

Syllabus Q4 2024

OIDD 6430

Analytics for Revenue Management

Class Schedule and Room: Tue/Thu 1:45-3:15pm, JMHH 350

Instructor

Noah Gans

Office Hours: Mon 4:30-6pm, Wed 12-1:30pm

Location/Zoom link on Canvas

Email: gans@wharton.upenn.edu

Teaching Assistant

Alison Kwok

Office Hours: Mon/Wed 1:45-3:15pm

Location/Zoom link on Canvas

Email: alisonkw@wharton.upenn.edu

Course Overview

In the 1980's, Yield Management revolutionized the airline industry. Since then, the tactical use of forecasting and optimization tools to squeeze more revenue out of scarce operational capacity has spread widely. This approach – in what has come to be known as revenue management (RM) or pricing and revenue optimization (PRO) – is now actively used in a range of industries, including various forms of passenger and cargo transportation, media and communication services, hospitality, sports and performing arts, and retailing.

RM thrives in industries in which: 1) short-run operating capacities are fixed and perishable; and 2) for which there is some element of demand elasticity that can be estimated and used to extract more revenue out of that limited capacity. In some cases, demand elasticity comes from the identification of higher-paying segments of the general population for whom capacity can be reserved. Early “yield management” models developed by the airlines identified business customers as favored and reserved capacity them. In other cases, companies can use broader estimates of price elasticity of demand to dynamically change prices in response to changing forecasts of potential capacity-demand imbalances. This approach is the core of the dynamic markdown management tools used by fashion retailers.

This course introduces you to the essential concepts and techniques required to understand and implement RM. This approach, in part, represents the tactical implementation – day-by-day or even moment-by-moment – of classical demand estimation and capacity allocation models whose origins can be found in applied microeconomics and marketing. But the need for repeated, rapid cycles of estimation and optimization has driven the development of a set of analytical tools that are particularly well suited for RM, and in this course we will focus on those tools.

Prerequisites

Students who have already taken OIDD 6120 and STAT 6130 should be well equipped for the class. Other students should have a solid understanding of elementary probability, statistics, and constrained optimization.

- Your background in probability and statistics should include an understanding of random variables, measures of central tendency and variation, sample statistics, and regression.
- Your background in constrained optimization should include an understanding of the algebraic formulation and spreadsheet implementation of simple linear programs (LPs), as well as shadow (dual) prices.

For questions regarding the specifics of your background, please contact me.

Syllabus Q4 2024

Related Courses

Managerial Economics (MGEC 6110) and Marketing Management (MKTG 6110) introduce core notions of customer segmentation and price discrimination. Pricing Policies (MKTG 7540) considers the estimation of willingness-to-pay and markdown policies in a broader strategic context. Operations Strategy (OIDD 6150) highlights the connection between capacity reservation, overbooking, and the newsvendor model. Applied Probability Models in Marketing (MKTG 7760) introduces complex structural models of consumer behavior, and forecasting (STAT 7110) covers a wide range of models that can be of value when forecasting demand.

Course Materials

All course materials are either downloadable from Canvas

<https://canvas.upenn.edu/courses/1776734>

or class handouts. Readings marked [SN-XX] are available from Study.Net, through Canvas.

There is no required textbook. For optional reference texts, I recommend the following books:

- Phillips (2005). *Pricing and Revenue Optimization*, Stanford University Press.
- Talluri and van Ryzin (2004). *The Theory and Practice of Revenue Management*. Springer.
- Gallego and Topaloglu (2019). *Revenue Management and Pricing Analytics*, Springer.
- Roberts (2022). *Hotel Revenue Management*, Business Expert Press.

Review Materials on Random Variables, Linear Programming, and Heat Maps

I have posted on Canvas three review videos, along with associated notes and Excel files. Two of the videos provide refreshers on the basics of random variables (RVs) and of linear programs (LPs). You should review the material on RVs before class 2 and the material on LPs before class 9. The third video is an optional review of how you can create heat maps in Excel.

To use the review materials, download PDF notes and Excel files from the relevant subdirectory within Canvas/Files/Materials for Video Reviews. Then go to the analogous subdirectory within Canvas/Class Recordings/Review Videos and, as you watch the video, follow along with the notes.

Course Requirements and Grading

Course grades will be based on a weighted average of the scores earned for class attendance, in-class participation, short homework exercises, case-homework assignments, and a final quiz.

Class Attendance	10%
In-Class Participation	5%
Short HW Exercises	25%
Case HW Assignments	30%
Final Quiz	30%

Attendance

On-time attendance is mandatory. At the start of each class, I will take attendance using Canvas's aPlus+ Attendance module. Please make sure you have access to Canvas/aPlus+ during class via a web page or an app on your phone/tablet. For instructions on how to use the app, follow this link: <https://support.wharton.upenn.edu/help/aplus-canvas-students>.

Syllabus Q4 2024

Absences from class will affect your attendance score as follows:

Number of Absences	0	1	2	3	4	≥ 5
Attendance Points	10	10	9	7	4	0

In-Class Participation

In-class participation points reflect my qualitative judgment concerning your effective contribution to the class. You should be attentive to class discussions. Your comments should be constructive, and they should respond to and “push forward” what is happening in class.

Policy on Electronics in the Classroom

I will make hard copy and PDF versions of class notes available before class. If you wish to follow the class notes with a tablet (that lays flat on a table), you are welcome to do so. You should only use tablets to follow class notes, not for other activities.

You can use laptops in two sets of circumstances. The first is that, before a specific class session, I may ask you to bring laptops to be used in class. The second is in response to a specific need for which you obtain explicit permission from me before class. Otherwise, you should shut down laptops and stow them away before class starts.

The only circumstance in which you should be using a phone in class is when checking into aPlus+. Otherwise, please put your phone on silent and stow it away in a bag or pocket before class starts.

Unauthorized use of electronics in class **may be marked as an absence** for that day. Please see the section on Attendance, above.

Short Homework Exercises

There will be five short-homework exercises that, in some cases, prepare you for an upcoming class and, in others, review material we’ve just covered. You will be able to download these from Canvas / Files after class on the day the homework is assigned, and you should **enter your answers into a Canvas Quiz by 1:15pm on the day the homework is due**. You may discuss the assignments with others, but your quiz answers must be your own. Late submissions will be penalized.

Case-Homework Assignments

There are three longer, case-homework exercises associated with cases we’ll cover in class. I will count the best 2 scores toward your final grade.

For each case, I will post on Canvas a set of questions to be answered. There is no need to write up the case as a memo, and you may answer the questions one at a time. Nevertheless, your answers to case questions should be crisp and complete. I will judge your answers based on the depth, clarity, and care with which you present them.

You should do these cases with a partner, and I have set up Case HW groups on Canvas where you and your Case HW partner can form a group. The first Short Homework asks you to sign up and report who your partner is. You and your partner should hand in one write-up for the two of you. **You should upload your write-up, along with any associated Excel (or other) files with analysis, to Canvas by 1:15pm on the day the homework is due. Late submissions will be penalized.**

Syllabus Q4 2024

Final Quiz

On **Tuesday April 23rd 1:45-3:15pm**, an in-class, open-book quiz will cover the tools and concepts developed in class. No electronics will be allowed during the quiz, but you will be able to bring your own written notes and printouts of whatever is posted on Canvas and Study.Net this quarter.

Homework and self-study problems will give you a good idea of the kind of questions you can expect on the quiz. In the last week of class, I'll also distribute a sample quiz that you can also use to practice for the final quiz.

While you may prepare in groups for the quiz, the notes you use during the quiz must be your own. Similarly, the work performed on the quiz itself must be your own.

Use of ChatGPT and Its Relatives in Case Write-Ups

There is no prohibition on your using ChatGPT or related platforms as you answer Case HW (or other) questions, but my initial tests suggest that these platforms are not (currently) analytically sophisticated enough to provide you with coherent answers. Once you answer a question, you might try running your answer through ChatGPT to see if the platform helps you to clarify your writing. **If you do use ChatGPT, you must explain what you asked it and explicitly point to the elements of your answers that it produced.**

Self-Study Exercises

Course materials include ungraded self-study exercises designed for practice in using the course's analytical models to solve problems. Exercises and solutions are posted on Canvas / Files.

I suggest you work in pairs on the self-study exercises. Having a partner will help to ensure that you do the work on a timely basis. You are also likely to find that discussing the problem with another person helps you in the learning process.

Class Schedule

Below is a summary listing of class topics, due dates, and classes to which you should bring laptops. To prepare for a session, go to the relevant "Prepare for Class XX" Canvas Assignment.

Class	Date	Topic	Video Review	Short HW	Case HW	Bring a Laptop
1	3/12	Intro, Customer Valuation Game				
2	3/14	Optimization for Statistical Estimation	RVs	#1		
3	3/19	Demand Estimation + Pricing: NYHC			#1	
4	3/21	Estimation with Censored Data		#2		
5	3/26	Segmentation and Peak-Load Pricing				
6	3/28	Dynamic Pricing Using DP		#3		
7	4/02	Dynamic Pricing Game: Retailer			#2	✓
8	4/04	Guest Speaker: Dave Roberts				
9	4/09	Capacity Allocation and Control	LPs			
10	4/11	No-Shows and Overbooking		#4		
11	4/16	Large Networks, Real-Time Control		#5		
12	4/18	Capacity Mgmt. at Harrah's, Wrap-up			#3	