University of Pennsylvania – Wharton School
Operations, Information and Decisions

OIDD 321: Introduction to Management Science

Tentative Syllabus – Fall 2019

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Office Hours: Thu 4:30-6:30pm, JMHH 557

Teaching Assistants

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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 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 of 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 answer 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	Aug 27 – Dec 5: TR 9-10:30am (001), 10:30am-12pm (002), 1:30-3pm (003)
Location	JMHH 380
Canvas site	You can download all relevant materials for each class, including reading material, cases, solutions to homework problems, software, etc.

Software Every student should have access to Microsoft Excel (versions 2013 or 2016 for Windows, and 2011 for Mac). Excel under Office for Mac 2011 can be used for optimization, but Windows Excel or lab computers will be needed to run Oracle Crystal Ball for simulation (classes 17-18, 21-23). 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. *Using Solver under Office for Mac 2016 can generate errors in models. If you run into issues, consider either downgrading to an earlier version of Office (2011), or using lab computers.*

Tentative Schedule

#	Day	Date	Topic	Prepare before class
1	Tue	8/27	Basics of model building in Excel.	Read "Data Table in Excel"
2	Thu	8/29	Advanced modeling. Multi-stage problems. Good modeling practice.	Read "Family Financial Plan" mini case.
3	Tue	9/3	Advanced modeling continued. 3D data tables.	Read extended "Family Financial Plan".
4	Thu	9/5	Formulating and solving linear optimization (LO) problems.	Read Sections 1-3 of the "Introduction to LO" handout.
5	Tue	9/10	Modeling nonlinear objectives using LO.	Read "Marine Weekly" mini-case.
6	Thu	9/12	Advanced applications of LO.	Read "Apple Distribution" mini-case.
7	Tue	9/17	Supply chain management & sensitivity analysis.	Read Section 4 of LO tutorial.
-	Tue	9/17	Assignment 1 due.	-
8	Thu	9/19	Large-scale LO and sensitivity analysis.	Read "BlueSky Airlines" mini-case.
9	Tue	9/24	Network optimization.	Read "Littlestown Waterworks" mini-case.
10	Thu	9/26	Quiz 1.	-
11	Tue	10/1	Introduction to discrete optimization.	Read "Capital Investment" mini-case.
12	Thu	10/3	More discrete optimization.	Read "Operating Room Scheduling" mini-case.
13	Tue	10/8	Advanced modeling with binary variables.	Read "Whole Wallet" mini-case.
-	Tue	10/8	Assignment 2 due.	-
-	Thu	10/10	*Fall Break – no class.*	-
14	Tue	10/15	Modeling with binary variables continued.	-
15	Thu	10/17	Portfolio and nonlinear optimization.	Read "Beating the Market" mini-case.
16	Tue	10/22	Ridesharing dispatch, surge pricing.	Read "Uber" mini-case.
-	Tue	10/22	Project proposal due on Canvas.	-
17	Thu	10/24	Optimization review.	
18	Tue	10/29	Quiz 2.	-
19	Thu	10/31	Getting started with Crystal Ball.	Read "Introduction to Monte Carlo Simulation in Crystal Ball" handout.
20	Tue	11/5	Monte Carlo simulation.	Read the "Blue Sky under Uncertainty" mini-case.
-	Tue	11/5	Assignment 3 due.	-
21	Thu	11/7	Advanced Monto-Carlo simulation. Flaw of averages.	Read "Pure Spring Beer A and B" .
22	Tue	11/12	Simulation optimization.	Read "OptQuest" handout.
23	Thu	11/14	Intro to decision trees.	Read "Decision Trees" handout.
24	Tue	11/19	Decision trees continued.	Read "Dynamic Pricing" mini-case.

25	Thu	11/21	Decision trees and dynamic optimization.	Read "Out-of-the-Money Option" mini-case.
26	Tue	11/26	Final project presentations.	-
-	Tue	11/26	Assignment 4 due.	-
-	Thu	11/28	*Thanksgiving Break – no class.*	-
27	Tue	12/3	Final project presentations.	-
28	Thu	12/5	Final project presentations.	-
-	Thu	12/5	Final project report due.	-

General Outline and Class Format

The course follows a "flipped-classroom" format. Class time is devoted primarily to hands-on exercises (individuals or teams of two) under the supervision of teaching staff. Students learn new concepts through a brief self-study before coming to class. The typical format will be:

1) Students identify their teammates and sign in using a Google Doc.
2) All students/teams will be given some time to read through a mini-case, 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 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 common mistakes.
4) The professor will then introduce a correct version of the model, spending some time on key novel concepts. This will be followed by a brief discussion of the main insights / "take-aways".

How to Prepare Before Coming to Class?

You will be required to read a short handout (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 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.

Laptop Policy

You are welcome to bring your own laptop to class instead of using the lab computer. However, you should keep your laptop 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 8:00am 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!

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: assignments, quizzes, class participation, and the final project. Their relative weights are as follows.

Assignments..... 20 points
Quizzes ..... 40 points
Final Project ..... 30 points
Class Participation..... 10 points

Final Project

The final project can be done in teams of 4-5 students. You should start forming a team, and brainstorming potential project ideas. The project proposal is due on Tuesday, October 22, and should be roughly two pages long. A final report of roughly 5 pages and a 15-minute final presentation in class will be due at the end of the semester.

The topic of the project is entirely of your choice! There is no formal requirement regarding the application area or the scope. You should see this as an opportunity to explore in more depth an idea or a problem that you find interesting and/or relevant. One way could be to start with an application discussed in class, and build a more detailed model – e.g., by adding realistic considerations/constraints, capturing different objectives and trade-offs, using real data, etc. But you could also explore a problem that we did not discuss at all! Your final report should provide enough detail for someone to be able to understand: (a) the problem that you are addressing, (b) the mathematical model that you formulated to address this problem, (c) the methods / techniques used to solve this model, and (d) a brief discussion of the summary and recommendations coming from your analysis. Your write-up should not exceed 5 pages (excluding any supporting Excel files).

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 date. 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.

Class materials adapted from Prof. Dan Iancu (Stanford GSB).