University of Pennsylvania - The Wharton School
Department of Operations, Information and Decisions

OIDD 321: Introduction to Management Science

Tentative Syllabus – Spring 2017

Professor Dan Iancu

Office Hours: TBA, Room: JMHH 552, daniancu@wharton.upenn.edu, or by appointment.

Teaching Assistants

TBA (S1), ???@wharton.upenn.edu, Office Hours: TBA, Room: TBA

Course Description

Recent years have witnessed a revolution in the use of data and quantitative solutions for informing (better) business decisions. With the wide availability of Big Data and easy access to vast computational resources, firms across virtually every industry are now using management science tools to inform their actions. How should a coffee store decide its sourcing and roasting strategy? How should an ad platform decide which ads to display where and when? How should a doctor or policy maker recommend a balanced diet that matches a patient's tastes and is not too costly? How should an airline price its tickets and manage its limited capacity? How should an investor decide whether (and how much) capital to inject in a limited number or risky projects? How should a hospital schedule its limited resources to balance the efficiency and workload of the staff? How should a supermarket chain decide where to open new stores, and whether to operate an online store? How should a retailer mark down its merchandise during a clearance sale? If you ever wondered how you could even start answering such questions in a quantitative way, then this is the right course for you!

Course Objectives

The main objective of OIDD321 is to provide basic skills in quantitative modeling, by familiarizing students with the critical steps in an analytical approach to decision-making:

1) constructing a quantitative model that can be used to address a (business) question,
2) implementing the model in software, and
3) using various tools, such as linear, discrete or convex optimization, Monte Carlo simulation, sensitivity analysis, decision trees and dynamic programming to generate and interpret recommendations.

Our core philosophy is that the best way to master these topics is through a hands-on approach. The class is thus taught in a "semi-flipped" format, with classroom time primarily devoted to exercises focusing on a variety of applications drawn from advertising, healthcare, finance, supply chain management, revenue and yield optimization. The instructional medium used is Excel, with appropriate packages for optimization (Solver) and simulation (Oracle Crystal Ball).

Schedule Jan 11 – April 26: (S1) MW 1:30pm–3:00pm, (S2) MW 3:00pm–4:30pm

Location TBA (computer lab)

Textbook There is no required text for the course. Two optional textbooks are:

- *Data, Models and Decisions: The Fundamentals of Management Science* by Dimitris Bertsimas and Robert Freund (ISBN 978-0975914601)
- *Spreadsheet Modeling and Decision Analysis* by Cliff T. Ragsdale, 5th Edition, Cincinnati: South-Western College Publishing, 2007.

Several copies are on reserve at Lippincott Library. Neither option is ideally suited for the purposes of our course, but they provide good references for the future. All relevant materials, cases, and assignments will be uploaded on the class website, in Canvas.

Canvas site The Canvas site will serve as the official course repository, from which you can download all the relevant materials for each class, as well as solutions to homework problems, relevant software, etc.

Software Every student should have access to Microsoft Excel (versions 2013 or 2016 for Windows, and 2011 or 2016 for Mac). Excel under Mac can be used for optimization (classes 1-8 and 12), but Windows Excel or lab computers will be needed to run Oracle Crystal Ball for simulation (classes 9 -11). This software will be available on computers in the lab, and licenses will be available for download through Canvas. We encourage you to download your copy as soon as possible.

Tentative Schedule

#	Day	Date	Topic	Prepare before class
1	Th	12-Jan	Basics of model building in Excel.	Read handout on "Data Table in Excel".
2	Tu	17-Jan	Advanced modeling. Multi-stage problems. Good modeling practice.	Read "Family Financial Plan" mini-case and look over the provided template.
3	Th	19-Jan	Formulating and solving linear optimization (LO) problems.	Read Sections 1,2,3 of the "Introduction to LO" handout, and watch video tutorial on LO.
4	Tu	24-Jan	Advanced applications of LO.	
5	Th	26-Jan	Modeling nonlinear objectives using LO.	Read "Marine Weekly" mini-case.
R1	F	27-Jan	Review session: linear optimization (TBA)	
6	Tu	31-Jan	Network optimization 1. Assignment 1 due.	Read TBA
7	Th	2-Feb	Network optimization 2.	Read TBA
8	Tu	7-Feb	Sensitivity analysis.	Watch video tutorial on sensitivity analysis, read Section 4 of LO tutorial.
9	Th	9-Feb	Large-scale LO and sensitivity analysis.	Read "BlueSky Airlines" mini-case
10	Tu	14-Feb	Introduction to discrete linear optimization (DLO).	Read "Capital Investment" mini-case.
11	Th	16-Feb	Additional applications of DLO (1).	Read TBA
R2	F	17-Feb	Review session: linear discrete optimization (TBA).	
12	Tu	21-Feb	Additional applications of DLO (2). Assignment 2 due.	Read "Whole Wallet" mini-case
13	Th	23-Feb	Advanced modeling using DLO.	Read TBA
14	Tu	28-Feb	Nonlinear optimization.	Read TBA
15	Th	2-Mar	Convex optimization.	Read TBA
		TBA	Project Proposal Due	
-	*TR*	*7,9-Mar*	*Spring Break – no class*	
16	Tu	14-Mar	Optimization Review 1.	Read TBA
17	Th	16-Mar	Optimization Review 2. Assignment 3 due.	Read TBA
		TBA	QUIZ (TIME: TBA, LOCATION: TBA)	
18	Tu	21-Mar	Getting started with Crystal Ball.	Watch video on "Introduction to Monte Carlo Simulation in Crystal Ball".
19	Th	23-Mar	Monte-Carlo simulation.	Read the "Blue Sky Under Uncertainty" mini-case.
20	Tu	28-Mar	Advanced Monte-Carlo simulation. Flaw of Averages.	Read the "Pure Spring Beer A" mini-case.
21	Th	30-Mar	Advanced simulation.	Read the "Pure Spring Beer A and B" mini-case.
22	Tu	4-Apr	Introduction to Dynamic Optimization and Decision Trees.	Read "Decision Trees" handout, watch video tutorial.
23	Th	6-Apr	Decision Trees Continued	Read the "Dynamic Pricing" mini-case.
R4	F	7-apr	Review session: advanced LO, sensitivity (M109, 5-6PM).	
24	Tu	11-Apr	Dynamic programming 1	Read TBA
25	Th	13-Apr	Stochastic and Robust optimization. Assignment 4 due.	Read TBA
		TBA	Final Project Report Due	
26	Tu	18-Apr	Final Project Presentations	
27	Th	20-Apr	Final Project Presentations	
28	Tu	25-Apr	Final Project Presentations	

Blue – optional review session Black – regular class session TBA – to be announced Red – assignments / exams

General Outline and Class Format

The course follows a "flipped-classroom" format. Class time is devoted primarily to hands-on exercises, done individually or in teams of two, under the supervision of the teaching staff. Formal lecturing only covers new concepts that are difficult to grasp "on-the-fly" or through a brief self-study done before coming to class.

The typical format for every session will follow three basic steps:

1. Students will identify their teammates and sign in using a Google Doc.
2. All students/teams will be given some amount of time to read through a mini-case describing a business problem, and implement a model that answers several questions. The teaching staff will be available throughout this time to answer any questions, help with model building, etc.
3. Several teams may be asked to briefly discuss their modeling approach and their answers. **This is not a graded component of the course.** It is perfectly OK (and, in fact, very helpful!) to have flaws in the model, as the best way to learn modeling is by "debugging" and understanding the potential errors that could be made.
4. The professor will then introduce a correct version of the model, spending some time on the key novel concepts. This will be followed by a brief discussion of the main insights / "take-aways".

How to Prepare Before Coming to Class?

In preparation for class, you will be required to read a short handout and/or watch a video (details will be posted in advance on the Canvas site). The goal of these materials is to get you up-to-speed with some elementary concepts, or to familiarize you with the case that will be modeled and discussed during class. **During class time, we will expect all of you to be familiar with the prepare materials, and may "cold-call" to ensure that is the case.**

On the more difficult cases, you may also find it helpful to attempt building the model by yourself or with your teammate, *before* class. While **this is not a formal requirement**, it may be highly beneficial in following the classroom discussion and assimilating new ideas in real-time.

Laptop Policy

Since classroom activities heavily rely on computers, you are encouraged to bring your own laptop to class. However, we will ask that you keep the laptop lid closed while there is formal lecturing.

Assignments

There are **4 assignments** in total. Each will be **released on Canvas**, and should be **turned-in via the Canvas "Assignments" tab, by 9:00am on the due date**. **Late submissions are not allowed.**

You are free to discuss the assignments and solutions **with other students in the class**, but you are **required to submit your own solution** through Canvas. Each assignment will be specific about what you must turn in, but you will generally have to submit Excel Workbooks showing all the relevant models, and containing explicit answers to each question. Your materials should be complete, legible, and concise, but there is no need to polish them for presentation.

Note. In deciding whether to work with other students, you should bear in mind that the best way to test your understanding is to first try out the problem(s) yourself. Therefore, we highly suggest first attempting to solve the assignment alone, partaking in all the steps: reading/parsing the case, thinking about the various modeling elements, structuring the model in Excel, and solving it. Consulting classmates for hints certainly makes sense if you find yourself getting repeatedly stuck and unable to make any progress, but remember that the best way to master the skill is to practice it by yourself!

Review Sessions

The course schedule contains several review sessions. These are entirely ***optional***, and are run by the teaching staff in order to review material already presented in class (no new concepts or ideas are introduced). Students are invited to bring their laptops to these sessions, so that we can conduct additional hands-on exercises. Prior to each session, we may post study problems on Canvas. To make the best use of the time, you should read and think about these problems before coming to the review. Solutions will be posted on the course website following the session.

Online Evaluations

An anonymous evaluation survey will be available online after the first few sessions. The information is used to continuously improve the class, and to adjust the pace and depth of the material, so we highly encourage you to provide feedback!

Grading

Four components are factored into your course grade: the assignments, the quiz, class participation, and the final project. Their relative weights are as follows.

Assignments	25 points
Quiz	30 points
Final Project	30 points
Class Participation	15 points

Final Project

The final project can be done in teams of four-five students. You should start brainstorming project ideas early, as the project proposal is due just before spring break. A report and a final presentation will also be required.

Class Participation

Students are expected to attend all regular class sessions. If extraordinary circumstances prevent you from attending a class, you should notify your instructor by email in advance, and submit any assignment **by the due deadline**. Two absences will not affect your grade, but three or more will. Tardiness to class or extensive excursions during class will also affect your grade.

During class, you may be called on to discuss particular issues from the prepare materials. If unusual circumstances prevent you from making a good-faith effort to prepare, and you do not wish to be called on in class, you should notify the instructor by email, in advance. More than one such occurrence will result in a reduction of the class participation grade.

Acceptable Use Policy

It is important for every student to understand the following policy:

> *The use of any materials prepared in a previous iteration of OIDD 321 or a similar course, irrespective of when that course may have been taught (e.g., in a different year, in a different quarter, at a different school, etc.), is **strictly prohibited**. This includes (1) any notes, spreadsheets, or handouts distributed by faculty in a prior iteration of OIDD 321 or similar courses, and (2) any notes, solutions, or spreadsheets prepared by former students of OIDD 321 or similar courses, in either written or electronic form.*

In view of this policy, you should not solicit or use solutions to previous cases or assignments. This includes posting/downloading to/from web sites. The reason for this policy is that access to previous years' materials severely diminishes the value of the learning exercise, and can create serious inequities between fellow students, jeopardizing the integrity of the academic environment. Since we operate under an honor code system, we expect you to obey this policy.