Universität Hamburg

FB Wirtschaftswissenschaften
Institut für Logistik und Transport

Revenue Management – Fall 2006

Lecturer

Joern Meissner, PhD (Columbia Business School)
Personal website: http://www.meiss.com
Email: joe [at] meiss.com

Time and Place

26.10.06, Thursday, 06–08pm, Room 2095/2197
27.10.06, Friday, 06–08pm, Room2095/2197
28.10.06, Saturday, 02–04pm, Room 2095/2197 (will tentatively be moved)
30.10.06, Monday, 06–08pm, Room 2095/2197
31.10.06, Tuesday, 06–08pm, Room 2095/2197
01.11.06, Wednesday, 06–08pm, Room 2095/2197

Course Website

http://www.uni-hamburg.de/fachbereiche-einrichtungen/fb03/ilt/

Course Description

Every firm eventually has to sell its products. Questions that arise in this context are, for example: What sales channels should the firm use? How should a product be priced in the different channels? How can the firm prevent cannibalization across channels? And how should prices be adjusted due to seasonality or after initial demand has been observed? In this course, we focus on how to set the best prices for the offered products, a decision very often linked to the profit performance of a supply chain.

Pricing and revenue optimization – or revenue management as it is also called – focuses on how a firm should set and update pricing and product availability decisions across its various selling channels in order to maximize its profitability. The most familiar example probably comes from the airline industry, where tickets for the same flight may be sold at many different fares throughout the booking horizon depending on product restrictions as well as the remaining time until departure and the number of unsold seats. The use of such strategies has transformed the transportation and hospitality industries, and has become increasingly important in retail, telecommunications, entertainment, financial services, health care and manufacturing. In parallel, pricing and revenue optimization has become a rapidly expanding practice in consulting services, and a growing area of software and IT development, where the revenue management system are tightly integrated in the existing Supply Chain Management solutions.

In this course you will learn to identify and exploit opportunities for revenue optimization in different business contexts. You will review the main methodologies that are used in each of these areas, discuss legal issues associated with different pricing strategies, and survey

current practices in different industries. As the ensuing course outline reveals, most of the topics covered in the course are either directly or indirectly related to pricing issues faced by firms that operate in environments where they enjoy some degree of market power. Within the broader area of pricing theory, the course places particular emphasis on *tactical optimization of pricing and capacity allocation decisions*, tackled using *quantitative models* of consumer behavior (e.g., captured via appropriate price-response relations), demand forecasts and market uncertainty, and the tools of *constrained optimization* – the two main building blocks of revenue optimization systems.

Course Assessment

The course will be assessed by an exam in class (50 minutes duration). The date will be agreed on in class. I suggest that we do it either shortly before or after the Christmas break. I will provide you with a mock exam and will hold an additional review session discussing this exam and answer open questions.

Reading and Lecture Notes

- Phillips, Robert: Pricing and Revenue Optimization, Stanford University Press 2005. Please make sure you order the book immediately, so it is in your possession at the beginning of the class. You can purchase this moderately priced and useful textbook at Amazon, for example:

  http://www.amazon.de/Pricing-Revenue-Optimization-Robert-Phillips/dp/0804746982/

- Further material and lecture notes will be posted on the institute's website. Please check regularly and download the samples Excel files that illustrate the example from the lecture.

Additional optional reading

- Talluri, Kalyan; van Ryzin, Garrett, The Theory and Practice of Revenue Management, Kluwer Academic 2004 (optional alternative reading with a deeper and more mathematical treatment of Revenue Management).

Acknowledgements

This class is based to a large extent on a course created by my doctoral advisor Prof. Costis Maglaras at Columbia Business School.

Detailed course outline

Disclaimers

This is a new course and the area of revenue management is still "hot", hence a lecture on this topic will, for the time being, always be a work-in-progress. While the topics that we will cover and their emphasis will follow what I describe in session 1, I might make small changes on the syllabus along the way (with advance notice).

One Session below is planned for 60 minutes, and I plan to cover roughly 3 sessions on 2 days, but I am flexible and prefer that you understand the concepts that we discuss in depth rather than rushing through the material just for the purpose of staying with my outline. **Your feedback in this process is valuable, and motivates continuous course improvement. Please do not hesitate to let me know, throughout the course, how I can improve the course and the learning experience it provides!**

Session 01

Introduction to Revenue Management

History of Pricing and Revenue Optimization (PRO). Factors driving the PRO boom. Multi-pricing in the airline industry. The workings of a revenue management system.

Preparation for class:

- Read: Background and Introduction (Ch. 1 of book by Phillips)
- Imagine that you are married with two children aged 5 and 9; you live in Cambridge, England, and are planning a family vacation to Barcelona. Your ideal is to leave London Stansted (the London airport most convenient to Cambridge) on Saturday morning, December 02, 2006, and return from Barcelona on Sunday evening, December 10. Visit the easyJet website http://www.easyjet.com/en/book/index.asp to determine the cost of round-trip airfare for your family, assuming that the tickets are purchased immediately. Does the information presented on the website motivate you to adjust your plan? Over the course of the next four weeks you will be asked to re-visit the easyJet website and monitor changes in the price of this vacation.

Session 02

Review of Price Theory

Capturing consumer surplus via differential pricing: personalized pricing, group pricing, versioning, and quantity discounts. Pricing with capacity constraints.

Preparation for class:

- Read: The Pricing and Revenue Optimization Process (Ch. 2 of book by Phillips). You can read through Chapter 2 of Phillips quickly, but be sure you understand what the

pricing waterfall means, and that you know the three "pure" approaches to pricing listed in section 2.3.

- Download: Football Stadium Pricing Problem. Use Solver to determine a profit-maximizing pair of prices (one for students, one for the general public) in the Football Stadium Pricing Problem, given a stadium capacity of 53,000. Also, if you can, determine the marginal value of an additional stadium seat. If a single price must be charged, what is the optimal choice? Is total consumer surplus larger or smaller when a single price is charged? What about profit?

Session 03

Market Segmentation with Differential Pricing

Preparation for class:

- Read: Versioning: The Smart Way to Sell Information (Shapiro and Varian, Harvard Business Review Article, will be posted on the web)
- Read: Cambridge Software Corp. (HBS Case, will be distributed in first class). If Cambridge Software is obliged to launch just one product, which one should it be, and how should it be priced? If several are allowed, which should be launched, and how should they be priced?

Session 04

Models of consumer demand

Models of consumer choice; Reservation prices; Aggregate demand models; Bundling.

Preparation for class:

- Download: Problems on bundling
- Prepare a solution to problem 1 from the Bundling handout.
- Check the easyJet website http://www.easyjet.com/en/book/index.asp to determine the cost of round-trip air fare for the family vacation described in the assignment for Session 1, assuming that the tickets are purchased *today*.

Session 05

Pricing as Constrained Optimization

Preparation for class:

- Read: Pricing with Constrained Supply (Ch. 5 of Phillips book)
- Download: Pricing Problems with Capacity Constraints
- Using Solver, prepare solutions for the Pricing Problems with Capacity Constraints

- Section 5.5 of Phillips introduces the important modeling issue of *diversion*; skim through Problem 7 at the end of the chapter, which serves to reinforce this material.
- Sections 5.5 and 5.6 merit your careful attention: the theme park example developed in section 5.5 is representative of an important application domain, and section 5.6 describes variants of peak-load pricing that are economically important in other industries.

Session 06

Markdown Management

Preparation for class:

- Read: Retailer: A Retail Pricing Simulation Exercise (Broadie and van Ryzin)
- Skim: Markdown Management (Ch. 10 of Phillips book)
- Before Christmas, Wal-Mart was stirring (NYT, Jan 2005)
- Download: The *Retailer* game and its data file (detailed instructions below)
- You may want to browse through the website of Profitlogic, the leader in retail markdown management services (i.e., provider of analytical software and consulting services in this area) at http://www.profitlogic.com/index.htm.
- Instructions related to the simulator called *Retailer* begin on page 7 of the assigned reading. Read pages 7-9 carefully, trying to infer the structure of the model that underlies the simulator (note particularly the footnotes on page 8).
- Download the data file Retailer.xls and, heeding the suggestions offered on pages 8-9 of the assigned reading, analyze this data to extract the information needed to formulate a markdown strategy. (An artificial element of this exercise is that all the items included in the historical data had a list price of $60, which happily is the list price for the item to be considered in the simulation.) Before starting the simulation exercise itself, work out at least a crude markdown strategy based on your data analysis, again paying careful attention to the suggestions offered on pages 8-9.
- Now download the zip file Retail.zip to a new folder called "Retail." Extract all files into this folder and play five iterations of the *Retailer* game, following the strategy you have formulated. (To get started, double click on Retailer.exe, the icon that contains a dollar sign. To begin an iteration click (Re)Start on the menu bar. With a little experimentation it should become clear how the mechanics work.) Come to class prepared to discuss your results, the reasoning behind your strategy, and any second thoughts you may now have about that strategy.
- Check the easyJet website http://www.easyjet.com/en/book/index.asp to determine the cost of round-trip air fare for the family vacation described in assignment for Class 1, assuming that the tickets are purchased *today*.

Session 07

Dynamic pricing

Preparation for class:

- Download: Coconut Rental Car Company. Prepare answers for the questions posed in the Coconut Car Rental Company mini-case.

Today's lecture centers on the subtle and difficult idea of "backward induction," also called "recursive optimization" or "dynamic programming." The assignment below introduces the general method through an example. Answer as many questions as you can, and think hard about the ones that stump you, so you are well positioned to learn from the ensuing class discussion.

Session 08

Capacity Control via Linear Programming

Preparation for class:

- Download: Westbrook Hotel
- Download: Capitol Airlines
- Look at the Hotel Forecasting Data available to download. The data in this file concern reservations and registrations for one-day stays at the hotel's highest daily rate (one of many "rate products" that the hotel sells). The heading at the top of the file and the explanatory note at the end explain the meanings of the various data entries. Be prepared to propose one or more common-sense methods, and at least one more sophisticated method, to forecast the number of room registrations for that same rate product on Monday, December 17, 2001. Think first of how to generate a point estimate, then how to generate a probability distribution.
- Prepare solutions for the Westbrook Hotel and Capitol Airlines problems.

Session 09

Capacity Control with Demand Uncertainty

Booking limits and protection levels. Critical fractile solution of the static allocation problem with two fare classes. Nested booking limits and dynamic booking control; introduction to overbooking.

Preparation for class:

- Read: Introduction to ... Yield Management (Netessine and Shumsky), pp. 34-39
- Read: Revenue Management & Capacity Allocation (Ch. 6 & 7 of Phillips)
- Download: Football Stadium Booking Control

- Prepare solutions for Problems 1-4 in Appendix B of the Netessine-Shumsky article, and be prepared to discuss them in class.
- Prepare solutions for the two questions posed in Football Stadium Booking Control, and come prepared to discuss them in class.
- The last third of this class session will treat the mechanics of dynamic booking control, specifically in an airline setting, discussing the elaborate systems that have been built around a few relatively simple formulas for determining booking limits.

Session 10 (if we have enough time)

Customer Acceptance and Legal Issues in PRO

Customer perception of dynamic pricing and price differentiation. Behavioral issues and prospect theory. Examples of unsuccessful or badly-perceived actions. Tactics for avoiding misperceptions and perceptions of unfairness. Implications for pricing strategy.

Preparation for class:

- Read: PRO and Customer Acceptance (Ch. 12 of Phillips book)
- Read: What Price Fairness? (Krugman, New York Times, 2000)
- We have already discussed in this course various practices that companies adopt in pursuit of "revenue optimization." Speaking strictly as a consumer, which of those practices do you find distasteful enough to affect your buying behavior?
- In your view, is economic life in the U.S. getting more or less "fair" as internet-based commerce increases in volume and importance?
- Visit the website http://papers.ssrn.com/sol3/papers.cfm?abstract_id=429762 to read at least the abstract of Andrew Odlyzko's 2003 paper titled Privacy, Economics and Price Discrimination on the Internet. (The entire paper can be downloaded from that site, and its long introductory section is both stimulating and enjoyable.) Assuming that Odlyzko is right in linking privacy erosion to price discrimination, and right about the inevitable public indignation, does this suggest to you any emerging business opportunities?