INFO I590: Introduction to Business Analytics Modeling
BUS C534: Simulation & Optimization for Business Analytics
Spring 2017

Instructors

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Modeling: An Overview

The area of business decision making using analytical models has been in existence since the late 1940s with the development of Operations Research as a discipline. This area encompasses a wide range of problem-solving analytical techniques and methods that have been applied to improve decision-making and efficiency. Some of the techniques and tools used in modeling include optimization, forecasting, simulation, statistics and probability, queuing theory, game theory, and decision analysis. Because of the complexity and computational nature of these fields, modeling in many ways has strong ties to computer science as well.

The challenge for modelers in practice is often trying to determine which techniques and tools are the most appropriate for a given problem. In many situations, several different techniques may be used for a particular problem. The quality of the results will depend on the assumptions and the applicability of the techniques in that situation. Thus, it is important to have a solid working knowledge of a range of these analytical techniques.

Course Outline and Objectives

This course is designed to provide a foundation in the use of modeling techniques in managerial decision-making. The course will cover three separate areas of modeling – forecasting, computer simulation and optimization. Computer simulation will be introduced and we will follow up on more advanced aspects of the topics in this course.
In particular, we will concentrate on input and output analysis for simulation models. In optimization, we will cover several different areas including linear programming, integer programming, nonlinear programming and genetic algorithms. We will also spend two weeks on forecasting and cover a broad overview of key forecasting techniques.

**Upon completion of this course, students should be able to:**

- Understand how analytical techniques and tools are used to provide solutions to operational problems in various business functional areas including finance, economics, operations, and marketing.
- Develop analytical models to analyze various business problems.
- Recommend sound solutions to complex business problems based on the results of their analysis.
- Solve complex problems using analytical techniques and tools on spreadsheets using various spreadsheet based add-ins. These include using Excel Solver for linear and integer programming problems, StatTools for statistical analysis, and @RISK for probabilistic simulations and risk analysis.

**Software, Books and Other Materials**

**Software:**

We will use Microsoft Excel for most of the analytical and modeling work in this course. Excel 2010; 2013 or later will work fine.

If you do not have a copy of Excel, you can download a copy from the IUWare site at no cost:

[http://iuware.indiana.edu/](http://iuware.indiana.edu/)

Indiana University has a license agreement with Microsoft and other vendors that provides IU students access to a range of products. So, any product on this site can be downloaded for use by you since you are an IU student.
Textbook and other materials:

We will use the following textbook in the course:

**Practical Management Science Fourth Edition** by Wayne L. Winston and S. Christian Albright  ISBN 9781111531317-This is an older edition (hopefully saves you some $$$)

This book has lots of excellent examples and cases. Also, the book emphasizes the use of spreadsheets and various “add-in” programs. We will start with add-ins and then expose you to other packages. It is an older edition and used copies work just fine!

Additional materials will be provided as needed.

Class Communications

Email communication:

We are still adapting to the new course management system (Canvas) and have found some features that make communication less efficient. One of these features is the messaging system inside of Canvas. Therefore, we request you EMAIL US DIRECTLY (not inside of the messaging system). Our email addresses are: dblocher@indiana.edu; rcutshal@indiana.edu Email both of us simultaneously and the first available will reply to you.

Simply put C534 or I590 in the subject line to help us out. We hope to resolve some of the issues with the messaging tool, but for now we prefer this approach.

We will also use Adobe Connect for online lecture sessions. There will be one online session each week. The online sessions have been scheduled for every Tuesday at 8:00 p.m. US Eastern Time. (except exam weeks) The first evening chat session will be held on **Tuesday, March 7th** at 8:00 p.m. US Eastern Time. The URL for all chat sessions will be:

http://connect.iu.edu/c534/

The online sessions are primarily lecture/tutorial sessions where we work either through a problem or a topic. The sessions are not mandatory but are highly recommended. Also, all sessions are recorded so you can always go back to review them.
Assignments

There will be a total of five assignments for credit. These will be spaced at regular intervals so that they will due approximately once every two weeks. You will be required to submit your assignments electronically through Canvas. All assignments have to be turned in on time and are due at midnight (Eastern Time) on the due date. There will be a penalty of 10% per day for turning in an assignment late.

Tentative schedule (due dates are Midnight each date)

HW1 Due March 19
HW2 Due April 9
HW3 Due April 23
HW4 Due May 7
HW5 Due May 21---*this is a HARD DEADLINE to allow solutions to be published for exam preparation

Grading

The assignments will count for 40% of your grade. You may work with another partner on the assignments. We will leave it up to you to select your own partner. Please note that the maximum number of people on a team can only be two. If you choose to work by yourself, that is fine too. The problems for each assignment will be posted on the Canvas site well in advance of the “official” assignment date.

There will be two exams, one in Week 7 covering the first half of the course and one in Week 12 covering the second half. The exams will be given online and are worth 60% of your grade. **YOU CANNOT WORK TOGETHER ON THE EXAMS!**

Class grades will be based on the homework assignments and the exam. The final score (Out of 100) will be translated into a letter grade based on the following scale:

- Above 90% A (A or A-)
- 80% to 90% B (B+, B or B-)
- 70% to 80% C (C+, C or C-)
- 60% to 70% D (D+, D or D-)
- Under 60% F

Please note that historically the breakpoint between an A and A- has been at around 95%. Similarly, the breakpoint between a B and B- has been at around 85%. These breakpoints could be lower, depending on the difficulty of the assignments and the exams.
Class Schedule and Readings

The class schedule outlined here provides an overview of the topics that will be covered in the course. Then, for each topic, we will provide a detailed outline of the readings, cases, examples and assignments in Canvas. We will also include in this outline all the important issues that you need to know for that topic. These outlines will be provided two weeks in advance.

Week 1: March 6-12  
**Optimization: Linear Programming - Introduction to Optimization**

This topic provides an overview of optimization techniques, particularly Linear Programming (LP). These techniques are used to arrive at optimal decisions. Linear Programming problems are solved using specialized packages. We will use Excel Solver (an Excel add-in) for this part of the course.

Possible Applications: Revenue management, financial management decisions, logistics, aggregate planning and price optimization.

Readings: Chapter 3: Pages 67-117

Week 2: March 13-19  
**Optimization: Linear Programming Continued**

Readings: Chapter 4: Pages 163-169, 188-194

Week 3: March 20-26  
**Optimization: Network Models and the Branch and Bound Algorithm**

Chapter 5: Pages 228-248

Week 4 March 27-April 2  
**Optimization: Integer Programming**

This topic covers optimization models where integer solutions are required. Integer programming provides wide ranging modeling capabilities but at the expense of computing effort. Several different models will be covered including the fixed charge, location and set covering models. An extension of this model is the mixed integer programming model where only some of the variables have to be integer.

Possible Applications: Marketing promotion optimization, production planning, and manpower scheduling.
Non-linear optimization addresses problems where the objective function has a non-linear form.

Possible Applications: Facility location, portfolio optimization, advertising response models and pricing.

In this part of the course we will cover how an Artificial Intelligence technique known as genetic algorithms can be used to enhance the linear, integer, and non-linear programming models discussed above. The evolutionary solver add-in to Excel will be used to solve such models.

Possible Applications: Transportation scheduling, routing, sequencing, manpower scheduling, revenue management, and price optimization

This part of the course will cover forecasting techniques. A range of models will be covered including qualitative models, decomposition models, exponential smoothing models, and more advanced regression-based models.
This chapter provides an overview of simulation models. Simulation models allow making inferences about decisions by using a computer model that imitates real-problem situations. The simulation models explicitly incorporate uncertainties as input quantities. The simulation varies these input quantities and keeps track of the output quantities of interest, to show an entire distribution of results. Since variation is present in every decision-making scenario, simulation allows us to make tradeoffs between risk and reward instead of relying on a single bottom-line result. @Risk is an Excel add-in package. Its features will also be demonstrated using examples.

Week 11: May 15-21
Simulation and @RISK

Readings: Chapter 10 Pages 587-602

This week we will cover special areas in simulation such as input and output analysis models. We will also present simulation models associated with Marketing, Finance, and Operations.

Week 12: May 22-26
Second Exam Week
APPENDIX

Kelley School of Business Assurance of Learning requirement

There are several key goals and objectives that we would like to accomplish with this course. In general, this course directly addresses the Kelley Direct MBA program Student Learning Objective 2, “Enable and make decisions based upon collection, appraisal, and analysis of data.”

In the table below, our more specific course objectives are stated, along with their alignment to the higher level goals of the Kelley Direct MBA Program Student Learning Objectives (SLOs).

<table>
<thead>
<tr>
<th>Upon completion of this course, students should be able to:</th>
<th>Which aligns with the Kelley Direct SLO:</th>
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<tbody>
<tr>
<td>1. Understand how analytical techniques and tools are used to provide solutions to operational problems in various business functional areas including finance, economics, operations, and marketing.</td>
<td>SLO 2.5: Build and enable a culture of evidence-based management.</td>
</tr>
<tr>
<td>2. Develop analytical models to analyze various business problems.</td>
<td>SLO 2.3: Model decisions and appraise risk.</td>
</tr>
<tr>
<td>3. Recommend sound solutions to complex business problems based on the results of their analysis.</td>
<td>SLO 2.2: Measure and interpret performance. SLO 2.4: Interpret and communicate analytical conclusions and insights.</td>
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<td>4. Solve complex problems using analytical techniques and tools on spreadsheets using various spreadsheet based add-ins. These include using Excel Solver for linear and integer programming problems, StatTools for statistical analysis, and @RISK for probabilistic simulations and risk analysis.</td>
<td>SLO 1.6: Leverage and integrate technology to enhance efficiency.</td>
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A complete listing of learning goals for the Kelley Direct MBA Program can be found in the Appendix to this syllabus.

As your instructors, one of our responsibilities is to help create a safe learning environment on our campus. Title IX and our own Sexual Misconduct policy prohibit sexual misconduct. If you have experienced sexual misconduct, or know someone who has, the University can help.

If you are seeking help and would like to speak to someone confidentially, you can make an appointment with:

The Sexual Assault Crisis Service (SACS) at 812-855-8900
Counseling and Psychological Services (CAPS) at 812-855-5711
Confidential Victim Advocates (CVA) at 812-856-2469
IU Health Center at 812-855-4011
More information about available resources can be found here:  
http://stopsexualviolence.iu.edu/help/index.html

It is also important that you know that federal regulations and University policy require me to promptly convey any information about potential sexual misconduct known to me to our campus’ Deputy Title IX Coordinator or IU’s Title IX Coordinator. In that event, they will work with a small number of others on campus to ensure that appropriate measures are taken and resources are made available to the student who may have been harmed. Protecting a student’s privacy is of utmost concern, and all involved will only share information with those that need to know to ensure the University can respond and assist.

We encourage you to visit stopsexualviolence.iu.edu to learn more.