OIDD 643
Analytics for Revenue Management

Students enrolling in OIDD 643 in Q4 2019 must attend the first class session and take the final exam at its regularly scheduled time (+ place), Wednesday May 8th, 12-2pm.

Class Schedule and Room
TR 3pm-4:30pm, JMHH 345

Instructor
Noah Gans
Office Hours: MW 4:30-6pm, JMHH 564
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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. The yield management models first developed by the airlines identified business customers as favored and reserved capacity for that group by requiring that low-cost fares include a weekend stay. 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 612 and STAT 613 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 and nonlinear programs (LPS and NLPs), as well as shadow (dual) prices.

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

Related Courses

The conceptual foundations for this course lie in Managerial Economics (MGEC 611) and Marketing Management (MKTG 611). These courses provide the basis for understanding core notions of customer segmentation and price discrimination. While the courses provide the background needed to understand the context for the tactical uses of the concepts, they are not needed to understand the specific tools that we will cover in the course.

Two other courses address topics that are central to this course but in a complementary fashion. Pricing Policies (MKTG 754) considers topics – such as the estimation of willingness to pay and markdown policies – in a broader strategic context, rather than with the narrower tactical and computational focus that we'll take. Operations Strategy (OIDD 615) highlights the connection between capacity reservation, overbooking decisions, and the newsvendor model that is central to much of operations management.

Two additional courses provide depth and sophistication to some of the estimation and forecasting issues that are touched on in the course. Applied Probability Models in Marketing (MKTG 776) introduces students to complex structural models of consumer behavior, and Forecasting (STAT 711) covers a wide range of models that can be of value when forecasting demand.

Course Materials

All course materials are either downloadable from study.net

http://www.study.net/

and Canvas

https://canvas.upenn.edu/courses/

or will be distributed in class.

For those who would like to have texts, I recommend:

- R. W. Phillips (2005). *Pricing and Revenue Optimization*, Stanford University Press.
- K. T. Talluri and G. J. van Ryzin (2004). *The Theory and Practice of Revenue Management*. Springer.

Course Requirements and Grading

Course grades will be based on class participation (10%), case write-ups (30%), homework questions (10%), and a final exam (50%).

Class Participation

One half of this grade will reflect basic measures of participation. On-time attendance is mandatory. You are expected to do the pre-assigned readings and to be prepared to discuss the readings in class.

The other half reflects my qualitative judgment concerning your effective contribution to class discussions and dynamics. You should be attentive to the class discussion. Your comments should respond to and "push forward" what is happening in class.

Case Write-Ups

There are three case write-ups, which should be done in groups of 5. Each group should hand in a hard copy of its write-up at the start of the associated class.

For each case, I will post on Canvas a set of questions to be answered. Your group may answer the questions one at a time. While there is no need to write up the case as a memo, 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.

Answers based on *quantitative analysis* should include summary charts or tables that are sufficient to communicate your findings. They should not describe each analytical step. Rather, for each analysis you should include this type of detail in an appendix.

Qualitative questions are often open-ended. Your analysis here should be thorough in its treatment and succinct in its description or explanation of individual points.

Short Homework Exercises

There will be four relatively short homework exercises that, in some cases, prepare you for an upcoming class and, in others, review material we've just covered. **I'll hand out the homework questions in class and ask you to enter your answers into a Canvas Quiz by 12pm on the day the homework is due.** You may discuss the assignments with others, but your answers to the quizzes must be your own.

Self-Study Exercises

The course also includes ungraded self-study exercises that are designed to for you to practice using the course's analytical models to solve problems. I will post sample solutions for the exercises on Canvas.

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.

Exam

An open-book exam will cover the tools and concepts developed in class. The exam will be scheduled by the University and is tentatively scheduled to take place **Wednesday May 8th, 12-2pm.** You must take the exam at the scheduled date and time to pass the course.

Homework and self-study problems will give you a good idea of the kind of questions you can expect on the exam. In the last week of class I'll also hand out a sample exam which you can also use to practice for the exam.

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

Class Schedule

Below is a summary listing of class topics and the due dates for case write-ups.

To prepare for a given session, you should go to Canvas

https://canvas.upenn.edu/courses/

and follow the appropriate link for instructions for the given class.

Session	Topic	HW Due	Case Due
1	Introduction: The Customer Valuation Game		
2	Review of Probability, Statistics, Optimization		
3	NY Health Club: Segmentation, Peak Load Pricing		Case 1
4	Estimating Demand and Willingness to Pay		
5	Coping with Censored Data	HW 1	
6	Dynamic Pricing using Dynamic Programming	HW 2	
7	Retailer: Markdown Pricing		Case 2
8	Capacity Allocation and Booking Limits		
9	Guest Lecture		
10	Capacity Allocation in Large Networks	HW 3	
11	Overbooking		
12	Harrah's Entertainment: Capacity Allocation		Case 3
13	Real-Time Control and Course Wrap-Up	HW 4	