 & Supplement	
No Class Sep 2nd (Mon), Labor Day				
**** Optional Ramp Session Sep 6th (Fri) 4-5pm, Room TBD***				
2 - Data Acquisition, Inference & Modeling Basics	Sep 9th (Mon)	Data compression, simple inference and cavaets Model construction and basis of math-programming	Chapter 3 & 6 (start)	***Quiz #1 (start of class)***
3 - Analytics of Optimization in DSS	Sep 16th (Mon)	Sensitivity and robustness of optimal prescriptions Dealing with non-linearities & multiple objectives	Chapter 6 & 7 (start)	**HW1 (due Wed Sep 18th 5pm)**
4 - Complex-Dynamic Optimization	Sep 23rd (Mon)	Frameworks, analysis and interpretation Randomized multi-scenario structuring and execution	Chp 7 & Suppl., Chp 8 (start)	
5 - Simulation Analysis & Control	Sep 30th (Mon)	Decision/performance tests; Tabular tool integration Use of control forms in managing simulations	Chp 8 & Suppl., Chp 9 (start)	*Quiz #2 (start of class)*
6 - Simulation Optimization & Intro to Programming Syntax	Oct 7th (Mon)	Joint use of simulation tactics & optimization "Surgery" and bottom-up coding; Basic syntax	Chapters 9 & Chp 11 (start)	**HW2 (due Wed Oct 9th 5pm)** ***Outlines (due Oct 10th Midnight)***
No Class Oct 14th, Fall Break (Oct 14th-15th)				
7 - Advanced Use of Automated DS	Oct 21nd (Mon)	Conditional action, loops and user-defined functions Error handling, non-standard objects and control	Chapter 11 (Chp 12 ref)	
8 - Leveraging User-Friendly Design	Oct 28th (Mon)	User front-end interface and protection Finishing touches on packaging / pitching	Chapter 13	*Quiz #3 (start of class)*
9 - Project Lab Intensives	Nov 4th (Mon)	Time devoted to on-hands project development and instructor assistance on technical issues		HW3 (due Mon Nov 4th 5pm)
10 - Project Lab Intensives	Nov 11th (Mon)	Time devoted to on-hands project development and instructor assistance on technical issues		
11 - Final Quiz	Nov 18th (Mon)			
No Class Nov 26th, Thanksgiving Break (Nov 28th-29th)				
12 - Final Presentations	Dec 2nd (Mon)	*Presentations (all Project applications due start of class)*		***Projects (Apps due Nov 18th start of class; YouTubes due*)***
13 - Final Presentations	Dec 9th (Mon)	*Presentations*		***End-of-term Quiz***