The University of Chicago
Booth School of Business
Managerial Decision Modeling
36106-01/81
Subject to Change

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Office Hours: Tuesday 2:30 PM - 3:30 PM, Wednesday 1:00 PM - 2:30 PM, or by appointment.

Canvas Website: https://canvas.uchicago.edu/courses
Course Website: http://faculty.chicagobooth.edu/kipp.martin/root/htmls/coursework/36106/36106.html

Teaching Assistant: Kevin Chen (hongfan.chen@chicagobooth.edu)

Required Reading


2. Course Packet. See the Canvas Site.

Required Software


2. The Palisade Corporation product DecisionTools Suite. This includes the Excel add-ins: Precision Tree, @RISK, and RiskOptimizer. This is available to students registered for this class at the class Canvas site. This software may prove useful in other Booth courses.
Hardware and Software Issues

1. You must have a laptop for this course. It is essential to bring your laptop to class every week.

2. As a Mac lover and user, I find this bullet point painful. *You must be Windows compatible.* The Decision Tools Suite is *not* compatible with the Mac version of Microsoft Office. If you are a Mac user I recommend installing and using VMWare Fusion. I do not own a Windows machine and I use VMWare Fusion to develop the cases and examples for this class. Therefore Mac users should be safe with this option.

Course Learning Objectives

1. Learn how to *structure* decision problems. In industry many extremely important decisions are made without clearly identifying the decision alternatives and relevant costs. In this class we will learn how to add structure to a problem by clearly identifying relevant variables, parameters, and sources of uncertainty.

2. Learn how to move from structuring a problem to actually building a mathematical model. Identifying the relevant variables, parameters, and sources of uncertainty is critical, but once this is done it is necessary to put this structure into an appropriate mathematical model. In this class we will learn about optimization models, decision tree models, and simulation models.

3. Learn how to incorporate uncertainty into the model. Virtually every decision problem involves uncertainty to some degree. It is important to understand which parameters can be treated as deterministic and which must be modeled using stochastic tools.

4. Learn how to analyze the model solution. Examine how robust the solution is, and how sensitive the results are to the model inputs.

5. Learn to use Microsoft Excel as the platform for model building, solution, and analysis. Microsoft Excel is one of the most widely used modeling and data analysis tools. In addition to standard Excel tools such as Goal Seek and Data Table, you will use learn to use important Excel add ons such as Solver, Precision Tree, @RISK, and RiskOptimizer. These tools can also be used in other Booth classes.
6. Learn how to apply spreadsheet modeling to important application areas such as finance, resource allocation, risk analysis, operations, marketing, and economics.

**Midterm and Final Review Sessions**

1. Tuesday, October 24: 5:00 PM - 7:00 PM, Booth 455 Room 132
2. Tuesday, December 5: 5:00 PM - 7:00 PM, Booth 455 Room 132

**Course Prerequisites**

Previous or concurrent exposure to statistics at the level of 41000, to financial accounting at the level of 30000, and microeconomics at the level of 33001 is helpful, but not required. Although the example models discussed in this class cross many functions of business, little background in those areas is required. Some basic financial and statistical concepts such as NPV (Net Present Value), mean/variance of random variables, cash flow and income statement, etc. are used in examples and assignment problems in the class. I will briefly review these concepts when necessary, and more importantly, I will demonstrate how these concepts are used in Excel. If you are not familiar with these concepts, you must be willing to put in extra effort.

I assume that you have some familiarity with Excel 2010. However, one does not have to be an Excel expert to benefit from the course. Knowing how to enter and copy simple formulas involving relative and absolute cell addresses, how to use general-purpose Excel functions (for example, the If() function) and how to draw different types of graphs in Excel is sufficient. To insure that your Excel skills are sufficient for the class, please review Appendix 1 and Chapter 3 in the Powell and Baker textbook before the first day of class.

**Review Material from Powell and Baker:**

- Appendix 1
- Chapter 3
Reading Outline

Week 1 (September 22)  Course policies and outline. Introduction to Spreadsheet Modeling. Introduction to Optimization.

- Spreadsheet engineering
- Excel Scenario Manager
- Breakeven analysis and Excel Goal Seek
- Excel Data Table
- NPV
- Josh Hamilton the $125 million man
- Install Solver
- Introduction to Optimization
- Optimal Resource Allocation
- Maximizing click-through revenue

Reading:

- Chapter 1, Sections 1.1-1.3
- Chapter 2, Sections 2.1-2.2
- Chapter 4, Section 4.3.2, Sections 4.4-4.6
- Chapter 9, Sections 9.1 and 9.2

Week 2 (September 29)  Linear Optimization Models

- Covering Problems
- The Diet Problem
- Cash Flow Matching
- Call Center Staff Allocation
- Sensitivity Analysis
Reading: Chapter 9, Sections 9.3-9.6, 9.8, Appendix 9.1

Week 3 (October 6) Network and Integer Programming Models

- Airline Revenue Management
- Integer Programming Models
- Capital Budgeting
- Covering Models with Binary Variables
- Internet Combinatorial Auctions

Reading:

- Chapter 11, Sections 11.1-11.3

Week 4 (October 13) Integer Programming Models Continued

- Modeling Fixed Costs
- Supply Chain Management
- Facility Location

Reading:

- Chapter 10, Sections 10.1-10.5
- Chapter 11, Sections 11.4-11.6

Week 5 (October 20) Nonlinear Models

- Basic concepts
- Portfolio optimization
- Corporate Average Fuel Economy (CAFE) Regulations
- Install the Palisade Corporation product DecisionTools Suite
- Begin Decision Analysis
- Decision Making under Uncertainty
• Sequential Decision Making

Reading:

• Chapter 8
• Chapter 13, Sections 13.1-13.3
• “Decision Analysis” by George Wu

Week 6 (October 27) Midterm Week

• Midterm Week – No Lecture

Week 7 (November 3) Finish Sequential Decision Making under Uncertainty, Begin Monte Carlo Simulation: Part I

• Decision Tree Sensitivity Analysis
• Software Installation: @RISK
• Simulation Basics
• Simulating Cash Flows
• Simulation Goal Seek

Reading:

• Chapter 14, Sections 14.1 - 14.3

Week 8 (November 10) Monte Carlo Simulation: Part II

• Multiple Simulations (RiskSimtable)
• Airline Overbooking
• Corporate Valuation
• Compound Distributions

Reading: Chapter 14, Section 14.4

Week 9 (November 17) Monte Carlo Simulation: Part III
• Probability Distributions
• Selecting a Distribution Based on Data
• How Many Trials?
• Generating Correlated Stock Returns
• Exchange Rate Simulation
• Municipal Bond Bidding (St. Bernard Case)

Reading: Chapter 14, Sections 14.6-14.8

Week 10 (December 1) Monte Carlo Simulation Plus Optimization
• Modeling the 2014 race for the US Senate
• How to Marry Optimization with Simulation
• Optimal Procurement for the US Navy
• Simulating a Stock Portfolio
• Managing Downside Risk
• VaR and CVaR

Reading:
• Lecture Notes

Note: There is no class November 24 due to a University holiday.
Homework Policy

Here is the homework policy in detail. If you do not feel comfortable with this policy I suggest you register for another section of this course.

1. This homework may be done in groups, not to exceed size four.

2. You **may not** discuss the homework assignment with anyone not in your group. You may not transmit or receive any written or electronic information about the assignment to other students not in your group.

3. Submit your Excel workbook file(s) to Canvas. Yes, submit the Excel workbook file(s), not just screenshots. Also submit to Canvas a pdf of the hard copy described in Item 4. The Excel spreadsheet and the pdf of the hard copy must be submitted to Canvas. You therefore must submit a pdf file **plus** your Excel workbook files to Canvas.

4. Please turn in a hard copy at the **beginning** of class with a screen shot of your spreadsheet and a brief description of what you did; for example, include a brief description of your key calculations and formulas. Explain the logic behind your model development. For a mathematical optimization model explain your objective function and constraints. It is important to submit the hard copy of your pdf so the TA does not have to print off copies for every group.

5. Submit only **one** electronic and **one** hard copy per group.

6. **Critical:** enter the name of every group member on the hard copy and somewhere in your spreadsheet. Please clearly indicate on the hard copy which group member submitted the assignment to Canvas.

7. Homework **must be turned in when it is due.** Your homework must be uploaded to Canvas by 9 PM on the Friday when the homework is due.

8. **No late homework is accepted.** Canvas will **not accept a homework after it is due and the entire group will receive a zero for a late homework.** See the calculation of the due date in Item 7. If you request to be exempt from this policy for any reason
(e.g. other commitments, travel, broken Internet connection, crashed hard drive, stolen laptop, etc.) I will reply with: “I realize this is going to make you understandably unhappy, but I have to establish a deadline and I have to treat everyone the same regardless of reason for homework being submitted late. Unless the deadline is enforced then it becomes meaningless. In other words, no.”

9. If you have any question regarding how to work the homework (e.g. valid assumptions to make, etc.), please email me with your questions and **NOT** the TA. However, if you have a question about how your homework was graded please first email and ask the TA. If you are not satisfied with the answer I will resolve any disputes.
Grading

There is a midterm, homework sets, and a final exam. These components have the following weights.

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Midterm</td>
<td>30%</td>
</tr>
<tr>
<td>Homework</td>
<td>30%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>40%</td>
</tr>
</tbody>
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The midterm is Friday, October 27 from 1:30 PM - 4:30 PM Section 01 and 6:00 PM - 9:00 PM for Section 81. The final exam is Friday, December 8 from 1:30 PM - 4:30 PM Section 01 and 6:00 PM - 9:00 PM for Section 81.

The midterm and final exam are open book, open notes. Please do not ask to have the midterm rescheduled or taken at another time. You may not take the midterm later in the class period. You must take the midterm promptly at the beginning of class. If you miss the midterm the weight is added to the final (i.e. the final counts for 70% of your grade). I strongly suggest you do not miss the midterm. This is a very dangerous option.

Attendance: Class attendance is extremely important. To master the material and apply these techniques in the real world requires full participation in class and goes beyond what is covered in homework and exams. You are permitted to miss two classes with no penalty. For each missed class thereafter your grade will be reduced by 3%.

Your grade is determined using the percentages given above and is final. There is no opportunity for extra credit projects, etc. for raising a grade you do not find satisfactory.

Regrading Policy

If you feel that your exam/homework was not graded correctly and wish to submit your work for regrading the following procedures must be followed.

1. All work must be submitted for regrading within two weeks from the date that it was returned.

2. You must indicate which questions you feel were graded incorrectly and clearly explain why you feel your answer is correct. This must be communicated in writing, not verbally.
3. Your entire exam/homework will be regraded with special emphasis on the questions you feel were not correctly graded. Thus, something that was overlooked before may now be discovered and your new adjusted score could be lower than before.

4. The amount of partial credit awarded on a question is a judgment call. As in baseball, judgment calls cannot be protested. Therefore you may not resubmit your work for the purpose of obtaining more partial credit.

**Other Issues:**

1. Students in this class are required to adhere to the standards of conduct in the Booth *Honor Code* and the Booth Standards of Scholarship. The Booth *Honor Code* also requires students to sign the following Booth Honor Code pledge, “I pledge my honor that I have not violated the *Honor Code* during this examination,” on every examination and homework.

2. Booth has established that the upper bound for a class grade point average is 3.33. Please realize that there are different grade combinations that result in a 3.33 and it is necessary to make tradeoffs. For example, an A and a B- average out to 3.33 and two B+ scores average out to 3.33. In the former case the B- student is unhappy. In the latter case the student who feels he/she deserves an A is unhappy. There may also be section-to-section variation and not every section will necessarily have a 3.33 average.

3. This course may not be taken pass/fail. Audits are not allowed.

4. I will address you by your first name, please feel free to address me by my first name. If you do not feel comfortable with that, Professor Martin also works.

5. Attending class is important. If you have to miss more than two classes you should consider taking this course when you have more time.

6. Provisional Grades: if you are graduating this quarter and are making reasonable progress, I will assign a D for an early grade. You are required to take the final exam. After you take the final exam, I will adjust your grade. If you are graduating early you must take the midterm.
7. Please attend the section for which you are registered. If an important conflict arises such as job interview you may attend another section. However, because of how we use Canvas you must take both the midterm and the final with the section for which you are registered.

8. Yes, I know you want to start Winter break early. However, you may not take an early final exam in order to get an early start on your Winter break. If you need to start your Winter break before the scheduled final exam, please do not take the course. Let me repeat, the final exam will not be given early.

9. Material covered in Week 10 will be on the final exam. Week 10 is 10% of the quarter.

10. The University of Chicago is committed to ensuring the full participation of all students in its programs. If you have a documented disability (or think you may have a disability) and, as a result, need a reasonable accommodation to participate in class, complete course requirements, or benefit from the University’s programs or services, please contact Student Disability Services as soon as possible. To receive a reasonable accommodation, you must be appropriately registered with Student Disability Services. Please contact the office at 773-702-6000/TTY 773-795-1186 or disabilities@uchicago.edu, or visit the website at disabilities.uchicago.edu. Student Disability Services is located at 5501 S. Ellis Avenue.

If you have an approved accommodation from Student Disability Services that you plan to use in this course, please contact Academic Services (AcademicServices@lists.chicagobooth.edu) as soon as possible. Academic Services will provide support to you and your instructor and coordinate the details of your accommodations on your behalf.
Additional Reading

Title: Competing on Analytics: The New Science of Winning
Author: Thomas H. Davenport, Jeanne G. Harris
Edition: First edition
Publisher: Harvard Business School Press
ISBN: 978-1-4221-0332-6

Title: Super Crunchers: Why Thinking-by-Numbers is the New Way to be Smart
Author: Ian Ayres
Publisher: Bantam Books
ISBN: 978-0-553-38473-4

Title: The Flaw of Averages: Why we Underestimate Risk in the Face of Uncertainty
Author: Sam Savage
Publisher: Wiley

Title: The Numerati
Author: Stephen Baker
Publisher: Houghton Mifflin Company
ISBN: 978-0-618-78460-8

Title: Microsoft Office Excel 2010: Data Analysis and Business Modeling
Author: Wayne L. Winston
Edition: Third edition
Publisher: Microsoft Press
ISBN: 978-0-7356-4366-9

Title: Financial Modeling
Author: Simon Benninga
Edition: Third Edition
Publisher: MIT Press
ISBN: 0-262-02628-7

Title: Practical Management Science
Author: Wayne Winston and S. Christian Albright
Edition: Fourth
Publisher: South-Western Cengage Learning
ISBN: 978-1-11-53132-7