University of Pennsylvania – Wharton School
Operations, Information and Decisions

OIDD 321: Introduction to Management Science

Tentative Syllabus – Spring 2023

Professor Hamsa Bastani (hamsab@wharton.upenn.edu)

Office Hours: TBD

Teaching Assistants

Arielle Anderer (aanderer@wharton.upenn.edu), Head TA, Office Hours: TBD
Lionel Schatz (sslionel@sas.upenn.edu), 10:15am Section, Office Hours: TBD
Katie Yang (yangkt@wharton.upenn.edu), 12:00pm Section, Office Hours: TBD

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 "blended" format, with both asynchronous learning (through recorded videos by the instructor) and small-group synchronous learning where students apply these methods to problems in advertising, healthcare, finance, supply chain management, revenue and yield optimization. We use Excel, with packages for optimization (Solver) and simulation (Oracle Crystal Ball).

Schedule	Sep 1 – Dec 8: MW 10:15-11:45am (001), 12:00-1:30pm (002) EST
Location	JMHH 380
Textbook	There is no required text for the course.
Canvas site	You can download all relevant materials for each class, including reading material, cases, solutions to homework problems, etc.

Software Every student should have access to Microsoft Excel (versions 2013 or 2016 for Windows, and 2011 for Mac). We will use Oracle Crystal Ball for simulation, but this software will only be made available on Wharton computers (or from your laptop through Wharton Virtual Lab). *Using Solver under Office for Mac can generate errors in models. If you run into issues, consider using Wharton's virtual computers.*

Tentative Schedule

#	Day	Date	Topic	Prepare before class
1	Wed	1/11	Basics of model building in Excel.	Read "Data Table in Excel"
-	Mon	1/16	No Class: MLK day	-
2	Wed	1/18	Advanced modeling. Multi-stage problems. Good modeling practice.	Read "Family Financial Plan" mini case.
3	Mon	1/23	Advanced modeling continued. 3D data tables.	Read extended "Family Financial Plan".
4	Wed	1/25	Formulating and solving linear optimization (LO) problems.	Read Sections 1-3 of the "Introduction to LO" handout.
5	Mon	1/30	Modeling nonlinear objectives using LO.	Read "Marine Weekly" mini-case.
6	Wed	2/1	Advanced applications of LO.	Read "Apple Distribution" mini-case.
7	Mon	2/6	Supply chain management & sensitivity analysis.	Read Section 4 of LO tutorial.
-	Mon	2/6	Assignment 1 due.	-
8	Wed	2/8	Large-scale LO and sensitivity analysis.	Read "BlueSky Airlines" mini-case.
9	Mon	2/13	Industry Guest Lecture	-
10	Wed	2/15	Network optimization.	Read "Littlestown Waterworks" mini-case.
11	Mon	2/20	Introduction to discrete optimization	Read "Capital Investment" mini-case.
12	Wed	2/22	More discrete optimization.	Read "Operating Room Scheduling" mini-case.
13	Mon	2/27	Advanced modeling with binary variables.	Read "Whole Wallet" mini-case.
-	Wed	2/22	Assignment 2 due.	-
14	Wed	3/1	Industry Guest Lecture	-
-	Mon	3/6	No Class: Spring Break	-
-	Wed	3/8	No Class: Spring Break	-
15	Mon	3/13	Modeling with binary variables continued.	Read extended "Whole Wallet" mini-case.
16	Wed	3/15	Ridesharing dispatch, surge pricing.	Read "Uber" mini-case.
-	Wed	3/15	Project proposal due on Canvas.	-
17	Mon	3/20	Portfolio and nonlinear optimization.	Read "Beating the Market" mini-case.
18	Wed	3/22	Optimization review.	-
-	-	3/26-3/28	Take-home quiz.	-
19	Mon	3/27	*Take-home quiz – no class.*	-
20	Wed	3/29	Getting started with Crystal Ball.	Read "Introduction to Monte Carlo Simulation in Crystal Ball" handout.
21	Mon	4/3	Monte Carlo simulation.	Read the "Blue Sky under Uncertainty" mini-case.
-	Mon	4/3	Assignment 3 due.	-
22	Wed	4/5	Monte Carlo simulation with Python.	-

23	Mon	4/10	Intro to decision trees.	Read "Decision Trees" handout.
24	Wed	4/12	Decision trees continued.	Read "Dynamic Pricing" mini-case.
25	Mon	4/17	Decision trees and dynamic optimization.	Read "Out-of-the-Money Option" mini-case.
26	Wed	4/19	. Final project presentations.	-
-	Wed	4/19	Assignment 4 due	-
27	Mon	4/24	Final project presentations.	-
28	Wed	4/26	Final project presentations.	
-	Sun	4/30	Final project report due, no class.	-

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. **This will be the primary component of the class participation grade.** The teaching staff will be available to answer any questions, help with model building, etc.
3) 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 occasionally be required to read a short handout before class (details will be posted in advance). The goal of these materials is to familiarize you with key concepts required to solve the mini-case.

The class mini-case will also be posted in advance. You may find it helpful to read over the mini-case and to think about a potential modeling approach by yourself *before* class.

Assignments

There are 4 assignments in total. Each will be released on Canvas and should be submitted via the Canvas "Assignments" tab, by 8:00am Eastern Time on the due date. Solutions will be released on the assignment due date so late submissions will receive zero credit.

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. Please follow the assignment style guide provided on Canvas > Handouts to ensure full credit.

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. Consult classmates for hints if you find yourself getting repeatedly stuck, but remember that the best way to master the skill is to practice it by yourself!

Quiz

There will be one take-home quiz through Canvas that can be taken on the virtual computers or your personal laptop. The quiz will be 4 hours long and can be taken in any single session within a 3-day window.

This is an "open-notes" exam, and you may use any course material from the current OIDD 321 Canvas web site only. You may **NOT** use any other material or consult with or accept help from anyone during this exam. Please follow the university honor code.

Online Evaluations

We will send out an anonymous evaluation survey mid-semester. The information is used to continuously improve the class, 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..... 25 points
Quiz ..... 30 points
Final Project ..... 30 points
Class Participation..... 15 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 Wednesday, October 27, 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 punctually attend **all** in-class sessions; we have a no-questions-asked policy for missing or being late to three classes (excluding the first two weeks), but missing or being late to additional classes will reduce your participation grade. However, given the circumstances surrounding COVID-19, please email the head TA **before class** for alternative arrangements if you are feeling unwell or suspect exposure.

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 MBA course on Optimization and Simulation Modeling from the Stanford Graduate School of Business.