University of Pennsylvania – Wharton School
Operations, Information and Decisions

OIDD 321: Introduction to Management Science

Tentative Syllabus – Fall 2020

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Office Hours: TBD

Teaching Assistants

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Note: this course will be fully online and follow a blended format (read below for details).

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 10: TR 9-10:30am (001), 10:30am-12pm (002), 1:30-3pm (003) EST
Location Remote Instruction

Canvas site You can view all relevant materials for each class, including class videos, 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 the Wharton virtual computers, and licenses will be available for download through Canvas. *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 Wharton's virtual computers.*

Tentative Schedule

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

24	Thu	11/19	Decision trees and dynamic optimization.	Read "Out-of-the-Money Option" mini-case.
25	Tue	11/24	Researcher guest lectures (healthcare, sustainability).	-
-	Tue	11/24	Assignment 4 due.	-
-	Thu	11/26	*Thanksgiving Break – no class.*	-
26	Tue	12/1	Final project presentations.	-
27	Thu	12/3	Final project presentations.	-
28	Tue	12/8	Final project presentations.	-
-	Thu	12/10	Final project report due, no class.	-

General Outline and Class Format

The course will be fully online and follow a blended format. Students are required to look over posted class materials and instructor recordings ahead of class. To adjust for this time commitment, in-class sessions will start 20 minutes later than the scheduled start time and will only last 60 minutes. In-class sessions are devoted to solving mini-cases in teams of three, under the supervision of teaching staff. The typical format will be:

1) Before class, students will independently read a mini-case and start thinking about a modeling approach.
2) Upon arrival to class, students will be randomly assigned to teams. Please arrive on time to facilitate this process. The teaching staff will be available throughout class time to answer any questions, help with model building, etc.
3) At the end of class, teams will submit their completed cases through Canvas. These will be graded based on completeness/effort rather than correctness. **This will be the primary component of the class participation grade.** It is perfectly OK to have flaws in the submitted model, as the best way to learn modeling is by "debugging" and understanding common mistakes.
4) After class, the professor will post a video that introduces a correct version of the model, spending some time on key novel concepts. Students should review and understand this material before the next class.

How to Prepare Before Coming to Class?

You will be generally required to read the mini-case for that class and start thinking through a modeling approach (adjust your efforts to ensure that you successfully complete and submit the case by the end of class). You should also watch the instructor videos and review solutions pertaining to previous cases so that you are caught up on key concepts.

Occasionally, you will be required to read a short handout (details will be posted in advance). The goal of these materials is to get you up-to-speed with some elementary concepts.

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 EST 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 ..... 25 points
Final Project ..... 25 points
Class Participation..... 25 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 Thursday, 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 in-class sessions. If extraordinary circumstances prevent you from attending a class, you should notify your TA by email in advance, and submit the in-class case by the end of your regularly scheduled class time. Two missing case submissions will not affect your grade, but three or more will. Regular tardiness to class will also affect your 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.