Revenue Management

A Practical Pricing Perspective

Edited by Ian Yeoman and
Una McMahon-Beattie

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To the daftest cat in the world, who recently passed away.
Ian Yeoman

To Graham, James and Lucy for keeping me sane.
Una McMahon-Beattie

To Dr Anthony Ingold, who inspired us to write the first book and continues to inspire us today and into the future
Thanks to Allyson Hutton for keeping us on track and to Tricia Lapham who helped with the proofreading.
Ian and Una

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Stefan Poelt is Senior Manager at Lufthansa German Airlines where he is responsible for the Revenue Management tools. He holds a PhD in Computer Science from the University of Dortmund, Germany. Stefan is recognized as an expert in Revenue Management methods. He has published several articles in the *Journal of Revenue and Pricing Management* and is a member of its editorial board.

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Emre Veral is currently Professor of Operations Management at Baruch College, Zicklin School of Business. At Zicklin, he supports the Honors MBA and Baruch-Mt Sinai Health Care Executive MBA programmes as well as the undergraduate Operations Management curriculum in the areas of

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Ben Vinod is with Sabre Holdings, which provides distribution and travel supplier technology solutions for the travel industry. From 1993 to 1999, Dr Vinod was Vice President of Airline Solutions, responsible for Pricing, Yield Management and Reservations Inventory Control. Currently he is Chief Scientist and Senior Vice President at Sabre Holdings.

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Forewords

Kevin Connor, Vice President, DHL Express, Long Time Revenue Management Cheerleader

Over the past two decades, companies of all sizes poured billions of dollars into enterprise reporting and costing systems. Names such as SAP and Oracle became commonplace and for good reason – their systems allowed companies to substantially grow profit margins by creating a whole new level of visibility and control over costs.

Concurrently, a handful of companies and universities began work on enterprise Pricing and Revenue Management. Through use of data analysis and science, these organizations reported preliminary gains of 2–4 margin points, with benefits tripling during the next decade. For companies such as legacy airlines, the Revenue Management contributions represented the difference between financial viability and extinction.

Curiously, the majority of companies that achieved significant benefits from enterprise cost management largely avoided making similar investments in Pricing and Revenue Management. When questioned, companies typically explain the gap as follows – "while costs are clearly visible, measuring lost revenue opportunities is more difficult". Many businesses naively rationalize that their business situation is "unique" and does not fit well with Revenue Management practices.

If you are or have been involved in establishing a Pricing and Revenue Management function, the corporate "inertia" described above probably sounds familiar. However difficult your situation, rest assured that Revenue Management practices are applicable in every business. While true that some of the most evolved Revenue Management applications can be esoteric, the basic steps – documenting beliefs, test business rules, measuring results and continually iterating rules – are fairly straightforward and will produce the majority of the benefit of highly complex solutions. This book will provide the readers with perspective about how others have overcome their own corporate "inertia".

Over the past five years, the Pricing and Revenue Management movement has finally picked up momentum in many new industries. You now find corporate financial reports prominently crediting "improved Pricing and Revenue Management" for improved results at pharmaceutical distributors, radio and television stations, banks, small package companies, cable companies and theme parks with many attributing $100 plus million gains to their Revenue Management efforts. One thing to note: if the gains by your competitors don't excite your management team, consider that several Revenue

Management studies have found that good Revenue Management results come in part at the expense of the competition!

Ian Yeoman and Una McMahon-Beattie are recognized subject matter experts in the field of Pricing and Revenue Management. They have created this book to help pricing managers from all industries understand the practical components of successful Pricing and Revenue Management and, more importantly, help readers generate their own thoughts on how the enclosed "lessons learned" might apply to their particular business situation.

The book is a compilation of experiences gathered from more than a dozen leading practitioners of Pricing and Revenue Management. The "case study" format of the book is organized around those common platforms faced by pricing organizations – foundational requirements, organizational issues, customer/marketplace considerations and technology – and concluding with real life stories as told by the project leaders of successful Revenue Management start-ups in new business segments.

This book will serve as an invaluable reference for those Pricing and Revenue Management practitioners looking for inspiration on how to improve their organization's financial performance and competitive standing through better pricing practices. Our hope is that after reading this book, you will be further inspired to push the Revenue Management revolution within your company, moving it from a back office function to an enterprise-wide strategic function, integrated into all parts of your organization's planning processes.

Robert G. Cross, Chairman and CEO, Revenue Analytics, Inc. and Author, *Revenue Management, Hard-core Tactics for Market Domination*

Revenue Management originated as a means to manage discount seat allocations to help avoid deadly price wars looming after airline deregulation. Bob Crandall, then CEO of American Airlines, famously said that this discipline "is the single most important technical development in transportation management since we entered the era of airline deregulation in 1979".

These concepts have become indispensible for airlines, hotels, cruise lines and other travel and transportation firms. Beyond those early adopters many other industries have begun to apply these notions in B2B as well as B2C environments with notable success. Industries as diverse as manufacturers, distributors and retailers frequently report 3–7 per cent increases in revenue upon adopting these techniques. Such revenue increases come from existing products and channels, so bottom line profit improvements of 40 to 50 per cent are not atypical.

The need for the accelerated learning and greater adoption has become more critical as businesses face growing transparency to both consumers and competitors resulting in intensifying competition and downward pressure on price.

Business must strive to keep pace. Hidden opportunities exist for business to increase price. Additional demand can be stimulated by offering discounts with discretion. Uncovering the specifics of when, where and how much is no easy task.

Revenue Management can assist. Its proven techniques are perfectly aligned to help companies understand consumer demand and make more accurate and profitable decisions relative to inventory, pricing, procurement and merchandising. Revenue Management is evolving from merely an inventory control function to an integrated strategic capability.

Central to this evolution is the ability to collect, store and analyse each individual customer transaction in a comprehensive and rigorous framework. This enables companies to model customer behaviour at a granular level and accurately predict consumer response to price, taking into account competitor price positioning.

Knowing probable customer behaviour and linking that with variable costs enables revenues to be optimized and profits to be maximized. This knowledge is a low-risk source of growth and profitability for virtually any company as it can be applied to product pricing, discounting, negotiated deals, bulk sales, promotions or virtually any transaction in which a seller desires to improve its chances of converting a sale at the highest possible margin.

Resources to help are scant despite a growing number of papers and books devoted to the topic. The published material often falls into one of two categories. There are publications which offer high-level strategic vision or advice, but not necessarily practical application. On the other hand, research papers are available on statistical and mathematical approaches to the topic, but they may not be immediately useful to the practitioner.

This book seeks to close the gap between idea and execution.

Dr Yeoman and Dr Una McMahon-Beattie have done a splendid job in collecting writings from some of the world's leading experts in the field, and they have presented them in an accessible format. The book offers practical insights in taking this rapidly evolving discipline from concept to implementation leveraging the experience of academics and professionals. It should be a valuable resource and spark of inspiration and motivation for years to come.

Richard Ratliff, Senior Research Scientist, Sabre Research

The science and business processes of Pricing and Revenue Management became more sophisticated following airline industry deregulation; these two related practices are becoming increasingly important for companies with perishable inventory that want to remain competitive in the e-commerce era. While the basic economic principle of matching customer demand and suppliers still remains true, modern Pricing and Revenue Management has grown in complexity for many reasons; for example, the ever-changing online marketplace, faster product time-to-market and lifecycles, fierce competition, new business models, more extensive distribution channels, and more sophisticated and demanding customers. Pricing and Revenue Management technology and business processes are evolving rapidly to meet these challenges, but it is often difficult for practitioners to keep up with new advances. This book touches on many different aspects of Pricing and Revenue Management and is intended to help bridge the gap between modern theory and practice.

The science of Revenue Management began about 30 years ago, and the core value propositions continue to be relevant today. In the 1980s, large-scale, global electronic marketplaces (known as Global Distribution Systems or GDS) were established in the travel industry, so in the 1990s, travel was well positioned for newly emerging online sales channels via the Internet. Today's travel consumers have nearly perfect information regarding air, car, hotel and cruise prices, so the industry is fiercely price competitive. Technologies such as demand forecasting, supply optimization, low fare search, product screen positioning, product cross-selling and competitive intelligence gathering have become vital for the success of travel companies. Revenue Management technologies are also gaining importance in other industries as more companies make their products and pricing available online.

Compared to Revenue Management, less progress has been made on decision support for product pricing. Consumers are well informed by use of travel agents and low fare search engines, and so to remain competitive in the marketplace, airlines often resort to straight price matching of competing airline offerings. An improvement to the price response process would consider quality of service differences across carriers (which can vary dramatically due to non-stop versus connections, departure times, elapsed flight times, carrier brand preferences and so on). Recent published examples show that customer choice models are proving useful for this purpose. Progress is also being made in areas such as Strategic Pricing, Dynamic Pricing and Game Theory applied to the travel industry.

Pricing and Revenue Management decision support tools are only effective when well integrated with a company's business processes. Systems alone cannot optimize revenue performance, but for those companies that are willing to modify their business practices to make use of the latest technologies, the gains are significant (often achieving 10 per cent plus improvements in profitability). Considerable advances have been made during the past decade in decision support for areas such as online merchandising, incorporating demand dependencies into Revenue Management optimization, customer relationship management, customer shopping and purchasing behaviour, and group sales. The reader should find this book helpful for gaining a better appreciation of these opportunities and their application in practice.

Introduction: How to do it?

Ian Yeoman and Una McMahon-Beattie

Any business must know its customers, specifically you need to know how much your customers will pay for a product and device appropriate strategies. This is not about offering the lowest price in order to fill capacity. It's about knowing your market segment, how much they will pay, when they will purchase and what distribution channels they will use. Pricing is about deciding your market position, that is, premium or low cost, whereas Revenue Management is the strategic and tactical decisions firms take in order to optimize revenues and profits. Since the publication of Peter Belobaba's PhD thesis work, *Air Travel Demand and Airline Seat Inventory Management* (1987), which was a defining moment in the management of complexity, capacity allocation and real-time inventory solutions, Revenue Management has come of age, fuelled by superior management science models and greater accessibility to technology in addition to the acceptance of the guiding principle of Revenue Management in enhancing the bottom line. At the same time, society has shifted from manufacturing to a service industries economy where the unit of inventory is time, in which the consumer year on year is more price sensitive. Today, in the age of the Internet, the management time slots as inventory along with instant purchase is the foundation of many consumer products and services. Hence, Revenue Management has spawned across many industries and applications. This book is a collection of chapters by leading researchers, experts and practitioners aimed at those wishing to be briefed on the latest research and theories as well as the "how to" of Revenue Management, including academics and students of price management and managers from an operations and unit level within constrained capacity service industries such as hotels, restaurants and airlines. The book is supported by a series of audio and power point presentations at Henry Stewart Talks (http://www.hstalks.com) under the series title of "Practical Pricing and Revenue Management".

The book chapters can be read individually or in chronological order, but please remember that this book has been written by a range of individuals with different backgrounds and industries – the style of writing varies from chapter to chapter. However, all of the chapters are authoritative and accessible to both a layperson or seasoned veteran.

Part I – Revenue Management theory and issues

The first part of the book tells the reader what Revenue Management is, management implications and issues, thus providing a comprehensive understanding of where Revenue Management is today and many of the contemporary challenges facing a variety of different industries grappling with implementation and management. In chapter 1, Catherine Cleophas and colleagues provide an overview of how Revenue Management is applied in different industries, which sets the scene for forthcoming chapters in the book. In chapter 2, Sheryl Kimes and Leo Renaghan explore the issue of managing space, the central component of inventory across all industries. The authors argue that if companies do not properly consider the configuration and ambience of their space, they are destined to sub-optimal revenue performance regardless of how effectively they manage price and time. Warren Lieberman of Veritec Solutions in chapter 3 writes about the impacts of staff effectiveness and the strategies and tactics that can be adopted. The chapter provides an overview of key organizational challenges faced when implementing pricing and revenue optimization programmes and identifies strategies and tactics that can increase the success of such efforts.

Traditional Revenue Management systems are excellent at maximizing revenue at flight level; they do not consider long-term relationship values and costs when making inventory decisions according to Ramesh Venkat of Emirates Airline in chapter 4. There is a need to develop models based on enterprise value than just price and inventory. This can be done by including cost and relationship values to maximize profitability. Future Revenue Management systems need to be proactive and embrace emerging pricing models with an operating time range that covers the whole financial planning period. Integrating Revenue Management with marketing, pricing and distribution represents a move from traditional Revenue Management to profit optimization. Una McMahon-Beattie argues in chapter 5 that trust is at the heart of relationship marketing strategies, and therefore there would appear to be a potential conflict between the aims of relationship marketing/customer relationship management and Revenue Management. This chapter therefore investigates the importance of consumer trust in Revenue Management and explores the ways in which trust can be utilized in developing and maintaining effective relationships with customers. In particular, it is suggested that consumers' level of knowledge of the "rules" in which variable pricing operates may well cause trust/distrust. In chapter 6 Ian Yeoman explores and sets out to describe the evolution of luxury and how consumers' attitudes and behaviours have changed. The chapter concludes with a discussion on the implications for premier priced goods and services.

In chapter 7, Ben Vinod of Sabre Technologies embraces the concepts of change, evolution to describe what is coming next, explaining how pricing and Revenue Management have transformed to make real-time decisions based on competitive market conditions. Product distribution through travel agencies continues to dominate the managed travel corporate landscape, while online travel agencies and supplier websites have made significant inroads in pursuit of the leisure business. Investment in merchandising branded fare products and ancillary services is a focus area for all aspects of the travel value chain, including pricing, Revenue Management and distribution. New innovations are also on the horizon with mobile applications and corporate collaboration tools to control travel spend. While the fundamental core value propositions have not changed, this chapter discusses changes in technology, the competitive landscape, and the future of Revenue Management and distribution.

Chapter 8, authored by Karl Isler of Swiss International Airlines, describes how Airline Revenue Management has changed over the last years, influenced by the advent of Internet distribution and Global Distribution Systems (GDS) functions like Origin and Destination (OD) control and seamless availability. The increased ability to price discriminate is seen as the main driver behind those changes. The author analyses current GDS functionality under this aspect and describes how it can be used to implement dynamic pricing, similar to the possibilities of the Internet. Further shortcomings of current GDS distribution and solutions proposed to improve the current capabilities are presented.

Jon Higbie of Revenues Analytics in chapter 9 gives a high-level overview of the analytic processes supporting B2B pricing and an introductory treatment of how to implement critical models. The author attempts to balance the treatment of business considerations with technical details of the underlying models. The intended audience includes practitioners searching for a deeper understanding of the requisite models and researchers seeking knowledge of the business context and current state of practice of B2B price optimization. Several real-world applications of B2B price optimization and key implementation issues are also discussed. The rest of the chapter demonstrates the three core models of the B2B pricing analytic process – the market response model, the contribution model and price optimization.

In chapter 10, Michael Zhang presents a general picture of fencing in the world of Revenue Management and discusses business issues related to the segmentation process and segmentation enforcement. The author then provides a survey of segmentation variables and uses them to develop the discussion of the corresponding fences in the practice of Revenue Management. A categorization of fences based on purchase patterns, product characteristics and customer characteristics is discussed and how fencing works in practice.

Part II – Applications

The second part of the book explores and demonstrates how Revenue Management works in different industries. Özgür Özlük in chapter 11 describes the evolution of search-based advertising and Revenue Management. In 2009, search engine advertising made up 47 percent of the online advertising revenue which totalled $10.9 billion. In this highly lucrative and visible branch of advertising, both publishers and advertisers put their best effort forward to utilize the system as efficiently as possible. In this chapter, the author discusses the Revenue Management questions faced in online advertising from both the publisher's and the advertiser's perspective. In Chapter 12, Raja Kasilingam presents the important differences between airline passenger Revenue Management and air cargo Revenue Management, from data requirements to implementation aspects.

In chapter 13, Warren Lieberman provides an overview of some of the key ways that hotels have been able to increase their revenues and profits through improved pricing, with illustrations of why these new approaches have been so financially important. In chapter 14, Stefan Poelt of Lufthansa Airlines focuses on practical aspects of airline pricing and Revenue Management from a network carrier's point of view. Beside the basic concepts of market segmentation, demand forecasting, overbooking and availability optimization, two main developments, from leg- to network-based Revenue Management and from independent to dependent demand structures are also described. As an example of airline-specific challenges some restrictions of legacy systems used in global distribution channels are mentioned. It is pointed out that most Revenue Management developments can be seen in the light of removing or relaxing wrong assumptions on which the first leg optimization methods have been based on.

Jiang Wang in chapter 15 addresses Revenue Management and optimal rents for apartments' letting starting with an introduction of the basic concepts in the apartment industry, followed by a description of a methodology by which the optimal rents can be derived. It then outlines the procedure for setting optimal rents, followed by an illustration with a case study. Finally, it concludes with the implication of this procedure in the practical application of Revenue Management for apartment operators. In chapter 16, Sunmee Choi addresses pricing in the restaurant business. In order to maximize revenue (or contribution), restaurant managers need to complement their traditional cost-driven pricing approaches with market-driven Revenue Management pricing approaches. Further, the traditional understanding of what restaurants sell and what constrains restaurants from producing more revenue needs to be refreshed and reflected in pricing policies. This chapter presents menu pricing and selling strategies from Revenue Management perspectives. Specifically, this chapter discusses concepts and examples of Revenue Management-driven pricing strategies such as optimal pricing (charging the optimal price in consideration of its impact on consumer choices), variable pricing (varying prices charged to different customers) and menu re-engineering (menu engineering in consideration of the third component of "time"). Finally, presented and discussed are selling strategies differentiated by the type of time period (busy or slow periods).

In chapter 17, José Guadix demonstrates how Revenue Management can be used in the carparking industries, highlighting issues and presenting an appropriate model. To conclude, in Chapter 18, Lila Rasekh and Yihua Li of Walt Disney World state the goal of the golf course Revenue Management system is to maximize the profits by developing the best reservation policy for each available tee time. This research is based on an analysis of golf course tee-time reservation practice. Specifically, this chapter presents a unique linear model that can be used to assign the demand to the available tee-times, and thus, maximize their utilization and the total revenue. The linear model uses the forecasted demand data. The model is solved by using the SAS-OR build-in branch and bound algorithm. To reduce the computational time, the authors propose a heuristic to find an initial feasible solution to the model. This initial solution reduces the CPU time substantially and enabled them to solve the larger scale problem by using the SAS-OR.

Overall, 18 chapters of wondrous knowledge about Revenue Management which is presented in an accessible, authentic and knowledgeable manner. Enjoy!

Reference

Belobaba, P. P. (1987) *Air Travel Demand and Airline Seat Inventory Management,* PhD Thesis, Flight Transportation Laboratory, Massachusetts Institute of Technology, Cambridge, MA.

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Part I

Revenue Management Theory and Issues

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1
The Applications of Revenue Management and Pricing

Catherine Cleophas, Ian Yeoman, Una McMahon-Beattie and Emre Veral

Introduction

Revenue Management (RM) and pricing may be described as the art of selling products to the right customers at the right prices. The concept is based on the assumption that different customers are willing to pay different prices for the same product and that by differentiating the price according to customer characteristics, overall revenue can be maximized. While the term "Revenue Management" often refers to the problem of defining the amount of products to be offered at one price, the term "pricing" usually refers to the problem of defining optimal prices. Historically (Bobb and Veral, 2008), Revenue Management started as an operations management function, focusing only on capacity allocation given exogenous demand estimates (Gallego and Van Ryzin, 1997). In the 1960s, American Airlines started to use Operations Research models for Revenue Management decisions. Littlewood (1972) presented the revenue maximization model through booking limits and inventory control systems. The 1980s saw Revenue Management become a robust and workable system for solving the problems of fixed capacity, time-varied demand, segmentation, perishable inventory and high fixed costs, bringing a practical solution. One significant milestone in Revenue Management was Peter Belobaba's PhD thesis work, *Air Travel Demand and Airline Seat Inventory Management* (1987) which was a significant contribution to management of complexity, capacity allocation and real-time inventory solutions.

From the practitioners' perspective, the 1990s saw not only a proliferation of Revenue Management applications in the airline industries but also the growth in the hotel and other hospitality and travel industries that faced similar problems. This proliferation was fuelled by superior management science models and greater accessibility to technology in addition to the acceptance of the guiding principle of Revenue Management in enhancing the bottom line. A unique characteristic of Revenue Management systems has been the extraordinary influence that the industry has exerted in developing and implementing novel ideas and applications. Today, Revenue Management is a management discipline rather than just a mathematical fringe issue.

The characteristics of Revenue Management

Kimes (2000) defines Revenue Management as the allocation of information systems and pricing strategies to allocate the right capacity to the right customer at the right time. Which in practice, has meant setting prices according to predicted demand levels so that price-sensitive customers who are willing to purchase at off peak times can do so at favourable prices, while price-insensitive customers who want to purchase at peak times will be able to do so. Kimes (2000) describes the conditions and characteristics of Revenue Management as the following;

Relative fixed capacity

Revenue Management is appropriate for capacity-constrained firms. Firms not constrained by capacity can use inventory as a buffer to deal with fluctations in demand, but capacity constrained-firms must make do with what they have. Capacity can be measured by both physical and non-physical units. Physical measures include the number of seats or rooms, whereas non-physical measurements are usually time-based and reflect the notion of a physical capacity used for certain periods, that is, seat hours for restaurants or tee-times for golf courses.

Predictable demand

Demand for capacity-constrained firms consists of customers who make reservations and walk in reservations. Both forms of demand can be managed, but different strategies are required. In sum, customers who make reservations and those who walk in constitute an inventory from which managers can select the most profitable mix of customers.

Perishable inventory

In capacity-constrained service firms the unit of inventory is time, whether it is a restaurant reservation or a hotel bedroom. Firms are selling a time slot for a specific purpose, which cannot be stored if it is not sold.

Appropriate cost and pricing structure

Industries using Revenue Management should possess a cost structure that features relatively high fixed costs and fairly low variable costs. Like hotels and airlines, other capacity-constrained industries must generate sufficient revenues to cover variable costs and offset some fixed costs. The relatively low variable costs associated with many capacity-constrained industries allow for some pricing flexibility and give operators the option of reducing prices during low-demand times.

Time-variable demand

Customer demand varies by time of year or time of day. Managers must be able to forecast time-related demand so that they can make effective pricing and allocation decisions to manage shoulder periods around high-demand periods.

How does Revenue Management work?

According to (Bobb and Veral, 2008), the central components of any Revenue Management system, whether used in the airline or any other industry, are identified as (1) forecasting, (2) inventory control/overbooking and (3) price fences to segment the market. Three principal issues are specific to the service industries that stand to benefit from the use of Revenue Management systems. First, is that these individual components are required to function robustly in the presence of dynamic changes such as cancellations, no-shows and walk-ups. Secondly, and more difficult to address, is the real-time interdependencies between the components. Thirdly, and least tractable are the competitors' real-time decisions which represent an additional level of complexity to the dynamics among the three components.

Industry classification and application

A broad range of industries have adopted Revenue Management and Table 1.1 classifies the industries by the type of product and customer inventory segmentation. For example, in car rentals the customer segmentation is based on time of booking, point of sale and return of the car whereas in the retail industry it is seasonality and product life cycle.

The remainder of this chapter is devoted to examining how Revenue Management is applied and used within different sectors.

Passenger transport

While airlines have been among the first to introduce Revenue Management, the required conditions can also be found in other transport services. The product is a ticket that enables a customer to fly according to a specified itinerary under given conditions (for example, first, business or economy

Table 1.1 Industry classification

Industry	**Product**	**Type of Customer Inventory Segmentation**
Passenger transport	Ticket for transport, seat	Time of booking, venue of booking, subscriptions, conditions
Car rentals	Right to use car	Time of booking, point of sale, return behaviour, conditions
Hotels	Overnight stay	Time and duration of booking, venue of booking, conditions
Cruises	Participation in cruise	Time and duration, packages
Casinos	Overnight stay	Hotel-like segmentation versus customer value
Freight	Transport or storage	Time and venue of booking, conditions, volume versus weight
Advertising	Placement of advertisement or commercial	Time of booking, subscription or bulk, placement, frequency
Telecommunication	Bandwidth in time or data	Subscription plan, age of customers, business versus private customers
Energy	Transport and usage of energy	Bulk buys, seasonality
Retail	Fashion, consumer electronics, groceries	Seasonality, product life cycle

compartment). As aircrafts have a fixed capacity, a limited number of tickets can be offered. Tickets lose their value at the time of departure. All of this also applies to train tickets. However, capacity is not as rigidly fixed: lower security standards may allow for passengers without seats. Forecasting demand is more difficult if tickets are not connected to a specific train departing at a specific time.

Customers can be segmented according to the time of booking, point of sale and distribution channel. For example, tourists are not willing to pay as much as business travellers, but they request tickets much earlier in advance and have less service requirements. The task is to reserve enough tickets for late booking business travellers, and sell the leftover capacity at reduced fares. Another task is the computation of prices that trigger a sufficient amount of demand in both customer segments while maximizing overall earnings.

Car rental

Usage of a car for a specific period is another perishable product. A car rental's fleet can be adapted by buying or selling cars, but flexibility comes at a price: capacity adjustments are possible but not desirable. When cars can be rented at one subsidiary and can be returned somewhere else, revenue and capacity management grow more complex. Customer segmentation is possible at the time of booking, duration of rental, point of rent (airport subsidiaries are more expensive) as well as insurance conditions. The car type obviously influences the fare too.

Hotels

The application of Revenue Management in the hotel industry was one of the first applications (after the airlines). Stays in hotel rooms, casinos and cruise ships are all products suited for Revenue Management and pricing. Once a night is over, the right to stay this night at a room in a hotel loses its value. Hotel capacity, measured in beds, is inflexible. The possibility of multiple day stays creates additional complexity. Customers can be segmented along the duration and timing of their stay, time of booking, as well as conditions of the stay. Conditions can include several levels of comfort, meal packages and flexibility of contract.

Cruise ships

Cruise ships represent a combination of transport, hospitality and entertainment. Customers pay for the opportunity of transport and overnight stays, but also for the cruise experience. Revenue is not solely generated from bookings, but also from spending during the cruise. This is where customer value comes into play. A ticket for a cruise loses its value once the journey has begun. As cruises cater predominantly to tourists who regard advance planning as desirable, very late bookings may be eligible for reduced fares. Customers can be segmented according to the time of booking as well as to packages booked along with the tickets.

Casinos

In casinos, the price of the hotel stay may not be the most profitable aspect of the product. Instead, customer value connected to gambling is emphasized. While the product also perishes as time passes, customers are not solely segmented according to the price they are willing to pay for the hotel room. The decision to accept a booking request is also based on expected spending on gambling: it may be opportune to encourage a gambling customer with special hotel rates. Tracking customer histories with regard to gambling becomes part of Revenue Management processes. Left-over capacity can be sold to guests not expected to bring much gambling revenue. Whether to reserve rooms for gambling guests or to sell them to regular guests becomes the vital question.

Freight

For cargo, capacity comes in two dimensions: weight and space. An aircraft may be able to transport a number of kilograms per trip, using a storage space defined by cubic metres. Demand can be segmented accordingly, as the supplier has to balance small, weighty cargo with light but bulky cargo. Furthermore cargo may require more or less careful handling. Cargo transport contracts can also include conditions concerning the flexibility or the speed of transport as well as insurance options.

Energy

Today, energy providers are in a competitive environment. This has two effects. On the one hand, energy contracts between private or corporate customers and the providers have become subject to flexible pricing. On the other hand, pipelines or power transmission lines are often still owned by the erstwhile state companies and now rented out. Energy transport is not unlike cargo and passenger transport in that there is a fixed capacity for a network. The price may be assigned according to the size of bids, so that the supplier tries to accept as many high-priced bids as possible while optimizing network usage.

Advertising

Revenue Management and pricing may also be applied to the sale of advertisement slots. Depending on the medium, advertisement capacity and customers can be segmented according to different characteristics. The first medium for which advertisements have been sold is print. The amount of real estate within a paper taken up by advertisements rather than news content defines its capacity. Once a publication is sold, the opportunity of advertising in it loses value. If the price of a publication remains constant, with every additional advertisement, the earnings of the publisher increase – provided that demand does not decrease. The fact that print publishing has two customers, readers and businesses willing to advertise.

When commercials are aired on a TV or a radio channel, the timing and duration of the spot define its use of capacity. Advertisements on websites are a rather young application of Revenue Management and pricing. As with the page of a newspaper, only a certain amount of two-dimensional space on a website can be rented for advertisements. Real estate on a website is available for 24 hours every day. Once a time slice passes, the right to advertise on the website loses value. Independently of the medium involved, long-term advance buys of advertisements may be encouraged by discount prices. Customers are also segmented according to their willingness to commit to bulk buys (for example, advertising in five out of 52 yearly issues) or subscriptions (for example, advertising in 12 subsequent volumes). The placing of an advertisement or commercial also plays a role: for example, online advertisements can be situated near the title or at the bottom. If the advertisement is to be placed near a thematically linked article, this may increase its value to the customer just as the broadcast of a TV commercial within a thematically linked show does.

Telecommunication

Companies providing telecommunication services rely on a given amount of bandwidth to sell a perishable product at low unit-based costs. This product is a certain amount of call time, text messaging or connectivity to the Internet defined by time or data rates. Market segmentation can be based on subscription plans that differ with regard to the time used or quantity of data transferred as well as the level of service.

Retail

The capacity of retail goods is limited once the production process of a batch ends. Fashion items and consumer electronics follow a product life cycle that may entail a bargain price in order to facilitate market entry followed by a rise in price as the product becomes well known and desired. As the market becomes saturated and newer products appear, the price of the product decreases until it goes out of sale. The goal is to sell as many highly priced units of the product as possible, and to avoid storage, salvaging and trashing. Another example is groceries. These products are edible (and saleable) for a certain amount of time after production, decrease in value as they become less appealing and lose value as they perish. Customers can be segmented according to socio-demographic factors linked to location and to whether they buy a product when it is still fresh or make use of reduced prices.

Manufacturing

Make-to-order manufacturing firms hold capacity rather than inventory in stock. When such firms experience demands exceeding capacity in the short term, they are faced with the decision to allocate available capacity to selected customers or orders. The firm has to make the accept/reject decision as the order arrives, and thus cannot change its mind later. Thus lies the opportunity for a make-to-order firm to maximize its profit by selectively rejecting low-profit orders in anticipation of future demand for high-profit orders (Patterson et al., 1997).

Package delivery

Package delivery services have fixed daily cargo space in their various modes of transport vehicles. Customers are segmented according to the speed of delivery, which allow firms to command price premiums. As an example, FedEx regularly overbooks its cargo space, counting on the ability of its five empty jets that are roaming over the USA every day to divert from their flight plans and absorb the overflow. On average, they deploy only two of the five spare planes each day. In addition, every night, the company also keeps about 10 per cent of planes half empty, allowing them to make unplanned stops and pick up more cargo (Leonhardt, 2005).

Summary

As this chapter highlights, Revenue Management is a widely adopted management tool or process used in capacity-constrained industries in which the unit of inventory is time. Revenue Management helps management make sense in the complicated world of pricing through providing a decision support mechanism for pricing decisions in highly competitive industries such as hotel and airline industries. Today, nearly everyone uses the Internet for making airline bookings and is familiar with the variable pricing, and therefore the customer is becoming the Revenue Manager, but that is another story.

References

Belobaba, P. P. (1987) *Air Travel Demand and Airline Seat Inventory Management*. Cambridge, MA: Flight Transportation Laboratory, Massachusetts Institute of Technology.

Bobb, L. and Veral, E. (2008) Open Issues and Future Directions in Revenue Management, *Journal of Revenue and Pricing Management*, 7(3), 291–301.

Gallego, G. and Van Ryzin, G. (1997) A Multiproduct Dynamic Pricing Problem and its Applications to Network Revenue Management, *Operations Research*, 45(1), 24–41.

Kimes, S. (2000) A Strategic Approach to Yield Management. In A. Ingold, U. McMahon-Beattie and I. Yeoman (eds) *Yield Management: Strategies for the Service Industries*. London: Continuum Books.

Leonhardt, D. (2005) Have Recessions Absolutely, Positively Become Less Painful? Available at http://www.nytimes.com/2005/10/08/business/08fedex.html?pagewanted=all (accessed 20 May 2010).

Littlewood, K. (1972) *Forecasting and Control of Passenger Bookings, AGIFORS Symposium Proceedings*. Israel: Nathanya.

Patterson, J. W., Balakrishnan, N. and Sridharan. V. (1997) An Experimental Comparison of Capacity Rationing Models, *International Journal of Production Research*, 35(6), 1639–1649.

2
The Role of Space in Revenue Management

Sheryl E. Kimes and Leo M. Renaghan

Introduction

Revenue management has been widely studied (for a review of the Revenue Management literature, see Boyd and Bilegan, 2003; McGill and van Ryzin, 1999; Weatherford and Bodily, 1992) and has been applied to a number of industries including the airline industry (Smith et al., 1992), the hotel industry (Hanks et al., 1992), the restaurant industry (Kimes et al., 1998), the golf industry (Kimes, 2000), professional services (Siguaw et al., 2003), broadcast advertising (Bollapragada et al., 2002) and meeting space (Kimes and McGuire, 2001). Companies using Revenue Management have shown a revenue increase of 2–5 percent (Hanks et al., 1992; Kimes, 2004; Smith et al., 1992).

Revenue management can been used in industries that have a relatively fixed capacity, perishable inventory, high fixed cost and low variable costs, varying customer price sensitivity, time-variable demand patterns and the ability to inventory demand through either reservations or through waiting lists (Cross, 1997).

Kimes and Chase (1998) proposed that companies using Revenue Management have two strategic levers at their disposal: the management of time and the management of price. Time can be managed by controlling arrival and duration uncertainty and reducing the amount of time between customers and purchase transactions. Price can be managed by determining the optimal mix of prices and developing the rate fences associated with these prices. The key to a successful Revenue Management strategy is to be able to determine the optimal balance between time and price.

This chapter proposes that a third lever, the management of space, is equally important as the management of time and price in a successful Revenue Management strategy. Space can be used to directly or indirectly generate revenue. With direct revenue generation, space is subdivided into units which can be sold directly to customers for a length of time (for example, hotel rooms, airline seats or storage space). Industries that use indirect revenue generating methods subdivide their space into units that are used to sell things to consumers (for example, retail, advertisements and restaurant menus). The focus of this chapter is on industries that directly sell their physical space to customers.

Space management in the context of Revenue Management has received limited attention in the literature, but has the potential to help companies achieve the full revenue potential of their capacity. The chapter will first give an overview of the three strategic levers, and then discuss how the interplay of space and time affects how companies position themselves. It will then delve into the role of space and present methods in which companies can effectively use space within their Revenue Management strategy.

The three strategic levers: price, time and space

Firms using Revenue Management typically sell physical space for a given length of time for a variety of prices. In fact, success in Revenue Management is defined as maximizing the revenue per available time-based space unit (RevPAST). For example, airlines seek to maximize revenue per available seat (the space) kilometer (a proxy of time); hotels try to maximize their revenue per available room (the space) night (the unit of time); and performing arts centers try to maximize their revenue per available seat (the space) performance (a proxy for time) (Figure 2.1). Implicit in all of these definitions are the concepts of price, space and time.

Price

The use of variable pricing is an outgrowth of both industry and market traditions. Any industry has the potential to use variable pricing; some choose to, others are reluctant to either because of tradition or perceived effect on customer satisfaction. Revenue can reflect more than just the price of the inventory unit; it can also include ancillary revenue sources such as food and beverage expenditures (in the case of hotels), insurance and other add-ons (in the case of rental car companies) and concession revenue (in the case of stadiums and arenas).

Industry	Measurement
Hotels	Revenue per available room-night
Restaurants	Revenue per available seat-hour
Car rental	Revenue per available car-day
Stadiums and arenas	Revenue per available seat-game
Golf	Revenue per available tee-time
Spas	Revenue per available treatment-hour

Figure 2.1 Selected measures of Revenue Management success by industry.

Space

Space can be sold either explicitly or implicitly. When sold explicitly, space is simply sold as space (that is, area, height or volume). For example, moving companies charge by volume, retail stores sell linear feet of shelf space, and print advertisements are sold by the line or square inch.

Conversely, when space is sold implicitly, the firm configures the physical space into an inventory type that helps meet customer needs from that space. For example, hotels configure their physical space into rooms; stadiums split their physical space into sections of seats; and restaurants convert their physical space into tables. Multiple versions of these inventory types may be used, and in some situations, the physical space requirements associated with these inventory types may vary.

When a company sells space implicitly, it can control the way in which the space is sold because it can define what space is. By being able to define space, companies can design space that appeals to different market segments and use that space to differentiate themselves and to generate revenue. Companies that sell space explicitly have limited opportunities to differentiate their space and thus have fewer opportunities for revenue enhancement.

Time

Like space, time can be sold either explicitly or implicitly. When companies sell time explicitly (whether by the minute, the hour or the day), they are better able to control their capacity because they know how long customers will be using the space. Companies that sell time implicitly typically sell service experiences and do not necessarily have control over how long customers use their space. For example, stadium operators sell tickets to a game (but do not explicitly state that customers can use the seat for a few hours). Restaurants sell meals (and customers purchase a dining experience), but internally allot a certain amount of time per table so that they can serve a sufficient number of guests to be profitable.

Companies that implicitly sell time can be split into two types, depending on what or who controls the length of the service experience. For example, the length of the service experience for airlines, stadiums and theaters is often determined by external forces (such as how far the flight is, how long the game lasts or how long the play lasts) which may be beyond the control of the company. Time plays a crucial strategic role for these sorts of companies because it may limit revenue potential.

Conversely, with restaurants and golf courses, customers exert more control over the length of the service experience. Companies must be careful about wresting control of time from customers because customers may feel as if they are being rushed. If a firm decides to control time, it must do so very carefully; either through how they design the service experience or how they design the space in which the service is offered.

It is more desirable to sell time explicitly because of the added control over the time that customers use space. It is much more difficult to manage implicitly sold time because of the possible impact on customer satisfaction.

Companies using Revenue Management have to decide how they want to balance their design and management of price, space and time so that they can maximize their long-term revenue.

The interplay of space and time

The interplay between space and time influences how companies position themselves to generate revenue (see Figure 2.2). A successful Revenue Management strategy revolves around the profitable control of capacity, specifically the profitable control of space and time. The more control companies have over time and space, the higher their revenue potential. This entails selling time explicitly (because of the enhanced control over when customers use the space) and space implicitly (because of the control over how the space is defined).

Industries can be categorized by how they sell space and time (see Figure 2.2). Category 1 industries such as restaurants, golf courses, theaters and stadiums have control over their space but have difficulty in controlling time. Revenue management practices often revolve around obtaining control of time while still maintaining customer satisfaction. Category 2 industries (for example, hotel, car rental and cruise industries) are in the ideal spot for revenue generation since they sell space implicitly for an explicit length of time. It is not surprising that the most sophisticated Revenue Management applications are found in these industries because of the control that they have over both space and time. This added control allows them to package different space and time combinations that appeal to different market segments and price them accordingly. Category 3 industries are rarely seen. It may be that the lack of control over space and time makes it

		Time	
		Implicit	Explicit
Space	Implicit	Restaurants Golf courses Stadiums/arenas Airlines	Hotels Rental car Spa
	Explicit	N/A	Self-storage Retail space Moving vans Gas pipelines

Figure 2.2 Strategic interplay of space and time.

very difficult to operate a profitable business. Category 4 industries such as self-storage facilities, advertising and moving vans sell both space and time explicitly. This allows them to have control over how long the customers use their space, but does not give them the control over how space is defined. This leaves them with limited opportunities for differentiating themselves from their competition and also with limited possibilities for developing ancillary revenue streams.

Category 2, the combination of implicit space and explicit time, is the most desirable one, and one to which industries in other categories should strive. The key is to determine how to gain more control over both space and time. In order to gain this control, companies need to learn how to control the length of time that customers use their space and to control how space is defined and configured. Time can be managed by refining the definition of time, reducing the uncertainty of arrival, reducing the uncertainty of duration and reducing the amount of time between customers. Our intent in this chapter is to develop similar tools for managing space.

Space: the third strategic lever

Since space is the primary product that is sold by most companies using Revenue Management, it must be carefully considered and designed. The fact that the capacity of physical space is relatively fixed makes this decision even more important. The design of the physical environment is often seen as a given, but should be considered in a more strategic fashion since it symbolizes what a company represents, helps customers and organizations reach their goals and can serve as a differentiator (Bitner, 1992). The design of the space can affect both customer and employee satisfaction (Bitner, 1992; Sommer, 1969) and can also affect revenue generation (Kimes and Thompson, 2004, 2005). If companies do not properly manage their physical space, they are destined to sub-optimal revenue performance regardless of how well time and pricing are managed.

When deciding how they want to maximize the use of their fixed capacity, firms have five tools at their disposal: (1) selection of inventory types, (2) space configuration, (3) space ambience, (4) ancillary revenue sources and (5) increase productive use of space.

Selection of inventory types

Inventory types vary by industry; for example, hotels offer different sized-rooms, airlines offer various-sized seats and convention centers rent different-sized rooms. The types of inventory units offered are determined by industry norms (for example, mid-priced hotels sell certain-sized rooms), but can also be used to differentiate a firm from its competitors (for example, our rooms are larger) and when attached to other ancillary services (for example, our rooms are larger and you have free Internet access) can lead to a competitive advantage.

Companies must first determine the demand for different inventory units, study the needs of different market segments and consider how to differentiate their inventory units from those of their competition. For example, casinos offer a mix of table games and slot machines. They must determine the types of games and machines that their clientele prefer and then select the inventory units to offer. Or Singapore Airlines found that some customers were very price insensitive and wanted a larger and more private first-class seat. Based on this, they decided to offer private suites on some of their flights.

The potential range of prices that can be charged for different inventory units depends on the market segment, the competition, the season, the services bundled with it, its location and the channel through which it is sold.

Once the inventory types have been selected, the demand, space and time requirements, ancillary revenue streams and price will be used to determine the optimal mix of those inventory units.

Space configuration

Once companies decide which inventory types to sell, they must then decide how to configure their physical space and how flexible they would like that space to be. Space configuration, or supply mix, affects customer throughput and revenue. Supply mix issues occur in a number of industries. For example, car rental firms must decide on the best mix of cars (Carroll and Grimes, 1995; Geraghty and Johnson, 1997), apartment rental companies must decide on the best mix of apartment sizes and performing arts centers must decide on the best mix of seat sections. If the supply mix is ignored, the revenue generated by even the best Revenue Management system will be sub-optimal.

Supply planning occurs in nearly all industries and can be divided into five parts: (1) number of facilities, (2) facility size, (3) supply mix, (4) supply mix flexibility and (5) the supply assignment rule (Kimes and Thompson, 2004, 2005). There is a considerable amount of literature on how to determine the number and size of facilities (Klassen and Rohleder, 2001; Lovelock, 1992; Ng et al., 1999; Sasser, 1976), but limited research has been done on the optimal supply mix (Kimes and Thompson, 2004, 2005).

Kimes and Thompson (2004, 2005) developed methods for determining the optimal supply mix in a restaurant context. They found that by adopting an optimal table mix, their test restaurant could serve up to 30 percent more customers while maintaining the same average waiting time. By adopting the optimal table mix, a restaurant can simultaneously increase revenue by processing more customers during busy periods while using fewer seats.

If the same, or more, revenue can be generated in less space, companies can reduce development costs. This has tremendous promise for a firm's expansion strategy, because less space may be required. For example, O'Charley's, 240-unit US restaurant chain, changed their table mix, reduced the number of seats from 271 to 183 and reduced restaurant size from 6900 to 5400 square feet while maintaining (and in some cases increasing) revenue. This allows them to reduce investment costs since they are able to obtain more favorable leases (Prewitt, 2007).

In order to determine the optimal supply mix, managers must balance customer demand for different space types with the space and time requirements of each space type, the revenue associated with each space type and the desired space flexibility.

The desired flexibility of the space configuration matters as does the timing of reconfigurations. For example, a performing arts center can change its definitions of seating sections depending upon the popularity of a particular show; for shows that are more popular, the higher-priced sections can be expanded to include more seats, and for less popular shows, the lower-priced sections might be expanded. Similar situations occur in convention centers, self-storage facilities and restaurants. All have the ability to reconfigure their inventory units to better accommodate customer demand, but the time and costs involved with reconfiguration and the impact on customer satisfaction must be carefully considered.

Space ambience

Companies that implicitly sell time can create an environment which may entice customers to want to spend more. Mehrabian and Russell (1974) proposed that customer behavior in different physical environments is a result of the interaction of three factors: arousal, dominance and pleasure. Arousal is defined as how much a certain environment excites people. Dominance measures how much control customers exert over their environment and pleasure is how much people like a physical setting. Different combinations of arousal, dominance and pleasure can cause customers to choose to be in an environment, choose to leave it or avoid it completely.

Space ambience can be divided into three components: (1) ambient elements that may affect the senses such as music, light and temperature; (2) design elements such as color, furnishings and layout; and (3) social elements such as control, crowdedness and customer interaction (Baker, 1986; Baker and Cameron, 1996).

Ambient Elements: Brighter lights, faster and louder music and lower temperatures are likely to increase arousal and cause customers to want to spend less time in a space (Areni and Kim, 1994; Baker, 1986; Baker et al., 1992; Milliman, 1982, 1986). The challenge for service designers and revenue managers is to determine the amount of arousal that maximizes revenue while maintaining or increasing customer satisfaction.

Design Elements: Color, furnishings and layout can also affect arousal, pleasure and dominance. Warmer and brighter colors have been shown to reduce the amount of time customers spend in an environment (Guilford and Smith, 1959; Shaie and Heiss, 1964). More comfortable furnishings, such as a 24-hour chair in a meeting room or a booth in a restaurant, may cause customers to want to stay longer, while less comfortable seats may make customers want to leave (Robson, 1999).

The layout of a physical environment can have a significant effect on customer approach behaviors (Mehrabian and Russell, 1974). For example, in environments perceived as pleasant, shoppers stay longer and spend more money (Donovan et al., 1994; Underhill, 1999).

Social Elements: Revenue generation is also affected by the degree of perceived crowdedness, perceived control and amount of customer interaction. Space configuration can have a negative impact on customer satisfaction (and revenue) if customers feel crowded. Behavior in public settings is related to a human need to establish and maintain personal territory (Proshansky et al., 1970). If customers feel as if they are too close to other customers, they are likely to experience a loss of control and try to leave or avoid the environment. Research on perceived control (Averill, 1973; Hui and Bateson, 1991; Langer, 1983) has shown that when customers perceive that they have less control over a service encounter, they are less likely to be satisfied with that encounter.

When services are designed to have a great deal of customer interaction (such as in stadiums and arenas or concert halls), customers may be more accepting of crowded conditions because they may be seen as part of the service experience. Conversely, in services which typically do not have much customer interaction, such as in a doctor's office or car rental locations, customers are likely to view crowded conditions less favorably.

Develop ancillary revenue sources

Another option for increasing the revenue potential of a space is to sell other services and products that customers can purchase while using the space or to take with them after completing the service experience. The key to determining which products and services to offer is to understand customer needs and to determine how to offer these products and services in a profitable manner.

For example, movie theaters can offer concessions and retail; stadiums can offer a variety of restaurant and bar options; spas can offer various add-on treatments; and car rental companies can offer different insurance packages and add-on features such as GPS or ski-racks.

Some industries have more potential ancillary revenue than others. The airline industry has traditionally had a limited ability to sell additional items, but recently in the USA has decoupled food offerings from the ticket price in economy seats. They can also sell entertainment (that is, movies), duty free items, and phone or Internet usage.

Ancillary revenue items are not necessarily desirable if they impact how long customers use the space during busy periods. Consider a restaurant on a busy Saturday night. It can offer a variety of menu items in an attempt to increase the average revenue per person, but if the sales of these items cause customers to linger so that other customers cannot be accommodated, this strategy could backfire.

Increase the productive use of the space

Companies have four ways in which they can increase the productive use of their space: (1) reduce the amount of idle time between customers or events, (2) extend the time the space is used, (3) offer multiple uses of the space and (4) offload non-revenue producing activities.

Reduce Idle Time: If companies can reduce the amount of idle time between customers or events they may be able to increase the revenue potential of their space. When space is not being used no revenue is generated from that space. For example, restaurants need to minimize the table turn time, convention centers need to minimize the amount of time between events and airlines need to minimize the amount of ground time between flights. By doing this, they increase the amount of time that the space is generating revenue.

Extend Time: Time extension is particularly useful in industries that sell an experience for an externally controlled length of time. For example, performing arts centers can offer pre-show and post-show events, spas can offer food and beverage offerings and cruise lines can invite guests to arrive a few hours before their cruise sets sail so that they can explore the ship (and spend money).

Sports stadiums face a similar opportunity. For example, baseball stadiums have been faced with high fixed costs associated with the stadium, but have traditionally only been able to generate revenue during games or by offering special events such as concerts or exhibitions. Baseball stadiums in Baltimore and Philadelphia have designed their space so that customers not only have a variety of entertainment, restaurant and retail options available during the game, but so that they also want to come before the game or stay after to enjoy the various offerings.

Extending time is not necessarily an option for companies that rely on customer throughput for revenue generation because of the potential impact on other customers who might want to use the service. For example, during busy periods, hotels do not want customers arriving early or staying late because of the effect on other customers; but during slow periods, hotels may be happy to accommodate these customers. Airlines cannot encourage customers to stay longer or arrive earlier because other customers need to use the plane.

Multiple Uses: Firms using retail management have a large investment in their physical space and must determine ways to better leverage that investment. If the capacity is only used 81 times per year for approximately three hours each time, as is the case for US professional baseball stadiums, it is difficult to recoup the fixed cost investment in a reasonable amount of time. Stadiums can opt to play host to multiple sports, restaurants can be open for multiple meal periods, meeting space could be rented out for multiple events on the same day and theaters could have several shows a day or play host to several theater companies.

Offload Production: Since firms using Revenue Management have a fixed capacity of space, they should strive to reduce or remove non-revenue producing operations to a less expensive alternative. For example, restaurants might move food production areas to an off-site location, hotels might move maintenance and other back-of-house functions either off-site or to undesirable locations within the hotel, and cruise lines could put staff sleeping and eating facilities on less desirable decks. The key is to keep as much of the physical space as possible devoted to revenue generation.

Conclusion

The management of space is equally important to the management of both time and price for companies using or contemplating the use of Revenue Management. Managers must understand the interplay of space, time and price in the development and execution of a successful Revenue Management strategy. Since the primary product that companies using Revenue Management sell is space for a certain amount of time, it is essential that they adopt a strategic view of their space. Companies need to manage both the configuration of their space and how they design the ambient elements of that space. Space is a scarce resource, and if not carefully managed and controlled, companies may never achieve their revenue potential regardless of how well they manage price and time.

References

Areni, C. and Kim, D. (1994) The Influence of In-store lighting on Consumers' Examination of Merchandise in a Wine-store, *International Journal of Research in Marketing*, 11, 117–125.

Averill, J. R. (1973) Personal Control Over Aversive Stimuli and its Relationship to Stress, *Psychological Bulletin*, 80(4), 286–303.

Baker, J. (1986) The Role of the Environment in Marketing Services. In J. A. Czepiel, C. A. Congram and J. Shanahan (eds) *The Services Challenge: Integrating for Competitive Advantage*. Chicago: American Marketing Association, pp. 79–84.

Baker, J., Grewal, D. and Levy, M. (1992) An Experimental Approach to Making Retail Store Environmental Decisions, *Journal of Retailing*, 68(4), 445–460.

Baker, J. and Cameron, M. (1996) The Effects of the Service Environment on Affect and Consumer Perception of Waiting Time: An Integrative Review and Research Propositions, *Journal of the Academy of Marketing Science*, 24(4), 338–349.

Bitner, M. J. (1992) Servicescapes: The Impact of Physical Surroundings on Customers and Employees, *Journal of Marketing*, 56(April), 57–71.

Bollapragada, S., Cheng, H., Phillips, M. et al. (2002) NBC's Optimization Systems Increase Revenues and Productivity, *Interfaces*, 32(1), 47–60.

Boyd, E. A. and Bilegan, I. C. (2003) Revenue Management and e-Commerce, *Management Science*, 49(10), 1363–1386.

Carroll, W. J. and Grimes, R. C. (1995) Evolutionary Change in Product Management: Experiences in the Car Rental Industry, *Interfaces*, 25(5), 84–104.

Cross, R. G. (1997) *Revenue Management: Hard Core Tactics for Market Domination*. New York: Bantam Dell Publishing Group.

Donovan, R. J., Rossiter, J. R., Marcoolyn, G. and Nesdale, A. (1994) Store Atmosphere and Purchasing Behavior, *Journal of Retailing*, 70(3), 284–294.

Geraghty, M. K. and Johnson, E. (1997) Revenue Management Saves National Car Rental, *Interfaces*, 27(1), 107–127.

Guilford, J. P. and Smith, P. (1959) A System of Color Preferences, *American Journal of Psychology*, 72, 487–502.

Hanks, R. B., Noland, R. P. and Cross, R. G. (1992) Discounting in the Hotel Industry, a New Approach, *Cornell Hotel and Restaurant Administration Quarterly*, 33(3), 40–45.

Hui, M. K. and Bateson, J. E. G. (1991) Perceived Control and the Effects of Crowding and Consumer Choice on the Service Experience, *Journal of Consumer Research*, 18(2), 174–184.

Kimes, S. E. (2000) Revenue Management on the Links: Applying Yield Management to the Golf Industry, *Cornell Hotel and Restaurant Administration Quarterly*, 41(1), 120–127.

Kimes, S. E. (2004) Revenue Management: Implementation at Chevys Arrowhead, *Cornell Hotel and Restaurant Administration Quarterly*, 44(4), 52–67.

Kimes, S. E. and Chase, R. B. (1998), The Strategic Levers of Yield Management, *Journal of Service Research*, 1(2), 156–166.

Kimes, S. E., Chase, R. B., Choi, S., Ngonzi, E. N. and Lee, P. Y. (1998) Restaurant Revenue Management, *Cornell Hotel and Restaurant Administration Quarterly*, 40(3), 40–45.

Kimes, S. E. and McGuire, K. A. (2001) Function Space Revenue Management: A Case Study from Singapore, *Cornell Hotel and Restaurant Administration Quarterly*, 42(6), 33–46.

Kimes, S. E. and Thompson, G. M. (2004) Restaurant Revenue Management at Chevys: Determining the Best Table Mix, *Decision Sciences Journal*, 35(3), 371–391.

Kimes, S. E. and Thompson, G. M. (2005) An Evaluation of Heuristic Methods for Determining the Best Table Mix in Full-service Restaurants, *Journal of Operations Management*, 23(6), 599–617.

Klassen, K. J. and Rohleder, T. R. (2001) Combining Operations and Marketing to Manage Capacity and Demand in Services, *Service Industries Journal*, 21(2), 1–30.

Langer, E. J. (1983) *The Psychology of Control*. Beverly Hills, CA: Sage.

Lovelock, C. H. (1992) Strategies for Managing Capacity Constrained Service Organizations. In C. H. Lovelock (ed.) *Managing Services: Marketing, Operations and Human Resources*, second edn. New Jersey: Prentice-Hall, pp. 154–168.

McGill, J. I. and van Ryzin, G. (1999) Revenue Management: Research Overview and Prospects, *Transportation Science*, 33(2), 233–256.

Mehrabian, A. and Russell, J. A. (1974) *An Approach to Environmental Psychology*. Cambridge, MA: MIT Press.

Milliman, R. E. (1982) Using Background Music to Affect the Behavior of Supermarket Shoppers, *Journal of Marketing*, 46(Summer), 86–91.

Milliman, R. E. (1986) The Influence of Background Music on the Behavior of Restaurant Patrons, *Journal of Consumer Research*, 13(2), 286–289.

Ng, I. C. L., Wirtz, J. and Lee, K. S. (1999) The Strategic Role of Unused Service Capacity, *International Journal of Service Industry Management*, 10(2), 211–238.

Prewitt, M. (2007) Chains Save Space, Support Sales with 'Value Engineering Principles', *Nations Restaurant News*, 15 October, p. 1.

Proshansky, H. M., Ittelson, W. H. and Rivlin, L. G. (1970) Freedom of Choice and Behavior in a Physical Setting: Some Basic Assumptions. In H. M. Proshansky, W. H. Ittelson and L. G. Rivlin (eds) *Environmental Psychology: Man and His Physical Setting*. New York: Holt, Rinehart & Winston, pp. 419–439.

Robson, S. K. A. (1999) Turning the Tables: The Psychology of Design for High-volume Restaurants, *Cornell Hotel and Restaurant Administration Quarterly*, 40(3), 56–63.

Sasser, E. E. (1976) Match Supply and Demand in Service Industries, *Harvard Business Review*, 48(November–December), 133–140.

Shaie, K. W. and Heiss, R. (1964) *Color and Personality*. Bern: Hans Huber.

Siguaw, J., Kimes, S. E. and Gassenheimer, J. (2003) Sales Force Revenue Management, *Journal of Industrial Marketing Management*, 32(7), 539–551.

Smith, B. A., Leimkuhler, J. F. and Darrow, R. M. (1992) Yield Management at American Airlines, *Interfaces*, 22(1), 8–31.

Sommer, R. (1969) *Personal Space: The Behavioral Basis of Design*. Englewood Heights, NJ: Prentice-Hall.

Underhill, P. (1999) *Why We Buy*. New York: Touchstone.

Weatherford, L. R. and Bodily, S. E. (1992) A Taxonomy and Research Overview of Perishable-Asset Revenue Management: Yield Management, Overbooking and Pricing, *Operations Research*, 40(5), 831–844.

3

Pricing and Revenue Optimization: Maximizing Staff Effectiveness

Warren H. Lieberman

Introduction

Given the significant impacts that pricing and revenue optimization programs have on a firm's profitability, it may come as somewhat of a surprise that rather little has been written about the impacts of staff effectiveness on such programs or the tactics and strategies that can be adopted to increase staff effectiveness (Okumus, 2004). Further, the criticality of staff effectiveness has been widely acknowledged, as "poor organizational planning is often the reason cited for the failure of a Revenue Management implementation, and poor training is frequently blamed for subsequent inadequate performance" (Talluri and Van Ryzin, 2004).[1] Indeed, based on the authors' experience over the past 25 years in more than a dozen industries, we estimate that superior pricing staff are likely to enable revenue gains of at least ¼ percent and perhaps as much as ¾ percent of revenue (excluding benefits resulting from improved decision support tools). This chapter identifies key principles that we have found enable staff to perform better and generate greater revenues.

A preliminary observation may be worth noting: frequently we talk in terms of failure or success. With respect to revenue optimization, such a dichotomy is likely to lead to errors, either through inaction or overreaction. We view revenue optimization success as a continuum; what makes the concepts in this and other chapters of the book so critical is that small advancements in revenue management success tend to have dramatic impacts on a company's bottom line. For many companies, improved pricing decisions enable greater revenues with little increase in operating cost; the leverage on profits is exceptional.

While the benefits of the principles in this chapter are easily observed and accepted, it is easy to lose sight of their importance; that this occurs in practice and that pricing and revenue optimization efforts suffer, has been noted by several authors (Brotherton and Turner, 2006). Companies that experience the greatest success in their pricing and revenue optimization efforts tend to be the ones where staff follow-through on these principles.

Interdepartmental collaboration

Fostering an environment where interdepartmental collaboration is not only encouraged but expected, is a widely recognized but frequently overlooked opportunity for increasing staff effectiveness. The extent to which pricing and revenue optimization staff cooperate with staff in other departments makes a huge difference in a company's ability to maximize its profits. While this principle may not come as a surprise, many companies do not take the steps that they should to facilitate interdepartmental communication and cooperation.

Collaboration generally does not come easily. It is not the path of least resistance. Collaboration does not just happen. You have to work at it. Carrying out regularly scheduled revenue optimization meetings (for example, weekly) involving multiple departments is one tactic to help accomplish this. Such meetings provide an excellent forum for reviewing upcoming events and sales opportunities, prioritizing their importance and deciding upon what pricing actions should be taken.

What can be done so things can go right and what needs to be avoided so they do not go wrong? Let's consider two case studies.

Good ideas come from lots of places

An upscale hotel, located at one of the national parks in the USA, typically sold out during the spring and summer seasons but was virtually empty in the middle of winter. For a number of years, this was simply accepted by the hotel's general manager and sales staff as a fact of life. Even though the hotel possessed a number of features that were enjoyed by its guests, it was difficult to experience many of the wonderful features of the national park in the winter and that was thought to be the primary draw of bringing people to the hotel.

Over time, a new pricing director was brought in. Uncomfortable with simply accepting things as they are, the pricing director wondered what could be done to stimulate demand during the winter. Rather than simply task her staff to develop a proposal for stimulating demand, she scheduled a brainstorming session, inviting representatives from departments beyond sales and marketing, including food and beverage, operations, finance and housekeeping.

Many ideas were suggested. As you might guess, offering a substantial discount was one of them, although concerns were raised about the potentially negative impact that a broad discounting program would have on the hotel's image.

During the discussion, several key issues surfaced. As the hotel was in a relatively remote area, it was noted that few guests stayed for only a single night. Also, it was observed that the vast majority of guests who stayed did so because the hotel offered a unique experience. Price was not generally uppermost in the minds of guests. The food and beverage representative gladly contributed the information that guests frequently commented that they ate so well during their stay that the food alone would have make their trip worthwhile.

Eventually, a basis for a program began to emerge. What if past guests were invited back during the hotel's slow period and offered a free night during the winter period? No strings attached. The invitation was simply a way to say thank you for having stayed. Hotel staff agreed that the location of the hotel was such that almost everyone who took advantage of the offer would elect to stay at least two or three nights simply because of the hotel's location.

To enhance the offer and to generate additional revenue, special events such as cooking presentations would be arranged by the hotel. Participation would be limited, making signing-up for these events even more attractive.

As ideas for the program took shape, each department suggested program elements. Invitations were sent out and the hotel's staff waited to see what type of response they would get. The response was overwhelming. Many past guests took the hotel up on its offer. Virtually all of them stayed for several nights. The winter occupancy rate rose to levels far greater than ever experienced. Also, because guests were offered a free night stay with no restrictions, the overwhelming feeling among the guests was that the hotel truly appreciated their business. Their loyalty to the hotel and to other hotels operated by the parent company, as measured by return visits, grew.

Had it not been for the pricing director taking the initiative to involve other departments, it is likely that this successful program would never have emerged. So one question revenue optimization staff should periodically be asking themselves is "What efforts are we taking to get input from multiple departments to help optimize our revenues and profits?" An appropriate follow-up question may be "Are we doing all we can?"

Sometimes things slip through the cracks

While interdepartmental cooperation does not always occur, the failure is often unintentional. Sometimes, it is simply a result of overlooking what should be done.

For example, monthly ridership reports at a passenger railroad revealed that overall demand was quite low on a number of routes. The marketing department saw building demand for these routes as its responsibility. The marketing and advertising departments worked on developing a campaign to stimulate passenger demand. Heavily discounted fares typically restricted to selected train departure times were advertised.

Only after the campaign was launched did the pricing department become aware of the wording of the advertisements. What the monthly ridership reports failed to reveal, and what the marketing and advertising departments did not realize, was that on certain times and days of the week, ridership levels were actually quite high; some trains even sold out quite regularly. At other times, though, ridership was extremely low, often approaching no riders at all. Unfortunately, because no one in the marketing or advertising department was knowledgeable about the ridership details, the advertisements were worded broadly, requiring many discounted tickets to be sold on the train departures with high demand. Revenue at the railroad was significantly diluted and the program was a financial disaster.

While the marketing and advertising departments did not intentionally avoid collaborating with other departments, the company's culture and department heads did not place a strong emphasis on putting in business processes to ensure that such cooperation occurred. As a result, simply by carrying out business as usual, the effectiveness of the railroad's pricing staff was diminished.

With authority comes accountability

Our next opportunity involves two parts. Authority as well as accountability for decision-making must be consistent. When one is present but not the other, substantial problems result. Pricing decisions frequently restrict sales efforts. For example, the extent to which a salesperson can negotiate price on a large deal may be limited because the pricing department establishes guidelines on the minimum prices salespersons can offer. Depending on the structure of the organization, the pricing department may not have the authority to enforce these guidelines. That authority may rest with the sales director.

That can be just fine so long as the sales director is also held accountable for their decisions. When mechanisms exist to hold the sales director accountable for actions that override the pricing guidelines, it is far more likely that the pricing guidelines will enjoy long-term success. The pricing department acts more in an advisory capacity than it does as the final decision-maker. For many companies, that structure works well.

Where things break down is when pricing staff do not have the authority to implement decisions, acting primarily in an advisory capacity and furthermore the company lacks performance measures and feedback mechanisms to hold others in the company accountable for decisions that override the directives or recommendations of the pricing department.

Of course, the converse is also true. When the pricing department has the authority to enforce its rules over the objections of the sales department, the pricing department, and not the sales department, should be held accountable for the revenue impacts of its rules.

Training programs

Training programs can be an invaluable part of any comprehensive effort to enable pricing analysts to be as effective as possible. Training programs should focus on four things:

- Theory: why action should be taken.
- Practice: what action should be taken.
- Process: how actions should be taken.
- Improvement: learning from prior actions.

Before discussing the elements of a successful training program, it might be useful to touch on some of the reasons why training programs do not always succeed. Perhaps the most common reason is that training is structured as a one-off event, not a recurring program. There's no follow-up.

Training may not produce desired results because only pricing and revenue optimization analysts are included in the program (Sfodera, 2006). As noted earlier, interdepartmental collaboration is critical for enabling pricing staff to be most effective. Having this become integral to a company's culture should extend to training programs.

Sometimes, training is focused primarily on system usage: learning a user's guide rather than business elements. The emphasis of training may be on technical rather than business understandings. This tends to result in revenue and the optimization analysts having less than a full appreciation for the context of their decisions.

When training programs are conducted in these ways, pricing and revenue optimization analysts are generally less well versed in how to think through and resolve problems. In addition, such programs may promote a standard way of doing things as opposed to fostering a creative environment in which analysts fully appreciate the value and possibilities of looking for revenue improvement opportunities in creative ways. In our experience this tends to reduce staff effectiveness.

Further, the narrow focus of such training programs can lead other departments to view pricing or revenue optimization as a black box. Staff and other departments fail to understand how their actions promote or hinder revenue optimization success. Consequently there is less support for developing better communications and working relationships among departments, as the need for doing so may not be fully appreciated.

We have found that the most successful training programs share a variety of characteristics. First, they contain both introductory as well as advanced modules. Training is recurrent; workshops build on one another rather than being isolated efforts.

Successful training programs teach the difference between good decisions and good outcomes. Sometimes, we can be rewarded for a good outcome even though the decision may not have been the right one. Alternatively, a bad outcome does not necessarily mean a bad decision was made. It is important for pricing analysts to fully understand these concepts so that they are best prepared to defend their decisions.

Analysts should be taught how to identify opportunities to drive more revenue and profit. Also, when recommendations from decision support tools should be trusted and when they should be questioned. Such learning plays a critical role in making sure that analysts accept responsibility and can be held accountable for their decisions.

Successful training programs should reinforce good work habits. They will contain some exercises that are relatively straightforward and some that require creative thinking. It is important that analysts see training programs in a positive light. They need to be challenged but they also need to have successes. Tests can be a key element of a training program as they help to measure analytic proficiency.

Training programs that contain these elements will not only help pricing analysts be more successful in their jobs, but can also help them become more valuable assets for the company. Not only can this reduce staff turnover, but it can help other departments develop a stronger awareness about the impacts of improved pricing and contribute to the overall success of a pricing program.

Career progression

Our fourth principle focuses on career progression: opportunities for pricing and revenue optimization staff to succeed within the organization. Examining the extent to which a firm's policies and procedures support, or impede, career progression for these staff can be quite illuminating. This is likely to be strongly associated with whether pricing and revenue optimization staff are viewed as technical resources or as business experts. To what extent do those outside the pricing department view such staff as potential resources for strengthening their own departments?

Also, how do pricing analysts view their opportunities within the company? Do they believe their career advancement is limited to the opportunities that arise within their department? When positions become available outside their department, do they apply for those positions? Or do they feel excluded from those hiring opportunities?

In our experience, companies that involve their pricing analysts in other areas aspects of the company are likely to have greater success with their pricing efforts. As analysts with pricing and revenue optimization experience spread throughout the company, more departments begin to have a better appreciation of how their own efforts, and the efforts of others in their department, will either reduce or enhance the effectiveness of the company's pricing actions.

Consider the experience of revenue optimization staff at an airline. At this airline, they were considered to be business analysts as well as technical experts. Consequently, when opportunities became available in other departments, revenue optimization staff were prime candidates for filling analytical positions in these departments. Over time, revenue optimization staff transferred into more and more departments. This had the effect of making the company's pricing and revenue optimization initiatives more successful as staff in other departments became less prone to acting in ways that overrode the intentions of pricing staff.

This can be contrasted with the experiences of another company, where pricing staff were deemed solely to be technical experts with no true understanding of the business. While department directors had respect for the technical capabilities of the pricing analysts, the directors did not believe pricing analysts understood the business, and consequently tended to find reasons why the recommendations from the pricing department were not consistent with those actions the business needed to take to operate most successfully. As a result, other department actions often undermined the recommendations made by the pricing department.

Pricing analysts were not sought to fill vacant positions in other departments. Advancement opportunities within the pricing department were also limited. The company was focused on containing its costs, so salaries for experienced pricing staff were not particularly high. Recognizing that their career paths in the company were limited, pricing analysts tended to leave the company after a few years. The relatively high rate of staff turnover in the pricing department meant that institutional information was lost. Because of this, the pricing department was less effective in finding revenue generating opportunities than it would likely have been had it consisted of more experienced staff. Within the company, however, there was no sense that the turnover within the pricing department was leading to suboptimal pricing decisions and consequently a loss of revenue and profit.

Decision support tools

Only relatively recently, perhaps in the past 20–30 years, have many companies adopted systematic and quantitative methods designed to optimize their revenues and profits. There is now relatively widespread recognition that it is advantageous to employ systematic and mathematically-based decision support tools for pricing.

To enable staff to make better decisions, the decision support tools should be consistent with the availability and accuracy of the company's data, information technology capabilities, business processes, policies and even its culture (Lieberman, 1993). For some companies, this can mean a simple alert and exception reporting system. For others, it can mean a comprehensive system that includes mathematically sophisticated and state-of-the-art optimization algorithms. The number of tools in the toolbox and also the sophistication of the tools can be increased over time. As a company gains experience with decision support tools, it typically becomes better prepared to implement broader and more complex decision support tools.

Understanding the job

If you thought that revenue optimization staff always know what they are supposed to be doing and how they should be doing it, you're in for quite a surprise. Information gleaned from staff surveys as well as interviews with revenue optimization staff have led us to conclude that one of the reasons staff do not perform as well as they might results from having a poor understanding of what they are supposed to do and how they are supposed to do it. Okumus (2004) provides a fascinating case study describing a hotel group's struggles to implement a yield management system, in which this is one of a variety of issues that appeared to limit how well yield management practices were deployed.

For staff to better understand what is expected of them, it can be valuable to develop a Best Practices Manual that formally benchmarks the goals, roles and responsibilities of staff, including recommended business processes. Including alternative competitive scenarios in the guide, with illustrative ways of addressing them provides a valuable "road map." Illustrative business processes can include periodic pricing meetings, evaluating bids or large orders, prioritizing sales opportunities to identify potential revenue optimization actions and ways to stimulate demand under varying conditions. Additional areas can be included over time, so that the best practices guide becomes a "living document." Best practices guides should evolve and expand over time. As staff turnover occurs, best practices guides can be quite valuable in terms of getting new staff up to speed as quickly as possible.

Another tactic firms use to help staff better understand what they are supposed to do and how they can be more effective in what they are doing is to carry out periodic pricing audits. As with financial audits, third party experts are brought in to review and evaluate the pricing practices being carried out by the company. While many organizations are legally required to carry out annual audits of their financial results and practices, these are backward looking initiatives. That is, they review what has happened in the past. Typically, such audits also focus on whether practices are legal. A pricing audit is different, focusing on the effectiveness and impacts of a firm's pricing practices as well as defining improved processes. While it may not be necessary to carry out a pricing audit every year, periodic reviews can be used to detect any inefficiencies or poor practices that might be corrected.

As improvements in pricing decisions typically have such great financial leverage, identifying and correcting deficiencies in pricing practices will typically provide benefits far greater than the cost of carrying out an audit. As we have noted, estimating the potential benefits of improved pricing is critical: without that understanding, it is typically difficult, if not impossible, to obtain senior management's approval to invest in such an activity.

Quantitative performance measures

Effective pricing typically focuses on making decisions that maximize a firm's profitability, consistent with its long-term customer service goals. Consequently, it is vital to have mechanisms in place that measure the impacts of decisions. Communication methods must be available to distribute that information within the organization and also to provide feedback to the pricing department so that staff decisions improve over time. Pricing staff should be able to learn both from their mistakes as well as from their good decisions.

Providing senior management with a one or two-page *flash report* is an effective tactic. Report contents will be industry-specific. Generally, such reports should be available on a daily or weekly basis. This helps create a corporate culture where it becomes accepted that it is not only possible, but also highly important to quantify and communicate the impacts of pricing decisions.

When quantitative estimates of the impacts of decisions are provided, the decisions themselves attract more notice among senior management and options are given more consideration. For example, suppose a potential pricing action has the potential to generate a significant amount of incremental revenue, but there is some risk associated with that decision. Or suppose there are operational challenges that need to be overcome. Based on experience, the likelihood that such a pricing action will be taken tends to be greater when a credible quantified estimate of the potential financial impact is provided, justifying the decision. It is far easier for a senior director or vice president to say "no" when the level of potential benefits is vague. When the potential benefits of an action are quantified, there tends to be greater discussion on finding ways to mitigate the risk or operational difficulties, if the potential benefits are deemed large enough.

The following example provides an excellent illustration of why it can be important to quantify the impacts of pricing decisions. In addition, this example also illustrates that successful pricing programs and decisions may need to be viewed on a long-term basis, rather than in the short term.

Suppose you are a sales agent for a company that resells tickets to concerts, shows and sporting events. You have two tickets left to an otherwise sold-out concert. The tickets are for premium seats and it is the day of the concert. Indeed, the concert is in six hours. You receive a request to buy one of the two tickets. Based on your past experience, you know that you occasionally receive requests for tickets within a few hours of when concerts begin. Indeed, if you turn down the request, based on your analysis of historical transaction data, you estimate that there is a 25 percent chance of receiving a request for both tickets, but given that the concert is only in a few hours you do not believe anyone else will call wanting to buy only one ticket. What do you do? Do you elect to sell one of the two tickets knowing that the other ticket will go unsold, or do you refuse to sell the individual ticket and hope that you receive a request in the next few hours for both tickets? If you choose the latter option, you realize that there is a chance that neither ticket will be sold. Further, how are you going to demonstrate to your supervisor that you made the right decision?

From an expected value perspective, the most profitable strategy is to sell the individual ticket. This would maximize the revenue received by your company.

From a short-term perspective, however, electing to sell a single ticket virtually ensures that you will have to explain your decision to your supervisor. One ticket will be unsold and if your supervisor believes that both tickets could have been sold, you risk being reprimanded for making the wrong decision.

Indeed, if as would be true for most companies, there is no detailed record kept of sales requests that go unfilled, the path of least resistance might lead you to decide not to sell the individual ticket and simply wait to see whether or not you receive a request for both tickets in the next few hours. Your supervisor would probably not even be aware that you had an opportunity to sell an individual ticket. But the long-term impact of doing so, on a repeated basis, would not maximize the firm's profit.

Assuming your supervisor, indeed the company, expects you to make decisions that maximize profit, this example demonstrates why it is important to quantify the impacts of pricing actions and share such information. In the absence of such information and without the ability to compare the impacts of the choices available, it is virtually impossible to defend your decision. You lose no matter what you do.

Analysing the competition

Thus far, the principles presented have focused on internal company operations. Our next opportunity is outwardly focused. The most successful pricing analysts develop good understandings of their customers, potential customers and of the competition. This information is used to set prices and modify product design, especially with regards to conditions of purchase or terms of use. Let's explore this in more detail, based on an actual situation.

Table 3.1 Traffic and service summary, ABC-XYZ market

Airline	**ABC to XYZ and XYZ to ABC Average Daily Passengers**	**Market Share (%)**	**Stops**	**Fare ($)**
AirMax	104	88	0	349
EZFly	14.5	12	1	349

As shown in Table 3.1, EZFly Airlines competes against AirMax on the route between cities ABC and XYZ. EZFly transports far fewer passengers in this market. AirMax has approximately 88 percent of the market share. AirMax offers non-stop service, while EZFly provides one-stop service. Based on travel time, EZFly's service is inferior. Both airlines offer the same roundtrip fare of $349. Although not shown in Table 3.1, AirMax's flights are quite full, but EZFly's flights depart with many empty seats (many of the passengers on AirMax's flights are connecting to/from other cities). EZFly's pricing department is considering what it can do to generate greater revenues on this route.

Because so few passengers are flying on EZFly from ABC to XYZ and from XYZ to ABC, there is minimal risk of revenue dilution due to a fare reduction. If EZFly reduces its fare and AirMax were to match it, AirMax risks significant revenue dilution. Based on their knowledge of the market, EZFly's pricing analysts believe that a fare reduction to $250 would stimulate a lot of new demand for travel between ABC and XYZ.

Figure 3.1 quantifies the potential financial risk faced by AirMax if EZFly reduces its fare from $349 to $250 resulting in some passengers choosing EZFly rather than AirMax. The horizontal line depicts the annual revenue

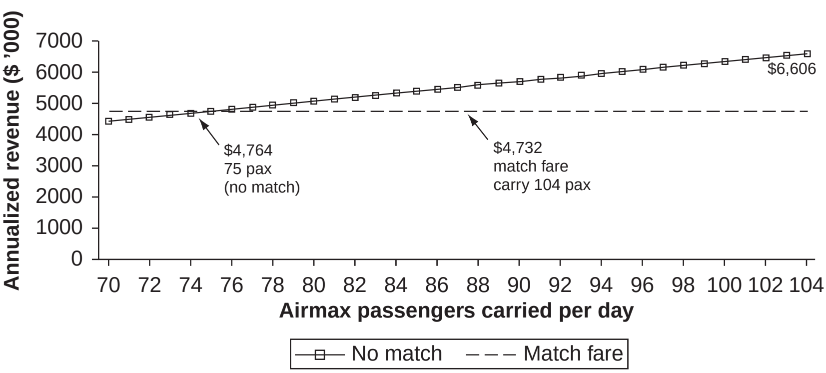


Figure 3.1 Potential AirMax revenue.

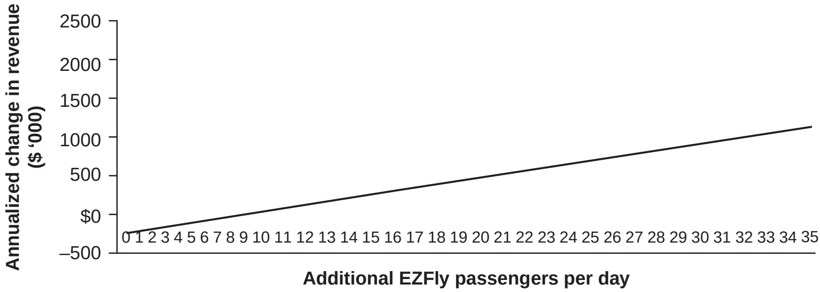


Figure 3.2 Potential revenue impact for EZFly.

received by AirMax if it lowers its price to $250 and continues to carry 104 passengers per day. Unless AirMax were to lose approximately 30 passengers per day due to EZFly's fare reduction, it would be financially better off not matching the reduced fare. Additionally, as shown in Figure 3.2, if EZFly can stimulate demand by at least six passengers per day, the price reduction will be profitable.

The proposal to reduce the roundtrip fare to $250 was approved by EZFly senior management and implemented. As expected, the reduced fare resulted in a significant increase in the total number of people traveling between ABC and XYZ and EZFly's load factors increased significantly. The pricing initiative worked as expected, with perhaps one exception: AirMax chose to match EZFly's fare. As AirMax could not transport many more passengers due to its flights already being quite full, it suffered significant revenue dilution. In that respect, EZFly's fare reduction was more successful than anticipated.

Final thoughts

Beyond financial measures, there are other ways to detect when pricing staff are likely to be more effective. For example, staff:

- are more analytical, less task oriented and less administrative;
- spend more time analysing and resolving problems and less time preparing reports;
- tend to be more focused on the total revenue picture.

Further, the director of revenue optimization or director of pricing may be viewed within the company as the *Chief of the Revenue Police*. The culture of the company may also shift, whereby the entire organization begins to buy in toward a profit maximization philosophy. These are some of the things that we have seen occur as organizations transform themselves and enable their revenue and optimization staff to become more effective.

Note

1. Of the 591 references listed in their book, approximately five appear to be related to the human resources aspects of revenue optimization. Several of those are specifically oriented to the hotel industry.

References

Brotherton, B. and Turner, R. (2006) Human Issues and the Introduction of a Yield Management System. A Case Study of a 4* Chain Hotel. In Fabiola Sfodera (ed.) *The Spread of Yield Management Practices*. New York and Heidelberg: Physica-Verlag, pp. 35–53.

Jones, P. and D. Hamilton (1992) Yield Management: Putting People in the Big Picture, *Cornell Hotel and Restaurant Administration Quarterly*, 33(1), 89–95.

Lieberman, W. H. (1993) Debunking the Myths of Yield Management, *Cornell Hotel and Restaurant Administration Quarterly*, 34(1), 34–41.

Okumus, F. (2004) Implementation of Yield Management Practices in Service Organisations: Empirical Findings from a Major Hotel Group, *Services Industries Journal*, 24(6), 65–89.

Sfodera, F. (2006) Yield Management in Advanced Systems of Hotel Management. In Fabiola Sfodera (ed.) *The Spread of Yield Management Practices*. New York and Heidelberg: Physica-Verlag, pp. 3–17.

Talluri, K. T. and Van Ryzin, G. J. (2004) *The Theory and Practice of Revenue Management*. Boston: Kluwer Academic Publishers, p. 620.

4
The Era of Convergence in Revenue Management

Ramesh Venkat

Introduction

In the last 45 years, the airline industry has undergone an expansion unrivalled by any other form of public transport. This expansion has been driven by falling costs and fares, which has stimulated higher demand for services. High growth for the most part has also spelt low profits. While some airlines have consistently managed to stay in the black, the industry as a whole has been only marginally profitable. The long-term trend for air transport is declining fares (ICAO.int, 2009). As customers get accustomed to low fares this could have a significant impact on revenue. Consequently, performance improvement may have to come through sensitivity to costs and how they are managed.

The years 2008–09 have been two years of tsunami for aviation. Fuel prices soared to \$140 from \$70 in 2008 and subsequently in 2009 the demand for travel dropped by 4.2 percent resulting in reduced passengers, yield and profitability (see Table 4.1).

Revenue management has been busy managing this bust and recovery, experiencing late and sporadic demand whose ebb and flow has never been more dramatic. Though revenue management technology has been advancing at a rapid pace most of these changes dealt with how to best respond to competitive pressures in the market place in a relatively stable environment. Effective pricing and revenue management technology also involved getting the right price to maximize revenue possible. This legacy view has not prepared traditional revenue management for the paradigm shifts in the business environment they faced in the last two years. The two commonly acknowledged revenue challenges facing airlines are:

- Major corporations are shifting to a more cost conscious culture (Mathies and Gurdergan, 2007). The distinction between business and leisure travelers is blurring with more of today's business travelers booking in advance, flying in economy class and searching for low fares to help their bottom line.

- Today's consumer has more information and choices in air travel than ever before. With a few clicks on the internet, travelers have access to countless permutations and combinations on how to get from point A to point B (Plunkett Research, 2010).

Organizations are now beginning to use cost and relationship management to support their strategic goals. They recognize the need to be more dynamic in order to deal with the rapidly changing environment and effects of globalization. Spurred by the increasing importance of cost, cost management has been adopted as a strategic focus. Managing costs has become a strategic partnership role, no longer simply a function of record keeping and reporting. It is no longer feasible to establish cost control based on intuition or rule of thumb. Therefore, a structured methodology is required in revenue and pricing management streams to manage cost in relation to revenue performance. As shown in Table 4.2, a minor change in cost has a major impact on profitability. When both revenue and costs move in tandem there is potential for dramatic increase in profitability.

Table 4.1 Demand for travel

YTD 2009 vs 2008	**Passenger growth (%)**	**Capacity growth (%)**	**Seat factor (passenger/ capacity)**	**Cargo growth (%)**	**Cargo capacity growth (%)**
Africa	−7.80	−3.60	69.7	−14.90	−4.20
Asia/Pacific	−6.80	−6.70	73.5	−12.40	−12.60
Europe	−5.3	−4.40	76.5	−17.70	−10.80
Latin America	−0.30	1.70	72.8	−7.80	−0.30
Middle East	10.40	13.50	73.1	1.60	6.10
North America	−6.10	−5.40	79.4	−13.00	−9.80
Industry	−4.20	−3.20	75.4	−12.70	−9.20

Source: IATA.org (2010).

Table 4.2 Profitability (USD million)

Impact of revenue and cost on profitability					
Increase in revenue (%)	0	0	0	½	1
Reduction in cost (%)	0	1	2	1	2
Operating revenue	8396	8396	8396	8438	8480
Operating cost	7450	7375	7301	7375	7301
Operating profit	946	1021	1095	1063	1179
% Increase in profit	–	8	16	12	25

Falling yields can be offset by further reductions in unit cost levels. Where this is not possible, airlines have no choice but to push up their load factors to remain profitable. When airlines lose control of this dynamic process of matching unit revenues, unit cost and load factors then they start making losses. When demand is strong, airlines have been able to ameliorate the potential squeeze on profits by increasing the average use by passengers of the seat capacity offered. The ability to offset the profit squeeze by increased passenger seat factors is reaching its limits and a small change in this with the mounting yield pressure will have a major impact on profitability.

A lower yield per revenue passenger kilometer (RPKM) implies a higher seat factor to attain breakeven seat factor and hence potentially a risky strategy to adopt as shown in Figure 4.1. With such a strategy, even a temporary shortfall in traffic is sufficient to create serious cash flow problems eventually leading to schedule disruption. Therefore cost control and further reduction is necessary if airlines need to sustain consistent profits due to their strategy of capacity expansion.

Over the last five years, low-cost carriers have changed the competition landscape (Deloitte.com, 2006). Pricing methodologies have evolved from the standard cumbersome rules and conditions to simple combination of one-way fares. Traditional pricing fences of network airlines to the segment market are being removed. Low-fare pricing can be considered as a synonym

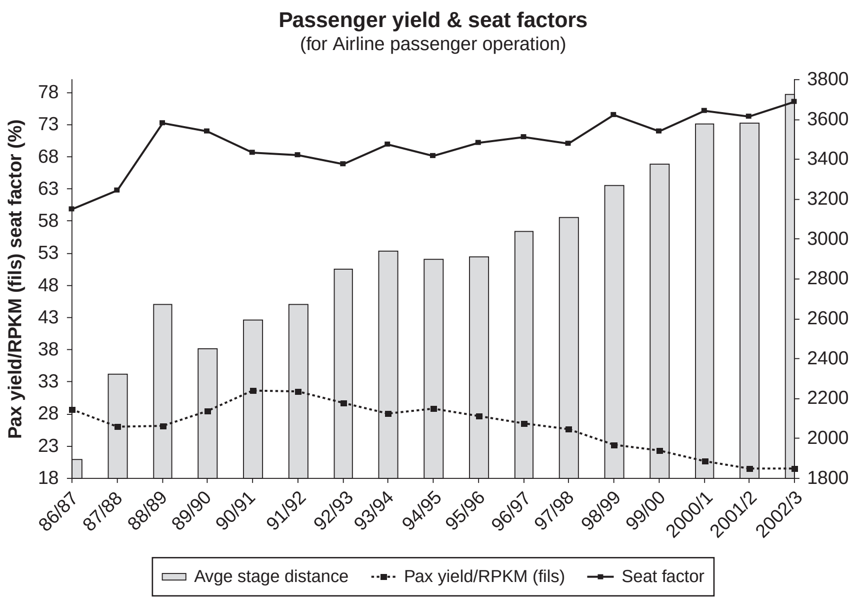


Figure 4.1 Increasing seat factor to combat declining yield.

for one-way, restriction-free pricing. The only remaining effective segmentation possible is through time of booking and choice of flight. Once the contingent of seats in a lower booking class is sold, the booking class is closed and the higher booking class becomes available for sales. The basic Revenue Management problem is recast from a portfolio mix problem to a price optimization problem with sensitivity to allocation and time to departure. In addition, there has also been a move on to cost-based models for bulk transportation. Carriers are thinking of offering price bands based on miles traveled to select customers so that the pricing model is simply based on distance flown as opposed to market dynamics.

The market is inundated with airline offers packaged with hotels, phones, supermarkets and so on through the Internet and reaching segments not possible before with the advent of sophisticated search engines. Airlines are also using other products like credit cards and hotels to help them burn ever increasing mileage balances providing a platform of converging products to common customers, creating a virtual mileage market with privately agreed exchange rates.

Industry channels such as corporate houses, online travel agencies, airline websites and call centers compete with each other to gain access to price and seats. Bypassing the standard Global Distribution Systems (GDS) to low-cost channels has become of paramount importance in most airlines. For many airlines the proportion of tickets sold through legacy GDS systems has dropped as sales are increasing on the Internet and through other low-cost distribution alternatives (airlineinformation.org, 2006).

The traditional Revenue Management systems are excellent at maximizing revenue at flight level; however, they do not consider long-term relationship values and costs of the various customer segments while making inventory decisions. There is a compelling need to develop models based on aggregate enterprise value of a transaction or a customer rather than just air price and inventory. Airfares are also not transparent in terms of what other costs are hidden or benefits provided. On some fares mileage is provided, on others passenger expenses like transportation or lounges are absorbed. This requires Revenue Management to take a more holistic view of a commercial transaction and its effects on the bottom line.

The advantages of e-ticket information have not been fully exploited in the airlines' Revenue Management operations particularly in the forecasting process, revenue accounting and financial reporting systems. Most airlines continue to use the standard models and do not take cognizance of the fact that the extent of ticketed bookings can be moved to a deterministic domain as opposed to remaining in a probabilistic one.

Today Revenue Management demand forecasts are based on historical average competitive schedules and fares. Previously, this approach did not pose a major problem, but with the emergence of restriction-free pricing during the past few years, the airline business has changed considerably.

Assumptions of stable, unchanging competitive availability are unrealistic in the current environment and can significantly reduce the value of Revenue Management.

Revenue streams

Airline organizations typically operate a frequent flier program to support their revenue objectives with innumerable restrictions on inventory, based on flight forecasts, imposed by Revenue Management. The Revenue Management systems do not fully appreciate the past relationship value of members and their potential future revenue contribution when they make inventory decisions. A tentative solution has been the categorization of members into different value groups such as silver, gold and so on; this classification, however, is far from a complete solution based on value relationship over a longer period of time.

Most airlines have "holiday" operations of their own and they have seat allotments similar to tour operator allocations. The prices for these seats are based on internal policies and often the subject of debates between revenue analysts and sales staff purely from a price/flight/seat/demand perspective. The Revenue Management systems generally do not consider the additional revenue potential in their decision-making process, for example, the potential additional earnings the customer could bring through commission by staying in a five star hotel for two weeks.

It is now a standard that airlines have their own website to sell their products and the direct channel offers many advantages, such as reduced distribution costs, direct communication and a close relationship with the customer. Such channels tend to maintain their exclusivity by offering prices and other benefits that are not generally offered in a public domain albeit with hidden costs. These customer benefits may be in the form of price reductions and/or services, adding to substantial costs, for example, limo services, theater tickets and so on. Revenue Management systems do a good job in selecting "maximizing" revenue streams but, however, are not adept at differentiating customers with identical revenue but with varying costs.

In addition, the airlines generate their revenue through the industry standard travel agency systems and other airline systems. Again, the Revenue Management systems do not consider the cost of booking fees incurred in various channels. Also the hidden costs of carriage need to be considered, for instance, if an airline is paying $10 as security fee per passenger from point A as opposed to nothing from point B, it is worthwhile offering more seats to point B on capacity-constrained flights.

From a completely different perspective, cargo and excess baggage also compete for transportation along with passengers for access to aircraft capacity. There have been instances when high yield perishable cargo revenue is more beneficial than the revenue earned from the lower end of the passenger market.

The above examples illustrate that many channels with different price and cost bases compete for airline capacity and present sufficient encouragement to consider relationship values, longer time spans and costs in a revenue management program to improve profitability. These requirements need to converge for better decision making and the author makes no attempt to guess or quantify the profitability increase of such an approach with a specific percentage.

Pricing conundrum and changes in the business environment

Recent years have seen significant changes in the underlying airline fare products. New fares with fewer rules and restrictions have resulted in greater revenue dilution and yield declines in many markets. New Internet-based e-channels have emerged. Web fares have proliferated and the pricing landscape has gone through a revolutionary transformation, from a typical seasonal day of the week flavor to a "pay as you use" approach. The airlines are moving toward a transparent business model, sharing with their customers a base price and a series of add-on prices for the services and benefits to compensate directly for the variable costs. Typical examples are $5 off if no miles are to be accrued; $3 off for no check-in bags; $3 for a coffee on board and so on. This way fares are becoming popular and are used by airlines to balance seasonal traffic imbalances (Malighetti et al., 2009).

Airlines have typically focused on pricing by itineraries for individuals and pricing for groups by some form of displacement cost. To a large extent they have been influenced by their competitive position in the markets based on their frequency and service excellence (Dolan and Simon, 1996). This over-dependence on competition in the market place exposes the airline to undesirable fluctuation in cash flows. For a certain portion of the inventory, the airlines need to develop longer term price relationships based on a cost and a profit target, to cope with market forces and uncertainty better. This strategy acts like a shock absorber dampening the impact of the markets and consequently, reducing revenue fluctuations (Cross, 1997; Holden and Burton, 2008).

In this age of product diversity, mass markets are progressively fragmented with different segments of customers demanding "customized" products. Product line pricing and price bundling present the airline with new opportunities to develop more "custom-built" relationships and value propositions than ever before. This fragmentation, however, makes traditional pricing management an unwieldy proposition by requiring rapid and multiple changes to a rapidly expanding and unstable pricing structure.

Also, up-to-date market competitive information has to be used to improve the airline's Revenue Management capability. It should be possible to use information from low-fare search results to optimize prices and availability in real time, considering current competitive conditions. Such availability and repricing capabilities are known as "active inventory."

Instead of relying exclusively on planning forecasts to predict selling conditions, active inventory uses actual current market conditions to reduce the impact of planning forecast errors. Also by pushing more automation and intelligence into real-time decisions, it helps simplify the management of markets and dates by Revenue Management analysts.

In elastic markets, with inventory being pre-committed this assumption may constrain revenue generation potential and growth. Airlines usually increase prices as one gets closer to departure. The extent to which these prices can be raised may need to be based on a more dynamic and closely monitored elasticity in these markets. At its optimum, a small increase in prices could generate greater revenue in many cases by moving demand from other carriers. In other cases, the reverse may hold true.

Sales challenges

The traditional demand models are focused on dimensions that are oriented toward flights, date and class of travel. Their principal aim is to maximize revenue on peak flights where the market demand is higher than the capacity offered. This uncompromising approach leaves the sales force with the challenge of switching off markets when not suitable and turning on markets when appropriate.

It is known that sub-optimal decisions have to be made during the peak for revenue generation during the non-peak; this is necessary to maintain continuous presence and to sustain relationships with the distributors in the market. The systems and processes must be able to clearly identify the cost of this short-term loss endured for longer term growth and market penetration.

Sales challenges can also arise from capacity growth. In the airline world, spending decisions are made far in advance of the selling process. Combined with this, the seat as a product is very perishable, making immediate decisions significant. In a scenario where supply or capacity expands quickly, the sales force is tasked to generate revenues far in excess of natural or organic growth rates. This involves incentivizing the market, adding costs to a situation where achieving route breakeven is a sensitive issue. In this case the sales person ends up chasing the same demand that was rejected in the past for short-term gain.

The other concern for sales is the value/volume conundrum. Based on a head office requirement, there are seasons where average fares need to go up and others where volume is required.

The sales force is also required to manage a business that is spreading into areas that are new and unfamiliar. How does one influence a customer who books online? How does a sales office manage the mix of channels at a local level? What is the future of ticket offices and call centers in an online world? These questions demonstrate that a narrow revenue focus is insufficient as business develops from a single channel relationship model to a multipronged dynamic system.

Ticket sales are also becoming increasingly global. Ticket shops now exist at an offline destination that has no connection with where the demand is coming from. The sales force has no idea how to influence an office decision on which airline to support and why. Some airlines try and manage these accounts through a global sales platform with these large accounts, while the servicing is still done at a local level. This creates complexities with the sales force – they do not see the reward of servicing these clients as it no longer helps them achieve targets. So far in the industry volume has been treated as incremental revenue. Perhaps it is time to bring in the cost implications as well.

Revenue Management process shift

To bring in the cost implications, airlines will need a commercial understanding of what requires to be changed in the current thinking and policy. The model in Figure 4.2 shows the potential phases involved.

Early allocations are made to ensure long-term relationships are covered. This exercise can be done before flights are in the system for sale and can include long-term series and inclusive tour allocations, corporate requirements, mileage rewards and other revenue sources with a high lifetime value. These allocations can cover between 20–30 percent of demand and provide an enviable platform in a poor year when demand drops. Medium-term allocations are made during the early booking cycle of the flight and focus on both revenue and cost. In this period, strategic fares are used and demand seasonality in terms of peaks and troughs are given importance. It is assumed that between 40–60 percent of the allocation of inventory is done during this phase. In the final phase, any remaining inventory (10–20 percent) is targeted through volume-specific offers, tactical fares as a top up mechanism that will generate incremental revenue. In this phase a marginal cost

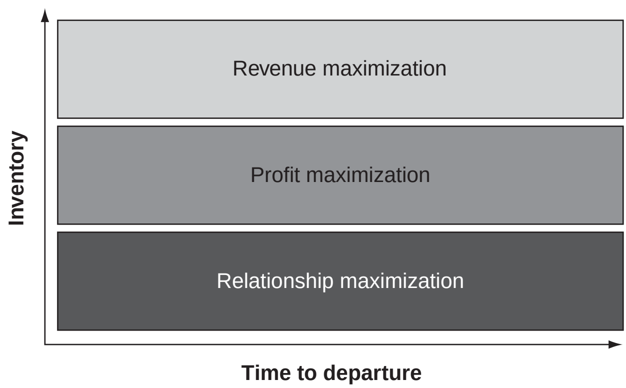


Figure 4.2 New phases involved in Revenue Management.

approach may be used and fixed costs may not be used to arrive at prices or availability.

Revenue Management paradigm shift

Therefore, in addition to revenue, there is a compelling need to include costs and relationship values to maximize profitability. Current Revenue Management systems are excellent reactive engines that maximize revenue on given flights; however the need in the future strongly lies in their ability to be proactive, and encompass emerging pricing models with an operating time domain that covers the whole financial planning period (typically 12 months).

Integrating Revenue Management with marketing, pricing and distribution represents a move from traditional Revenue Management to profit optimization. Integration is achieved with a system that integrates data from each department, synchronizes analysis, and automatically alerts users when action is needed or conflicts arise. Using this systematic approach, forecasts from Revenue Management drive the appropriate promotion strategies from the marketing department, which offer customer-centric pricing based on customer willingness-to-pay, the value of the customer to the firm after costs and overall demand levels. Customers are encouraged to book through the most profitable channels. Under this integrated framework, all departments have a single view of the data and can coordinate actions with the goal of overall profit optimization.

The model in Figure 4.3 shows the inclusion of cost and enterprise revenue as the new themes that will drive Revenue Management in the future.

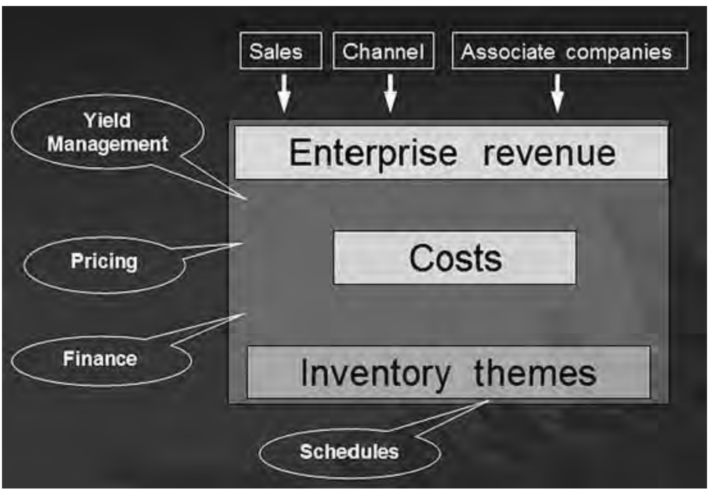


Figure 4.3 Cost and enterprise revenue.

The model involves segregating revenue streams by source, allocating relevant cost components, aggregating results across segments and time windows, building profitability data by revenue stream and running an inventory rule engine that works on top of published schedules. The inventory themes resulting from this model will then dictate availability at each channel and point of sale.

Segregating revenue streams may not only identify geographical sources of revenue and associated costs of sale but will also reflect channel penetration strategies and its costs. Current models struggle to isolate B-to-B agency demand from B-to-C customer channels like airline websites. Without this clarity airlines are unable to optimize channel mix and develop them according to corporate requirements.

The model may also be sensitive to revenue or costs from associated companies and identify special agreements that provide a discount or benefit either via incremental revenue or reduced costs. Sometimes these companies are part of a group or a joint venture. In other scenarios they are part of a specific tie-up on a limited or local scale. These tie-ups can become complex, with barter agreements and non-cash related transactions such as using miles or giving away a certain number of free tickets. The value of these transactions needs to be recognized though as arriving at a value may not be simple or easily agreed.

The model also provides a platform to converge financial thinking and policies with Revenue Management goals. In annual budgeting processes, for example, revenue and cost budgets are driven independently, though usually cost budgets are constrained to a predetermined level below revenue budgets. Apart from this broad adjustment, revenue generation is driven by the unbridled desire by the sales force to achieve revenue targets, setting aside any qualms on how much that revenue costs to generate.

There is also a sensitivity required towards the time dimension, both in terms of response or speed to the market and, more importantly, in scoping the various time windows that need to be assessed before decisions are made. In the short term, a high value customer may be offered rebated inventory as a reward for past or future value. In the medium term, a marketing promotion may require Revenue Management to release lower fare inventory in return for market development and growth during the year. In the long term, lead-in promotions could be a precursor to more frequencies or new routes. All these situations are managed today, without a proven rationale or the support of appropriate process or technology solutions (Bearden et al., 2006).

A working model of this thinking is shown in Figure 4.4.

The model adjusts standard availability through profit filters to arrive at profit-based availability and optimization. As a first step, standard availability is arrived at by applying forecasted market demand on to the airline schedule as usual. This schedule is picked up from reservations systems. The

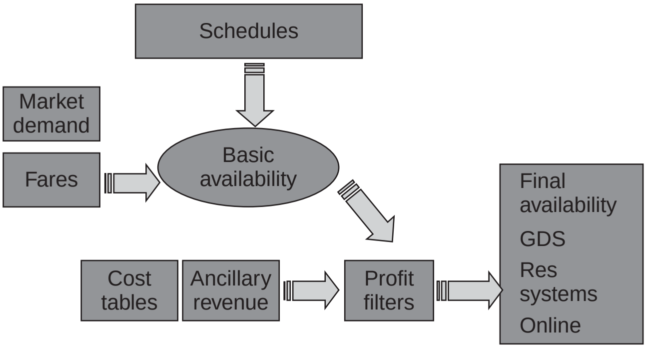


Figure 4.4 Profit-based availability and optimization.

availability processor also picks up market demand, either historical flown values or forecasted demand from forecasting systems.

The new element in the model is the input of base cost tables, ancillary revenue information and a set of profit filters. The cost tables can be worked through a historical aggregation process or from a live finance feed to provide updated data. Enterprise costs are pro-rated and specific line costs are allocated to revenue streams to arrive at total costs and profitability by type of revenue. The revenue classifications are arrived at earlier at the granularity level that is required by the airline.

The ancillary revenue and associated company data is a finance department feed, that instead of being reported as a miscellaneous item now joins the core feed for decision making. Ancillary revenue has become a significant part of revenue generation in some airlines but is not usually attached to its source and therefore does not influence Revenue Management decision making.

As basic availability is passed through the profit filter logic, final availability gets adjusted in line with profit-making capability, thus aligning availability to the most profitable demand instead of toward the highest paying line, and thus optimizing the network for maximum profitability. The author is aware that at some scheduled airlines, work has already begun on models similar to this.

The entire spectrum of revenue generation processes and the costs associated with them must be converged and homogenized before processing. This requires normalization of revenue and costs, and development of a uniform Revenue Management currency, which needs to be accepted and adopted throughout the organization for access to airline inventory.

This would also bring about the much needed transparency across channels/divisions and a paradigm shift to focus and systematically reward profits as opposed to revenue generation. Is this perhaps the beginning of a new wave of profit-centric Revenue Management (PCRM)?

Conclusion

The objective of this chapter was to identify gaps in current capacity-based Revenue Management systems and explore opportunities to align systems toward corporate profitability. Conventional Revenue Management systems maximize revenue for a given capacity based on market demand and pricing structures at an individual flight/date level with models that are predominantly transactional in nature. They do not consider profitability, cost structures, relationship value and ancillary revenue opportunities from a long-term perspective whilst allocating flight inventories. After discussing and analysing the nature of revenue streams, sales challenges and emerging pricing principles, this chapter has proposed a practical model that includes the above missing elements. In essence the model recommends standard availability considering profitability.

From a process perspective, the entire gamut of Revenue Management processes and the costs associated must be converged and homogenized. This requires normalization of revenue and costs and the development of a uniform Revenue Management currency which needs to be accepted and adopted throughout the organization for access to airline inventory. It is expected that this would bring about the much needed transparency across channels/divisions and a paradigm shift to focus and systematically reward profits as opposed to the current total focus on revenue.

References

Bearden, N. J., Murphy, R. O. and Rapoport, A. (2006) *Decision Biases in Revenue Management: Some Behavioral Evidence*. New York: Centre for Decision Sciences.

Cross, R. G. (1997) *Revenue Management*. New York: Broadway Books.

Deloitte.com (2006) Flight Path to Success. Available online at http://www.deloitte.com/view/en_CA/ca/industries/consumerbusiness/tourismandtransportation/e768c5275d0fb110VgnVCM100000ba42f00aRCRD.htm (accessed 08 March 2010).

Dolan, R. J. and Simon, H. (1996) *Power Pricing, How Managing Price Transforms the Bottom-line*. New York: The Free Press.

Holden, R. and Burton, M. (2008) *Pricing with Confidence: 10 Ways to Stop Leaving Money on the Table*. New York: Holden Advisors Corp.

ICAO.int (2009) Group on International Aviation and Climate Change (GIACC) Montreal. Available online at http://www.icao.int/env/meetings/2009/Giacc_4/Docs/Giacc4_ip05_en.pdf, date accessed 10 March 2010.

IATA.org (2010) Economics, Geneva. Available online at http://www.iata.org/whatwedo/economics/Pages/index.aspx, date accessed 10 March 2010.

Malighetti, P., Paleari, S. and Redondi, R. (2009) Pricing Strategies of Low-cost Airlines: The RyanAir Case Study, *Journal of Air Transport Management*, 15, 195–203. Available online at http://www.esi2.us.es/GT/explotacion/articulos%20demanda/Pricing%20strategies%20of%20low-cost%20airlines-%20The%20Ryanair%20case%20study.pdf, date accessed 10 March 2010.

Mathies, C. and Gudergan, S. (2007) Revenue Management and Customer Centric Marketing – How Do They Influence Travellers' Choices, *Journal of Revenue and Pricing Management*, 6, 331–346. Available online at http://dx.doi.org/10.1057/palgrave.rpm.5160109, date accessed 10 March 2010.

Plunkettresearch.com (2010) Travel Airline Hotel & Tourism, U.S.A. Available online at http://www.plunkettresearch.com/Industries/TravelAirlineHotelTourism/TravelAirlineHotelTourismStatistics/tabid/253/Default.aspx, date accessed 10 March 2010.

5
Does the Customer Trust You?

Una McMahon Beattie, Adrian Palmer and Ian Yeoman

Introduction

Trust of products, services and organizations is not a subject that people regularly think about. Indeed, trust may sound like some “faddish” or “fuzzy” concept to Revenue Management professionals but a significant amount of research has indicated that profit depends on it to a surprisingly large extent. It is something that can really make a marked difference when it comes to establishing, building and maintaining healthy buyer-seller relationships. What is clear is that in today’s society, characterized by widespread consumer distrust of companies and public bodies, revenue managers need to work hard at developing a trust-based relationship with their customers.

Indeed, in the service industries where demand is variable and fixed costs are a high proportion of total costs, the practice of Revenue Management through variable pricing has become widely accepted as a method for maximizing financial returns. However, the perception of trust and its effect on variable pricing decisions is an undervalued and under-researched area. It will be argued here that price discrimination which is implicit in Revenue Management systems may undermine trust in an organization, when buyers perceive that they have been treated less fairly than other buyers. Trust is at the heart of relationship marketing strategies, and yet there would appear to be a potential conflict between the aims of relationship marketing and the technologically-integrated customer relationship management (CRM), and Revenue Management.

This chapter therefore, sets out to discuss customer perceptions of pricing and the concept of trust by examining the interactions of revenue, pricing and trust within the context of ongoing buyer-seller relationships. It suggests that Revenue Management concepts may be at variance with the principles of relationship marketing and it explores some ways to avoid possible conflict between the two.

Revenue Management and pricing

In 1999, McGill and Van Ryzin set out an extensive understanding of the relationship between pricing and revenue in the airline industry and concluded there was a lack of understanding about the relationship between price and Revenue Management decisions. This is still very much apparent today. Central to this understanding is the customers' perception of pricing and the interaction of revenue pricing and trust, where the maintenance of trust is fundamental to supporting an ongoing buyer-seller relationship. Indeed, Belobaba (2002) stated that operations research has tackled the problem of modelling Revenue Management variables but has been slow at tackling pricing decision support tools and techniques which are of high importance where revenue management data sets become useless in periods of economic recession. Furthermore, Talluri (2001) considered that traditional Revenue Management modelling and algorithms have ignored consumer purchasing behaviour and have treated pricing in an ad hoc and haphazard manner. This has resulted in airlines not integrating pricing and Revenue Management in a holistic manner.

In times of economic downturn pricing sensitivity is particularly important since segmented consumers have different degrees of sensitivity based upon an infinite range of utilities, which include value, time of purchase, elasticity and trust. Indeed, one of these key determinants of an understanding of the perceptions of dynamic pricing is trust. Kimes (1994) has previously stated that there is a relationship between Revenue Management and customer satisfaction. If Revenue Management results in a serious decline in customer satisfaction and repeat business, the use of Revenue Management may be unwise. The biggest influence on this conclusion is if customers perceive a lack of trust and unfairness from the patronizing firm. Kimes (1994) stated that trust will be higher if consumers have a full and clear understanding of the choices and restrictions upon purchase. Hence, one of the contributing factors to the success of Internet-based purchases of airline inventory with companies such as easyJet is that the consumer sees the benefits and explanations of Revenue Management decisions in an explicit and clear manner. The consumer has a range of choices presented by the airline itself and not an intermediary, agent or online auction site and the consumer can clearly offset price and convenience against rates and booking restrictions.

Trust

If customers don't trust a company, then it doesn't really have a relationship with them. So companies need to know what trust is. Trust is a relational construct and it has been seen to be at the heart of relationship marketing with its focus on establishing, developing and maintaining effective, ongoing buyer-seller relationships. It has been positioned as an important antecedent, mediator and outcome of successful buyer-seller relational development. In comparison to other relational constructs such as commitment, relationship satisfaction and/or relationship quality, Doney and Canon (1997) contend that trust alone is the critical relational construct. As Berry (1996, p. 42) succinctly argued, trust is "the single most powerful relational marketing tool available to a company".

Importance of trust

In social sciences the importance of trust has long been recognized. Young (2006, p. 440) argued that "the ability to trust enables humans to interact in relationships and is thus essential for psychological health". Additionally, Blau (1964) and Kanter (1977) recognize its importance in business and work relationships as well as social relationships. This is supported by Doney and Cannon (1997) whose review of the literature in social psychology, sociology, economics and marketing contended that people can develop trust in public institutions as well as individuals. To summarize, researchers have seen trust as an essential ingredient in a healthy personality, as a foundation for interpersonal relationships, as a prerequisite for cooperation and as a basis for stability in social institutions and markets.

Benefits of trust

Trust has been seen as a key element in establishing ongoing relationships and in maintaining a company's market share. Svensson (2004) has argued that it contributes to the strength of interpersonal relationships, intra-organizational relationships and inter-organizational relationships. Rousseau et al. (1998, p. 394) have indicated that as well as generating cooperative behaviour, trust reduces harmful conflict, decreases transactional costs, promotes adaptive organizational forms such as network relationships, facilitates the rapid formation of ad hoc groups and promotes effective response to crisis. Bejou et al. (1998) have highlighted its role in reducing the perceived risk in purchasing products/services.

Trust defined

Trust is a rich and complex concept with a confusing array of definitions. However, despite the divergence of opinions and certain difficulties in measuring trust, Doney et al. (2007) have indicated that a consensus is emerging in marketing that trust encompasses two essential elements: *credibility* and *benevolence*. They state that;

> Trust in a partner's credibility is based on the belief that one's partner stands by its word, fulfils promised role obligations, and is sincere. Trust in a partner's benevolence is a belief that one's partner is interested in the firm's welfare and will not take unexpected actions that would have a negative impact on the firm.
>
> (Doney et al. 2007, p. 1099)

It follows, they argue, that trust requires a judgement as to the *reliability* and *integrity* of the exchange partner. This represents a cognitive or evaluative definition of trust. Chow and Holden (1997) support this view by defining trust as an expectation by the parties involved that the written or verbal promises or statements are reliable. More specifically, Moorman et al. (1993) defined trust as a willingness to rely on an exchange partner in whom one has *confidence*.

The trust literature also suggests that those involved in the exchange must be *vulnerable* to some extent for trust to become operational. As Rousseau et al. (1998, p. 395) state, "Trust is a psychological state comprising the intention to accept vulnerability based on positive expectations of the intentions or behaviours of another." Indeed, from a philosophical viewpoint, Blois (1999, pp. 197–198) sees trust as the acceptance of vulnerability in order to reduce social complexity. Thus a number of researchers view trust as a behavioural intention or behaviour that reflects reliance on another party and which involves vulnerability and uncertainty. Inherent in this is the association of trust with *risk* taking behaviour.

A number of researchers have noted the importance of context in attempting to understand trust. Bigley and Pearce (1998) have argued that since trust is context dependent the search for a universal definition of trust is likely to be unsuccessful. In terms of definition they argue that the question should not be "what is trust?" but "which trust and when?" (Bigley and Pearce, 1998, p. 406).

Why look at trust and variable pricing?

Three characteristics of trust make it vitally important for examining the impact of variable pricing on customers. First, trust is risky and therefore has significant implications for customer purchase decisions. Second, it cannot be completely substituted making the reliance on trust almost a necessary condition of purchase exchange. Third, where a trusting relationship develops it represents an intangible value which, from a resource dependence perspective, may help explain exchange relationships better. Furthermore, research by Doney and Cannon (1997) has suggested that whilst traditional aspects of the marketing mix, namely *price* and reliable delivery, actually make a sale, trust operates as an "order qualifier", not as an "order winner". As such, trust, like product quality, must be at a satisfactory level for the product or service to even be included in a purchaser's consideration set. This has significant implications for revenue managers both in establishing a satisfactory level of trust and in the implementation of strategies that maintain it.

Encouraging trust

A number of key factors have been identified as important in the process of encouraging customers to trust in products or services. Frequent exposure to the company products/services or the company name or brand can cause it to be seen as a well-known name that can be trusted. Linked to this is the perceived *popularity* of the product and service, the idea being that if a large number of customers buy the product or service it must be reliable and should be trusted. The perception of a company as *caring* for its customers is also important in developing trust and we have witnessed a number of companies beginning to invest in the integration of Revenue Management and CRM technologies in an endeavour to foster customer loyalty and maximize long-term profit. It is hoped that this integration will allow for customer information gathered at a number of contact points, including front-line personnel, call centres and websites, to improve individual customer satisfaction and maximize yield on each customer simultaneously. Such technology also allows customer personalization. Based on the data held in a customer's profile, a person browsing a hotel company's website for accommodation availability in London could be presented with information on airline schedules, entertainment and retail suggestions. This gives the perception that a company is more *on the side of the customer* than other companies and this may have a positive effect on the level of consumer trust.

However, this chapter is specifically concerned with examining the impact of variable pricing on consumer trust and its managerial implications.

Why do we use variable pricing?

It is generally accepted that there is considerable evidence of a lack of sophistication in pricing used within the services industries, with a suggestion that various forms of cost-based pricing predominate (Zeithaml et al., 1985). What Revenue Management tries to do is to reconcile the supply demand though the price mechanism and exploit "consumer surplus". This is understood by economists as the difference between the price that a consumer actually pays for a product and the highest price that they would actually be prepared to pay for it. A company which charges a uniform price for its products or services will only achieve maximum profits through this pricing method where consumers' evaluation of the product offer is homogeneous and there is no consumer surplus. What firms seek to do is to move from the position shown in Figure 5.1a that in Figure 5.1b.

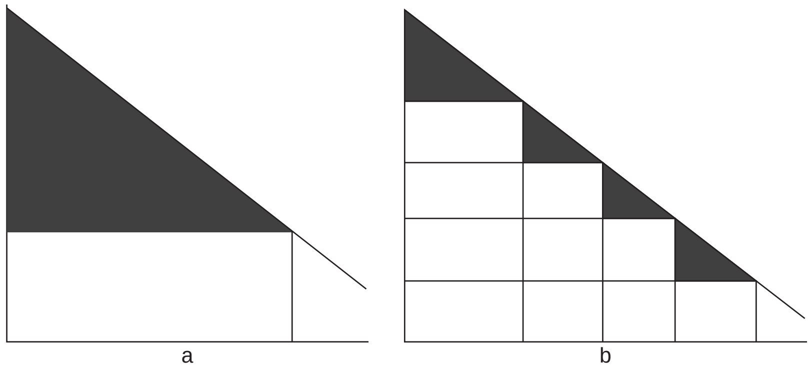


Figure 5.1 Consumer surplus and different pricing treatments.

Lipsey and Chrystal (2007) have stated that classical micro-economics has been based on an assumption of perfect knowledge within a market place such that price differences between individual customers would become transparent and those individuals who were charged higher prices by one seller would migrate towards sellers offering lower prices. Over time, models of imperfect competition have developed to partially overcome this effect, by recognizing that product/service differentiation produces a number of sub-segments in a market which can be discriminated with differential bundles of product/price offers. Additionally, where one customer is charged more for an identical product than another customer, this may be assumed to reflect their greater satisfaction with the product and this greater level of satisfaction will negate the temptation to migrate to a similar, but lower priced product (McMahon-Beattie et al., 2002). Transaction cost economic approaches would also factor in the cost of switching as a reason for price differentials being sustained.

The impact of information technology on pricing

Information technology is allowing service organizations to set their prices in very much the same way as traditionally practised in eastern bazaars – by individual bargaining and haggling. The "price list" is not typical of small businesses dealing with small numbers of buyers. It has no part in the business methods of traders in many eastern countries for whom bartering on a one-to-one basis is the norm. Price lists emerged in response to the industrialization of economies and the growth in the size of markets served by individual firms. They became a method of simplifying transactions between a large organization and large numbers of its customers.

Over time, there has been a tendency for societies to fragment in their motivations to make purchases, which has been reflected in companies developing increasingly fine methods of segmenting markets (Bowens et al., 2005). In the move from mass marketing to target marketing, firms subtly developed multiple price lists, based on slightly differentiated product offers aimed at different market segments. Today, the process of market segmentation has proceeded to the point where companies can realistically deal with individual market segments. Intriguingly, the conditions for pricing by suppliers of consumer goods and services would appear to be reverting to those which apply in eastern bazaars, in which the seller seeks to apply a price which is uniquely appropriate to each individual buyer. There is plenty of evidence of this move towards unique one-to-one pricing in the Internet-based auction sites which grew in number during the late 1990s. Online auctions represent an extreme case of one-to-one pricing which is being facilitated by information technology. Much more pervasive is the ability of firms to subtly adjust prices offered to individual customers. Rather than having a fixed price list, an enquirer for a specified product may receive different quotations at different times of enquiry. Similarly, two different enquirers may simultaneously receive different price quotations.

Pricing, transparency and fairness

Traditional haggling over prices in open markets is visible for all to see. With many modern information technology-based systems of individual pricing, the results are less visible and can typically only be compared indirectly. This lack of openness in pricing creates conditions for mistrust. Indeed, several pricing studies suggest that consumers' reactions to a price change depend not just on the magnitude and direction of the change, but on buyers' perceptions of the seller's circumstances and motivations that led to it. For example, Kahneman et al. (1986) examined how consumers' perceptions of the "fairness" of price increases were influenced by the circumstances that led to them. In line with the theory of dual entitlement, Kahneman et al. found that buyers typically perceive a given price increase as "fair" if it is a reaction to an increase in seller costs, but as unfair if it is a reaction to increased consumer demand. Similarly, Lichtenstein et al. (1989) examined how consumers' attributions regarding a retailer's motives for discounting a product influenced their attitudes towards the deal. They found, for example, that consumers had more negative attitudes towards the deal when they attributed it to the retailer's desire to unload a difficult-to-sell offering. Trust and fairness therefore can be seen to have a reciprocal relationship. Maxwell (2008, p. 104) argues that "trustworthiness is influenced by fairness and a perception of fairness is influenced by trust". Both, she contends, are mutually reinforcing. Customer perceptions of fairness are therefore important, especially in relation to the use of information technology, since there is a greater opportunity to offer price differentials to consumers on a one-to-one basis.

Fairness and Revenue Management

A number of studies have considered customers' perceptions of fairness within Revenue Management. Choi and Mattila (2004, p. 3) have stated that Revenue Management "practices might alienate customers owing to perceived unfairness, and this led to decreased customer satisfaction and goodwill, and ultimately to lost business from these customers". According to Kimes and Wirtz (2003b), customers may view the price discrimination and demand-based pricing implicit in revenue management as unfair for several reasons. Notably, they suggest that if customers consider peak-demand prices as higher than their reference price, or see regular prices as higher than their reference price due to benefiting from frequent low-demand prices, then they may perceive the prices charged as unfair. Additionally, customers may believe that companies are not providing more "value" for higher priced offerings at peak-demand times. Examining demand-based pricing methods for restaurants with the use of in-person intercept surveys in New York, Singapore and Sweden, they suggest that such pricing in the form of time-of-day pricing, coupons and separate lunch/dinner pricing is seen as fair, weekday/weekend pricing was perceived as neutral to slightly unfair and pricing based on table locations was seen as somewhat unfair engendering potential negative customer reactions. Additionally in a similar study in the US golf industry, the same researchers noted that varying price levels were seen as extremely unacceptable by a random sample of 1000 golfers.

Choi and Mattila (2006) have contended that the provision of an appropriate level of information on hotels' pricing policy is believed to have a positive impact on customers' perceived fairness of Revenue Management. In line with this Rohlfs and Kimes (2005), indicate that consumers (in hotels) will accept the idea of variable prices as long as they understand that they are receiving the "best available rate" for each night of a multiple night stay. Respondents to this small survey of 153 travellers indicated that being offered the best available rate for each night of their stay was more "fair" and "honest" than being offered a single blended rate for a multiple night stay.

Emergence of CRM

The adoption of Revenue Management strategies by service companies has often been accompanied by the development of CRM systems. CRM has been hailed by many as a panacea for developing a true marketing orientation by an organization – that is, providing a differentiated product offer that meets the needs of individual customers, rather than the "average" customer. As with Revenue Management, the adoption of CRM systems has been particularly great in the services sector where high fixed costs relative to variable costs allow considerable scope for price-based differentiation. CRM systems have an additional benefit of allowing a company to identify its customers, in terms of their previous purchase history and likely future purchase preferences. CRM systems have been widely used to target responsive segments with differentiated offers to fill spare capacity. However, it could logically follow that an infrequent visitor to a hotel may be identified as belonging to a segment which could be tempted to fill spare capacity by the offer of an attractive price, whereas a regular customer may be presumed to have a higher degree of attitudinal loyalty, and the transaction costs to them of switching to another hotel may be presumed to be high. The customer who is identified by their CRM profile as loyal may therefore be effectively "punished" for their loyalty.

Conflicting nature of Revenue Management and CRM

Service companies face a number of challenges when they engage in Revenue Management and CRM practices simultaneously. For example, CRM centres on profitable relationships with customers in order to maximize the lifetime values of current and potential customers. Revenue Management, however, aims to maximize revenue by allocating perishable inventory to existing demand using price discrimination. It uses fixed perishable capacities by charging different customers different prices for essentially the same service in an attempt to balance demand and maximize revenues per capacity unit. As such, the essential difference between Revenue Management and CRM, therefore, is the time horizon for revenue maximization (Mathies and Gudergan, 2007). Revenue Management aims to maximize revenues from each individual transaction rather than considering the long-term gains that might be achieved from each customer. CRM focuses on the lifetime revenues per customer where necessary short-term trade-offs may be made in light of possible increases in long-term revenues. Related to this is the fact that in Revenue Management customer segmentation utilizes price elasticities and associated consumer willingness to pay whilst in CRM customers are segmented on their lifetime profitability. It follows that customers with a high lifetime value could fall into a number of different elasticity segments and receive inconsistent treatment and pricing. The most obvious example here is the typical business traveler who is usually price insensitive but when booking the family holiday may be very price conscious. As mentioned earlier, customers who are forced to pay higher prices for essentially the same service/product than others may feel a sense of unfairness, particularly if they perceive that a company is charging higher prices without increasing value for them. This feeling of unfairness will have obvious consequences for the maintenance of a lifetime relationship with customers.

It has been argued that by building up a profile of customers' preferences and by focusing on the lifetime profitability of buyer-seller relationships, service companies can provide products and services that fit customers' needs.

Kahn (2000, p. 4) argues that "If a company earns a customer's *trust* and if, as a result of that trust, customers share strategic information about their preferences and needs it will be difficult for competitors to duplicate the relationship." However, companies who use Revenue Management may fail to earn the trust of the customers since variable pricing, and the fact that a company may not be offering a customer the best rate available, would appear to undermine trust and affect the development of long-term buyer-seller relationships.

Consumer to consumer interaction and its impact on relational exchange

The development of relationship marketing implicitly assumes that dialogue will be private to the parties to that dialogue. However, dialogue may occur between different segments, either directly or indirectly through the media. The effect of such dialogue may be to undermine a buyer's trust in a supplier, on the basis that the buyer did not receive the most favourable treatment from the supplier. There have been examples of bad publicity resulting from such attempts at CRM-based price discrimination. The online retailer Amazon.com is reported to have attempted to charge visitors to its website discriminatory prices for its DVDs, based on information about their previous behaviour, revealed in cookies embedded in their computer. A number of news media carried reports of "unfair" treatment by Amazon, which led the company to withdraw – at least temporarily – from its CRM-based price discrimination. Although the increasingly sophisticated Internet infrastructure makes discriminatory pricing possible, it also increases the possibilities of firms' being "found out" in their attempts to discriminate between customers (Garbarino and Lee, 2003). Indeed current research in relationship marketing fails to consider the impact of customer to customer communication on the levels of trust in a seller.

Increase in opportunities for breaches of privacy

Opportunities for breaches of privacy between buyer and seller and for one customer to talk to another about a service or product have increased considerably in recent years both online and offline. The Future Foundation (2007) report on "The Networked Society" has noted that people are eating out and socializing more than ever before, with more people visiting friends in their homes more often than they did 30–40 years ago. In an online context, Hoffman and Novak (1996) and Maclaran and Catterall (2002) have warned that whilst marketers are aware of the benefits that the Internet has brought in terms of one-to-one marketing, they are in danger of ignoring the many-to-many consumer interactions on the Internet. Datta et al. (2005, p. 72) have noted that it has "brought new mechanisms for consumers to talk, pass and disseminate messages about their positive and negative experiences about a product or service to their close ties or other community members who are not known to them". The growth of virtual meeting places has been noted by a number of commentators and at least five different types of "virtual communities" have been highlighted. These are bulletin boards, rings, lists, dungeons and chat rooms. To this list add the recent growth in social networking, such as Myspace, Facebook and Bebo, which have provided the consumer with the opportunity to network with an unprecedented amount of people. Indeed the Future Foundation (2007) notes that the new 2.0 generation of technologies are further encouraging many-to-many communication, with individually produced podcasts, videos, blogs, playlists and recommendations freely available to anyone.

Simply put, when a consumer has an urge to communicate their experiences of a product or service and its pricing, it is not just a communication channel that they now choose but also whether they are going to tell one friend, all their acquaintances or indeed the whole world.

Developments in trust and pricing

In the area of pricing there is a shortage of studies that seek to integrate operational efficiency with human perceptions and attitude change. Numerous studies have measured the short-term behavioural response to variable pricing such as an increases or decreases in sales, but affective consumer responses have been under-researched. However, recently McMahon-Beattie (2009) has carried out a study of the effects on buyers' trust of variable pricing based on the principles of Revenue Management. Trust is a focal point for this research which assesses the affective consequence of variable pricing as applied using Revenue Management techniques. This research used a longitudinal approach to measure issues of trust perceived in companies' efforts at price discrimination. As such, it sought to understand the role of trust as a mediating variable between what a company does in terms of pricing and how customers react.

The research comprised a longitudinal survey of individuals who had agreed to receive a participating hotel chain's regular newsletter. The focus of the study was a real service offer which was a two-day hotel stay package. Hotels have a wide range of price discretion with high fixed costs relative to variable costs. The sample of respondents was drawn from both the leisure market and the "corporate direct" segment. Corporate direct customers are corporate clients who book rooms themselves. It was believed that these segments were in the best position to experience the effects of variable pricing and related promotional offers. A monthly newsletter was sent over a period of six months to a sample of 2273 individuals on the hotel chain's mailing list. This gave details of an actual promotional programme for the two-day leisure break, called "The Champagne Sparkler".

The mailing list was randomly divided into two communication "treatments" – one receiving uniform discounted prices, the other receiving variable discount prices. The first group was charged the same price each month (£100), while the other group was charged the same mean price, but monthly prices varied (£80, then £120, then £100 and so on). The weekend break was given a distinctive name so as to increase its memorability with respondents. Following the six-monthly newsletter, recipients were invited to take part in an online survey.

Butler's (1991) measurement scales

Trust was measured using a multiple item scale based on those developed by Butler (1991). Butler's scales have been developed from the work of Jennings (1971) and Gabarro (1978) and have been validated in a number of subsequent studies. The scales were adapted for this study on the basis of the inputs of focus groups and the scales included availability, competence, consistency, discreetness, fairness, integrity, loyalty, openness, promise fulfilment and receptivity. Butler added an 11th condition which was overall trust to permit investigation of the relationship of the other ten conditions and overall trust in an individual.

Supplementary behavioural and demographic data were gathered by direct questioning, and by cross-referencing with details previously collected and held on the company's database. A total of 474 responses were received, representing a response rate of 20.8 per cent.

Findings

Statistical tests were used to compare the differences between the uniform and variable pricing groups in their perceptions of trust in the hotel group. Differences were examined between gender, age, income, educational attainment and prior experience and the individual trust items developed to measure trust within the pricing context.

The overall results relating to respondents' perceived level of trust were not in accordance with prior expectations. In general it was found that those respondents receiving variable discount prices were more trusting than those receiving uniform discount prices. For example, in relation to the statement "I trust this hotel company", a significant difference was found between the uniform discount group and the variable group (uniform discount group mean rank = 164.60; variable group mean rank = 145.46, $u = 10456.0$, $p = 0.039$). This indicated that those respondents receiving variable discounted prices trusted the hotel more.

However, further analysis indicated a number of complex differences between the groups when assessed in the context of measures of trust and respondents' demographic and behavioural background. For example, it might have been expected that frequent hotel visitors from the variable pricing group would be more likely to distrust variable pricing used by hotels, on account of their greater awareness of the practice. The findings indicated that, in comparison to infrequent hotel visitors in the variable pricing group, frequent visitors agreed more that:

- The hotel company could be trusted.
- The hotel company gave them fair offers.
- The hotel company dealt with them honestly.
- They would stay loyal to the hotel company.
- The hotel company treated them better than other hotels.
- The hotel company gave them a fair deal.
- They were willing to book new offers if they were offered to them by the hotel group.

The idea that higher levels of educational achievement results in savvy consumers who are likely to be more distrustful of business practices was not borne out by the responses of some of the more highly educated respondents. Whilst those holding a higher degree/postgraduate qualification were generally less trusting in the variable discount group than those in the uniform group, this was not true of the other levels of educational attainment. In general it was found that respondents with a relatively high level of educational attainment such as a degree or equivalent, a DipHE or equivalent and a A/AS/SCE level or equivalent were significantly more likely to trust the hotel in the variable pricing group. Younger respondents who had received variable prices were also significantly more likely to trust the hotel than older respondents. Whilst gender had not been expected to be associated with differences in perceptions of trust, significant differences were found. Females were less trusting of variable prices than males.

Importance of rule familiarity

Given the above, it could be argued that it is not variable pricing in itself that causes distrust, but consumers' level of knowledge of the "rules" in which variable pricing operates. From experience of the benefits that variable pricing may bring to a consumer, and based on an understanding of how and why these benefits may be obtained, consumers may come to trust a business use of variable pricing as a legitimate business practice. As such, it could be argued that younger, highly educated males who are frequent purchasers would appear to be the most trusting of variable pricing practices. One explanation could be that frequent exposure to variable pricing in the hotel sector and other sectors had led respondents with this profile to develop expectations based on variable pricing as a norm. This group have arguably understood the "rules" and benefited from deals which their knowledge of the rules has allowed them to obtain. The observed gender effect is an interesting one and may simply reflect females' historically low levels of purchasing involvement compared to males. As in the case of age effects, it might be expected that eventually greater experience will feed through to higher levels of trust for companies that use variable pricing.

However, at present this study shows that a company using variable pricing is less likely to be trusted by the obverse of the profile described above, namely older, female, infrequent purchasers who are of lower educational attainment. Consumers' familiarity with the rules associated with variable pricing in Revenue Management therefore becomes a key consideration for Revenue Management professionals.

Managerial implications

The trend towards ever-greater segmentation of markets has proceeded largely unchallenged, fuelled by vendors of increasingly sophisticated software. The technical limitations of one-to-one pricing have diminished and many service organizations, including airlines, hotels and car rental companies, have increased the range of prices that they charge different types of customers and in different situations. Complexity in pricing may give grounds for consumer mistrust. Mistrust may come about inadvertently where a customer is unwittingly given a price/product offer which is not in accordance with their wishes or expectations. More seriously, it may arise where there is a perception that a company has gone out of its way to offer a price/product which the company knows is not in the best interests of the customer. This perception is likely to be facilitated by customers talking to one another and comparing prices they have paid for an apparently similar service offer. This is a common phenomenon for many types of services which are consumed in the presence of fellow customers.

Consumer trust is not adversely affected by price discrimination which is an integral part of both Revenue Management and CRM. However, it should still be noted that where variable pricing is based on a consideration of costs and/or capacity constraints, managers need to ensure that these reasons are made clear to customers. If pricing is not transparent and pricing rules are not familiar to the consumer then it is more likely that mistrust will occur.

In broader terms revenue management professionals may engender consumer trust in a number of practical ways, for example, by suggesting to customers ways in which they could save money, for example, by shifting to quieter periods. In this way companies do not lose the business of customers who are resistant to higher variable prices and thereby maintain the buyer-seller relationship. Additionally in relation to loyal customers, practitioners need to avoid giving the appearance of "punishing" regular customers for their loyalty with higher prices which are not matched by some other benefit which goes with that loyalty. Using CRM systems which track past buying behaviour, it could indeed logically follow that an infrequent customer/visitor could be identified as belonging to a segment which could be tempted to fill spare capacity by the offer of an attractive price, whereas a regular customer may not have access to this price offer and be effectively punished for their loyalty. As such Revenue Management professionals must adopt measures to avoid such an occurrence.

Conclusion

There are strong theoretical reasons for hypothesizing that a consumer's trust in an organization may be undermined where there is a perception that they might not have obtained the best deal available from the supplier. Recent research however, has indicated that consumers may respond well to variable pricing and that is does not necessarily undermine trust in a service provider. What consumers need is clear transparent pricing and a familiarity of the rules in which variable pricing operates. In today's dynamic market place, the well-known saying "trust is hard won and easily lost" is one that revenue managers would be well placed to keep in mind should they want to make a significant impact on their bottom line.

References

Bejou, D. Ennew, C. T. and Palmer, A. (1998) Trust, Ethics and Relationship Satisfaction, *International Journal of Bank Marketing*, 16(4), 170–175.

Belobaba, P. B. (2002) Back to the Future? Directions for Revenue Management, *Journal of Revenue and Pricing Management*, 1(1), 87–89.

Berry, L. L. (1996) Retailers with a Future, *Marketing Management*, 5(1), 39–46.

Bigley, G. A. and Pearce, J. L. (1998) Staining for Shared Meaning in Organization Science: Problems of Trust and Distrust, *Academy of Management Review*, 23(3), 405–421.

Blau, P. M. (1964) *Exchange and Power in Social Life*. New York: Wiley.

Blois, K. (1999) Trust in Business to Business Relationships: An Evaluation of Its Status, *Journal of Management Studies*, 36(2), 197–215.

Bowens, J., Makens, J. and Kotler, P. (2005) *Marketing for Hospitality and Tourism*, 4th edn, New Jersey: Prentice-Hall.

Butler, J. K. (1991) Toward Understanding and Measuring Conditions of Trust: Evolution of a Conditions of Trust Inventory, *Journal of Management*, 17(3), 643–663.

Choi, S. and Mattila, A. S. (2006) The Role of Disclosure in Variable Hotel Pricing, *Cornell Hotel and Restaurant Administration Quarterly*, 47(1), 27–35.

Chow, S. and Holden, R. (1997) Toward an Understanding of Loyalty: The Moderating Role of Trust, *Journal of Managerial Studies*, 9(3), 275–298.

Datta, P. R., Chowdhury, D. N. and Chakraborty, B. R. (2005) Viral Marketing: New Forms of Word-of-Mouth through Internet, *Business Review, Cambridge*, 3(2), 69–75.

Doney, P. M. and Cannon, J. P. (1997) An Examination of the Nature of Trust in Buyer-Seller Relationships, *Journal of Marketing*, 61, 35–51.

Doney, P. M., Barry, J. M. and Abratt, R. (2007) Trust Determinants and Outcomes in Global B2B Services, *European Journal of Marketing*, 41(9/10), 1096–1116.

Future Foundation (2007) The Networked Society. Available online at http://www.nvisiononline.co.uk (accessed 10 February 2010).

Gabarro, J. J. (1978) The Development of Trust Influence and Expectations. In A. G. Athos and Gabarro, J. J. (eds), *Interpersonal Behaviour: Communication And Understanding In Relationships*, Englewood Cliffs, NJ: Prentice Hall.

Garbarino, E. and Lee, O. F. (2003) Dynamic Pricing in Internet Retail: Effects on Consumer Trust, *Psychology and Marketing*, 20(6), 495–513.

Hoffman, D. L. and Novak, T. P. (1996) Marketing in Hypermedia Computer-mediated Environments: Conceptual Foundations, *Journal of Marketing*, 60, 50–68.

Jennings, E. E. (1971) *Routes To The Executive Suite*, New York: McGraw-Hill.

Kahn, B. (2000) That Elusive Customer Loyalty: How to Build It, Learn from It and Profit from It. Available online at http://knowledge.wharton.upenn.edu/articlepdf/269.pdf (accessed 12 August 2007).

Kahneman, D., Knetsch, J. and Thaler, R. (1986) Fairness as a Constraint on Profit Seeking: Entitlements in the Market, A*merican Economic Review*, 76(September), 728–741.

Kanter, R. M. (1977) *Men and Women of the Corporation*. New York: Basic Books.

Kimes, S. E. (1994) Perceived Fairness of Yield Management, *Cornell Hotel and Restaurant Administration Quarterly*, 35(1), 22–29.

Kimes, S. E. and Wirtz, J. (2003b) Has Revenue Management Become Acceptable? *Journal of Service Research*, 6(2), 125–135.

Lichtenstein, D., Burton, S. and O'Hara, B. S. (1989) Marketplace Attributions and Consumer Evaluations of Discount Claims, *Psychology and Marketing*, 6(Fall), 163–180.

Lipsey, R. G. and Chrystal, A. (2007) *Economics*, 11th edn, Oxford: Oxford University Press.

Maclaran, P. and Catterall, M. (2002) Researching the Social Web: Marketing Information from Virtual Communities, *Marketing Intelligence and Planning*, 20(6), 319–326.

Mathies, C. and Gudergan, S. (2007) Revenue Management and Customer Centric Marketing – How Do They Influence Travellers' Choices, *Journal of Revenue and Pricing Management*, 6, 331–346.

Maxwell, S. (2008) *The Price is Wrong: Understanding What Makes a Price Seem Fair and the True Cost of Unfair Pricing*. New Jersey: John Wiley and Sons.

McGill, J. I. and van Ryzin, G. J. (1999) Revenue Management: Research Overview and Prospects, *Transportation Science*, 33(2), 233–256.

McMahon-Beattie, U., Yeoman, I., Palmer, A. and Mudie, P. (2002) Customer Perception of Pricing and the Maintenance of Trust, *Journal of Revenue and Pricing Management*, 1(1), 25–34.

McMahon-Beattie, U. (2009) Variable Pricing and Consumer Trust, PhD submission, University of Gloucestershire.

Moorman, C., Deshpandé, R. and Zaltman, G. (1993) Factors Affecting Trust in Market Research Relationships, *Journal of Marketing*, 55(1), 81–101.

Rohlfs, K. V. and Kimes, S. E. (2005) Best-Available-Rate Pricing at Hotels: A Study of Customer Perceptions and Reactions, *CHR Reports*, 7. Available online at http://www.TheCentreForHospitalityResearch.org (accessed 18 July 2007).

Rousseau, D. M., Burt, R. S. and Camerer, C. (1998) Not So Different After All: A Cross-discipline View of Trust, *Academy of Management Review*, 23(3), 393–404.

Svensson, G. (2004) Vulnerability in Business Relationships: The Gap Between Dependence and Trust, *Journal of Business and industrial Marketing*, 19(7), 469–483.

Talluri, T. (2001) Revenue Management Under a General Discrete Choice Model of Consumer Behaviour, International Airline Transport Association Revenue Management and Pricing Conference, Athens, Greece, 17–19 October.

Young, L. (2006) Trust: Looking Forward and Back, *Journal of Business and Industrial Marketing*, 21(7), 439–445.

Zeithaml, V. A., Parasuraman, A., and Berry, L. L. (1985) Problems and Strategies in Services Marketing, *Journal of Marketing*, 49(Spring), 33–46.

6
The Changing Meaning of Luxury

Ian Yeoman and Una McMahon-Beattie

Introduction

When Marie Antoinette supposedly said “let them eat cake”, she was seen as a luxury junkie who’s out of control spending grated on the poor and unfortunate French people. But today, cake has become one of our favourite luxury foods. A revolution has taken place where individuals in the world have got richer. Luxury is no longer the embrace of the kings and queens of France but the mass marketing phenomenon of everyday life. Simply put, luxury has become luxurification of the commonplace (Berry, 1994; Twitchell, 2001). The word luxury is derived from *luxus,* meaning sensuality, splendour, pomp and its derivative *luxuria,* means extravagance, riot and so on. The rise of the luxury in Western society is associated with increasing affluence and consumption. It is a phenomenon that has been creeping up in society for hundreds of years. At the turn of the twentieth century, it was Thorsten Velben (1899) who coined the term “conspicuous consumption” in his theory of the leisure class. Veblen’s argument is based upon the belief that as wealth spreads, what drives consumers’ behaviour is increasingly neither subsistence nor comfort but the “attainment of esteem and envy of fellow men”. Because male wage earners are too circumspect to indulge themselves, they deposit consumption on surrogates. Vicarious ostentation is observed in Victorian men who encouraged their wives and daughters to wear complicated trappings of wealth. Velben thought that the purpose of acquisition was public consumption of esteem, status and anxiety displayed by materialism. What Velben termed as conspicuous consumption were the trophies such as slaves or property where people would show off their wealth. The ideas contained in Veblen’s study of luxury and conspicuous consumption were developed in the works of John Galbraith such as *The Affluent Society* (1958) and Vance Packard’s *The Hidden Persuaders* (2007), *The Status Seekers* (1962a) and *The Pyramid Climbers* (1962b). Galbraith’s work moved us from an understanding of luxury based upon royalty and those that were born into money to those that made their money such as the

Carnegies and steel, Ford and the motorcar or Hughes and aircraft. Further works by Schlor at Harvard University (1991, 1998) explored how Middle America was becoming more affluent and wealthy. Luxury goods were no longer luxury goods but everyday household goods (Silverstein et al., 2005).

The changing meaning of luxury

The concept of luxury is incredibly fluid and changes dramatically across time and culture. In the past it was associated with champagne, caviar, designer clothes and sports cars. Nowadays with increased affluence, luxury is a blurred genre which is no longer the preserve of the elite. More and more consumers have traded up as the old values of tradition and nobility have become less important. People are enjoying much more material comfort in comparison to previous generations, resulting in a trend of a cultural shift for personal fulfilment and aspiration through experience. Therefore, it could be argued that luxury is increasingly about experience and authenticity (Yeoman et al., 2005), rather than monetary value. This is not to say that luxury is about status, but luxury is more than monetary value. Indeed, they run side by side. This focus on aspiration and experience means increasing emphasis on personal transformation through, for example, wellbeing and travel. It means that consumers want to improve their life. This is what Danziger (2005), Israel (2003) and Gambler (1997) identify as the feminization of luxury, where luxury has moved on from its male trophies and status symbols towards experience and indulgence. This is perhaps attributed to women's increasing buying power in society which is driving luxury markets such as wellbeing, clothes and tourism. At the same time, the old world luxury of consumption and elitism still prevails especially in emerging economies of China. So today, luxury can be categorized into materialism, enrichment or time (see Figure 6.1).

Materialism

Materialism is not dead. Fast cars and Ferraris are man's desire for exclusive, expensive, best quality, self-indulgent, conspicuous, tangible overt goods and experiences. As luxurification is becoming more commonplace due to the rises in disposal income of the middle classes, consumers start to trade up. In 1985, 99 per cent of Chinese consumers could be classified as poor, but by 2025 only 10 per cent will be, according to forecasts by McKinsey (Figure 6.2). McKinsey (Farrel et al., 2006) has established that urban households will make up one of the largest consumer markets in the world, spending about 20 trillion RMB (0.12 RMB: US$1). Over the next 20 years an increasing number of rural Chinese will migrate to the cities to seek higher paying jobs. These working consumers, once the country's poorest, will steadily climb the income ladder, creating a massive new middle class. Rapid economic growth will continue to transform the impoverished but

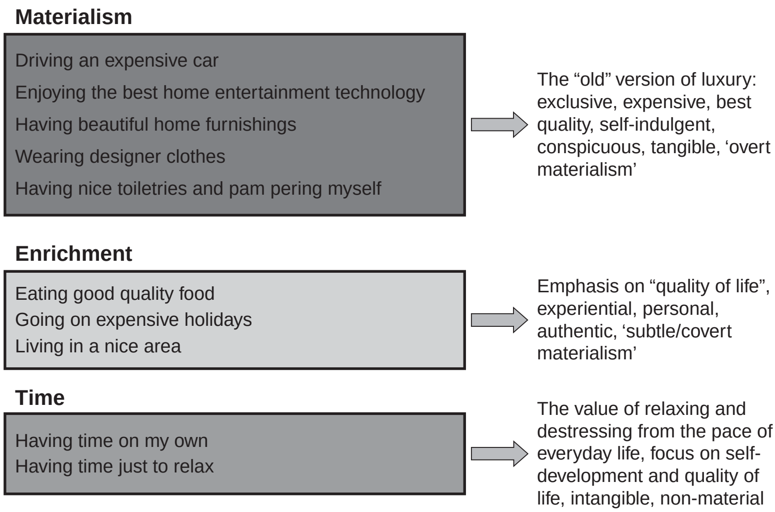


Figure 6.1 The changing meaning of luxury.

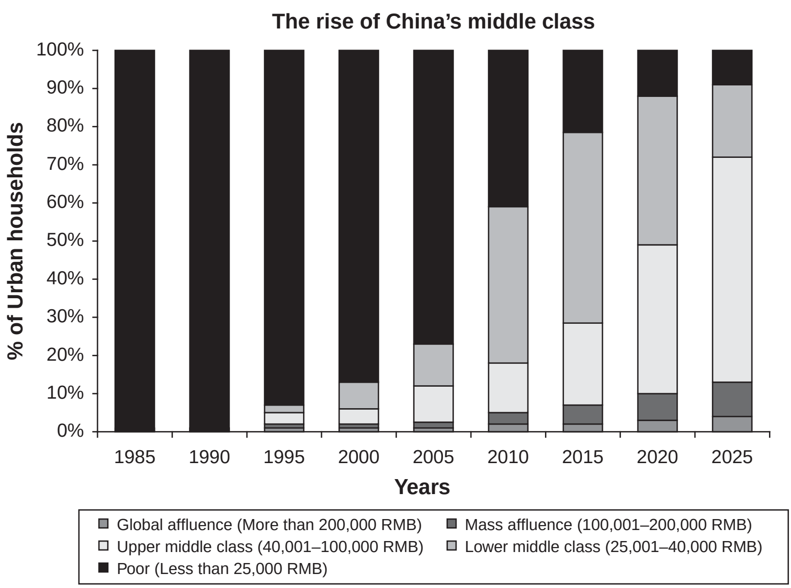


Figure 6.2 China’s rising middle-class consumers.

largely egalitarian society of China's past into one with distinct income classes.

As China's economy grows, there will be a steep growth in the middle class through to 2015 with lower middle classes emerging, defined as households with annual incomes of 25,001–40,000 RMB. A decade later, the upper middle class, with annual household incomes of 40,001–100,000 RMB, will follow. These numbers may seem low compared with consumer incomes in the world's richest countries – current exchange rates and relative prices tend to understate China's buying power – but such people are solidly middle class by global standards. When accounting for purchasing power parity, a household income of 100,000 RMB, for instance, buys a lifestyle in China similar to that of a household earning US$40,000 in the USA. By about 2015 the lower middle class number will exceed some 300 million people, representing the largest segment in urban China and accounting for about 44 per cent of the urban population with a total spending power of 4.8 trillion RMB. By 2025 this segment will comprise a staggering 520 million people – more than half of the expected urban population of China – with a combined total disposable income of 13.3 trillion RMB.

The rising middle classes of China means massive expansion of luxury spending in this country which is characterized by aspirational and conspicuous spending. China is now Louis Vuitton's second biggest market and Mercedes-Benz's fourth largest. In other emerging markets like Russia, perceptions of luxury differ from mature markets such as the UK and France. Russian consumers perceive luxury as expensive holidays, driving an expensive car, living in a nice area or nice beautiful home furnishings (Figure 6.3).

Examples of materialism stretch no further than "bling", which is a slang term popularized in hip hop culture, referring to flashy or elaborate jewellery and ornamented accessories that are carried, worn or installed, such as cell phones or tooth caps. The concept is often associated with rappers (Yeoman, 2008). Bling features in many luxury materialistic products. Taking mineral water as an example, Bling H20 (http://www.blingh2o.com) is bottled water that comes in limited edition, corked, 750-ml frosted glass bottles, embellished with Swarovski crystals. Established in 2005 by a Hollywood writer-producer who noticed that "you could tell a lot about a person by the bottled water that they carried", Bling H20 aims to be the "Cristal Champagne" of bottled water and is spotted at everything from the MTV Awards to the Emmys. The bottles cost from US$17 to US$480. Then there is Evian, whose limited release Palace (http://www.evian.com/us/) bottle is only available in high-end bars and restaurants. Featuring a specially designed pouring top and accompanied by a stainless steel coaster, the bottle sells for US$15–20. Then there is Tasmanian Rain (http://www.tasmanianrain.com) captured on the pristine north west coast of the island of Tasmania, Australia. The water is collected "just minutes from where the

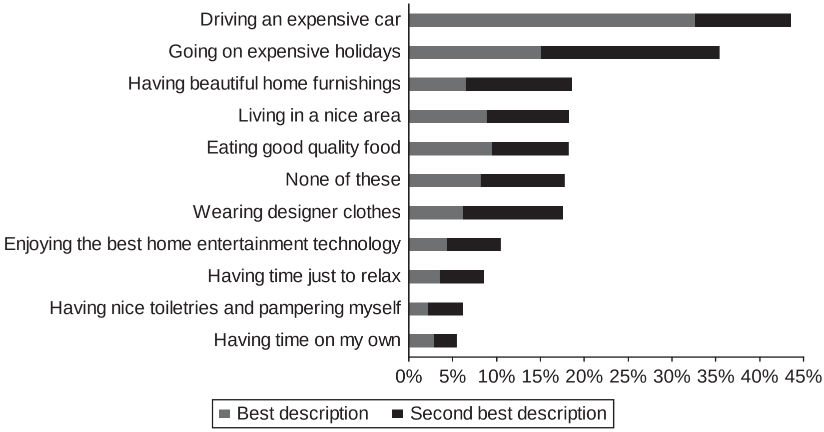


Figure 6.3 The percentage of Russians who choose the following as the best or second best description of "luxury" in their life.
Source: http://www.tomorrowstourist.com/Future Foundation (2008).

World Meteorological Organization records the world's purest air". As this rain has travelled eastward via air currents over Antarctica and 10,000 miles of ocean, it contains 17 parts per million of dissolved solids. Tasmanian Rain is collected by a custom-designed catchment facility and never touches the ground. On a final thought, taking bling to the extreme, Portuguese paper products company Renova sells Renova Black (http://www.renovaonline.net/black), lauded as the first fashionable and world's most expensive toilet paper. Price per roll is €3.00. Renova Black is also available as Renova Red, Renova Orange and Renova Green.

According to the website http://www.trendhunter.com, an interesting subtrend associated with materialism is the "best of the best" in which an avalanche of interesting, well-designed goods and services from all over the world has been unleashed. Consumers expectations have been raised and they are getting use to the "best of the best". The best museums and hotels have a modern contemporary feel, a growing number of mundane products are getting an upgrade, a growing trend of brands is co-creating as famous designers work with blue chip brands to take on anything from phones to suitcases to mass-produced coffee machines.

Architecture is also a great example of "best of the best"; it is the world of starchitects that is now truly leading in design, in lifestyle marketing, in introducing new domestic services and convenience concepts and their innovations are by default, very visible to the public. Which means that consumers will come to expect similar design, services and branding innovations in other industries too. For example, the new financial exchange of the Shenzhen Stock Exchange (SSE) (http://www.szse.cn/main/en) is designed by

Rem Koolhaas's Office for Metropolitan Architecture (OMA). The 250-metre high building features a floating base, edged up the tower to become a platform to support and launch the area which it liberates on the ground. Financial information streams down digital banners hanging from the elevated platform, and the space between the raised platform and the ground is used as a covered urban plaza, large enough to accommodate public festivals. The Songjiang hotel in Shanghai is designed by Atkins Architects and is a five-star resort hotel. Atkins won an international competition for the contract, the challenge of which was to build a luxury hotel in a water-filled quarry in the area. The project incorporates environmentally friendly elements such as green roofing. The final hotel will have room for 400 beds and will include underwater guestrooms. It is part of a larger project that Atkins is undertaking, which is designing a new city on the outskirts of Shanghai for 500,000 people called Songjiang Garden City. The best of the best means consumers are getting used to chic and becoming intuitively materialistic.

Enrichment

UK consumers enjoy a variety of sophisticated pastimes and distractions and so many of our leisure activities are treated as indulgences. Indeed, our transformed leisure tastes have dramatically altered consumer expectations of luxury. Now, luxury is sought increasingly through experiential offers as well as through the purchase of material goods. Since the 1990s consumer spending portfolios have shifted to include ever increasing levels of spending on leisure activities, eating out, hotels and so on. This is classified in Figure 6.4 as spending on "enrichment". According to forecasts, such spending will

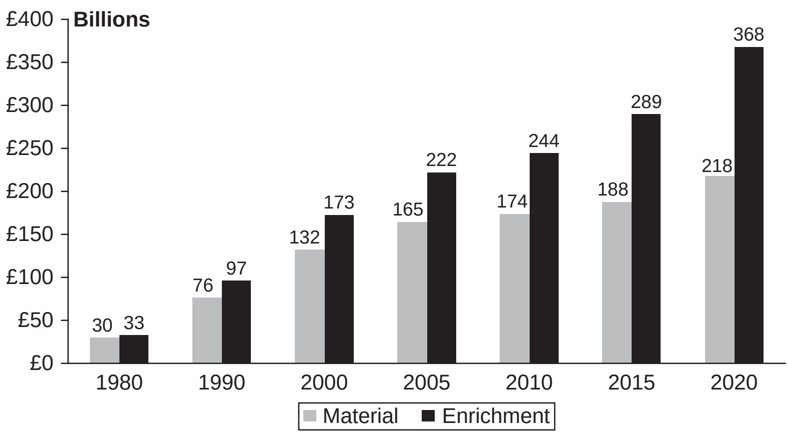


Figure 6.4 Growth in spending on enrichment.
Source: Office of National Statistics/Experian.

continue to grow at an impressive rate while material goods spending will sustain demand experience and enrichment will be defining features of our future consumption of luxury.

Enrichment is all about improving the quality of your life through experimental and less subtle material – not the "bling" but the wow. This drives the desire for new experiences – the constant search for novelty and change or diversity and activity. As a consequence, Chris Anderson (2009) calls this the "Long Tail" in which the future of products are micro markets, hence in the tourism industry we see product offerings such as "Knitting Holidays with Royal Caribbean Cruises" or the "Australian Garden Gnome Festival in the Blue Mountains" (Yeoman, 2008). One of the drivers of experimental life is individualism. As consumers become more culturally and financially liberated, they break cultural norms and an identity is formed which is more fluid. As they seek novelty and experiences, they also want to identify with similar minded people, or what some sociologists call collective individualism (Yeoman, 2008). The individualistic modern consumer sees an advantage in joining forces with others, finding the best sources of intelligence, pursuing economies of scale and sharing experiences – leveraging the input, knowledge and network of groups and communities and entering into a kind of "sharing" engagement more generally. This creates a sense of belonging, whether it is the ramblers club or supporting the local football team. Niche markets and short break holidays are built on collective individualism, like minded people sharing activities such as knitting holidays or garden gnomes. With rising affluence, consumer values have changed, with a lessening emphasis upon material possessions and an increasing concern for experiential and quality of life issues. The consumer is spending in new ways that grant them access to new experiences or awareness of new ways of living. As goods and services are no longer enough, in today's society an increasingly competitive environment means retailers must learn to stage experiences; this is what Pine and Gilmore (1999) called the "Experience Economy". The biggest beneficiary of this phenomena has been the leisure industry and out of home expenditure. As affluence has increased over the past 30 years there has been a corresponding rise in the repertoire of activities that consumers "try out" in any given time period. Today, consumers differentiate themselves with what they do rather than what they buy; they are more individualistic than any other generation.

Increased affluence allows consumers to trade up more regularly allowing for luxury to become an everyday event for more people. To satisfy their preoccupation with self-expression and individualism, consumers of the new luxury frequently mix and match a wide variety of high and low-status brands. And not only can they afford to buy luxury, but increasingly they view it as something they should have as an established and unquestioned privilege.

Consumers today want to undertake a broader range of activities and want to experience new things that were available in the past and certain activities are no longer regarded as "special". For example, most people do not feel that going out for a meal is any longer something out of the ordinary. This is not to say that they don't enjoy going out for a meal or that a meal can't be a special occasion – but simply that eating out is now regarded as a more everyday activity than in the past. There is a profound yearning for new experiences – which has resulted in a "checklist mentality" when it comes to trying new things. Consumers increasingly try out something once so they've had the experience but won't necessarily do it again – a one-off experience that doesn't have to enter their regular portfolio of activities. In doing this they will also often take a risk and try something adventurous. The consumer wants to be challenged, is seeking a thrill and wants to avoid boredom (Yeoman, 2008).

Time

In the Western world, there has actually been a decrease in paid work time during the last decade – although there is a misconception that the opposite is happening (Yeoman, 2008). Still, people's perception that they live under increased time pressure is growing, perhaps because after time has been allocated to both paid and unpaid chores like housework, the leftover time for leisure is crammed with an ever growing desire for doing more stuff, go on more holidays, regularly seeing friends and family and so on – but there still only remains 24 hours in the day. Women as well as people in the family stage/career stage are more likely to report stress. In effect free time has become an ever more sought after resource and so has the understanding of "quality time" changed. This means that luxury for more people translates into the simple pleasure of having time on their own to relax. This can mean legs up reading a book or, as many leisure providers have already spotted, taking a liking to recreational therapies such as spa treatments or yoga classes. This is about striking the balance and combining the desire for leisure, self-development and new experiences, and creating a time oasis for all those busy, stressed out people.

Products that can help busy consumers enjoy more time for themselves are arguably bestowed with a luxury or premium dimension and are closely related to consumer desires to enjoy experiential leisure indulgences. Examples include The Pure Package (http://www.purepackage.com), a delivered-to-your-door healthy meal plan or Radox campaign (aimed at women) which stresses the need for "selfish time" (be-selfish.co.uk) and positions its products as a source of luxurious self-indulgence. The time booster is still a valid expression of luxury for the modern day consumer.

Given societies established long working hours culture and tendency of consumers to be acutely aware of day to day time pressures, the luxury dimension of time is naturally elevated, whether it is luggage services, such as Firstluggage http://www.firstluggage.com, which takes the hassle out of worrying about whether your luggage has arrived at your holiday destination. FlyLite (http://www.flylite.uk.com) takes the concept a few steps further. The company not only picks up and delivers a member's bag, but also packs it, dry cleans the contents and keeps everything in storage until the customer's next flight. How it works? Customers receive a suitcase from FlyLite, which they pack with their favourite travelling gear, from suits and shoes to golf clubs and toiletries. FlyLite then collects the bag and stores the contents. A full inventory is made and placed online, allowing users to browse through their wardrobe and select what they'll need for their next trip, using a simple drag and drop interface. After they've entered their destination and arrival dates, FlyLite takes care of the rest. Leaving customers to zip through airports, fly blissfully luggage-free, and find their suitcases waiting for them at their destination, without having to worry about clean socks or packing. The service costs US$100–200 per trip and is currently only available in the USA.

So it seems that people are generally welcoming the growing intensity of their lives, but they are also beginning to search new oasis of time and space to complement (but not replace) their hectic hours. There's a growing perception, both from consumers and business alike, that downtime can actually be beneficial. Several organizations have already started to tap into this need for time oasis with, for example, a vast array of new holiday formats emerging (such as rural retreats, remote beach getaways, spa resorts and so on). The Japanese-style Yotel (http://www.yotel.com) in London's Gatwick Airport offers luxurious and stylish cabins for rent for travellers with very early departures, or who might have a long layover between flights or are delayed for hours. Four hours in a standard cabin costs a very affordable UK £25 (UK £40 for a premium cabin). Here you can snooze the hours away comfortably and in style.

A similar concept is found in Vancouver Airport and New York's Empire State Building where MetroNaps (http://www.metronaps.com) operates an urban catnapping business. For US$14 you can treat yourself to 20 minutes in their very futuristic (luxurious) looking sleep pods. Meanwhile, the slow travel movement emerges out of eco-ethical concerns but springs from the trend known as authentic-seeking (Yeoman, 2008). The challenge to consumerism posed by global warming could make the slow travel revolution a very real phenomenon. People will not be able to jet off everywhere so they will have to become more patient and welcoming of less plugged-in, less always-on-the-go lifestyles. The slow travel phenomenon takes this into account – it advocates train journeys across Europe and local excursions. The slow travel, slow design, slow food developments are all about having fun and active experiences but here the emphasis is on taking a step back, having a more authentic moment and savouring time.

Changing behaviours

Luxury and quality

For many, luxury is often achieved not through the accumulation of multiple goods but through the purchase of a particular, special item. Many consumers aspire to access goods, experiences and treats that would normally not feature in one's day to day consumption. Research by the Future Foundation (2010) has noted significant numbers across all ages and social grades who agree that they would "rather own one good thing than lots of cheap things". One extracts the sense that at least a small dose of luxury is taken as a birthright by the mass of consumers and that millions are primed to upgrade to quality rather than accumulate quantity. The feature drives the evolution of *premiumization*: we all grow less motivated by the ordinary. Data by the Future Foundation (2010) suggest that the youngest age groups are consistently the most aspirational – over half would pay significantly more for a car and over 40 per cent for a pair of jeans in a luxury category. However, there is also another trend at play here. Verifiable quality is playing an ever sharper role within consumer expectations. It is just not particularly fashionable to presume in favour of the pretty and the over-priced – as if that were collectively a guarantor of a luxury outcome. Across so many markets, recession strengthened the maximizing instinct – the willingness to take time to scrutinize offers in search of both a quality and value-for-money result.

Luxury for rent

The appeal of renting luxury products instead of buying continues to rise. Nearly a quarter of 15–24 year olds and over a fifth of 25–34 year olds are favourable to the idea of getting access to luxury products by hiring or renting them according to research by the Future Foundation (2010). The renting trend chimes with another evolution in luxury consumption – that of the weakening appeal of showy, materialistic wealth and a growing intolerance for wasteful consumerism. Tracking data by the Future Foundation (2010) show us that high levels of eco-sensitivity remain and these attitudes will naturally impact upon luxury purchasing and indulgence. Although an ultra-hedonistic type of luxury indulgence is still something that consumers will – at least occasionally – want to satisfy, certain luxury aspirations are undoubtedly subject to greater scrutiny and questioning now. Luxury in this decade naturally become a lot less noisy, a lot less ostentatious – but it remains a potent and almost universal motivation nonetheless.

As a consequence, luxury has now become so democratic that it is ubiquitously for rent. The growth of websites such as http://www.bagborroworsteal.com offers couture and designer handbags for rent – allowing a larger group of consumers a share in the luxury lifestyle, without the need for a luxury-sized salary. Bag Borrow or Steal was first to market offering the concept of borrowing luxury products and is leading a revolution in the way consumers shop for designer goods or gain access to exclusive events/lifestyles. "Quintessentially" (http://www.quintessentially.com), an international concierge service and members' club, offers customers access to first-class airport lounges, designer fashion shows, nightclubs and exclusive events closed to the public for a membership fee ranging between UK £750 and £2500. You can rent a Ferrari or Aston Martin car for an evening from the Classic Car Club and connect to auction sites like Ebay (http://www.ebay.com) and Portero (http://www.portero.com) where you can bid for second-hand luxury items for a fraction of the price-tag for new items. These services enable customers to "access the inaccessible". For both emotional and practical reasons consumers are, on the margins, rejecting owning products in favour of renting them. This development indicates a shift in the consumer mindset towards the ownership of possessions and luxury items. Renting allows consumers to sporadically dip into the luxury lifestyle without paying the full (unaffordable for most) price for the privilege. Fractional living like this gives them a chance to adopt an alternative, more glamorous and stylish persona for a short period of time and indulge in celebrity lifestyle – all on a budget.

Mercurial consumption

According to research by the Future Foundation (2010) over 60 per cent of UK consumers agree that they shop around extensively to get the best deals. Consumers are very aware of tariffs, even when they think about treats and indulgences (whose suppliers may once have expected that as incomes generally grew many consumers might take a more carefree attitude to price). Searching for discounts is becoming a more commonly attractive behaviour and any negative or socially unappealing association in relation to bargain-hunting in luxury markets are. Flatters and Wilmott (2009) call this mercurial consumption in which consumers extensively search out for bargains. The use of technologies and websites such as http://www.farecast.com, which advises travellers of the optimal time to purchase an airline ticket or price, or grabbing last minute offers from websites, such as http://www.grabaseat.co.nz, which offer last minute air travel deals to New Zealand consumers, or http://www.5pm.co.uk, which offers diners the chance of discounted meals after 5 pm that evening. Basically technology and social media networks accelerate this trend of mercurial consumption.

Exclusivity

The discount club Little Emperors (http://www.littleemperors.com) offers customers concessions of up to 60 per cent from a range of luxury brands including Cartier and Jimmy Choo as well as discounts on experiences and services like holidays, chauffeuring and restaurants. Elsewhere on the

Internet, successful luxury shopping sites include http://www.vente-privee.com and http://www.Cocosa.com.

One of the challenges for luxury brands is that they face the risk of being perceived as too accessible and losing their exclusive appeal. Appealing to the masses can be lucrative but luxury goods manufacturers also run the risk of, so to speak, disturbing their meaning-narrative. These brands have long been perceived as scarce and out of reach. Louis Vuitton (http://www.louisvuitton.com) has had to fight hard to preserve its image after thousands of fake copies of its handbags can now be found in almost any street market around the globe. Burberry (http://www.burberry.com) has suffered when somewhere along the line the brand became the new status symbol for working-class youth (Yeoman, 2008). Luxury brands at the top end risk over-exposing themselves by expanding too far into the mass market and must find new ways to maintain their luxury credentials. In other words, they have to redefine "real luxury" from "mass luxury". The definition of luxury has also gradually expanded from material goods such as designer clothes and jewellery and many of the traditional luxury providers now face competition from new forms of luxury such as new types of lifestyle holidays, spa retreats and other "experience providers".

New expressions

Consuming luxury in a more socially aware manner is a trend that is growing in importance. Thirty-one per cent of Britons (Future Foundation, 2010) agree they would be prepared to pay significantly more for a luxury car if it were environmentally friendly and a quarter would pay more for a luxury ready-meal if it were locally produced. Just over a fifth would pay more for a luxury shampoo that was environmentally friendly. It is clear that such still emerging twenty-first century values are becoming more commercially significant. Luxury is becoming more closely aligned with deeper issues such as eco-awareness, intelligence, healthy and ethical lifestyles. The appeal of say, a technologically superior Smartphone's sophisticated game console that is focused on improving body or mind, personalized professional fitness services or rich and locally produced foods has been strengthened because of their associations with social values that are increasingly thought to be attractive, admirable and aspirational.

Premium pricing

Luxury has a psychological association with premium pricing. Allsop (2004), states that premium value is price and quality plus the intangibles of style, uniqueness, occasion and experience. Here, goods and services such as home furnishings, holiday accommodation, food for a dinner party, restaurants and home electronics have a high perception of value. But goods such as plane tickets and electricity have no added value. Hence the implication for marketing is that consumers are willing to pay more for certain goods and not for others. To the marketer it means creating a brand equity or value for which the consumer is willing to pay extra. Marketers view luxury as the main factor to differentiate a brand in a product category, as a central driver of consumer preference and usage (Vigneron and Johnson, 2004). In order to understand the "extra value", it is important for marketers or pricing managers to identify the key factors from a consumer perspective. The factors are:

- Never underestimate the customer – as consumers have a desire, interest, intelligence and capability to trade up. They are willing to pay for that extra value, time or aspiration.
- Consumers will shatter the price – volume demand curve. Consumers are not looking for an incremental improvement. Pricing managers must go for premium prices and higher volume, not being scared to take a risk.
- Always create a ladder of genuine benefits rather than confusing the consumer with meaningless innovations. This means technical and functional benefits that result in emotional advantage for the consumer. Additionally, do not pretend to be something you are not.
- Escalate innovation, elevate quality and deliver a flawless experience. The market for luxury is growing but it is unstable. This is because the market does not stand still as new competitors enter the market. It is a constant battle to keep ahead, as there will always be a lower priced alternative around the corner.
- Extend the price range and positioning of the brand. It is important to create, define and maintain a distinct character and meaning for each product offering at every level in the value chain. This way, there is a tenfold difference between the lowest and highest price points. Luxury means driving aspiration and accessibility.
- Remember to customize value chains to deliver benefits. Create wealth and quality in the chain and ensure that this is managed.
- Use influence marketing and success through brand apostles. In a world where advertising is under pressure due to choice and trust, put your emphasis on core customers who will deliver your luxury product capital.
- Continually attack your product like an outsider. Think as the competition or a maverick. The competition will beat you if you don't.
- Authenticity is the new exclusivity.

Conclusion

As society becomes more wealthy the definition of luxury changes, making luxury more accessible to the masses but creating difficulty for luxury products to defend that exclusivity. Over the last decade, the concept of luxury has transformed itself from materialism to time and aspiration, making luxury more reachable and democratized. Smaller, affordable luxuries and premiumized products are strengthening their appeal as consumers continue to satisfy their need for regular treats and indulgences in their lives. At the same time, luxury products have set out to protect their exclusivity through premium pricing and authenticity.

References

Allsop, J. (2004) Premium Pricing, Presentation given at the Changing Lives Conference, Future Foundation, Queen Elizabeth Conference Centre, London, 2 December.

Anderson, C. (2009) *The Long Tail. How Endless Choice is Creating Unlimited Demand*. New York: Random House.

Berry, C. J. (1994) *The Idea of Luxury*. Cambridge: Cambridge University Press.

Danziger, P. N. (2005) *Let Them Eat Cake: Marketing Luxury to the Masses – As Well as the Classes*. New York: Dearborn Trading Publishing.

Farrel, D., Gersch, U. and Stephenson, E. (2006) The Value of China's Emerging Middle Classes. Available online at http://www.mckinseyquarterly.com/Economic_Studies/Productivity_Performance/The_value_of_Chinas_emerging_middle_class_1798 (accessed 27 September 2007).

Flatters, P. and Wilmott, M. (2009) Understanding the Post Recession Consumer, *Harvard Business Review* (July–August), 87(7–8), 106–112.

Future Foundation (2010) Consuming Luxury Available at http://www.nivisiononline.co.uk (accessed 26 January 2010).

Galbraith, J. K. (1958) *The Affluent Society*. New York: Houghton Mifflin.

Gambler, P. (1997) *Female Economy*. Illinos: University of Illinois Press.

Israel, B. (2003) *Bachelor Girl: The Secret History of Single Women in the 20th Century*. London: William Morrow & Co.

Packard, V. (1962a) *The Status Seekers: An Exploration of Class Behaviour in America*. New York: Penguin Books.

Packard, V. (1962b) *The Pyramid Climbers*. London: McGraw Hill.

Packard, V. (2007) *Hidden Persuaders*. London: Ig Publishing.

Pine, J. and Gilmore, J. (1999) *The Experience Economy*. Boston: Harvard Business School Press. Boston.

Schlor, J. B. (1991) *The Overworked American: The Unexpected Decline of Leisure*. New York: Basic Books.

Schlor, J. B. (1998) *The Overspent American: Why We Want What We Don't Need*. New York: Basic Books.

Silverstein, M., Fiske, N. and Butman, J. (2005) *Trading Up: The New American Luxury*, 2nd edn. New York: Portfolio.

Twitchell, B. J. (2001) *Living it Up*. New York: Columbia University Press.

Vigneron, F. and Johnson, L. W. (2004) Measuring Perceptions of Luxury, *Journal of Brand Management*, 11(6), 484–506.

Velben, T. (1899) *The Theory of the Leisure Class*, Reprint 1973. Boston: Houghton Mifflin.

Yeoman, I. (2008) *Tomorrows Tourist*. Oxford: Elsevier.

Yeoman, I., McMahon-Beattie, U. and Brown, M. (2005) The Authentic Tourist. In J. Hassan (ed.) *Scotland 2020*. Edinburgh: Scottish Book Trust, pp. 160–165.

7
The Future of Airline Distribution and Revenue Management

Ben Vinod

Introduction

With the steep decline in asset values in 2008 and the deepening worldwide economic crisis, these are uncertain times for the tourism industry. In 2009 demand dramatically weakened across all customer segments. Under these economic conditions, airline CEOs are focused on airline profitability, capacity reductions, economic slowdown, escalating fuel costs, low-cost carrier (LCC) competition, ancillary revenues, channel efficiency, alliances/joint ventures and reducing complexity (Vinod, 2009b). Many of these core initiatives are influenced by Revenue Management and product distribution.

Revenue Management and product distribution are inextricably linked to each other. Product distribution is the storefront that displays the recommendation of the Revenue Management process – the supplier's products that are available for sale. There are two distribution channels – direct and indirect. The direct channels have an online and offline component, the supplier website and call center, respectively. The direct channels transact directly with an airline's computerized reservations system (host CRS). The indirect channels also have an online and offline component, online travel agencies (OTA) and brick-and-mortar travel agencies. The indirect channels typically transact with a global distribution system (GDS) for schedules, fares and availability. The indirect channels contribute over 50 percent of the bookings worldwide.

Suppliers must have an integrated Revenue Management and distribution strategy (Vinod, 2009a) to capture all customer segments across all channels at the right price and the right time to maximize network revenues and profitability.

Factors influencing the future of Revenue Management

Revenue Management came into existence after the deregulation of the US airline industry in 1979. From its cautious, early beginnings in the early to mid 1980s (Crandall, 1998), the science and business process have matured. Based on its value proposition, Revenue Management has enjoyed broad adoption with suppliers of perishable inventory – airlines, hotels, rental cars and cruise lines (McGill and Van Ryzin, 1999). Business process adoption and alignment has been a consistent priority. The immediate questions are: *How has Revenue Management changed? Does traditional Revenue Management (as it was defined in the mid 1980s) still work today?* The answers are not simple. While the core concepts continue to be valid, there have been significant changes, influenced by technology and the competitive landscape. Key factors are:

1. The growth of the Internet for online bookings has provided a new data source and transparency to available (bookable) competitive fares.
2. The growth of LCCs and their simplified one-way restriction-free tariff structure invalidates the core assumption of demand independence for fare products.
3. Network carriers have to adapt origin and destination (O&D) controls to compete effectively against LCCs.
4. Acknowledgment that Revenue Management should focus on *not what the supplier is willing to accept, but what the customer is willing to pay.*
5. Renewed focus on customer retention and getting closer to profitable customers.
6. Promotion of branded fare products and unbundling.

Future direction in Revenue Management

The future direction of Revenue Management is influenced by the competitive landscape, new business models, LCC competition, technology, business constraints and profitability concerns. Key areas of focus are described below.

Competitive Revenue Management

The traditional Revenue Management process does not consider market conditions, which is a problem in the Internet era of openly available competitor fares and schedules. Traditional Revenue Management creates demand forecasts based on historical bookings and determines "optimal" inventory controls. Today, though, it is important for airlines to become "competitor aware" (Ratliff and Vinod, 2005).

There are two aspects to this problem. First is the ability to forecast demand taking into account competitor schedules and the available selling fares. Second is the monitoring of competitor *selling fares* to adjust inventory controls based on the quality of service. At Sabre, consulting engagements with airlines have demonstrated that incorporating competitive data can result in a 5 percent to 15 percent growth in the average ticketed fare.

Consumer choice modeling (Ben-Akiva and Lerman, 1985) is based on the choices that a customer observes and selects to estimate demand for an airline's product. It predicts the probability that a customer will select a particular flight within a set of alternatives. The selection is influenced by a flight's attractiveness compared to competing schedules and fares. Schedule attributes (for example, non-stop, departure time, elapsed time and so on) and fare attributes (for example, selling fare, restrictions) provide the ability to react quickly to changes in market conditions. Consumer preferences can be calibrated with shopping data (Ratliff and Mishra, 2004) or airline passenger name record and ticket data. This approach follows the *actual demand process* of how a specific air product is purchased. Consumers typically select an itinerary based on schedule attributes and price. Following the demand process produces more accurate forecasts than traditional approaches.

Consumer choice-modeling is also an elegant method to forecast demand for restriction-free products, where only the price point determines the product and demand is *dependent* on the price points. It can also be used to forecast demand for new markets, and estimate up-sell rates, down-sell rates, recapture rates, price elasticities and cross-elasticities. This framework has numerous applications. For example, an OTA can calibrate a choice model and display hotel search results to maximize conversion rates.

Restriction-free pricing and the LCC impact on network carriers

The rapid growth of LCCs in the late 1990s with aggressive pricing and marketing initiatives has produced renewed competition that threatens the existence of major US airlines, global pure play and international flag carriers (McDonald, 2006). Today's LCCs have sustainable business models, accounting for more than 30 percent of industry capacity. While traditional network carriers have reduced in size, LCCs have been growing at an impressive 20 percent per year until the current economic downturn. LCCs compete directly with legacy US carriers on over 80 percent of the domestic market. In Europe, the flag carriers continue to decline as LCCs continue to grab market share. At the end of 2009 there were over 50 operating LCCs in Europe.

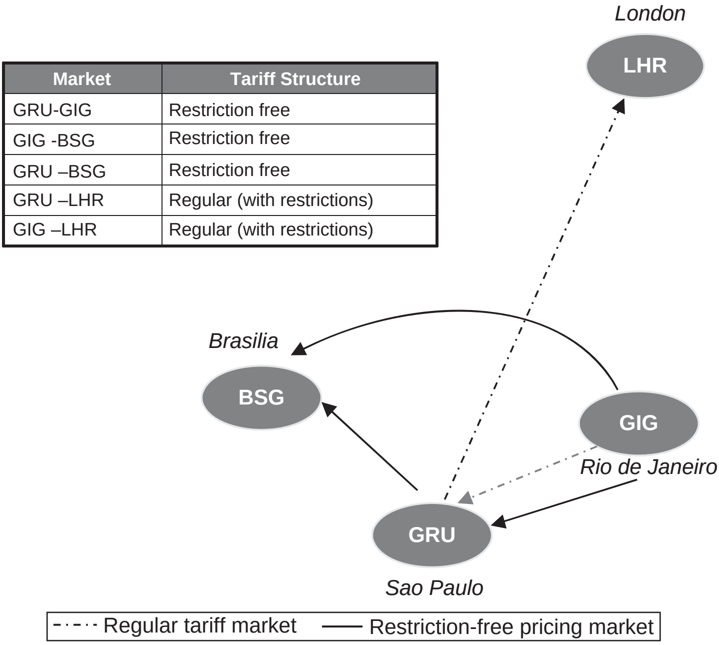
LCCs have a simple, no-frills product for the price-conscious customer – high frequency, point-to-point operation to secondary airports, a homogeneous fleet, high fleet utilization and significant consumer direct distribution typically through their website. LCCs promote a simplified one-way, restriction-free tariff structure that is rapidly altering customers' valuation of air travel. Further, liberalization has reduced the barriers to entry for new low-cost airlines, which can alter competitive fares overnight. Typical restrictions imposed on all fares are refund penalties and ticketing time limits. The fare is the primary determinant of the customer segment. In this scenario, an airline files multiple fares with identical minimal fare restrictions for all fare classes. Selecting a fare higher in the hierarchy is dependent on the immediate lower fare being closed for sale. The fare structure theoretically promotes a 100 percent sell-down to the lowest available fare. There is always only a single selling one-way fare in the market, which invalidates a fundamental assumption of Revenue Management that fare products are independent. It is now required to forecast demand based on the fare class that is closed. Active monitoring and closure of the selling fare is required to promote sell-up to the higher fare.

New optimization methods for handling restriction-free pricing have been developed (Ratliff and Weatherford, 2009). With dynamic programming or conditional demand versions of expected marginal seat revenue (EMSR) (Gallego et al., 2009), price-demand curves can be used with available seats to determine the optimal timing and price to be offered, subject to business constraints encapsulated as rules. This has a revenue advantage over a manual rules-based environment practiced by many LCCs.

To counter the competitive threat from LCCs, fare simplification has been adopted to varying degrees by network carriers. Ultimately, the success of these fare simplification initiatives depends on whether demand stimulation can be sustained and revenue dilution can be contained without risking the loss of market share to LCCs. The dilemma is how to compete effectively against the LCCs in short-haul markets where route profitability is usually the exception rather than the rule. While retaining their traditional fare structure for connecting (flow) traffic, network carriers must compete against the LCCs on the short-haul routes and manage seat inventory with a *hybrid* tariff structure. TAM Airlines (Transportes Aéreos Marília, S. A.) based in Sao Paulo exemplifies this point (Figure 7.1). In the TAM scenario, all fares filed in the domestic (Brazil) market are restriction-free while international markets have regular fare products with restrictions. To control seat inventory by O&D, an airline must trade off the optimal mix of restricted and unrestricted fare passengers. Demand models are required for forecasting traditional fare classes (independent demand) and restriction-free fare classes (dependent demand). To determine optimal inventory controls, the network optimization model should trade off the two types of demand subject to demand uncertainty and business constraints.

Customer centricity

Getting closer to the customer to improve retention and create targeted personalized offers requires an investment in business intelligence to transform raw data into intelligent information to develop a business strategy. Investment in this infrastructure supports active monitoring and alerting to *sense and respond* (Haeckel, 1999) to prevailing market conditions in real-time. For the online direct and indirect channels, channel analytics provides a new dimension to increase conversion rates by influencing the display based on



Market	Tariff Structure
GRU-GIG	Restriction free
GIG -BSG	Restriction free
GRU –BSG	Restriction free
GRU –LHR	Regular (with restrictions)
GIG –LHR	Regular (with restrictions)

Figure 7.1 The network carrier problem: operating in a hybrid tariff environment.

the channel customers are acquired from – paid search, meta, direct URL, natural search, customer relationship management (CRM) and so on and their interactions on the website.

Unlike brick-and-mortal retailing, where demographic data (for example, age, income, ethnic background) play a key role in assortment planning, what is important in the travel domain is "what the customer is currently shopping for" and less on detailed demographic data to create targeted offers. For example, if someone is shopping for a ski trip to Vail for next week, demographic data are less important and it is an accepted fact that customers over a range of age and income groups would pay a lot more to go to Vail on short notice. In travel, detailed demographic data are more useful for customer acquisition such as targeted email campaigns to promote a destination, real estate companies that sell vacation ownership time shares and so on.

In an effort to attract and retain profitable customers, customer-centric performance measures such as customer lifetime value, corporate booking volumes, customer profitability, customer churn rates and customer retention rates will influence Revenue Management and inventory control decisions in the future.

Growth in online shopping and impacts on availability accuracy

The exponential growth in online bookings over the past decade has provided customers with instant access to competing schedules and fares through OTAs. This unparalleled transparency has propagated a bargain-hunting mentality among leisure online travelers, resulting in a disproportionate growth in availability processing due to increased shopping activity. The look-to-book measure is the ratio of shopping requests to actual bookings. While the look-to-book ratio for a traditional travel agency channel may range from 4:1 to 20:1, the look-to-book ratio for the online channel could be significantly higher and range from 100:1 to well over 1000:1 for certain markets.

With these high shopping volumes, OTAs resort to cached availability to reduce transaction costs and shopping response times by limiting the direct queries to an airline's host CRS for true last-seat availability. The cache is refreshed based on algorithms that are a function of age and usage of the availability data. When an item is not found in the cache, the response to a shopping request can be based on pre-stored availability status (AVS), numeric availability status (AVN) or a direct query to the airline's host CRS to refresh the cache.

Maintaining an accurate availability cache is a challenge. Inaccuracies can result in lost bookings, when the customer experiences a price jump since the cache thinks a class is open for sale while it is truly closed. To improve cache accuracy, Sabre was the first to deploy cached availability by O&D, class and country point of sale. This constituted a significant improvement over cached availability by segment class. An availability proxy (Vinod, 2007) or availability push from airlines can also improve cache accuracy. Cache enhancements are an active area of research.

Merchandising

Generating incremental revenues is an important priority, resulting in initiatives to charge customers for extras such as advance seat selection, lounge access, meals, in-flight Internet access and so on. An independent survey conducted by Leflein Associates (Alexander, 2006) showed that travelers would pay for extra perks, such as more frequent flyer miles, more overhead bin space and the ability to sit in a child-free section of the aircraft.

To overcome the perception of an airline seat as a commodity (Arnoult, 2008; Moore, 2007), a popular initiative is the introduction of branded fare products with its associated *attributes*. Airlines want to offer transparency to customers based on the value of the service rendered and also promote the sale of ancillary services (Vinod, 2008). Historically, airline seats have always been sold from the bottom up – from the lowest qualified fare. With branded products, an airline can sell from the middle or the top, based on a consumer's preference for the attributes associated with a branded product.

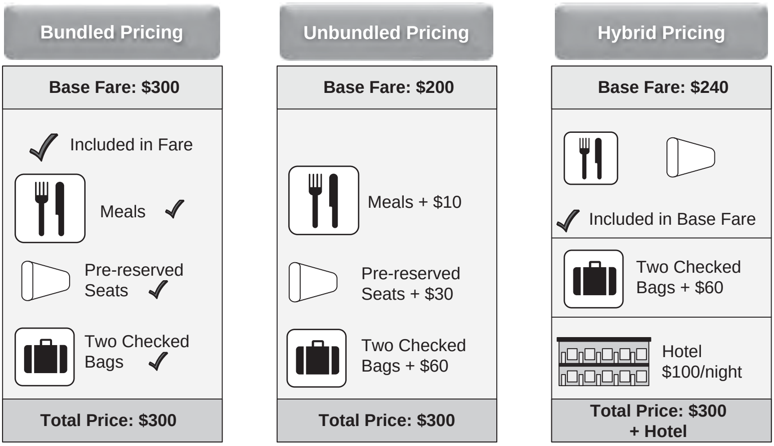


Figure 7.2 Evolving trends in merchandising.

Branded fare products and unbundling impact the end-to-end travel value chain from product definition to shopping, selling, fulfillment and post-travel customer care (Vinod and Moore, 2009). Figure 7.2 illustrates the evolution of merchandising.

The promotion of service differentiation with branded products and sale of ancillaries are collectively referred to as "merchandising". For example, Air Canada has three branded products in economy (Tango, Tango Plus, Latitude) and two branded products in the premium cabin (Executive Class Lowest, Executive Class Flexible). Each branded product is a distinct segment with bundled attributes, such as access to the Maple Leaf lounge, priority baggage check-in, fare refundability, advance seat selection, frequent flyer miles accrual and change fees. In addition, even with the purchase of a lower valued branded product, customers can pay for specific ancillary services such as advance seat selection. The distribution infrastructure of suppliers and GDSs should adapt to make the filing and settlement simple. The Airline Tariff Publishing Company (ATPCo) in conjunction with the International Air Transport Association (IATA) is providing a service fee solution. The fee types are OB (ticketing fees), OC (optional service fees) and OA (booking fees). Airlines that fail to adopt an *à la carte* pricing model will likely lose customers and potential revenue (Nason, 2009).

There are several challenging problems that need to be addressed from a pricing and Revenue Management perspective. They are:

1. Composition of the Branded Fare Products

To determine the composition of a branded fare product, two assumptions are required. First, customers will choose a branded fare product that maximizes their utility. Second, price consistency is mandatory that ensures the price of the higher brand is less than the lower brand inclusive of the prices of ancillary items included in the higher brand. The problem is challenging since it is required to find the profit maximizing set of ancillary services to include in each branded fare product.

2. Tariff Structure

Determine the tariff structure based on a customer's willingness to pay for attributes associated with a branded fare product. The tariff structure should maintain fare differentials between branded products such that it eliminates dilution and promotes up-sell to higher valued branded products.

3. Ancillary Services Pricing

Ancillary services typically have the same price across the airline network. Future pricing of ancillaries will vary by market for services such as pre-reserved seats based on competitive market conditions and length of haul. An active area of research is to quantify a customer's willingness to pay for ancillary services to determine their value. Established methods include multinomial choice analysis (Balcombe et al., 2009; Ben-Akiva and Lerman, 1985; Train, 2003), the Van Westendorp pricing model (Hague, 2008; Van Westendorp, 1976) and conjoint analysis (Green et al., 2001; Hair et al., 1984) which considers tradeoffs between various combinations of price and product features. An experiment based on stated preferences (Martin et al., 2008) was used to provide empirical evidence of estimated valuations that air passengers have on quality of service attributes such as comfort, food, ticket change fees, frequency and reliability.

4. Discount Allocation Control

Discount allocations should be based on the total value, inclusive of ancillary revenues forecast and its associated risk. Second, the seat inventory control framework should ensure that availability is synchronized across branded fare products for the same fare level. This ensures that *all* branded fare products at a fare level are either open for sale or closed for sale.

Close-in re-fleeting with Revenue Management forecasts

Close-in re-fleeting (Shebalov, 2009) is the process of adjusting fleet assignment using tactical demand forecasts and revenue estimates from Revenue Management. Berge and Hopperstad (1993) evaluated capacity changes from a family of two or more aircraft models using current bookings, no-show forecasts and expected remaining demand that resulted in a profit improvement of 1–5 percent. Later research identified optimal swap opportunities (Talluri, 1996), combining re-fleeting with flight retiming (Jiang and

Barnhart, 2006), computational improvements to fleet assignment (Sherali et al., 2005) and application of stochastic programming for fleet assignment (Pilla et al., 2008).

In the traditional airline planning process shown in Figure 7.3 the revenue estimates between capacity planning and Revenue Management are inconsistent. Fleet assignment is based on aggregate revenue estimates, while Revenue Management is more granular and forecasts demand by booking class, models demand uncertainty, nesting and accounts for changes in revenue due to demand interactions. The Revenue Management estimate of expected revenue is more accurate. Estimates of expected revenue and demand forecasts by flight leg (service) can be used by the leg-based (O&D-based) fleet assignment model to improve network revenue performance.

Close-in re-fleeting impacts the airline planning process. It is gaining acceptance in schedule planning and operations due to its potential benefits. Consulting studies at Sabre with airlines adopting close-in re-fleeting have shown that the approach results in higher revenues (1–1.4 percent), lower load factors (0.5–0.7 percent) and higher yields (2.1 percent).

Intelligent fare management

Price leadership in a market is viewed as a competitive weapon. Pricing actions can be both tactical (short term) and strategic (long term) (Vinod, 2010; Vinod et al., 2009).

Tactical pricing is the traditional fare management process of responding to a fare action taken by a competitor on a specific market. Airline pricing has relied on reactive fare matching based on rules to respond to competitor actions. The objective is often to match a competitor's fare to *preserve* market share. Fare matching can be *replaced* by a response based on the quality of service offered by the competitor that initiated the fare action. If the quality of service offered by a competitor that initiated a fare action to lower a fare is inferior, a fare match response may not be the desired response.

Strategic pricing is a proactive approach to determine a new tariff structure based on market objectives, business constraints and a customer's willingness to pay for a specific product. The objectives almost always vary by market or market entity (a group of markets where the fares are related). For example, a market may have an overriding goal of maximizing market share because of dominant competitors and to be a player requires revenue volume. Likewise, for another market, the airline may have the dominant share, and the objective of maximizing margins instead of volume may be more appropriate. In some situations, a market may be experiencing low demand and improving bookings may be a primary objective. The marketing objective should satisfy market reality expressed as business constraints. Examples of business constraints are price relationships that need to be preserved between fare products, the expected traffic distribution with the new tariff structure and competitor response to a fare action. Computational

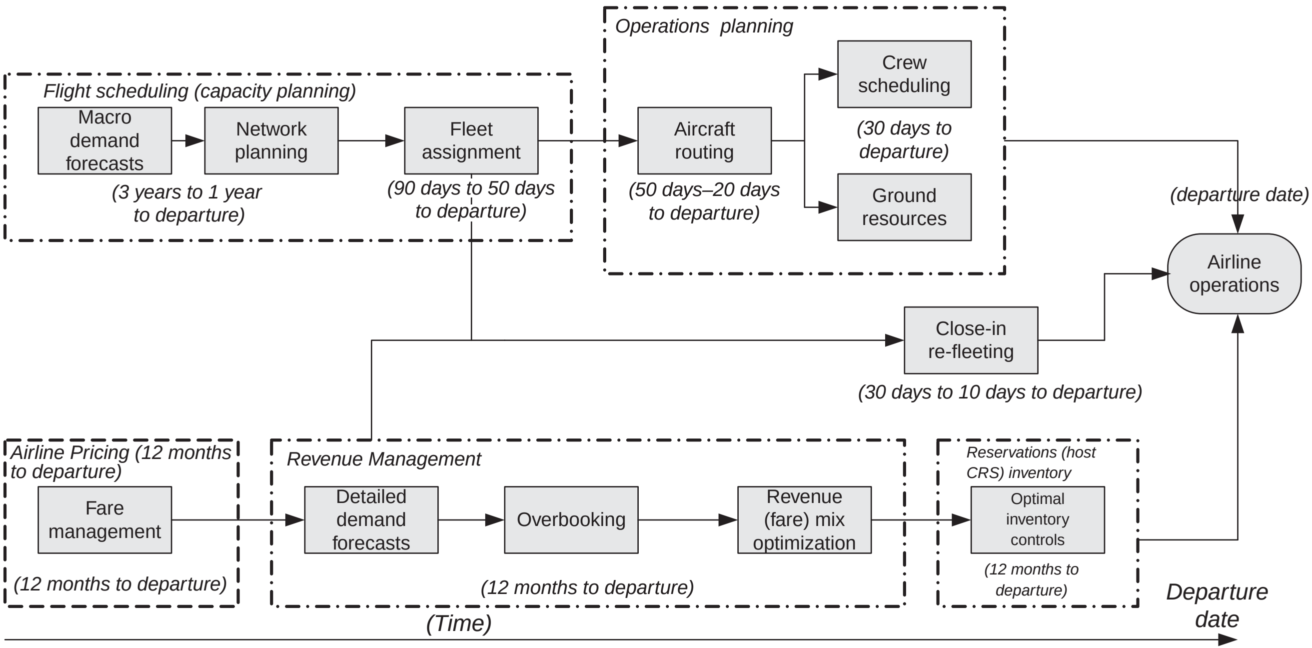


Figure 7.3 Close-in re-fleeting in the airline planning process (approximate time period in the planning horizon).

experience with a non-linear optimization model calibrated with airline data at Sabre shows that optimizing fares can typically provide revenue improvements of 1–5 percent in a market. A secondary benefit is ensuring price consistency in a market over time.

e-Commerce and group sales automation

A "group" is a large party that negotiates a special fare for a block of seats. Of the 100 largest airlines in the world, group revenues constitute 10 percent of total traffic. Acquiring group business is perceived as high cost. Revenue Management accommodates profitable group requests to retain market share. To reduce group handling costs, self-service automation is a key trend in the management of group bookings.

An airline call center is a cost center. An online group e-commerce solution can transform a cost center into a revenue center if it can accept and manage group bookings, support alternate payment methods, promote merchandising of hotels, tour bus and local attractions, and subject to the mix and match constraints of air and non-air content to create a complete full-service experience for group customers. Airlines can leverage wholesale private label hotel deals from OTAs such as Travelocity's Travelocity Partner Network or Expedia's Worldwide Travel Exchange which return a percentage of the profit on non-air bookings minus costs to their partners.

To enable a group portal, group acceptance should be automated end-to-end, specifically group itinerary pricing for air. Traditional group acceptance relies on the tariff desk to "translate" the *minimum acceptable fare* (an estimate of the breakeven fare from Revenue Management) to a fare that can be quoted to the customer in the contract.

There are several secondary benefits as well. First, through the portal, airlines can promote targeted group deals to popular destinations based on the origin city derived from the website user's IP address. Second, when customers request a block of seats, the display order can be modified based on market strategy such as maximizing profits, market share or quality of service. Automation also ensures a consistent repeatable process, eliminates nepotism and revenue dilution. It can also support GDS agency requests for seats from an airline, with ticketing on the originating GDS request.

Host CRS/GDS connectivity enhancements for broader adoption

Seamless connectivity for availability and sell between a GDS and a host CRS enables real-time true last seat availability and instant confirmation at the time of booking from a travel agency desktop. It is also a *requirement* for inventory control by O&D and by point of sale (Vinod, 1995).

Over the past five decades, the traditional protocol for interactive availability, sell and seat maps between an airline's host CRS and the travel agency desktop required EDIFACT (Electronic Data Interchange For Administration, Commerce and Transport). Over the past three years, GDSs have provided XML (eXtensible Markup Language) as an alternative to distribute products offered by LCCs. Travel agencies can now view real-time availability, flight information and seat maps from an airline's reservations system that does not support EDIFACT. Navitaire, for example, which provides reservations system services to several LCCs, worked with Sabre to enable this new capability. This capability enables the GDS to display travel content not generally enabled through traditional legacy systems. Through XML, the GDS can display and sell air content with a presentation similar to that used by the airlines through their websites. XML has the added benefit of reducing communication costs.

The future of distribution

Distribution vendors deliver higher yielding tickets[1] than supplier websites in exchange for long-term assurance of full content and a broad set of protections that are critical for travel agencies and corporations. Airline-pay, traveler-pay and agent-pay channel fee models ultimately increases the cost of travel for individuals and corporations. The current airline distribution business model efficiently balances the needs of all constituents including airlines, corporations, travelers, travel agencies and the GDSs that serve them. However, future competitive conditions in the marketplace will determine the long-term success of the current business model. This section discusses key trends and the future of distribution.

Participation in all channels of distribution

Airlines need a multi-channel strategy to have access to all customer segments. Withholding content from any channel has never been a winning strategy. With the rapidly changing demographic landscape (Locke, 2009), suppliers must have a multi-channel strategy to attract and capture customers that shop across channels. This is because a customer typically has multiple profiles based on the circumstance for travel. Surveys have shown that a typical customer relies on travel agents for corporate and high-end complex leisure travel, a supplier website for one-click simple purchases, a city ticket office occasionally for convenience and family trips or review consumer-generated media (CGM) and purchase through an OTA like Travelocity, Expedia or Orbitz. There is also evidence that the next generation of travelers will differ dramatically (Locke, 2009), may not be brand aware and have a propensity to be channel jumpers. Hence, travel suppliers should capture all segments of the market and achieve this optimal mix by capturing the true value of the channel by understanding the associated revenue per transaction and the true costs.

Globalization of travel programs

Corporations are seeking globalization of their travel programs. Aligning with one travel management company (TMC) versus multiple TMCs to ensure global transparency, optimal management of the travel budget, control and security over their travel programs will continue to grow in the next decade.

Content aggregation is very significant for customers

Content aggregation is important for large managed programs to meet their travel needs where the content is searchable, bookable and can be fulfilled. GDSs will continue to invest in tools that efficiently aggregate content into a single integrated display. With the growing demands for efficiency, consistency, security and globalization in the corporate travel market, corporations adopt best-in-class travel procurement programs that ensure that they can achieve their business objectives efficiently while managing their overall travel spend with true end-to-end visibility. Corporations cannot afford to establish direct relationships with suppliers to procure travel, but require an efficient marketplace that serves as a one-stop shop through a GDS. In the corporate marketplace, TMCs have very rigorous and complex requirements for fulfillment, exception handling and back-office integration which only a GDS can provide.

OTA service fees are gone forever

In North America, airline direct websites typically do not charge a booking fee while the OTAs charged a nominal booking fee per ticket. Priceline started a new trend by abandoning booking fees in 2008 in an attempt to improve booking volumes and market share. Hotwire, owned by Expedia and a key competitor of Priceline, quickly matched. This change was not considered significant since neither Priceline nor Hotwire sold a high volume of published fares in the online marketplace. Studies at Sabre have shown that leisure customers, especially those that pay a low fare, are extremely sensitive to booking fees. While the relationship is not linear, every dollar reduction in service fees produces a significant increase in incremental bookings.

Priceline has seen a growth in its booking volumes after it dropped the booking fees. However, the major OTAs – Expedia, Travelocity and Orbitz – continued to have booking fees until Expedia dropped the booking fees in March 2009, followed by Travelocity and later by Orbitz. With this change, consumers are the real winners since prices are the same as the supplier sites. OTAs have seen a surge in booking volumes beyond the planned growth, probably because of consumer shifts from the supplier sites. Figure 7.4 shows the aggregate year over year percentage growth in OTA booking volumes as observed in marketing information data tapes (MIDT) data through November 2009.

While the elimination of booking fees constitutes a significant drop in revenues for the OTAs, effective cross-selling of non-air products (hotels, rental car and so on) should offset some of the loss. An additional benefit is parity with supplier sites on meta search sites such as Kayak, TripAdvisor,

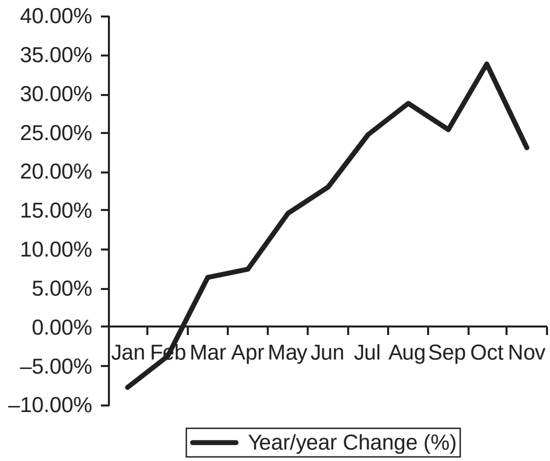


Figure 7.4 Aggregate OTA booking volume change (2008/2009).

IgoUgo and fly.com, whose business model is based on referral fees and advertisements, which produce incremental traffic.

Investment in merchandising

The GDSs will continue to make significant investments in merchandising across the travel value chain (Vinod and Moore, 2009). With the proliferation of branded fare families and unbundling, comparing competing itineraries from airlines based merely on the *base fare* is no longer sufficient. Agencies will require shopping based on similar attributes promoted by carriers to ensure a true comparison based on total value. Frequently, customers are unsure of how much the total trip will cost until they get to the airport. Hence, host CRSs and GDSs should empower travelers and travel agents to compare the true costs of flights when ancillary services are taken into account. With attribute-based shopping, users can specify ancillary services such as one or two checked bags, in-flight meal, preferred seat selection and so on when they search for flights. The true cost of an itinerary minimizes consumer angst about the range of new fees imposed by airlines.

Enabling branded fare products and ancillary services requires standards for the distribution of product attributes and messaging protocols (Moore, 2010). This effort is well underway among the GDSs, ATPCo, Airlines Reporting Corporation/Billing & Settlement Plan (ARC/BSP), leading OTAs, TMCs and several airlines. Airlines can now file fares that incorporate their bundling and unbundling via ATPCo OC fare filings. Beginning in 2010, airlines and agencies will be able to settle these via standard ARC and BSP solutions called electronic miscellaneous documents (EMD).

Growth of merchant hotels

Merchant hotels provide a contracted rate to an OTA that they mark up and sell either individually as hotel bookings or as packages. The mark-ups always ensure rate parity with the supplier website and do not shift bookings between channels. OTAs will continue to add more merchant hotels to their portfolio not just in primary markets but also in secondary markets. With this growth, an OTA has access to a large number of properties by market and managing the screen real estate for hotel shopping requests that maximizes conversion rates is of critical importance.

The perceived benefits of increased visibility achieved by distributing a hotel brand through an OTA has been recently characterized as the "billboard effect" (Anderson, 2009). The study confirmed the long held claim by OTAs about the halo effect of generating incremental bookings and improving the average rate on the OTA channel as well as the hotel website and call center. This experiment was conducted in cooperation with Expedia and JHM Hotels, with JHM Hotels alternately displayed and removed from the Expedia site. Booking data indicated that bookings through other channels were higher when the JHM properties were displayed on Expedia.

Social networks and contextual collaboration

According to online market research firm Compete Inc., 71 percent of consumers are influenced by CGM and two-thirds of travelers prefer consumer reviews and experiences to confirm a decision, or to decide between their top considerations.[2] With this information explosion, community and social networking is proving to be a huge new influencer in booking travel. Over the next decade it should gain accelerated adoption and become mainstream (Klein, 2009). The second generation of web-based communities such as social networking sites, wikis and blogs has reinforced interactivity, collaboration and sharing of experiences. Online vendors realize the importance of social networking since it drives traffic to their sites and supports conversions of shoppers to bookers. Over 40 percent of US online leisure travelers use online social networking tools in their travel research, such as IgoUgo.com and TripAdvisor.com.

For leisure trips, the dreaming and planning phase of travel is where social networking data are most valuable to OTAs and supplier websites. A future enabler for social networking is contextual collaboration that uses *presence technology* to access and share information instantly. For example, when reading a destination review, a travel planner may have a question about the content. The name of the person who submitted the review can be made available as a live link, and if the person is online the question can be submitted instantly for a response. In concept, it is similar to instant messaging, except that it could be accessed from within other applications. With the rapid acceptance of social networking, real-time collaboration will become mainstream and an integral part of the booking process.

Social networking has also made inroads in the corporate travel industry. Review sites are influencing the selection of not only hotels and destinations but adjacent travel components such as restaurants (Rose, 2008). Social media capabilities are also being incorporated into corporate booking tools.

There are parallels between CRM and social networking. While CRM is widely accepted at the enterprise level, the return on investment (ROI) has never been well understood. Like CRM, integrating online channels to social networking sites is “table stakes”. However, this in itself cannot provide a measurable ROI. With the vast amount of social networking informational data that is available, the question is: *how can this data be leveraged in the customer life cycle – marketing (for example, acquiring new customers, campaigns, paid search, natural search), interactive selling (for example, shopping experience, selling, up-sell/cross-sell), fulfillment (for example, ticketing, selling add-ons, advertising for local attractions) and service (post-travel care)?* If text mining and pattern recognition of this data can augment the customer life cycle, travel suppliers and OTAs could measure incremental bookings, brand loyalty and repeat customers – leading to a measurable ROI for social networking.

Collaboration between Revenue Management and interactive marketing

With the growth in online bookings, collaboration between Revenue Management and interactive marketing is required to improve the screen quality of the airline website and marketing spend for sponsored (paid) search.

When an airline has a large number of services in a market, it is costly and inefficient to display either the wrong options or a large number of options on the website that do not improve conversion rates. If a limited number of options are displayed, single dimensional metrics such as lowest fare, number of alliance partner carriers, total number of itineraries, website response time and so on do not capture the required interactions. Given a set of alternatives, discrete choice analysis techniques can be used to improve screen quality. Besides optimally ranking options based on schedule and fare attributes, unobserved factors such as market presence, promotions or ease of use of the website can be aggregated into a website-specific constant (Jiang, 2009).

Sponsored search advertising, where advertisers pay a fee to Internet search engines to be displayed alongside organic (non-sponsored) web search results is the most significant source of revenues for search engines (Ghose and Yang, 2009). For instance, Google make money by auctioning advertisements and adWords is a pay-per-click model for the advertiser. To realize the benefits of paid search, travel suppliers need to develop a keyword strategy (Blankenbaker and Mishra, 2009). Figure 7.5 shows the relationship between the expected return and the maximum bid for a broad match keyword. The profit maximizing bid level is around $0.40. This represents 16 clicks/day and a booking every four days based on the expected

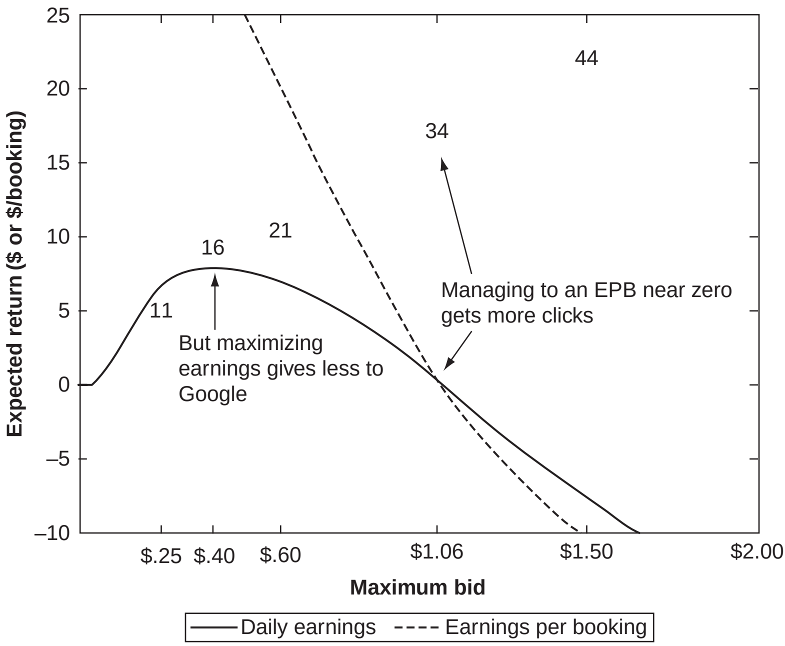


Figure 7.5 Expected return and maximum bid for a keyword.

conversion rate. An alternate strategy is to have self-funding advertisements, which corresponds to an earnings per booking (EPB) equal to zero.

EPB = Profit/Number of bookings, and

Profit = Value booked-Cost per click Number of clicks

This occurs with a maximum bid of $1.06, which yields 34 clicks/day and a booking every other day. In this case additional traffic is purchased (34–16 = 18 clicks/day) by reinvesting all the profits in more advertising. This analysis assumes that the only value of traffic is potential sales. The curves would be different if there was additional value (from advertisements on the site for instance) for just “eyeballs”.

For a supplier that manages a portfolio of keywords, the question is whether marketing dollars are spent wisely, and this depends on the marketing objective. Does the advertiser want to maximize site traffic, profit or a combination of the two? Consider a market where a hotel has distressed inventory and the obvious objective is to maximize traffic to the website. In this scenario managing to an EPB of zero, by spending the profits that accrue from the keyword for more traffic, is the right strategy. However, for a popular destination, the objective would be to maximize profit for every dollar spent on keywords since there is sufficient demand to sell out with less advertising.

Proliferation of mobile applications for travel

Mobile applications for travel stagnated in the 1990s without a sound business model and limitations in technology. With the broad adoption of 3G (broadband wireless), mobile has interactive capability. A PhoCusWright business travel survey (Schetzina and Rose, 2009) indicated that business travelers will use smart phones to find local attractions, get navigation assistance, access supplier sites, read user reviews and to access social networking. With global positioning systems (GPS), mobile applications can process location and context to recommend restaurants. Over 2000 travel-related mobile applications are available today (Klein, 2009). Besides iPhone, Blackberry and Microsoft will soon have app stores, thereby creating a broader footprint. Sabre's GetThere corporate booking tool recently launched a mobile application for travel managers to review and approve trips, thereby speeding up the approval process.

Business travelers use mobile devices to stay connected on the road, but are not part of the corporate managed travel program today. Mobile technology will be included in future corporate travel programs and influence how travel is booked, managed and paid for; besides its impacts on convenience, safety and productivity.

A recent survey by Sabre[3] indicates that smart phones are a traveler's preferred tool to manage post-booking activity. Mobile service adoption, to receive timely and relevant information about flight status, weather, viewing hotel locations via map, flight performance and destination city guides, is popular with both corporate and leisure travelers. A key finding of the survey is the traveler's willingness to accept advertising in return for free use of travel applications. "There's been a lot of experimentation with pay-for-services in the past. With advertising emerging as a more palatable choice for travelers, application providers and retailers now have a way of monetizing their offering and driving more value out of a potentially lucrative marketing channel," said Greg Webb, President of Sabre Travel Network.

Collaboration and business travel

Corporations collaborate to meet their business needs. Collaboration can take on many forms such as business meetings (local or business travel), document sharing (for example, WebEx LiveMeeting), audio (conference calls, telephone calls), text (email, mail, text message, social networking sites) and video (traditional video conference).

In the absence of top line growth in 2009, corporate travel came under scrutiny to reduce expenses without negatively impacting the business. A business trend affecting travel is the continuing evolution of collaboration tools to divert travel for internal meetings. Corporations like Cisco and Hewlett Packard are investing in advanced broadband collaboration telepresence technology. Telecom providers like AT&T and Verizon also act as resellers of these systems to their corporate customers. Hotels are also investing in video conferencing equipment to rent conference rooms that include the use of the equipment. This capability is a revenue generation opportunity to offset lower room occupancy and yields.

Corporate booking tools such as Sabre's GetThere are enhancing the travel planning workflow by providing the ability to collaboratively book video conferencing facilities, similar to how air, hotel and rental cars are booked today. This requires maps to display building and conference room location, room size, real-time availability to make a booking and compatibility verification of units at two or more locations that are part of the video conference. To justify a trip, a return on investment collaboration calculator that trades off the cost of travel (for example, airfare, hotel, rental car, incidentals) to the direct variable costs of operating the video conference units for a specific duration can be deployed for pre-trip approvals. In addition, travel avoidance carbon credits can be recorded by corporations and used when the European Union Greenhouse Gas Emission Trading System (EU ETS) adopts the cap-and-trade program for airlines in 2012.

Conclusions

With the growth in online channels and demands from the end consumer, the last decade has seen significant changes in both Revenue Management and distribution. Suppliers of perishable inventory need a balanced distribution strategy by participating in all channels to attract and retain valuable customers. To ensure greater control of their travel environment, corporations are globalizing their travel programs to drive efficiencies in travel spend and security. Aligning with one TMC versus multiple TMCs will continue. There will be further consolidation in the TMC market, providing them with more leverage against airlines and GDSs in future negotiations. Merchandising will be a critical priority for GDSs to support branded fare products and the sale of ancillary services. Mobile services will see accelerated adoption through the entire travel value chain. OTAs will continue to add merchant hotels in primary and secondary markets and promote package sales. Hotels were severely impacted by the recent economic downturn and need airlines to be successful to improve room occupancy rates. They will also work closely with OTAs and GDSs to improve their performance. Text mining and pattern recognition of social networking data will be leveraged across the customer life cycle leading to a measurable ROI for investments in social networking. Corporate travel will rebound but creative alternatives such as collaboration tools will arise to contain costs. The supplier competitive landscape is constantly changing and strategic, tactical and business process adjustments will be required to respond to market conditions and remain competitive. GDSs and OTAs will have to work closely with travel suppliers and customers to generate incremental revenues for suppliers and enhance the customer experience.

Incorporating competitor schedules, competitor fares and O&D restriction-free pricing will be dominant areas of focus as Revenue Management models are refined. Product design is required to ensure adequate segmentation of branded fare products. In addition, optimal pricing of branded fare products and ancillary services will be required to simplify the products, promote up-sell and minimize revenue dilution. Group self-service automation is an evolving trend that will reduce costs, enforce consistency and generate incremental revenues with merchandising. Collaboration between interactive marketing and Revenue Management to spend marketing dollars wisely will become a necessity as travel suppliers increase their marketing spend through online channels at the expense of offline channels. Customer-centric measures such as lifetime value, customer profitability and retention will play a greater role in influencing Revenue Management decisions.

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Notes

1. David Neeleman, jetBlue CEO at the 3rd quarter 2006 earnings call.
2. Y Consumers Make a Big Splash (Part 2), Australian Business Marketing Services, 6 May 2008.
3. Appetite Grows for Mobile Travel Services; Sabre, m-Travel.com, 11 November 2009.

References

Alexander, K. L. (2006) Paying More for Small Extras, *Washington Post*, 31 January.

Anderson, C. K. (2009) The Billboard Effect: Online Travel Agent Impact on Non-OTA Reservation Volume, Cornell University School of Hotel Administration, *Cornell Hospitality Report*, 9(16), October.

Arnoult, S. (2008) Building a Brand, *Air Transport World*, June, 33–35.

Balcombe. K., Fraser, I. and Harris, L. (2009) Consumer Willingness to Pay for In-flight Service and Comfort Levels: A Choice Experiment, *Journal of Air Transport Management*, 15, 221–226.

Ben-Akiva, M. and Lerman, S. (1985) *Discrete Choice Analysis: Theory and Application to Travel Demand*. Cambridge, MA: MIT Press.

Berge, M. E. and Hopperstad, C. A. (1993) Demand Driven Dispatch: A Method for Dynamic Aircraft Capacity Assignment, Models and Algorithms, *Operations Research*, 41, 153–168.

Blankenbaker, J. and Mishra, S. (2009) Paid Search for Online Travel Agencies: Exploring Strategies for Search Keywords, *Journal of Revenue and Pricing Management*, 9(2–3), 155–165.

Crandall. R. L. (1998) How Airline Pricing Works, *American Way Magazine*, 1 May.

Gallego, G., Li, L. and Ratliff, R. M. (2009) Choice-based EMSR Methods for Single Leg Revenue Management with Demand Dependencies, *Journal of Revenue and Pricing Management*, 8(4), 207–240.

Ghose, A. and Yang, S. (2009) An Empirical Analysis of Search Engine Advertising: Sponsored Search in Electronic Markets, *Management Science*, 55(10), 1605–1622.

Green, P. E., Krieger, A. M. and Wind, Y. (2001) Thirty Years of Conjoint Analysis: Reflections and Prospects, *Interfaces*, 31, S56–S73.

Haeckel, S. H. (1999) *Adaptive Enterprise: Creating and Leading Sense-and-Respond Organizations*. Mass: Harvard Business Press, July.

Hague, N. (2008) “The Problem with Price,” *B2B International*, downloaded from http://www.b2binternational.com/library/whitepapers/pdf/the_problem_with_price.pdf.

Hair, J. S., Anderson, R. E. and Tatham, R. T. (1984) *Multivariate Data Analysis with Readings*, second edn. New York: Macmillan.

Jiang, H. and Barnhart, C. (2006) Dynamic Airline Scheduling, AGIFORS Annual Symposium, Rome, September.

Jiang, H. (2009) A Nested Logit-based Approach to Measuring Air Shopping Screen Quality and Predicting Market Share, *Journal of Revenue and Pricing Management*, 8(2–3), 134–147.

Klein, T. K. (2009) What Will Change Everything? Keynote Speech at Tourism Technology Conference (to.te.c), Palais Brongniart, Place de la Bourse, Paris, France, 6 November.

Locke, G. (2009) Consumer Behavior Trends and their Impact on Airline Product Distribution, *Journal of Revenue and Pricing Management*, 8(2–3), 267–278.

Martin, J. C., Roman, C. and Espino, R. (2008) Willingness to Pay for Airline Service Quality, *Transportation Reviews*, 28(2), 199–217.

McDonald, M. (2006) Yielding to the LCCs, *Air Transport World*, March, 36–37.

McGill, J. I. and Van Ryzin, G. J. (1999) Revenue Management: Research Overview and Prospects, *Transportation Science*, 33(2), 233–256.

Moore, K. (2007) Exploiting Revenue Opportunities with Multi-channel Distribution and Last-minute Inventory, Paper presented at the Ancillary Revenue Airline Conference, Frankfurt, Germany, November.

Moore, K. (2010) Airline Unbundling: Historical Footnote or Business Model Step Change, The Business Travel and Meetings Show Conference, London, UK, 9–10 February.

Nason, S. D. (2009) The Future of a La Carte Pricing in the Airline Industry, *Journal of Revenue and Pricing Management*, 8(5), 467–468.

Pilla, V. L., Rosenberger J. M., Chen V. C. P. and Smith B. (2008) A Statistical Computer Experiments Approach to Airline Fleet Assignment, *IIE Transactions*, 40(5), 524–537.

Ratliff, R. and Mishra, S. (2004) Competitive Fare Shopping for Yield Management, Paper presented at the AGIFORS Reservations and Yield Management Study Group, Auckland, New Zealand, March.

Ratliff, R. and Vinod, B. (2005) Airline Pricing and Revenue Management: A Future Outlook, *Journal of Revenue and Pricing Management*, 4(3), 302–307.

Ratliff, R. and Weatherford, L. (2009) A Review of RM Methods for Dependent Demands, AGIFORS Cargo and Revenue Management Study Group, Amsterdam, Netherlands, May.

Rose, N. (2008) Behind the Firewall: Social Networking for the Corporate Travel Industry, *PhoCusWright Spotlight*, January, 1–8.

Schetzina, C. and Rose, N. (2009) Mobile: The Next Platform for Travel, PhoCus Wright, March.

Shebalov, S. (2009) Practical Overview of Demand Driven Dispatch, *Journal of Revenue and Pricing Management*, 8(2–3), 166–173.

Sherali, H. D., Bish, E. K. and Zhu, X. (2005) Polyhedral Analysis and Algorithms for a Demand-driven Refleeting Model for Aircraft Assignment, *Transportation Science*, 39(3), 349.

Talluri, T. K. (1996) Swapping Applications in a Daily Airline Fleet Assignment, *Transportation Science*, 30, 237–248.

Train, K. E. (2003) *Discrete Choice Methods with Simulation*. New York: Cambridge University Press.

Van Westendorp, P. H. (1976) NSS – Price Sensitivity Meter (PSM) – A New Approach to Study Consumer Perception of Price, *Proceedings of the Venice ESOMAR Congress*. European Market Research Society, pp. 139–167.

Vinod, B. (1995) Origin and Destination Yield Management. In D. Jenkins (ed.) *Aviation Daily's Handbook of Airline Economics*. New York: McGraw-Hill.

Vinod, B. (2007) Seat Availability: Alignment with the Revenue Management Value Proposition, *Journal of Revenue and Pricing Management*, 5(3), 315–320.

Vinod, B. (2008) The Continuing Evolution: Customer Centric Revenue Management, *Journal of Revenue and Pricing Management*, 7(1), 27–39.

Vinod, B. (2009a) Distribution and Revenue Management: Origins and Value Proposition, *Journal of Revenue and Pricing Management*, 8(2–3), 117–133.

Vinod, B. (2009b) Current Trends in Pricing, Revenue Management, Seat Inventory and Distribution, Paper presented at the Victoria Management School, University of Wellington, New Zealand Tourism Seminar Series, 22 September.

Vinod, B. (2010) The Complexities and Challenges of the Airline Fare Management Process and Alignment with Revenue Management, *Journal of Revenue and Pricing Management*, 9(1–2), 137–151.

Vinod, B. and Moore, K. (2009) Promoting Branded Fare Families and Ancillary Services: Merchandising and its Impacts on the Travel Value Chain, *Journal of Revenue and Pricing Management*, 8(2–3), 174–186.

Vinod, B., Narayan, C. P. and Ratliff, R. M. (2009) Pricing Decision Support: Optimizing Fares in Competitive Markets, *Journal of Revenue and Pricing Management*, 8(4), 295–312.

8

Global Distribution Systems (GDS) Capabilities, Origin and Destination (OD) Control and Dynamic Pricing

Karl Isler

Introduction

The key driver for the evolution of airline pricing and Revenue Management since the US deregulation in 1978 is the ability to price discriminate. Price discrimination can lead to increased efficiency and is tolerated by the public if it is not perceived as too unfair. We believe that the airline industry would not be able to offer its current public service level for both leisure and business customers without it. Since the whole industry is permanently operating on low or negative margins we also do not believe that such practices extract too much surplus from the customers.

The capabilities for price discrimination go hand in hand with the technical development of computerized distribution and Revenue Management systems. It is therefore useful to look at this process starting from the early introduction of reservation systems or global distribution systems (GDS) for travel agents, up to the use of the Internet under the aspect of the airlines' desire to price discriminate. Specifically the Internet, as pioneered by low cost carriers, offers unprecedented new opportunities for differential pricing (see Odlyzko, 2003 for an extensive discussion).

As early as 1946 airlines experimented with a computerized reservation system in order to keep track of bookings and passenger information. By the 1960s many other airlines established their own reservation systems and placed terminals in their ticketing offices which allowed seats to be booked directly from a centrally maintained inventory database. Travel agents required direct access to those systems and automating their side of the booking and ticketing process as well. In the 1980s and early 1990s airlines started to form consortiums with the purpose of building global distribution systems (GDS) allowing airlines and travel agents to communicate via a common distribution protocol and network. With such GDS the agent can query schedules, seat availability and fare information as well as book seats and issue tickets. Whenever a booking is made at the GDS terminal by the travel agent, a message is transferred to the airline inventory system allowing the latter to update its booking status and to store necessary passenger information. The airline inventory system then sends messages back to all the GDS to inform them about a possibly changed seat availability status. When the agent issues a ticket, the GDS transfers information to the billing settlement plan (BSP), a system administered by IATA (International Air Transport Association) which handles payments and the disbursement of commissions to travel agencies. Later on the airlines divested most of their direct holdings in the GDS and independent distribution companies emerged, about four of the larger ones sharing the major part of the travel market with a few smaller ones.

Despite the increasing spread of Internet distribution and its tempting possibilities for price discrimination, GDS channels still proved to be essential since they are used by travel agents to distribute products and prices of various subscriber airlines at one location. Based on the work of Isler and D'Souza (2009), this chapter describes how GDS distribution mechanisms can be enhanced to come closer to the Internet benchmark with respect to differential pricing.

Price discrimination

A general definition of price discrimination is as follows: a seller charges different prices to different buyers for the same goods or service and this difference cannot be explained by cost reasons alone (see Phlips, 1983 for a literature overview). The term "discrimination" has a negative connotation nowadays; however we state it here as a purely technical term for the fact that there are different prices for different customers and we do not implicate any unethical or illegal behavior.

How price discrimination can increase efficiency can be seen by looking at a toy example, slightly adapted from Odlyzko (2003). Consider an airline with a two-seat airplane. The costs to fly from A to B are $1400. Imagine that there are two potential customers; one would pay a maximum of $1100 and the other $600. It is easy to see that there is no single price covering the airline's cost. If it charged $600, both customers would buy but the revenue would only be $1200. If the airline charged $1100, the revenue from the single customer would not be sufficient either. Therefore, with a single price scheme the airline would go bankrupt or not fly at all.

If the airline now is able to charge the first customer $1000 and the second $500 the revenue exceeds the cost by $100. Also each customer would have paid $100 less than his maximum willingness to pay, so everybody should be happy. It appears as if the differential pricing forced the customers to cooperate and share the costs in order to make the service feasible. The extreme case, when all customers are forced to share the costs in relation to their perceived value, could actually be called communism.

Even if price discrimination leads to higher efficiency, it is much resented by the public. Differential pricing policies are often perceived as unfair, and there is a danger that public disdain will lead to calls on authorities for intervention. Price discrimination is therefore concealed in practice and takes on more subtle forms. An airline, for example, can price a morning flight higher than a noon flight. We may argue that this is not the same product and therefore not price discrimination. However, the reason for such a pricing policy is the assumption that customers value a morning flight more than a noon flight and is not cost motivated. In fact the costs may be exactly identical. We therefore ignore such subtleties in the definition of price discrimination.

There are two key conditions necessary to make price discrimination possible. First, there have to be customers with different willingness to pay, and the seller needs to have sufficient information about the willingness to pay before making a price quote. Second, arbitrage must be limited. It should not be possible for a low paying customer to resell the goods to another passenger who would have paid more otherwise.

Both conditions are fulfilled in the airline industry. Different willingness to pay is inherent to the purpose of the trip. Willingness to pay is believed to be higher when flying for business purpose compared to leisure travel. The second condition is satisfied as well. Mainly because of security reasons an airline ticket is personal and cannot be resold to other passengers.

Another fact helps price discrimination in the airline industry tremendously, namely that the marginal cost of transporting an additional passenger is quite low. Most costs are fixed and related to the decision to fly the schedule. This leaves almost arbitrary room for differential pricing.

Traditional distribution systems

Travel agents still sell the majority of network airline tickets and therefore constitute the most important distribution channel. Price discrimination in traditional distribution works as follows. The airline pricing department does not simply post a price for each flight but creates fare products where price discounts are tied to certain restrictions, called fare rules. The majority of those rules are itinerary related and may involve conditions on the travel date (seasonal fares), the weekday of departure (weekend and midweek fares) and the round trip pattern (Saturday night stopover and so on). Another well-known rule type restricts the purchase date (advanced purchase fares). Others restrict the rebooking or refund flexibility. All these rules relate to estimates of willingness to pay. So it is assumed that a high willingness to pay business passenger would not like to stay away from home over the weekend and therefore will not buy a fare with Saturday night stopover restriction, even if the price could be substantially lower.

Another important aspect of airline pricing is the fact that the pricing unit is actually not a flight itself, but a contract to travel from A to B, or as it is often termed OD (Origin and Destination). This is related to the way network airlines organize their flights around a connection point or hub. In this way, many ODs are created, a large part involves a connection at the hub. This is yet another way to price discriminate. Suppose the customer wants to travel A-C, which can be offered by the airline with a connection A-B-C. However, there may be a competing airline flying A-C directly. What the first airline can charge for A-B-C is therefore influenced by what the second airline charges for A-C. Therefore the price for A-B-C has no relation whatsoever with the price for A-B and B-C. It is certainly not the sum of the constituent flight prices. Paradoxically, market forces can drive the price for A-B-C to be lower than the price B-C, even if the airline may incur higher marginal costs for carrying a connecting compared to a local passenger. The reason for such a pricing pattern is that passengers value direct flights higher than connections.

A single flight can be sold as part of many different fare products with various prices. Differential pricing thus creates opportunity costs if capacity is limited. Why sell the last seat for a low priced fare product if later on it could be sold with a higher priced fare product? This is where traditional Revenue Management comes into play. The trick the airlines use for stopping sales of fare products is to require a reservation. Because of this requirement it is possible to limit the number of seats assigned to a fare product by declaring it to be sold out, even if physically there are still seats available. Those mechanisms are implemented in the airline's computerized inventory systems, where the actual booking numbers of all flights are recorded. In practice a reservation code, called booking class, consisting of one letter of the alphabet, must be booked for any fare product. Therefore, not only do the fares have to be distributed, but also the number of seats available per booking class. Standard algorithms have been developed by airlines in order to predict the demand by booking class on a flight and to set limits on bookings for lower valued classes. Belobaba (1987) provides a good description of these widely used algorithms; the book by Talluri and van Ryzin (2004) provides a wealth of additional details.

The system of fares, rules, booking classes and reservation procedures can become quite complex and difficult to work with. Airline groups cooperated to build computerized reservation systems for travel agents, which subsequently were operated by independent GDS providers when airlines divested their stake holdings. These systems were built after the blueprints of the airlines own reservation systems and connect the travel agent terminals with the airline inventory systems. The GDS deliver the necessary information about the fares, rules and availability status for bookings to the travel agent. Airline internal systems export this information to the GDS. When a travel agent books a seat, the airline receives a message and can update the inventory, recalculate the availability and update the status in the GDS. Also the fare quote and billing mechanism is implemented in the GDS.

We therefore have the schematic overview of traditional distribution as described below.

Internet distribution

The emergence of the Internet offered a new distribution channel which was first used by low cost carriers most effectively. Typical low cost carriers do not use GDS as primary distribution channels because of complexity and costs.

On the Internet the customer enters travel information directly into a form on the web page. Based on information in the request the web server quotes a price. This makes it much easier for the customer to understand the available alternatives without being forced to consult a travel agent. It is important to understand that this distribution mechanism offers new mechanisms for price discrimination (see also the discussion in Odlyzko, 2003). Since the customer is in direct contact with the web server, the price quoting mechanism can take advantage of the information collected about the customer, estimate his willingness to pay and quote a price accordingly. In the following we will refer to this online form of pricing as dynamic pricing.

Even if the low cost carriers usually sell one-way fares it is obvious that they do differential pricing as well, as, for example, prices often increase closer to departure.

Most airlines nowadays also use a web page on the Internet to sell flights. However, many of them are linked to a GDS distribution channel or to the in-house inventory system with similar distribution capabilities like the GDS. None of the network airlines have taken the step to abandon GDS distribution entirely and rely on the Internet only. A major advantage of GDS is the fact that they distribute for many airlines simultaneously. A customer may not want to browse through numerous web pages in order to find the best fares, but may want to compare prices and schedules of several airlines. This is exactly what is offered by the travel agent using GDS.

Seamless availability and dynamic pricing via GDS

In the early 1990s the GDS developed a new distribution mechanism, mainly to cope with the desire of network carriers to distribute availability not in a flight-specific manner but dependent on the origin and destination of the customer request. Since the alphabet has only 26 letters it is not possible to assign a different booking class to every connecting and local fare product involving a flight. This means that closing a class on a flight automatically closes all fare products in the same class for all connections. This is clearly not optimal from a network point of view, as can be seen by the following example. Consider a short-haul feeder flight connecting to a long-haul flight. The feeder flight is predicted to get full, while the long-haul flight is

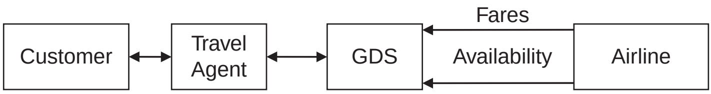

Figure 8.1 GDS distribution.

predicted to leave with empty seats. It is beneficial to close the booking class with the lowest fare on the feeder flight in order to reserve the necessary space for higher fares. But this will close the lowest fare also for the connecting itinerary, even if the lowest connecting fare is substantially higher than the lowest open local fare on the feeder flight.

Distributing availability by OD poses quite a challenge to the distribution system of Figure 8.1. While it is relatively easy to post and change the availability status per flight in a GDS database, it is impossible to push all possible OD availability combinations for a network of realistic size to the GDS. Therefore a mechanism called "seamless availability" was implemented. The new mechanism connects in real time to the airline inventory systems and queries the availability for each agent request. Upon such a request, the airline inventory calculates availability and within a fraction of a second. This is possible with reasonable effort, because the network optimization problem has a relatively simple structure. Just as it is favorable to accept a booking request for a single flight if the expected revenue from the fare product exceeds the opportunity cost, the same is true for a connecting request if the expected OD revenue exceeds the sum of the opportunity costs on each flight. The opportunity cost on a flight is of central importance and is often termed bid price (BP) or hurdle price, even if it is not a price. The airline inventory has to estimate the total revenue (TR, which we equate to the fare F) and compare with the sum of bid prices:

$$\begin{aligned} \mathrm{TR} = F &\geq \sum_{\text{flights}} \mathrm{BP}_{\text{flight}}, \quad \text{accept the request} \\ \mathrm{TR} = F &< \sum_{\text{flights}} \mathrm{BP}_{\text{flight}}, \quad \text{don't accept the request} \end{aligned} \tag{8.1}$$

This new distribution scheme is depicted in Figure 8.3.

A comparison of airline Internet distribution (Figure 8.2) with Figure 8.3 shows that seamless availability offers similar interactivity between customer and inventory system, at least with respect to availability. The response can be conditioned on information in the request. Therefore seamless availability also offers new and powerful mechanisms for differential pricing. Namely, instead of creating fare products with fixed static rules, the airline can publish fares with no rule differentiation, meaning pure price points, in each booking class. Seamless availability may then be used to dynamically

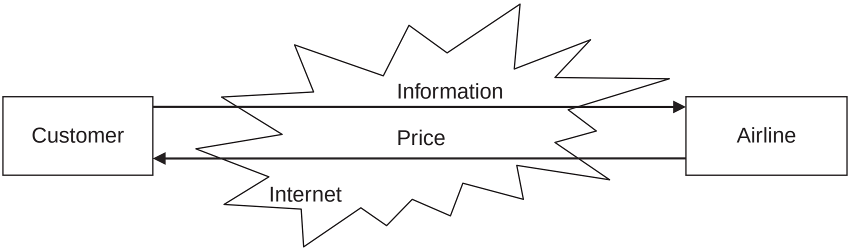

Figure 8.2 Airline website distribution.

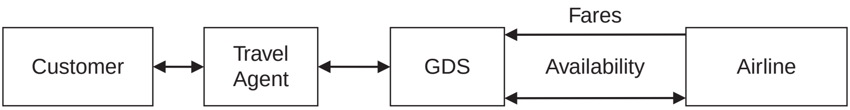

Figure 8.3 GDS distribution with seamless availability.

switch price points on and off according to the estimated willingness to pay. Such a mechanism actually transforms availability into a price quote; very similar to what is possible on the Internet.

How does the Revenue Management equation (8.1) have to be changed when booking classes mean price points and not independent fare products? The answer is rather simple and can be found in standard economic textbooks. If the seller can price discriminate, he would set the price such that marginal revenue equals marginal costs. As we have argued before, marginal costs are very small for carrying an additional passenger. The main cost component is thus marginal opportunity costs, which are the bid prices. We therefore have to change equation (8.1) to

$$\begin{aligned} \mathrm{MR} &\geq \sum_{\text{flights}} \mathrm{BP}_{\text{flight}}, \quad \text{offer the fare} \\ \mathrm{MR} &< \sum_{\text{flights}} \mathrm{BP}_{\text{flight}}, \quad \text{don't offer the fare} \end{aligned} \tag{8.2}$$

The customer will buy the lowest fare offered and thus equates marginal revenue to marginal costs. Again, standard economic theory says that marginal revenue can be expressed as

$$\mathrm{MR} = F - \frac{F}{|\varepsilon|}, \tag{8.3}$$

where ε denotes the price elasticity, the change of demand with respect to change of fare. Price elasticity of course depends on the fare itself but we did not write the argument explicitly for the sake of clarity of the presentation. Thus it becomes clear that to transform an OD Revenue Management system into a dynamic pricing engine the only additional capability required is to subtract price elasticity dependent constants from the fare during online evaluation.

How is the price elasticity determined? The accuracy of price elasticity estimates depends essentially on the information in the request. Here we recover the standard airline price discrimination techniques again: willingness to pay may depend on all the dimensions such as seasonality, advanced purchase and round trip pattern listed above. The important difference is, however, that the complexity of fare rules is now internalized in the inventory system and may be changed very dynamically without need for publication. Dynamic pricing thus means to integrate the two traditionally distinct airline departments of pricing and Revenue Management, as it is not possible to separate the availability calculation from pricing according to equation (8.2).

In a competitive environment, prices of other airlines are of course major drivers for the perceived price elasticity. With dynamic pricing it is of utmost importance to not only monitor the published fare levels of the competitors but also gather information on the current availability. Competitive prices influence both sides of the dynamic pricing equation (8.2) above. Currently algorithms for estimating price elasticity and bid prices in the presence of competition are not fully developed and some inputs have to be provided manually. It has also been argued by Isler and Imhof (2008) that long-term focused strategic constraints will have to be provided by pricing analysts in order to prevent competitive spiral down, which is Bertrand's paradox for price competition.

GDS improvements for dynamic pricing

In the previous section we have described how GDS distribution can be extended to support dynamic pricing. Practically there are numerous difficulties when doing so. Most of these are rooted in the fact that GDS are legacy systems, their booking mechanisms originally designed to facilitate single flight transactions. Weaknesses in the transaction protocol can be used by agents to provide misleading information such that a dynamic pricing engine quotes a lower fare than intended by the airline. This goes that far that some of the valuable information in the request cannot be used because the risk of abuse is too high. Such deficiencies of the GDS functionality may unfortunately present a competitive advantage for the agents of this GDS and there may not be enough incentive to improve. Since there are several GDS providers with different level's of functionality it is also very difficult to maintain fare parity and fairness among them as the agents of more secure GDS do not have the possibility to outsmart the pricing logic.

Some elementary functions for avoiding agent abuse have already been implemented by the GDS in the context of OD control. However, with dynamic pricing the incentives for agents to trick the system get larger, as it is possible to avoid restrictions on fares. A typical example is to pretend to book a connection of two flights. Once the booking is made the agent could cancel the second flight, thereby obtaining a booking on a flight where the same booking class is closed due to an advanced purchase restriction. The GDS have implemented functionality, termed “married segment logic,” allowing the airline to mark some flights as belonging together such that no flight can be canceled from the group without consent of the airline. Unfortunately it is still possible with most GDS to work around this limitation by issuing a lot of fake bookings which eventually confuse the logic and allow the agent to break marriages.

Since GDS allow single flight bookings, it is also of utmost importance that the information about previously booked flights is contained in the request. This functionality is termed “journey data.” Still, not all GDS deliver journey data consistently. It also took quite some time for some GDS to implement marriage to journey data, which is of course necessary in order to avoid the situations described above.

Round trips, one-ways and point of commencement

Valuable information about price elasticity can be deducted from a round trip analysis of the request. The elasticity estimate may well be different if a passenger on the first flight Monday morning from A to B is on his inbound portion or on his outbound portion of the trip. Therefore it is useful to know the point of commencement of travel (POC). Also the return pattern, meaning length of stay or if a weekend is involved, carries powerful elasticity information.

So why not make the availability dependent on round trip information? This is unfortunately quite risky today because of the specialties of how married segment logic is implemented in the various GDS. The original intent of the logic was to keep a connection together if it was booked as a connection. It therefore depends on what GDS consider to be a connection. Some may have a limitation that flights form a connection only if the ground time does not exceed a certain limit (16 hours, for example); others consider an itinerary looping back to the point of origin as not being a connection. Even worse is that there may be hard coded limits on the number of flights which can be married, for example, three flights. While this is not too bad for connections, it is quite insufficient when considering round trips.

Round trip pricing is a bundling technique. Airlines need to be able to lock together all flights which are sold in the same bundle by marriage. This lock should not be broken without consent of the airline, neither in the booking process nor in the subsequent issuance of the ticket.

Failure of round trip marriage allows the agent, for example, to conceal the true point of commencement. He may book a flight from A to B such that a later flight from B to A looks like an inbound flight. However after receiving favorable availability for the latter, the first flight could be canceled. This poses serious problems when considering POC for the availability calculation. Airlines usually take the agent location, the point of sale (POS) as a proxy for POC. This practice becomes more and more difficult as, for example, it is not allowed in the European Union to discriminate against agents by nationality or residence location when selling the same thing.

If round trip marriage were available, airlines could tap the benefits of round trip pricing, yet publish one-way fares only. In order to demonstrate how this would work, let's assume that we are given a consistent round trip price structure. The one-way price can be defined as the minimum over all round trip prices containing the given one-way. It cannot be more expensive, since the customer would then buy a round trip and throw away the return coupons. This is a practice quite commonly encountered today. We now can look at round trip prices in the following way: each passenger buys an outbound one-way first. If he wishes he may end the transaction now. If he wishes to buy a return flight, the dynamic pricing engine can offer arbitrarily deep discounts depending on the now known round trip pattern. For this we need of course journey data, which we could image similar to a shopping basket in Internet distribution. The price of additional items will depend on what is already contained in the basket.

It is not hard to see that all possible round trip pricing schemes can be implemented as a one-way outbound plus a possibly discounted inbound one-way. One question remains: could the outbound one-way plus the inbound one-way become cheaper than the original round trip? The answer is no, if the round trip structure satisfies the consistency condition that it is not possible to buy two round trips and get a cheaper round trip by throwing parts of the tickets away.

Are booking classes a necessary evil?

We end this chapter by describing an idea which would bring GDS distribution even closer to the possibilities of the Internet. As ingenious as booking classes for Revenue Management may have been when GDS were the only sales channels, as such they become a limitation and development obstacle for dynamic pricing. Low cost carriers on the Internet are actually capable of instantly quoting a continuous price covering the whole desired range. In comparison the possible price points from 26 booking classes via GDS look rather poor, even if one thinks of a round trip price as a combination of two one-ways. On top of that, airlines usually have to reserve some booking classes for special segments like staff travel, frequent flyer redemption bookings and the like, thus reducing the possible price points even further.

The dynamic pricing equation (8.2) is not dependent on the amount of price points. It is valid for continuous prices as well. An enormous step forward for GDS to cope with Internet distribution would therefore be a similar approach to the fares in Figure 8.3 as was implemented for the availability, namely to respond with the price directly. Such functionality could be termed "seamless fares." Of course we do not imply here to seamlessly distribute the entire fare content including the rules, but the fare level only. Certain characteristics of the fare rules, like refund and ticketing conditions, could still be published traditionally. Fare publication would, however, omit the level or indicate the lowest possible level only. Booking classes would still exist, but would code only the remaining rules which are valid for all price points. The airline inventory system would not be polled for availability anymore, but would respond with the final price.

Conclusion

We have argued that price discrimination is the main driver for airline Revenue Management and drastically influenced the way GDS distribution was implemented. With the Internet even more powerful discrimination mechanisms are possible. GDS continue to be an important distribution channel even if their interactive functionality is rather limited compared to what is possible on the Internet. Increased interactivity is offered by the seamless availability functionality originally introduced to enable OD Revenue Management. This mechanism becomes much more powerful if used for dynamic pricing, by making the response conditional on elasticity estimates derived from the information in the request.

The downside is that incentives for agents to trick the system also grow when doing so. Even today there are still loopholes in most GDS which allow agents to quote prices lower than intended, for example, by breaking segment marriage. It is important to look at married segment logic and journey data under the aspect of enabling efficient differential pricing in order to fix the shortcomings, specifically when trying to include round trip information.

It is recommended that GDS come up with a mechanism to secure discrimination by point of commencement for availability requests, and also the subsequent sell and ticketing process. Discrimination by point of sale as proxy is increasingly inaccurate, specifically with online travel agent engines, and may even be illegal in certain regions of the world.

The limited number of booking classes is the major obstacle for true dynamic pricing. We therefore proposed that not the availability but the fare level itself should be distributed seamlessly. The move to such a dynamic pricing is, however, disruptive to the current offline agency workflow and GDS processes. No GDS may want to go there first, unless there is buy-in from the travel agency community it supports. GDS investment in this capability may also be an issue, especially with the downward pressure on booking fees. If the current offline agency workflow and GDS processes do not change and the GDS do not invest in improving their capability then they risk losing present content from the airlines whose product they distribute. Internet aggregators pulling price information directly from airline web pages and assembling the possible offers of several airlines may well prove to be an alternative.

References

Belobaba, P. P. (1987) Airline Yield Management: An Overview of Seat Inventory Control, *Transportation Science*, 21, 63–73.

Isler, K. and D'Souza, E. (2009) GDS Capabilities, OD Control and Dynamic Pricing, *Journal of Revenue and Pricing Management*, 8(2/3), 255–266.

Isler, K. and Imhof, H. (2008) A Game Theoretic Model for Airline Revenue Management and Competitive Pricing, *Journal of Revenue and Pricing Management*, 7(4), 384–396.

Odlyzko, A. M. (2003) Privacy, Economics, and Price Discrimination on the Internet. *ICEC 2003: Proceedings of the 5th International Conference on Electronic Commerce*. Pittsburgh, PA and New York: ACM, pp. 355–366.

Phlips, L. (1983) *The Economics of Price Discrimination*. Cambridge: Cambridge University Press.

Talluri, K. T. and van Ryzin, G. J. (2004) *The Theory and Practice of Revenue Management*. Dordrecht: Kluwer Academic Publishers.

9

B2B Price Optimization Analytics

Jon A. Higbie

Introduction

Business to business (B2B) pricing differs from business to consumer (B2C) pricing. In both paradigms modeling demand as a function of price is central, but the nature of demand in the two cases is different, necessitating different analytic models. B2C is characterized by large demand volumes, each transaction representing a very small proportion of total revenue. On the other hand, B2B is characterized by relatively smaller transaction volumes, with each transaction representing a much larger proportion of total revenue. The fundamental differences in transaction volumes and revenue per transaction require different analytic processes. In the B2C setting demand can be modeled in aggregate and individual price recommendations applied to multiple transactions. In the B2B setting, each transaction is analysed and priced individually, characteristics enabled by the relatively smaller volume of transactions, and necessitated by the much larger revenue impact of each transaction.

In the context of this chapter, B2B pricing decision problems are characterized by the following features:

- A distinct offering or deal, often characterized by a contract.
- Some degree of custom pricing, including discounts, freight costs and other deal terms.
- Deals can be characterized as won or lost.[1]

Applications of B2B price optimization analytics

Determining the optimal price for such decision problems has often been referred to as bid price optimization (Agrawal and Ferguson, 2007; Lawrence, 2003), or quote optimization, or customized pricing (Phillips, 2005). In this chapter, B2B price optimization means the same thing.

B2B price optimization analytics have been successfully applied in a variety of settings. United Parcel Services (UPS) has applied the analytic processes to determine the optimal terms for parcel delivery contracts (Garrow and Ferguson, 2008). Marriott International has applied B2B price optimization analytics to group/event pricing and is achieving $60 million per year of incremental profit (Hormby et al., 2010). From the author's own experience, the same analytic processes for optimizing quote prices are used in the following industries:

- Automotive: corporate fleet accounts.
- Industrial products: energy services, electrical components, lighting fixtures, service and repair contracts.
- Telecommunications: bundled data and voice contracts.

It is rare for companies to publicly acknowledge the extraordinary impact of B2B price optimization on revenues and profits. The Marriott example cited above is a very rare exception. Most companies choose to keep the benefits private. The author has observed that companies implementing B2B pricing analytics achieve a 2–5 percent increase in contribution.[2]

Figure 9.1 depicts a common B2B pricing process. The pricing analytics group is responsible for conducting ongoing analysis to continually improve pricing models. As part of this process this group creates pricing guidelines used by sales to construct proposals. Pricing guidelines are reviewed and

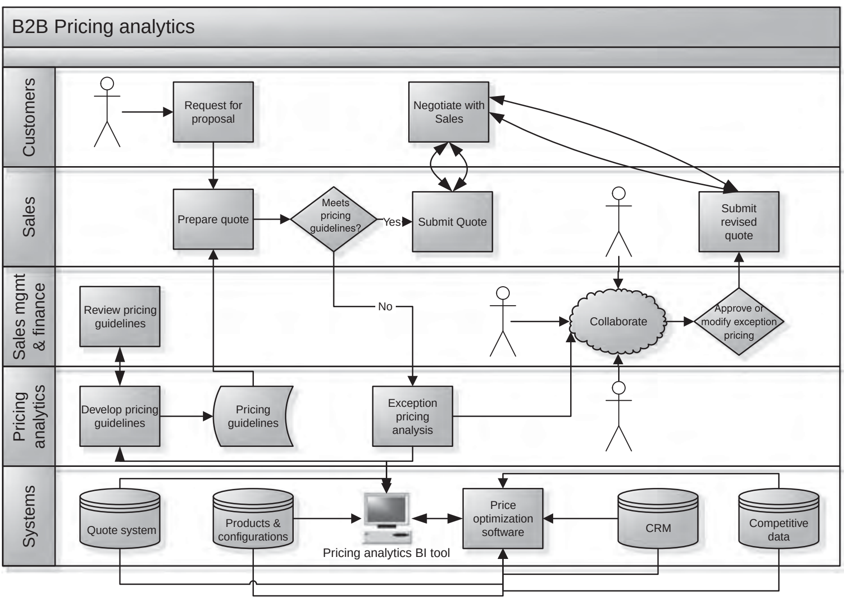

Figure 9.1 A typical B2B pricing process.

ultimately approved by sales management, usually by the finance department attached to sales. During the negotiation process if a proposed price meets the guidelines the deal can be closed without further pricing review. One of the ancillary benefits of price optimization analytics is a streamlined price approval process, allowing sales to close deals faster. For proposals outside the guidelines exception pricing may be requested by sales, in which case, the pricing analytics team will perform further analysis to support a collaborative pricing decision involving the account representative, pricing analytics and sales management. Other duties of the pricing analytics team include measuring pricing performance, ensuring data integrity, monitoring the capture of loss data and gathering competitive pricing information. Key information systems leveraged include the quoting/proposal system, invoicing, product definition and configuration, customer relationship management (CRM) data and competitive data. A price optimization software solution may also be included, but this system should be integrated with the quote system to ensure seamless presentation of price recommendations to sales.

B2B price optimization: special considerations

The objective of B2B price optimization is to maximize contribution by estimating the optimal price to quote. Important considerations include:

- compensation and incentives
- pricing performance measurement
- line item or total quote optimization
- marginal costs
- what price to show sales
- business process
- competition, strategy and market share.

In this chapter the primary focus is on the analytics, but some of these considerations with analytic implications will also be addressed.

The sales organization is often incented on volume or revenue, not contribution. In such cases these incentives are not aligned with the contribution maximization objective. To enhance the success of price optimization, contribution incentives should be implemented. This is a very sensitive organizational change and may not be achievable in the short run. The pricing analytics team can support this change process by consistently measuring pricing performance. These performance metrics may eventually be folded into the revised sales incentive structure.

Requests for proposal often have multiple line items. For example, a corporate fleet account may have a long roster of make, model and trim options from which the customer can purchase. In many cases each line item may be thought of as a separate quote, but sometimes there are clear package or bundle effects. Consider a proposal for lighting components for a major construction project. The project calls for a long list of different bulbs and fixtures, but the proposal is an “all or nothing” proposition. Either you win the bid and get all the business, or you lose and get nothing. In such cases the mix of products and the pricing on each line item need to be optimized *in toto*. Such analysis can and has been done, but for the sake of brevity and to keep the focus on the analytic process a line item level optimization is assumed for the remainder of this chapter.

In price optimization standard financial definitions for contribution and marginal costs are not typically used; marginal costs are only those costs that are incremental to winning the bid. For example, in shipping costs, installation costs are included, but allocated sales administrative costs or any fixed costs are not included. Opportunity costs represent contributions that you forgo if you win the bid, and should be included. For example, a hotel that wins a bid to host a convention will forgo revenues they might achieve if they had instead sold the rooms to another group or to several individuals.

The price to present to account representatives is a key consideration. While analytics can determine the optimal price, many organizations do not want to share this price with sales. In these cases the rationale is that sales will typically seldom quote above the optimal price; hence on average the optimal price will not be achieved. If this concern is a key driver organizations may choose to present only a stretch price. Models estimating customer response to price are key determinants of the optimal price. With any estimate there is error, and this error can be used to estimate a confidence range around the optimal price. Some organizations choose to present this range (floor and ceiling) instead of or in addition to the optimal price.

If accelerating the sales cycle is an objective, then analysis will be required to determine pricing guidelines within which no approval is required for the account representative to quote a price. For price requests outside the guidelines, special exception pricing analytics will be required to support the decision process. Often the same product may be sold through multiple channels. For example, a parts distributor may sell to some customers directly, or may sell through distributor relationships, complicating pricing analysis. While these considerations must be addressed in an application, the remainder of this chapter focuses on the analytic process.

The B2B pricing analytic process

Figure 9.2 outlines the price optimization analytic process. The first step is to develop segmentation schemes to support development of the market response model (MRM). The MRM predicts demand as a function of price,

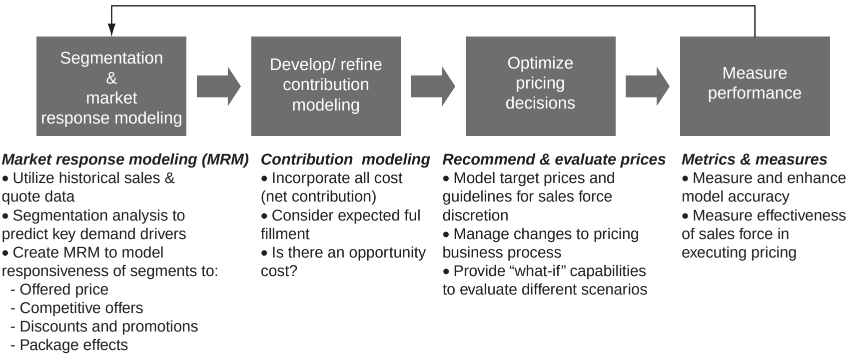

Figure 9.2 The price optimization analytic process.

segment and other key driver variables. Examples of typical segmentation variables include order lead time, product and customer attributes like industry and the number of years they have been a customer (tenure). The key independent or driver variable is always the own offer price. It goes without saying that own price cannot be optimized without a demand model that is a function of own price. Besides price, many other driver variables should be considered in the MRM analysis. Foremost among these are competitive prices. Competitive price is usually a strong predictor of customer response to own price; however, competitive price is not absolutely essential as will be discussed in the section on data issues. Besides competitor price, other driver variables that are frequently strong predictors of price response include the types of discounts or promotions offered, package effects and economic factors such as the producer price index (PPI), interest rates, housing starts and a stock market index (NASDAQ). The distinction between segmentation variables and driver variables is blurred. Any variable may define a segment or serve as a driver variable. There really is no difference. Segments and driver variables are in essence independent variables in an equation where demand is the dependent variable. Categorizing as segment or driver variables serves as a way to organize the problem to compute the MRM.

The next logical step in determining optimal prices is development of the contribution model. The contribution in a B2B pricing context is not (typically) the same as in a finance context. Here the only concern is with costs that are truly incremental to winning the bid. By combining the MRM and the contribution model the expected contribution can be formulated as function of own price. Optimizing this function, subject to any other constraints gives us the optimal price recommendation. Continuous measurement of pricing performance closes the process loop. Analysis of pricing performance drives MRM and the contribution function changes, and the price optimization process starts again.[3]

Data requirements

Key data elements to support B2B pricing analytics include:

- Historic quote data
  - "wins" and "losses"
  - reason codes
  - line item detail
  - price data
  - sales costs and discounts
- Product data
  - all products
  - product hierarchy (channels and segments)
  - configurations
  - marginal costs
- Customer data
  - sales history
  - D&B and other data for segmentation
- Competitive data
  - competitors by product and by deal
  - competitive quotes by deal

Detailed quote data is the most important data source. Often many of the other data elements, like costs can be found on quote detail records. Additional product detail can be found in product definition tables which may be part of a configuration management system. Further customer detail may exist in a CRM system, and can often be supplemented by joining with other data sources like Dun & Bradstreet®.

Quote and product data provide price and cost used to build the contribution function. Quote and product data, along with the other data sources, provide additional attributes that explain customer response to quote offerings. When identifying data sources for B2B price optimization analytics, a key guiding principle is to collect all available data attributes that may help explain customer response to the own price offering.

Common data issues

Competitive data can be a very strong predictor of customer response to quote price, but can be difficult to obtain in the B2B setting. Some quote systems allow account executives to identify the competitors for a bid. This detail may often include competitive prices. Organizations often do not fully trust competitive intelligence reported by the sales force, thinking – often rightly so – that their estimates are biased low. The account representative may feel incented to estimate competitive prices low, in order to get a low price from sales management, making it easier to win the deal. This tendency is often exacerbated when sales incentives are revenue or volume based, rather than contribution based. However, bias in the competitive rate data does not necessarily mean that it will not be useful in predicting customer response to own price (the MRM). If competitive price estimates are strongly correlated with the "true" competitive price, then even a biased estimate may prove to be a key driver in the MRM.

Keeping in mind that what is most important is a variable that is strongly correlated with competitor price, there are often suitable surrogates in cases where competitive prices are not available. For example, distributors often source their products from the same supplier. As a result, competitor prices will likely be strongly correlated to (own) procurement cost. In such cases cost of goods sold may prove to be a key demand driver. In other instances, competitors may offer the same products in both B2B and consumer channels. Consumer prices can be obtained from websites or other accessible channels. Consumer prices are often strongly correlated with B2B prices.

Bids that are won have very detailed information, since these quotes are converted to orders which in turn generate invoices for fulfilled product. Losses, on the other hand, seldom have the same degree of detail as wins. Account representatives are not highly motivated to report lost deals, and sometimes don't bother entering them at all. Further, entering detailed order lines and offered prices for losses is perceived by account representatives as extra, unnecessary work. Finally, companies rarely ever compete for every deal, so even if diligent in reporting losses the sum total of all win-loss records is a subset of the entire market. For example, one might observe a win rate of 80 percent from own quote data, but a have a market share (estimated from external sources) of only 10 percent – an extreme case of a biased win rate estimate. Even in this extreme case of bias, if the loss recording process is relatively consistent an adequate customer response to price can be predicted.

Though challenging, all of the loss data issues described here can be overcome and have been overcome in successful implementations of B2B price optimization. Incomplete loss data can be supplemented by sampling from detailed quotes or for similar wins. If there are no loss records, external estimates of market share can be used as a basis to construct loss data. Leveraging the expertise of customers, sales and product experts and applying survey techniques such as the Delphi Method (Linstone and Turoff, 1975) loss data can be estimated in cases where none exists.

Most companies constantly struggle to accurately measure costs at a detailed level. Isolating and estimating the truly incremental cost of winning a bid is almost always a significant challenge. Part of the incremental cost is the opportunity cost of winning the bid. The author has conducted several studies with companies to measure the impact of cost estimate errors on determining optimal price, and has found that even large errors in cost lead to only small errors in price. Typically a 10 percent error in cost leads to only a 1 percent error in the computed optimal price which in turn results in much less than 1 percent reduction in incremental contribution. Price optimization can be successfully applied even with rough estimates of incremental cost.

Computing the market response model

From an analytic perspective, estimating the MRM is the most challenging step in B2B price optimization. The MRM predicts win/loss as a function of own price and other deal characteristics. Other characteristics are represented by the segment and driver variables discussed above in the section on B2B price optimization: special considerations. The equation below outlines the demand model where f is the MRM and s is a segment.

$$\text{Win Probability}_s = f(\text{Own Prices, Competitor Prices, Other Driver Variables}_s)$$

The magnitude of own price change relative to the competitors' price change may also be a key driver. To model this effect an interaction term would be incorporated into the MRM. Simplifying the notation and ignoring other driver variables the MRM with interaction effects would be represented by the following equation:

$$L_{\text{win},s} = f(P_{\text{own},s},\ P_{\text{comp},s},\ P_{\text{own},s} \times P_{\text{comp},s})$$

There are many modeling decisions and challenges to overcome in developing the MRM.

- segmentation schemes
- driver variables, including potential interaction terms
- data issues.

Developing a MRM to support B2B price optimization *is* challenging, but the challenges *are* tractable. Each of the diverse applications described above – auto fleet sales, industrial products, package delivery, telecommunications – and many others have successfully surmounted these challenges.

For the remainder of this chapter most of these challenges will be set aside, focusing on a simple model where demand is merely a function of own price, understanding that a "real world" MRM is more complex while assuring that the additional complexities can be handled.

Market response model forms

The universe of potential MRM forms is unlimited, but there are two common forms that have proven successful.

The logistic function is a common model form, and has a strong statistical foundation for estimating functions with a binary response (win-loss) (Neter et al., 1996).

$$L_{\text{win}} = \frac{1}{1 + e^{-(\alpha+\beta P)}}$$

Another common model is the capped linear model.

$$L_{\text{win}} = \begin{cases} 1 & \text{where } P < P_{\min} \\ \alpha + \beta P & \text{where } P_{\min} \leq P \leq P_{\max} \\ 0 & \text{where } P > P_{\max} \end{cases}$$

Figure 9.3 depicts these two model forms graphically.

The capped linear model closely approximates the logistic model over much of the price range. In practice the capped linear model has some advantages. As a linear function computations may be simplified. The linear model also imposes strict bounds on the optimal price. However, the logistic function is more statistically sound, and constraints on price recommendations can be imposed in the optimization step. The logistic model will be used for the remainder of this chapter.

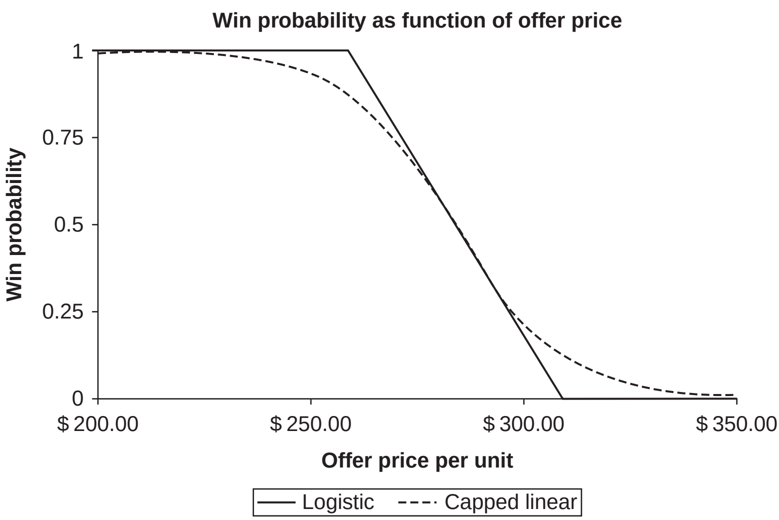

Figure 9.3 The logistic and capped linear market response models.

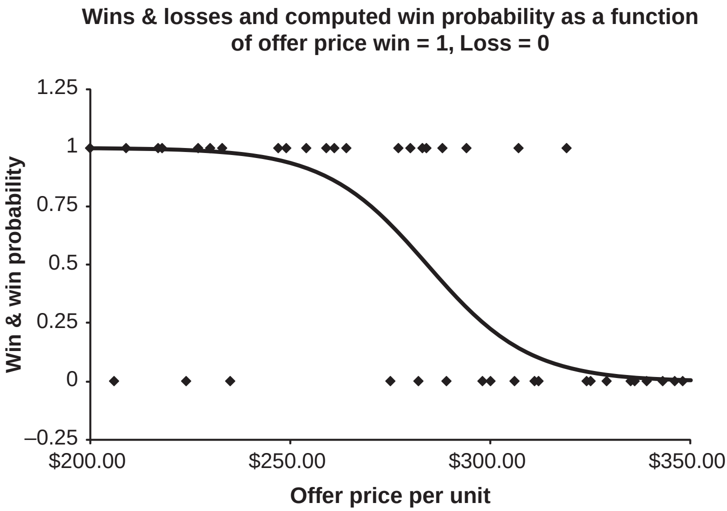

Figure 9.4 Estimating a logistic MRM. Data points represent bid wins and losses. The curve represents the fitted logistic regression function.

For each model, β is the critical price response term and α is a constant. β should be a negative value, meaning as price increases, demand decreases. It is common that early attempts to develop the MRM yield positive β. When this occurs the segmentation and MRM analysis cycle need to be repeated, trying new segmentation schemes and different driver variables. Careful statistical analysis is required to estimate good MRMs.

Figure 9.4 depicts how the MRM is estimated from quote history. The points on the graph represent observed wins and losses; 1 = a win and 0 = a loss. The MRM is estimated using logistic regression methods (Neter et al., 1996). Readily available and widely used statistical packages like R (http://www.r-project.org/) and SAS® have built-in functions for logistic regression.

The β terms in the MRM are price response terms, not elasticity estimates. When practitioners talk about price optimization the term price elasticity is often used generally and out of context, leading to misunderstandings. Elasticity has a precise mathematical definition.

$$\text{elasticity} = e = \frac{\%\text{ change in demand}}{\%\text{ change in price}}$$

With a little calculus and algebra, elasticity can be given by the following equation:

$$e = \frac{(\Delta D/D)}{(\Delta P/P)} \rightarrow \frac{\partial D}{\partial P} \cdot \frac{P}{D}$$

To get a specific, numeric value for elasticity from an MRM, a price must be given as a reference point (unless the MRM is a constant elasticity model[4]). Elasticity at a specific price is called a point elasticity. For example, stating that the elasticity for a logistic MRM is −2.2 is incorrect. It may be correct to say that the point elasticity is −2.2 at a reference price of $300. Note that a linear MRM is not the same as a constant elasticity model. For both the linear and logistic MRM elasticity becomes less negative (less elastic) as price decreases and more negative (more elastic) as price increases. Where $e > -1$ demand is said to be inelastic, meaning the rate of decrease in demand is slower than the rate of increase in price. Where $e < -1$ demand is described as elastic. At the long-run average price elasticity generally (but not always) should be less than −1. As a rough guide $-4 < e < -1$ in most B2B settings. Any point elasticity that is well outside this range within normal pricing bounds should raise suspicions about the reliability of the MRM.

Determining the contribution function

Relative to computing the MRM, determining the contribution function is easy. The key challenges are typically identifying the correct cost components and finding reasonable estimates for the costs. For purposes of computing optimal prices, the contribution function should only incorporate revenue and cost that are truly incremental to winning the bid. To get to the right cost, you need to dig deeper than standard financial metrics. Cost of sales from an accounting perspective includes selling and administrative expenses that are not incremental to winning a bid. Costs derived from fixed assets like plant depreciation should be excluded. Production labor costs generally should be excluded, since labor costs do not typically change (significantly) the likelihood of winning a bid. Sales department salaries and any other general sales expenses should also be excluded.[5]

Types of costs that should be part of the contribution model include:

- account discounts
- applicable promotions
- freight allowances
- any other truly incremental cost to serve.

As a guide, if incremental costs significantly exceed 50 percent of incremental revenues, then costs that are not truly incremental may be incorrectly included.

For some applications (but not all) opportunity costs are an important consideration, and these costs can be quite large relative to revenues. In this context opportunity cost is the contribution you would forgo (or the step cost you would incur) if you win the bid. Most B2B price applications have opportunity costs that are so small they can safely be ignored. The following is a list of applications where opportunity costs can be safely omitted:

- telecommunications services
- package delivery services
- automotive fleet sales
- print advertising.

A common property of the above applications is that delivery capacity and/or delivery time are flexible. Opportunity costs are more significant in constrained capacity applications. Consider hotel group pricing (Cross et al., 2009). If a hotel "wins" a group the associated rooms will be removed from sale. If the hotel "loses" the group they can sell those rooms to another group or to individual customers. For hotels precisely estimating the opportunity cost – also referred to as the displacement cost – can be extremely complex. In fact, solving for the minimum displacement cost can be far more complex than all other parts of group price optimization. Some organizations have stalled efforts to implement group price optimization until they have solved the displacement cost problem. In the author's view this is a mistake, since typically a 10 percent error in estimating cost commonly results in only a 1 percent error in price (Figure 9.5).

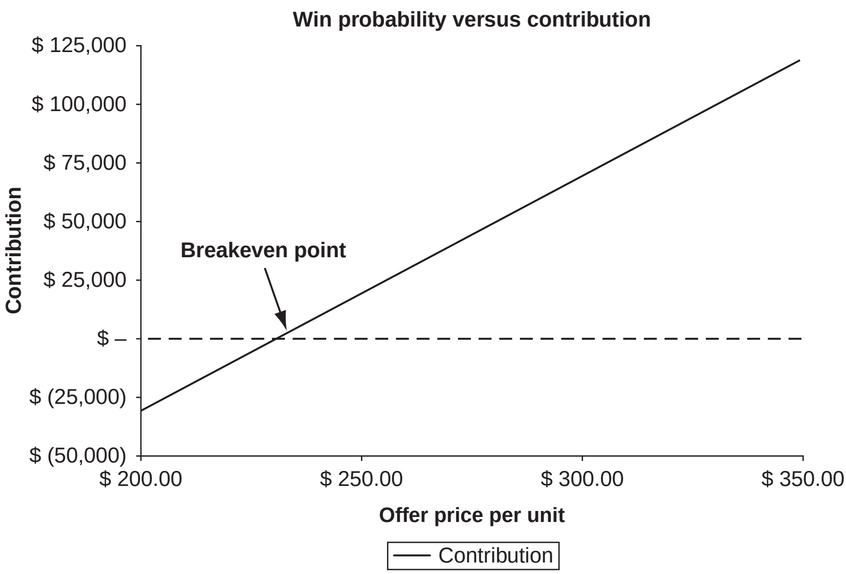

Figure 9.5 Example contribution function with opportunity cost of $230,000.

All the example applications cited in this chapter utilized less than ideal cost data. For nearly all companies improving the measurement costs is a continuing and never-ending process. The benefits of immediately implementing price optimization outweigh the requisite investment and delay of pursuing perfect cost data.

Determining the optimal price

The aim is to determine the price that maximizes expected contribution. Expected contribution is simply the product of the contribution function and the win probability function.

$$E(\text{Contribution}) = \text{Contribution} \times \text{Win Probability}$$
$$E(M) = C(P) \cdot L(P).$$

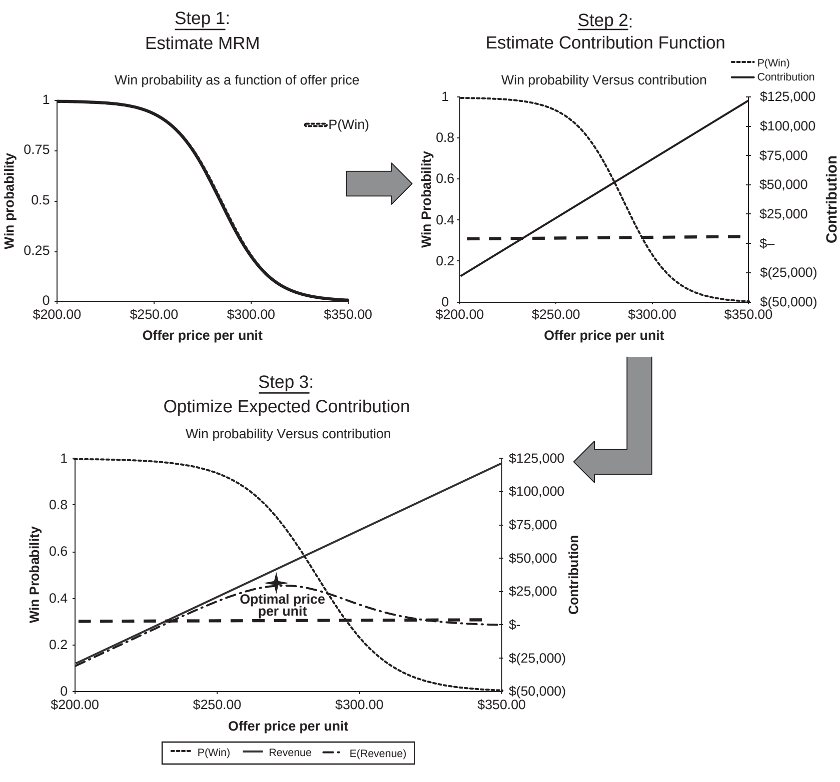

Figure 9.6 Putting it all together – price optimization.

Some practitioners are intimidated by the prospect of optimization; it sounds too complex. Though optimization methods can be complex, expressing the price optimization model is straightforward, and solution methods are available. Even for models that are non-linear and represented by a system of equations there are approaches that will yield a near optimal, if not a provably optimal solution.

In the following example a linear contribution function and a logistic win probability function are used; therefore the resultant expected contribution function is convex. Because it is convex the optimal price can be determined using simple differential calculus. The optimal price is the point at which the derivative of the expected contribution function with respect to price equals zero.

$$\frac{\partial E}{\partial P}\Big|_0 \rightarrow P^*$$

Determining the optimal price for this example is succinctly illustrated in Figure 9.6.

First, segmentation and regression techniques are applied to estimate the MRM. Next, relevant cost and revenue elements are gathered to construct the contribution function. Finally, the expected contribution function is expressed as a product of the contribution function and the MRM. Finally, an optimization method is applied (in this case simple differentiation) to determine the price that maximizes expected contribution.

Concluding remarks

The aim of this chapter has been to remove some of the mystery and fear preventing the reader from implementing B2B price optimization analytics. Though there are certainly obstacles, as there are in any application of analytics to business, these obstacles can be overcome and have been overcome by many companies. There is a good chance that one or more of your competitors have already implemented price optimization.

There exists a litany of excuses proffered to forestall implementing price optimization:

- "Our loss data is incomplete or missing."
- "Competitive price data is poor or nonexistent."
- "Let's wait until the latest activity based costing initiative is complete. Then we will have accurate cost data."
- "First we need to perfect the opportunity cost model, then we can move on to price optimization."
- "It is not possible to model our customer demand."
- "Optimization is too complex. We are not ready for that."

There will always be data issues. Loss data, competitive prices and cost information are never going to be perfect. Companies need to make the best decisions immediately with the available information while continuously striving to improve data quality. Though daunting and often frustrating, particularly in the beginning, customer demand can be modeled. Take heart from the knowledge that others have succeeded. Optimization is not as scary is it may sound. Think of it as simply a method for deciding what price to offer, and in business you have no choice but to offer a price for your product. It makes sense that by applying analytics companies can do no worse, and can do better, than they are now.

I emphatically urge you to start employing B2B price optimization analytics right away. The benefits are substantial, and I hope that after reading this chapter you will conclude that the benefits are also achievable for your company.

Notes

1. In some cases contracts may be accepted by the customer, but the volumes ordered against the contract are zero, or much smaller than would be expected. These cases are typically characterized as a loss.
2. Contribution, in the context of B2B price optimization, is proportional to but is not necessarily the same as contribution margin as measured by finance. We will further clarify what is meant by incremental contribution later in this chapter, but for ease of understanding the reader may think of it as contribution margin.
3. Price optimization performance measurement is an important topic, but one that rightly deserves its own chapter and is only lightly treated here. Unfortunately the topic is not adequately covered in the literature. Pricing performance measurement is covered in depth in Higbie et al. (2007), a workshop presented at the 4th Annual Revenue Management and Price Optimization Conference.
4. Constant elasticity models are generally not suitable for B2B MRMs and are not discussed here. To learn more about constant elasticity models, see Phillips (2005), pp. 49–52.
5. In some cases sales commissions are counted as incremental costs, but typically they are not. The rationale for excluding commissions is that the sales incentive plan is aligned with company profit objectives; however, when incentive compensation is based on revenue, not contribution, as is common, it can be argued that sales commissions should be considered incremental costs.

References

Agrawal, V. and Ferguson, M. (2007) Bid-response Models for Customised Pricing, *Journal of Revenue and Pricing Management*, 6(3), 212–228.

Cross, R. G., Higbie, J. A. and Cross, D. Q. (2009) Revenue Management's Renaissance, *Cornell Hospitality Quarterly*, 50(1), 56–81.

Garrow, L. and Ferguson, M. (2008) Revenue Management and the Analytics Explosion: Perspectives from Industry Experts, *Journal of Revenue and Pricing Management*, 7(2), 219–229.

Higbie, J. A., Cross, D. Q. and Cross Z. N. (2007) How Good Are We Really? Measuring Pricing and Revenue Management Success, workshop presented at the Revenue Management and Price Optimization Conference, Atlanta, October.

Hormby, S., Morrison, J., Dave, P., Myers, M. and Tenca, T. (2010) Marriott International Increases Revenue by Implementing a Group Pricing Optimizer, *Interfaces*, 40(1), 47–57.

Lawrence, R. D. (2003) A Machine-learning Approach to Optimal Bid Pricing. In H. K. Bhargava and Y. Nong (eds) *Computational Modeling and Problem Solving in the Networked World*. Norwell, MA: Kluwer Academic Publishers, pp. 97–117.

Linstone, H. A. and Turoff, M. (eds) (1975) *Delphi Method: Techniques and Applications*. Reading, MA: Addison-Wesley.

Neter, J., Kutner, M. H., Nachtsheimm, C. J. and Wasserman, W. (1996) *Applied Linear Statistical Models*, 4th edn. New York: McGraw Hill.

Phillips, R. L. (2005) *Pricing and Revenue Optimization*. Stanford, CA: Stanford Business Books.

10
Fencing in the Practice of Revenue Management

Michael Zhang

Introduction

Market segmentation, as a key strategic element in the practice of Revenue Management, will generally increase revenues and profits but the price difference between the markets segments will motivate some customers to try to switch segments. For example, a customer might visit a retail store to "touch and feel" a product but then goes home and buys it online at a lower price. Once a market segmentation structure has been put in place, firms use various conditions and restrictions to maintain separation of the price categories. Devices such as less information, prolonged purchase processes and advanced purchase and refund penalties "fence" customers into different market segments and make it difficult or time consuming for the customer to migrate from one market segment to another.

A "fence" is a device that is designed to preserve market segmentation and limit spillover between market segments. Imposing appropriate fences is crucial for the success of Revenue Management (Hanks et al., 2002; Kimes, 2002). However, many questions surrounding fences remain unanswered. For example, how to structure effective fences for a Revenue Management application in practice? More fundamental to this question is how to choose segmentation variables to divide the single market into multiple submarkets profitably? What is the difference between fences in the traditional marketing sense and fences used for Revenue Management? Further, how to integrate fencing decisions with other Revenue Management decision making? Fences result in significant challenges for Revenue Management managers, but the systematic analysis of fences is limited in the Revenue Management literature (Cooper et al., 2006; McGill and van Ryzin, 1999; Talluri and van Ryzin, 2005; Weatherford and Bodily, 1992).

In this study, we approach the above questions by examining the practice in Revenue Management. The reminder of this chapter is organized as follows. We begin the discussion with issues of market segmentation and fences in Revenue Management to provide more understanding of fencing. Then a taxonomy of fences is presented to facilitate further analysis and comparison. Assessment and use of the taxonomy for several industrial cases are also provided. We conclude by briefly discussing future research questions.

Market segmentation and fences in Revenue Management

Market segmentation is the process of subdividing a market into distinct subsets of customers that behave in the same way or have similar needs (Capon and Hulbert, 2001). The process aims to improve the understanding of a given market, particularly the nature and diversity of customer needs. This improved understanding of customer characteristics can lead to greater customer satisfaction through a clearer focus for a firm's market strategies, including product design and communication programs. The combination of improved customer satisfaction and more efficient resource allocation may lead to greater competitive advantage and superior profitability.

The first stage of the segmentation process involves the selection of suitable variables for grouping customers. These are also referred to as base variables or the segmentation bases. According to Wedel and Kamakura (1998), a *segmentation base* is defined as a set of variables or characteristics used to assign potential customers into homogeneous groups. The most frequent segmentation bases include demographic variables such as age, income, occupation, education, household status and geographic location; psychographic variables such as lifestyle, activities, interests and opinions; product use patterns; and product benefits. Many segmentation users employ mixtures of these methods.

Market segmentation in Revenue Management is motivated by the desire to grow revenues. The fundamental principle is to capture more revenue by setting different prices to different market segments, as opposed to the case where all available products are sold at the same price. The first question that arises is how to select the appropriate segmentation variables to segment customers profitably. Aaker (1996) pointed out that "in any given context there are literally millions of ways to divide up the market." In empirical studies, almost every consumer behavior variable has been proposed for segmenting markets (Wind, 1978); however, a number of studies have shown that traditional segmentation variables such as age, income and occupation are, in general, poor predictors of willingness to pay (Haley, 1968), and consequently, provide less than optimum segmentation methods for Revenue Management. For example, someone on a business trip is more likely to pay a higher price for a convenient downtown location than someone with the same demographic and psychographic profile who is on vacation. The vacationer is willing to shift venues to save money.

Table 10.1 Examples of segments in the practice of Revenue Management

Industry	**Example of market segmentation**
Airline	Business, leisure, grouped, negotiated, students, children, seniors, military
Hotel	Leisure, conventions, meetings, contract accounts, tours/groups
Advertising	Upfront, scatter
Freight	Express, heavy weight, volume
Energy	Small, medium, large, power demand, office, retail, restaurant, grocery, school, lodging guaranteed, controlled lighting, space heating
Telecommunications	Business, individual

Selection of successful segmentation variables for Revenue Management requires the identification of customers' different valuation for the same product, which enables the firm to separate the available assets into products that are allocated and priced according to the willingness to pay of different groups of customers (see Table 10.1 for examples of customer segments in Revenue Management). As Revenue Management expands its application areas, generalizing the segmentation variables in Revenue Management becomes necessary.

A distinguishing feature of market segmentation in Revenue Management is that the firm does not have precise information about the preferences of individual customers. The firm typically offers a *set of choices* and customers self-select from this set. Fences enable the self-selection process and allow Revenue Management systems to function profitably. Rather than running counter to customer orientation, fences allow customers to purchase the product they want, when they want it, and to accept the cost trade-off consequences. Properly designed fences allow customers to self-segment on the basis of willingness to pay and can also help to differentiate the price. For example, customers can choose to purchase a Via Rail ticket at a low price that is accompanied with a high changing fee, or they can purchase a ticket at a higher price that also offers a lower changing fee.

In the market segmentation process customers are trying to behave rationally and fences ensure that such rational customer behavior is consistent with the firm's objectives. A variety or combination of fences can provide alternatives for customers. Also, fences can make comparisons very difficult for customers, which could improve the perceived fairness in the practice of differential pricing. One downside of fences is that they are more difficult to manage than other approaches (Hanks et al., 1992). In addition, by imposing restrictions, fences actually reduce overall demand at a given price point by shifting the demand curve downwards; pricing managers must strike a balance between the conflicting revenue effects of effective segmentation versus reduction in overall demand.

A taxonomy of fences in Revenue Management

We next present a taxonomy of fences. The taxonomy aims at assisting firms in placing themselves and their service offering within a framework that will help them design better applications, match them with the most suitable market conditions and direct them to the most receptive target market base. Furthermore, the classification is also aimed at assisting the process of understanding the function of fences, with a view to understanding customers' valuation and therefore enforcing market segmentation effectively. Reorganization of these distinct types of fences has implications for analysis and optimization of existing Revenue Management systems.

The prevalence of Revenue Management in a variety of industrialized areas has resulted in a proliferation of fences in practice. However, little attention has been given to fences or fencing mechanisms. To our knowledge, only Hanks et al. (1992) classify fences into two categories – physical and non-physical. It is not our intention in this research to look extensively at the market aspects or to present an exhaustive description of the market segments enforced by fences. Rather, we confine our research to the practice of Revenue Management, whose objective is to maximize revenue through selling essentially the same product or service. The key problem is to maximize the gain from market segmentation which requires identifying market segments and therefore designing and implementing effective fences to limit customer migration across segments.

We focus on approaches to differential pricing of essentially the same product. Particular interest is paid to providing an actionable framework for firms implementing Revenue Management to understand the application of fences. We note that some segmentation variables (in purchase pattern and product characteristics) can serve as fences. For example, airlines segment the market by using the variable "time of purchase." Customers who make advanced purchases are segmented into leisure travelers, who are offered a low price ticket. At the same time, business travelers are *fenced* off because they can't meet such restrictions.

We present an array of segmentation bases recognizing customer heterogeneity in terms of willingness to pay. We identify customers' valuation when the market is segmented using this array of segmentation bases. We then provide the corresponding fence. Specifically, we lay down three broad categories of these segmentation bases; differential pricing can be achieved by setting fences around those bases.

The first category is purchase pattern, which has been recognized as an indicator of variation in the buying decision process. Classic work in marketing has emphasized the importance of patterns demonstrated when customers make their orders. In particular, time, channel (location) and method of payment have been given attention within different customer segments (McDonald and Dunbar, 1998). These differences provide a justification for segmentation.

The second category is product characteristics. Market segmentation assumes that because consumption behavior is generally not random, it is possible to identify and isolate groups of individuals within the total market who demand different kinds of product characteristics (for example, the ability to return a product, the potential and the duration of using a product). It is also possible to identify the individual characteristics of the consumers (for example, a tendency for innovations, safety-oriented choices, accumulated consumer experience and so on). Product characteristics are certainly relevant to consumer choices because they help customers see the product as unrivaled and unequaled. High valued consumers show high intensiveness and variableness when using services, and they seek services more often.

The final category is customer characteristics. Market segmentation has long focused on customer characteristics that are descriptive and measurable and therefore have been widely used in segmenting markets. In particular, customer characteristics are likely to be determined and recorded on the user's account record. Most computer reservation systems allow customers to group themselves during the booking process. Generally, fences based on customer characteristics restrict discounted rates to members of certain organizations (for example, AARP or AAA), employees of certain companies (for example, corporate volume discounts) and certain groups of customers (for example, frequent guests, loyal guests, senior citizens or students).

Fences based on purchase pattern

Revenue Management segmentation has some unique features: customer preferences are not necessarily based on the product itself but rather on the conditions of purchase. For market segments identified by purchase pattern, fences can be created as rules or restrictions attached to the product or service. Based on the time of purchase, channel of purchase and method of payment, products and services can be priced to appeal to different market segments. In the practice of Revenue Management, this type of fence often functions with appropriate penalties such as changing fees or limited refundabilities to enforce the segmentation.

Time. In particular, the consumer's buying decision is often dictated by particular circumstances at a specific moment of time. Fences are developed based on the time remaining until the product can be consumed, as well as on other demand factors. Two common fences are listed below.

- *Advanced purchase*. Advanced purchase requirements necessitate that customers pay for the product or service before a given date. This fence ensures that leisure travelers obtain a limited number of discounted seats for a given flight and has been proven as a very effective fence. By using this practice, airlines are able to segment individual customers into something like 200 segments (see Domestic Airline Fares Consumer Report (2008) for more examples).

- *Advanced reservation*. Similar to advanced purchases, customers are fenced depending on the time of reservation. Note that a reservation may or may not guarantee availability. Those who place a higher value on availability may pay a higher price.

Channel. There is widespread support (for example, Geyskens et al., 2002) for the relationship between customer valuation and channel (location) of purchase. For example, customers with lower willingness to pay may choose to purchase a product from outlet stores that are traditionally located far from town. With the advance of e-commerce, more customers are willing to search the Internet to find the product with the lowest price. Firms must consider the impact of channel selection when launching their distribution strategy. In fencing firms could prolong the purchase procedure, provide less information and impose penalties for low-priced channels; those fences are used to stop customers switching channels.

Method of payment. Purchase patterns differ in commitment to method of payment. It is common that customers get a lower price when they pay by cash or check compared with paying by credit card. With advances in the Internet, online bidding or auctioning has become favorable to customers who are not restricted by time constraints and who desire a lower price. McDonald and Dunbar (1998) provide a comprehensive list of methods of payment. In practice, firms could impose time-consuming activities or penalties along with payment requirement as fences.

Fences based on product characteristics

Selecting this array of variables as segmentation bases reflects a widespread recognition that customers differ in terms of the importance they attach to different characteristics provided by the product or service. Therefore, fences can be developed from understanding customers' different preferences. This type of fence is especially useful in smoothing demand and therefore in reducing lost sales costs.

Usage of product. Usage of product is a behaviorally based segmentation basis. Usage is valued in a different way for different customers. Therefore, price can be customized with fences designed by utilizing a particular usage in terms of time, location and volume.

- *Time of usage* (*schedule*). In many cases, discounts are available only during non-peak demand. One common example from the airlines is the off-peak travel requirement, which centers on the travelers' different valuation of timing. Within a 24-hour period, and between two particular destinations, airlines usually offer multiple numbers of flights with significantly different fares. The peak-demand periods generally are during the week, from mid-morning until early evening. The off-peak demand period is either early in the morning, at night or during the weekend. For leisure travelers, travel on off-peak flights would be seen as only a minor hassle if it allowed them to save significantly on their airfare. For business travelers, off-peak travel is rarely an option because their ultimate need is to get to their destination as their schedule demands, which is almost always during peak periods. Therefore, on off-peak flights, business travelers are considerably excluded, and most of the seats are sold at discounted prices to leisure travelers. In the hotel industry, customers who arrive at a hotel on weekdays (Sunday to Thursday) tend to be business travelers who are willing to pay a higher price than leisure travelers, who tend to arrive on weekends (Friday and Saturday). The buy-down happens when a business traveler buys a low-priced product and changes the time of usage. Thus, firms must attach penalty rules such as changing fee, restricted cancellation or non-refundability with the low-priced product.

- *Specified usage requirement*. Discounted products or services are available only for a specified time. For example, discounted airline tickets often contain a minimum stay requirement. The most common result of this restriction is that travelers have to stay through Saturday night at their destination before taking their return flight. For a leisure traveler, this presents little trouble because their vacation period extends typically over a weekend and Saturday is the desired day to return home. Conversely, business travelers normally have fulfilled the purpose of their trip during the week and are unwilling to waste their weekend away from home in order to save on airfare. Thus, this fence serves to block business travelers from purchasing lower fares.
- *Minimum usage requirement*. Lower prices are for longer stays only. The length of usage is determined by the purpose of the usage. For example, business travelers usually have a shorter traveling period than leisure travelers. Car rental companies charge higher daily rates than weekly rates. Such a requirement together with changing penalties can serve as fences to stop business travelers from consuming the low-priced service.

Alternation charge (*refundability*). Some customers have little uncertainty for their actions, while others may work under a more dynamic environment and therefore cannot predict their activities accurately. Also, the likelihood to ask for a refund is sometimes correlated with willingness to pay; customers have to choose between a higher price versus a lower price with an added cancellation penalty. Therefore, firms can offer less options or opportunities to change with a changing penalty to fence off high-priced customers. This type of fence is widely used in the media and in the electricity, gas and manufacturing industries.

Transaction time. Since customers value time consumed differently, firms can exploit this trait by prolonging the transaction time. One example is that a firm can restrict the redemption of coupons to certain locations or certain times or they may require coupon users to send the coupons back to the manufacturer for redemption. In reality, firms often employ increasing difficulty and complex transaction or other time-consuming activities as fences.

Service options. Customers who prefer higher levels of service usually have a higher willingness to pay. When variable cost is relatively small, different service options can serve to distinguish market segments.

- *Salesperson*. Some customer segments want to utilize the knowledge and consultative skills offered by a salesperson, and they expect a high level of service. These customers should be willing to pay a higher price, based on perceived value. Other customers consider their purchase purely transactional in nature, and they prefer to receive discounted prices. In those cases, the availability of salesperson can serve as a fence.
- *Bundling*. Package holidays combined with some trip restrictions limit the product to leisure customers. For example, discount airline tickets are offered with the condition of purchasing hotel and/or car rental service at the same time. Essentially, firms remove the options in service by bundling; that is, customers who prefer more options have to pay a higher price. The fence applied is the restriction of service options.
- *Delivery term*. Customers with express orders are willing to pay more for them. In manufacturing, customers who follow a scheduled maintenance plan, or refurbishing, are typically price sensitive, while emergency repairs are typically performed for price-insensitive customers. Therefore, high-priced customers are separated from low-priced market by the fence of low-speed delivery.

Information. Customers have different preferences in terms of information. Information is a natural type of fence by which to maintain the identified segment. A portion of all customers will make their purchase decision only when complete information has been attained. Those customers are willing to pay a higher price in order to know exact information about the product or service. *Anonymity* of the product producer or service provider is therefore a fence, the objective of which is to sell extra product to low-priced markets in an effort to clear variable costs without tipping off the high-priced markets.

Fence based on customer characteristics

As one of the most popular sets of segmentation variables in the marketing literature, grouping customers solely according to their own characteristics has the advantage in ease of implementation. Fences built up from this array of segmentation variables usually require proper monitoring actives.

Age or status. Discounts are offered for seniors, children and students. Monitoring activities are useful in markets where identification can be checked, for example, *checking ID* at movie theaters or of sponsorship members at symphony concerts.

Group. Groups are generally considered leisure customers. The fence of *minimum number grouped* maintains separation of group rate customers from individual customers.

Business or individual. Customers operating businesses usually place higher value on the product or service they need. By *identifiable contract,* business and individual buyers can be distinguished at the time of contract. As an example, telephone companies charge a higher price to business users than they do to individuals.

Spent amount/budget. The rationale for this lies in the fact that, in many situations, the second or more unit(s) of a product or service has a lower value to customers than does the first. Also, quantity discounts and free shipping are used as incentives to encourage large business customers to purchase in quantity. To distinguish customers by volume, firms can apply fences such as *minimum consumption/amount/budget requirement*.

Size of business. The fence *minimum size of business* can be used for situations where high-volume buyers value a product less than low-volume buyers. We fence off the low price by making it available only after so many purchases have been made at the higher price. For example, in retailing, businesses are segmented as small, medium and large. Prices charged therefore, vary according to the size of the business.

Frequency. An example can be found in the plan offered by a movie theater chain wherein a client receives discounts for successive visits within a certain period. The number of visits is tracked by means of a card that is issued free at the first visit. The typical fence is *minimum purchase times/frequencies requirement*.

Table 10.2 summarizes the above discussion into a taxonomy of fences.

Assessing and using the taxonomy

Table 10.3 shows four illustrative examples. The first is for the air travel market, which is presented because, despite having been extensively examined in analytical and conceptual market segmentation and Revenue Management research, and despite having achieved significant success in the practice of Revenue Management, no published research has summarized the

Table 10.2 A taxonomy of fences

Category	**Segmentation base**	**Fence**
Purchase pattern	Time	Purchase or reservation made before certain date
	Location/channel	Different information or purchase procedure for separated location or channel
	Method of payment	Changing penalty or time-consuming activities for different method of payment
Product characteristics	Product usage	Requirement of minimum, specified usage or particular schedule with changing penalty
	Alternation charge	Charge for flexibility, refund penalty, changing penalty
	Transaction time/cost	Prolonged time or increased complexity in transaction
	Service option	Availability of salesperson, removing options by bundling, low speed or non-priority delivery
	Information	Disguised information, anonymity
Customer characteristics	Age/status	Checking ID
	Group	Minimum number grouped
	Business or individual	Identifiable contract
	Size of business	Minimum size of business
	Spend amount/budget	Minimum amount/budget requirement
	Loyalty	Minimum purchase times
	Frequency	Minimum frequencies requirement

fences in this market. Furthermore, in previous studies, optimal decisions to exclude fences would appear to have been reached based on the assumption that fences are perfect or that fencing is essentially costless.

The last three examples are golf courses, telecommunications and the B2B sales force, which are relatively non-conventional in the practice of Revenue Management. To maximize revenues, golf course operators can think of the course's tee times as finite commodities and golfers as representing highly variable demand. In telecommunications, the perishable inventory is bandwidth/sec; Revenue Management is achieved by "innovative" services explicitly designed to use only spare capacity, with the marginal cost of providing service negligible when capacity is available. For B2B sales force, the Revenue Management problem lies in the management of the sales force as a revenue-producing asset and the salesperson as service with limited and perishable resources. These examples suggest that there remain numerous ways in which markets can be segmented and fences can be developed.

Table 10.3 Examples of fences suggested by the taxonomy

Category	**Air travel**	**Golf course**	**Telecommunications**	**B2B sales force**
Purchase pattern	Advanced purchase before certain date; Different information for channels such as online purchase, bid or agent purchase	Advanced deposit or advanced reservation before certain time; Deposit to reserve tees; Catering for walk-in	Advanced purchase before certain date; Different information for channels such as online purchase, bid or agent purchase	Advanced deposit or advanced reservation before certain date; Different information for channels
Product characteristics	Non-peak schedule; Schedule with rules in check-in speed, flexibility, refund penalty, changing fee; Less alternative options; Bundling; Disguised information	Schedule or duration of use with changing penalty; Less alternative options; Bundling; Availability of golf cart or other amenities	Limited service availability; Maximum usage with penalties; Particular schedule with changing penalty; Less detailed information; Low-speed responding time	Minimum, specified, schedule with refund penalty, changing penalty; Limited service availability; Limited options; Prolonged transaction time; Availability of salesperson; Bundle; Low-speed delivery
Customer characteristics	Age; Group like AAA, Air mile program; Group; Business	Membership; Group; Minimum purchase times	Minimum size of business; Group	Minimum size of business; Minimum budget; Minimum quantity; Group

The classification of segmentation may have distinct implications for the firm (for example, the time of purchases relates to the allocation decision). These examples show how explicit consideration of the three generic types of fences can assist a firm that is implementing Revenue Management with its selection of segmentation bases and development of fences. Once the firm has understood the cost configuration in market segmentation and fencing, it can then develop plans and strategies based on systematic cost-benefit analysis.

Managerial implications

The taxonomy offers a reasonably complete categorization of fences that need to be considered when segmenting the market within the context of Revenue Management. Qualitative differences among the three types of fences require that the firm employs a variety of analytical tools to determine the optimal fences when aggregating customers into segments. We conclude the managerial implication of the taxonomy as follows.

Conceptualization. The taxonomy provides a more complete approach to the conceptualization of fences, and offers a checklist to ensure that the most significant variables are not overlooked. This is a particularly important use of the taxonomy, and several examples have been provided to show how consideration of each of the three categories suggests relevant ways of looking at fencing problems. Furthermore, the taxonomy allows users to think about the segmentation process and to consider that market segments should be addressed as targets. We conjecture that the taxonomy is useful in the practice of selecting appropriate segmentation bases, and that viewing fences in terms of the three generic types provides a strategic framework for understanding fencing mechanisms. This has the potential to stimulate new ways of creating effective fences.

Analysis. The taxonomy suggests the need to use a wide range of tools and techniques. When a segmentation scheme already exists, the taxonomy can be used as a tool for evaluation. It can be used to improve poor schemes, which might be of negative value in that the costs of developing and servicing the scheme may be greater than any supposed gains. A hotel trying to choose among commercial Revenue Management tools, such as NetSuite, JDA, SoftRax or PROS, can assess the segmentation and fences according to the extent to which they account for each of the three categories, determining whether the costs of purchasing and implementing the Revenue Management tool are justified by the gains from further segmenting the market.

Optimization. It follows that the taxonomy can be used to modify or improve existing fences. For instance, where one or more of these types of fences exists in a market, but is not accounted for in the segmentation scheme, the scheme may be suboptimal. This condition might be rectified by reorganizing a combination of different fences. As an example, a focus on frequent buyers may be suboptimal if frequency is not strongly correlated with profit growth. Such a situation could exist if frequent buyers did not buy much on each purchase or if extra fencing costs reduced their contribution to profit.

Conclusions

The strategic importance of fencing activities is inherent in their vitality to the practice of Revenue Management. In this chapter, we have discussed business issues related to the segmentation process, segmentation enforcement and the implementation of fencing in Revenue Management, distinguishing fences from other segmentation devices and showing how to choose segmentation variables to separate markets with the objective to grow revenues. We provided a survey of segmentation variables and used them to develop the discussion of the corresponding fences in the practice of Revenue Management. We categorized fences based on purchase patterns, product characteristics and customer characteristics, laid out a taxonomy and provided examples using the taxonomy. We suggest that management can look at their particular business situation and decide whether or not fencing is applicable. If fencing is essential, the manager must consider each of the elements listed in the taxonomy and then decide which descriptor best fits the situation. The next step is to choose the optimal fencing decisions (that is, price, inventory and cost devoted to fences) and apply them to the situation in order to improve the firm's financial results.

References

Aaker, D. (1996) Measuring Brand Equity Across Products and Markets, *California Management Review*, 38(3), 102–120.

Capon, N. and Hulbert, M. (2001) *Market Management in the 21st Century*. New York: Prentice-Hall.

Cooper, W., Homem-de-mello, T. and Kleywegt, J. (2006) Models of the Spiral Down Effect in Reveneue Management, *Operations Research*, 54, 968–987.

Domestic Airline Fares Consumer Report (2008) Office of Aviation Analysis. Available at http://ostpxweb.dot.gov/aviation/X-50%20Role_files/consumerairfarereport.htm (accessed 5 January 2010).

Geyskens, I., Gielens, K. and Dekimpe, M. (2002) The Market Valuation of Internet Channel Additions, *Journal of Marketing*, 66, 102–129.

Haley Russell (1968) Benfit Segmentation: A Decision-oriented Research Tool, *Journal of Marketing*, 32, pp. 30–35.

Hanks, R., Cross, R. and Noland, P. (1992) Discounting in the Hotel Industry, *Cornell Hotel and Restaurant Administration Quarterly*, 33(1), 15–23.

Hanks, R., Cross, R. and Noland, P. (2002) Discounting in the Hotel Industry, *Cornell Hotel and Restaurant Administration Quarterly*, 43, 94–103.

Kimes, S. (2002) Perceived Fairness of Yield Management, *Cornell Hotel and Restaurant Administration Quarterly*, 43, 21–30.

McDonald, M. and Dunbar, I. (1998) *Market Segmentation: How to Do It, How to Profit from It*, 2nd edn. London: Macmillan.

McGill, J. and Van Ryzin, G. (1999) Revenue Management: Research Overview and Prospects, *Transportation Science*, 33, 233–256.

Talluri, K. and Van Ryzin, G. (2005) *The Theory and Practice of Revenue Management*. New York: Springer Science and Business Media.

Weatherford, L. and Bodily, S. (1992) A Taxonomy and Research Overview of Perishable-asset Revenue Management: Yield Management, Overbooking and Pricing, *Operations Research*, 40, 831–844.

Wedel, M. and Kamakura, A. (1998) *Market Segmentation: Conceptual and Methodological Foundations*. Boston, MA: Kluwer Academic Publishers.

Wind, Y. (1978) Issues and Advances in Segmentation Research, *Journal of Marketing Research*, 15(3), 317–328.

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Part II

Applications

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11

Search Engine Advertising: An Overview from a Revenue Management Angle

Özgür Özlük

Introduction

After having been used by the military and the academia for several years, the Internet became mainstream in the early 1990s. Ever since then, Internet use has been spreading globally in leaps and bounds. The number of global Internet users was only around 16 million in 1995 and that figure has reached around 1.75 billion in 2008.[1] Of course, it didn't take too long for advertisers to notice this new medium that has the potential of reaching millions in a brand new way. In fact, online advertising (which we will use interchangeably with Internet advertising in this chapter) has been around since 1994. One of the first of such advertising efforts was in the form of banner ads – a few pioneer examples of this were the result of an advertising agreement between Hotwire and AT&T, and appeared online in October 1994.

Much like the growth of global Internet usage, the deployment of online advertising and the revenue generated through it has been increasing at a steady rate since the early 1990s. Online advertising revenues were less than $1 billion in 1997; in 2008 they added up to an amount more than $23 billion.[2] The two most prominent types of online advertising are banner advertising and search engine advertising. Banner advertising refers to the online ads where a high-aspect image is placed on a web page in an effort to attract traffic to the advertisers' websites and is typically seen as the Internet equivalent of newspaper advertising. Search engine advertising is where relevant online ads are placed on web pages that show results from user search queries. When the $10.9 billion revenue generated through online advertising in the first half of 2009 is closely examined, it can be seen that search engine advertising and banner advertising take the lion's share of the revenue. In particular, 47 percent of online advertising revenue comes from search engine advertising, and 22 percent of online advertising revenue comes from banner ads.

In this chapter, we will examine the pricing and revenue management issues within the context of search engine advertising.

Search engine advertising

Compared to banner advertising that has been around since 1994, search engine advertising is a relative newcomer. In 1998, the first search engine advertisements had appeared on GoTo.com. This website had later been renamed Overture, and was acquired by Yahoo! in 2003. In 1999, BeFirst became the second such website where search engine advertisements could be found. But search engine advertising became more prevalent after Google's launch of AdWords in 2000. In 2002, Google incorporated click feedback into their model making their search engine advertising engine much more powerful. In 2005, MSN incorporated behavioral targeting into their search engine (Fain and Pedersen, 2006). Behavioral targeting aimed at providing the users with much more focused advertising by examining the users' search habits. Today, there are five major players for search engines: Google, Yahoo, Microsoft, Ask and AOL.

Based on the numbers from recent years, Google is the industry leader amongst the search engines. In fact, looking at the search volumes in June 2009, one can see that 65 percent of all the searches performed on the Internet are conducted through Google's site.[3] This establishes Google as the leader in search engines and, consequently, for search engine advertising. For this reason, we will use Google as our primary example in this exposition.

Let's take a closer look at how search engine advertising works. When the visitor to a search engine website conducts a search with a phrase or a keyword, they are presented with two types of results. One set of results is the organic search results. The organic search results are based on the popularity/relevance of the websites computed by the ranking algorithms of the search engine companies. In addition to these organic search results, typically, at the top and the right hand side of the organic search results, the visitor is presented with sponsored results. These sponsored results are based on advertising campaigns built by advertisers, and they are published by the search engine. For example, when a Google visitor types in a search phrase, let's say "antique books," Google examines the list of its existing advertising campaigns to see if there are any that are a close match to this keyword and displays the matches on the sponsored results portion of the results page in an order that is based on several factors which will be discussed later in the chapter. We would like to refer the readers to Jansen and Mullen (2008) for a more detailed examination of search engine advertising.

Revenue Management perspectives

Whenever Google displays search results for their visitors, in addition to organic search results, they provide sponsored results. These sponsored results are Google's advertising inventory. Google's advertising inventory per results page can have as few as one or as many as 12 advertising slots. So from a Revenue Management perspective, Google needs to figure out how best to utilize this advertising inventory and the advertisers need to figure out how best to show their ads.

There are several important Revenue Management questions that face the publishers and advertisers in the online advertising arena, specifically within the search engine advertising arena. The publisher needs to think about how to allocate their advertising space. Some of the typical questions that the publisher has to answer are:

- How much of the web page should be allocated to advertising?
- What portions of the web page should include advertising?
- How many ads should be displayed on the web page? and most importantly
- How much to charge for the available advertising inventory?

The advertisers, on the other hand, will be working with a limited budget. They may need to think about how to allocate their overall budget. In general terms, this may mean figuring out how much of their overall advertising budget will go to online advertising and specifically how much to spend on search engine advertising. The advertisers also need to think about how to allocate their search engine advertising budgets into different campaigns. And also, given that there are many slots on a search engine advertising results page, the advertisers need to figure out how much to pay for different slots or which slots to aim for.

Publisher's research questions

From a pricing and Revenue Management perspective, the most important question the publisher needs to answer is how much to charge for the use of inventory. There are three established models for this purpose: cost per impression (CPM), cost per action (CPA) and cost per click (CPC).

CPM is the most traditional way of charging for broadcasting ads. If a TV channel makes an agreement with an advertiser to show their ad, then each time the commercial is shown the publisher gets a fee from the advertiser. This is the same model used in CPM for online advertising as well. Once the publisher shows an ad to the visitor of their search engine results page, then the publisher can immediately charge the advertiser for this impression they have displayed. CPM is most useful for the advertisers when the advertiser is more interested in generating brand awareness but not necessarily trying to get the customers to take certain actions. One major drawback of the CPM method from an advertiser's point of view is that a publisher using this method may not have the correct incentive to try and reach a focused market segment for the advertiser.

On the other side of the spectrum, we can observe the CPA scheme. Under the CPA scheme, the publisher gets a fee when a visitor clicks on an ad displayed and takes a specific action upon being directed to the advertiser's website. Amazon has a program called affiliates program which is a great example for this scheme. A publisher can get an Amazon link and place it on their web page; this link can be a text link, an image link or an enhanced link. When a visitor to the publisher's web page clicks on the Amazon ad, she is directed to a product page on amazon.com. On this product page, if the visitor purchases the item, then the publisher gets a percentage of the sale from Amazon. Sometimes referred to as performance-based pricing, the CPA scheme is very attractive for advertisers since it reduces the uncertainty of the risk taken by advertising expenditure (Feng and Xie, 2007).

The middle ground between the CPM and CPA methods is the CPC scheme. Under the CPC scheme, the publisher gets an advertising fee, not when the visitor is given an impression of the ad or not when the visitor actually takes an action on the advertiser's website, but when the visitor chooses to click on the link shown that will redirect the visitor to the advertiser's website. In practice, CPC is the most commonly used scheme for search-based advertising. So in the rest of this chapter we will assume that cost per click is always the utilized scheme. One major drawback to the CPC scheme is that it is open to click fraud. Click fraud is defined[4] as a type of Internet crime that occurs in online advertising when a person or an automated script imitates a legitimate user clicking on an ad for the purposes of generating a charge per click without having actual interest in the target of the ad's link.

Under the CPC scheme, the main research question is how a search engine should decide on how much to charge for different slots under their sponsored links. Google uses a closed auction for this purpose. Suppose for the keyword of "bike tours" there are three slots available and we have four bidders. Let's assume we have the following bidding instance shown in Table 11.1.

Given this bidding instance, Bidder 2 will get the top slot paying Bidder 3's bidding price, Bidder 3 will get the second slot paying Bidder 1's bidding price and Bidder 1 will get the last slot paying 43 cents, which is the bid price of Bidder 4. If the search engine offered only one advertising slot per results page, the scheme that we just described turns into a classical Vickrey-Clarke-Groves (VCG) auction. With multiple positions available on each results page, this scheme is called a generalized second price (GSP) auction (Edelman et al., 2007). The main concept in generalized

Table 11.1 Bidding example

BIDDER	BID PRICE
1	50¢
2	96¢
3	66¢
4	43¢

second price auction work is that each advertiser pays the next highest advertiser's bid.

In practice, for Google, each advertiser pays the next highest advertiser's bid plus 1 cent. But the difference between the generalized second price auction that is used by many search engines and Google does not end there. When ranking bidders to figure out which slots they will get, Google does not only look at the bid prices but also examines another characteristic called the quality score. The quality score for a bidder is determined mainly by the historical click through rate (Fain and Pedersen, 2006). In the following simplified example displayed in Table 11.2, let's assume that Google has a forecast of the expected number of clicks or each bidder if their advertisement was displayed under the sponsored links 1000 times.

In this case although Bidder 2 has the higher bid, Bidder 3 gets the top slot and Bidder 2 gets the second slot. This scheme is successful because it makes the sponsored links more relevant for the visitor of the search engine; at the same time, it is increasing the likelihood of a positive contribution into the revenue stream of Google. As a result of its revenue generating potential, correctly ranking the bids becomes very important for a search engine. However, this is not an easy task. In 2004, the number of keywords per campaign per month was around 15,000 (Richardson et al., 2007). This means the search engine at any given time will have a large inventory of ads with no prior information on click-through rates. For this reason, one can find quite a few papers on predicting click-through rates (CTR) (for example, Regelson and Fain, 2006; Richardson et al., 2007).

Table 11.2 Bidding example continued

Bidder	Bid price	Expected clicks per 1000 impressions
1	50¢	50
2	96¢	100
3	66¢	250
4	43¢	100

Advertiser's research questions

For decades trying to predict the effectiveness of an advertising campaign had been very difficult for advertisers. In fact, famous and respected US merchant and one of the forefathers of modern advertising John Wanamaker had once said, "Half of my advertising is wasted; I just don't know which half." With the advance of online advertising and particularly search-based advertising, now there is great visibility into the effectiveness of marketing campaigns. So from an advertising perspective, online advertising is a great development. In addition to the visibility of campaign effectiveness, one important feature of search engine advertising is that the advertiser can change their bid at any given time. This flexibility ensures that advertisers can react to changes in the marketing environment or to their competitors in a very effective and timely manner. In addition, setting up a campaign is so cheap and easy in search engine advertising that entry and experimentation in advertising has a much lower cost for search engine advertising. Because of all of these positive developments, advertisers are eager to invest in search engine advertising. Next, we will look at important questions that the advertisers need to answer when they are investing in search engine advertising.

First and foremost, the advertiser needs to figure out which keywords to include in their marketing campaign. There are two important results in the literature on this issue. Grappone and Couzin (2006) claim that the best strategy in online advertising, search engine advertising, is to use focused keywords that target the "long tail" of advertising opportunity rather than using generic terms. For example, if the advertiser has a website in which they sell shoes then they should bid for a specific keyword such as "Prada pumps" instead of a more generic keyword like "shoes." In their study, Rusmevichientong and Williamson (2006) look at the tradeoffs between exploration and exploitation. The authors suggest that the advertisers should balance between exploring the revenue that might be generated through new keywords versus trying to exploit the information that the advertiser already has gathered through the keywords that have been used so far. Shin (2009) examines the impact of different branded keyword purchase strategies. For example, when one searches for "Gucci" on Google's engine, the first sponsored result and the first organic result are both www.gucci.com whereas when a search for "Dior" is conducted www.dior.com only shows up amongst the organic search results. The author examines the interaction between the keyword selection of an advertiser and the competitive landscape.

Once the advertiser decides which keywords to use in their marketing campaign, the next question is how to allocate their advertising budget between these different keywords, or more precisely, how much to bid on each keyword in their marketing campaign. We will look at a basic model

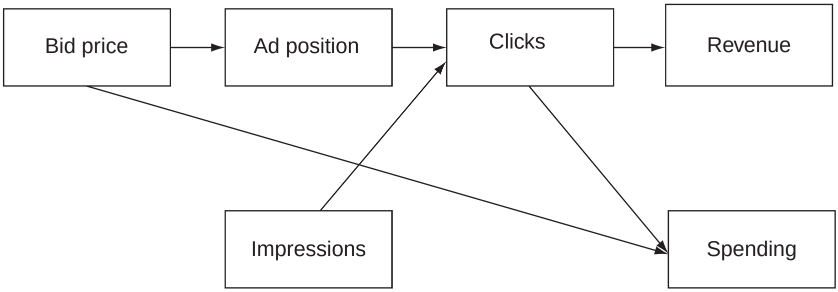

Figure 11.1 Model used by Özlük and Cholette (2007).

that answers this question. Özlük and Cholette (2007) look at the process in the following way (shown in Figure 11.1).

First, the advertiser decides on a bid price; the bid price determines the ad position. The ad position along with the number of impressions that the advertisement will get determines how many clicks the ad will receive. Each click has the potential to generate revenue, but also each click will cost the advertiser. So the advertiser's goal is to find the right bid price that will maximize their revenue while obeying the budget limitations. The basic mathematical model used by Özlük and Cholette is:

$$\text{Maximize} \quad \text{Revenue} = \sum_{i=1}^{N} r_i f_i(x_i)$$

subject to

$$\sum_{i=1}^{N} x_i f_i(x_i) = B$$

$$x_i \geq 0$$

where N is the number of keywords, r_i is the expected revenue from the ad keywords through each click, f_i is the response function for the ad keywords, x_i is the bid price for the ad keywords and B is the total budget. In this model, the objective function is to maximize their revenue and the only non-trivial constraint dictates that the total money spent through clicks should not exceed the budget. Using this model, Özlük and Cholette produce two important results. First of all, the more the expected value generated by a click for a keyword, the higher bid price it should receive. For example, if you have a keyword 1 with expected revenue per click of \$1 and keyword 2 with expected revenue of per click \$5, then keyword 2 should receive the higher bid guaranteeing it a higher slot on the advertising inventory of the search engine and potentially increasing the revenues of the advertiser. The second important result is the more elasticity the response function of a keyword has, the higher the bid price the keyword should receive.

Abrams et al. (2007) is another study that examines the problem as a budget allocation problem, where they investigate the problem an advertiser faces when she has multiple keywords to bid on in the presence of bidder budget constraints. They structure the problem as an integer programming model and discuss numerical results based on the column generation technique. In addition to these two models, there are other deterministic models in the literature that are used to look at the search-based advertising problem. For example, Zhou et al. (2008) consider the bidding optimization under budget restrictions as a multiple choice knapsack problem and develop heuristic bidding strategies that produce reasonably suboptimal results.

There are also several stochastic models that analyse the advertisers' problem for search-based advertising. Muthukrishnan et al. (2006) direct their attention to both the auction nature of keyword bidding and the widespread uncertainties associated with the response functions for keywords. They postulate that a search engine selling keywords can predict probability distributions associated with these keywords and then attempt to solve the advertiser's allocation problem through the application of stochastic models. Aggarwal et al. (2008) develop and study a framework that approaches the search engine process as a three party process; in addition to the two common components for the search engine bidding process (the publisher and the advertiser), they also model the behavior of search engine users/visitors.

Practical findings in the literature

In addition to these theoretical results, the literature also includes some research findings that are of practical interest. Brooks (2004) worked with an extensive data set to look at how rank determines impressions a keyword will get, the click-through rate the keyword will receive and the conversion rate that will be observed for a keyword. The results are displayed in Table 11.3.

Here, the conversion rate means whether the click-through will convert to a sales or an action for the advertisers. When we examine the relationship between rank of an ad and the relative impressions, it is easy to observe that the higher the rank of an ad, the less impressions it will receive. This table is based on data collected by Google AdWords. Since Google search results do not always display ten or more ads on a page, an ad that is ranked 5 may not show up on the first page of the search results and hence may not always get the impressions. As a result, as one goes further down on that page the relative impressions decreases.

When we examine the association between the rank versus the click-through rates, we observe once more that the higher the rank of an ad,

Table 11.3 Impressions, click-through rates (CTRs) and conversions for google search-based ads – Brooks (2004)

Rank	Relative impressions (%)	Relative CTR (%)	Conversion rate (%)
1	100.0	100.0	100.0
2	77.2	77.4	91.1
3	71.3	66.6	75.1
4	67.9	57.4	72.4
5	65.8	52.9	69.3
6	62.3	50.2	71.9
7	60.6	39.7	67.6
8	58.3	34.3	64.9
9	58.6	26.0	72.3
10	52.6	26.3	87.7

the lower the click-through rate is. But note that the degradation in click-through rate is higher than the degradation in impressions when the rank increases. Lastly, the table shows the relationship between rank and conversion rates. Here something curious happens. As the rank increases, the conversion rate does not necessarily go down. This is because if a user has chosen to click on an ad that has ranked 10, then they may be very determined to make a purchase or to take an action.

In 2006, Ganchev et al. examined large quantities of data from Overture's search engine. Here, we present two important graphs from a paper they published in 2007.

In Figure 11.2, we show how the price paid by the top bidder correlates with the total number of bidders in the auction for keywords. As you can see, there's almost a linear relationship between the number of bidders and mean price of the first position and the relationship is increasing. Here note that the increasing trend is not necessarily surprising. The more bidders we have, you'd expect to have the higher top bid price.

Figure 11.3 shows the correspondence between bid position and mean prices. The authors normalized the bid prices so that the first price is always $1 and then there's an equal contribution from each auction. An exponential decay fits the means surprisingly well in this curve. However, it should be noted that this behavior is not for individual auctions but for aggregate results. So for individual auctions, you may not see such a clear relationship between the bid position and the mean price.

Lastly, we look at some findings of Ghose and Yang (2009). There are four major findings in this paper. The first one is the ranking of an ad is negatively associated with the click-through rate and conversion rate which is an expected and intuitive result. The higher the rank position number of an ad, the lower on the results page it will appear, the less impressions it will get

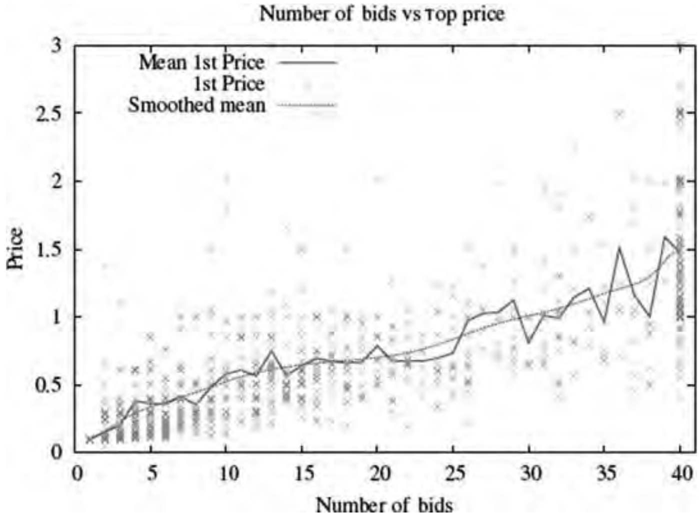

Figure 11.2 The price paid by top bidder as a function of number of bids.

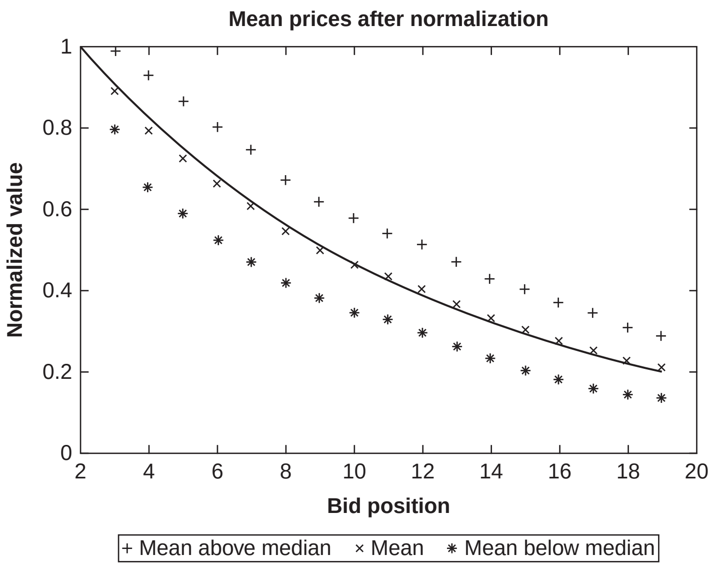

Figure 11.3 Mean price of bids for different advertising positions.

which will then mean less click-throughs, less enthusiasm and hence less conversion. The second result states that adding a retailer-specific piece of information to the keyword of a campaign usually increases click-through rates. So if a shoe company decides to invest in a keyword campaign, they will end up increasing the effectiveness of the campaign if they include the name of the retailer as a part of their keyword. The third result says if one adds any brand-specific information to the campaign keyword, this increases the conversion rate. This implies that if instead of bidding for the keyword “shoes”, you bid for “Adidas shoes” then this doesn’t only increase your click-through rate, but also increases the chance of visitors taking an action and perhaps making a purchase once they click onto the advertisement displayed under sponsored links. The last interesting finding of the study is about the length of keywords. The authors suggest that the longer the keyword in a campaign becomes (or the more words are included in the keyword in a campaign), the less click-through rate will be observed.

Conclusions

In this exposition, we have given an overall look at the literature that has been published on search-based advertising in recent years. The literature is comprised of two main streams of models: models that examine this advertising problem from the publishers’ point of view and models that examine the problem for the advertisers’ point of view. In either stream, one can find deterministic and stochastic models; though it should be noted that auction-based stochastic models are likely to generate more insightful results since auctions dominate the process of securing a good spot in a search-based advertising campaign.

As we can witness, Internet usage is growing day by day so Internet advertising is expected and destined to grow as much as well. It is also easy to see that research in this area of Revenue Management and search-based advertising is multi-disciplinary: computer science, operations research and statistics are only a few of the disciplines that can provide input in this area. Since this research field is relatively new, it is also comparatively under-served. However, the number of contributions into the field is growing every day and in the upcoming years we can expect more research. With the latest economic downturn, the wasted half of the advertising expenditure spent has obviously become an even a greater important issue for advertisers; therefore the research on Revenue Management for search-based advertising is even more crucial these days.

Future directions

The most important underlying challenge to further research is the fact that search engine advertising is evolving and changing face every day. When people conduct a search on Google these days, in addition to the sponsored results, they are not only given a list of organic results links but provided with maps, image results and shopping links. How does this new face of search results affect users' click habits? When Google displays the same store's link under both sponsored and organic results, how do the users behave? These are only a few of the tens of very interesting research questions that need to be answered.

It is also interesting to realize that although there is a plethora of theoretical articles on search-based advertising, there is not enough emphasis given to producing empirical and data driven papers written with academic rigor. This is highly contradictory with the fact that there is an abundance of data available through online portals presenting great opportunities for researchers. I hope and trust that in the future we will see more in-depth academic research on this very exciting area with a special emphasis given to solid empirical analysis.

Notes

1. Based on data from http://www.Internetworldstats.com/stats.htm (accessed 20 September 2010).
2. Based on data from http://www.iab.net/insights_research/947883/adrevenue report (accessed 20 September 2010).
3. http://www.comscore.com/Press_Events/Press_Releases/2009/12/comScore_Releases_November_2009_U.S._Search_Engine_Rankings (accessed 20 September 2010).
4. From http://en.wikipedia.org/wiki/Click_fraud (accessed 20 September 2010).

References

Abrams, Z., Mendelevitch, O. and Tomlin, J. (2007) Optimal Delivery of Sponsored Search Advertisements Subject to Budget Constraints, *ACM Conference on Electronic Commerce*, June 2007, pp. 272–278.

Aggarwal, G., Feldman, J., Muthukrishnan, S. and Pal, M. (2008) Sponsored Search Auctions with Markovian Users, Working paper. Google Inc, Mountainview, CA.

Brooks, N. (2004) Atlas Rank Report. Available at http://www.atlassolutions.com/pdf/rankreport.pdf and http://www.atlassolutions.com/pdf/rankreportpart2.pdf (accessed 7 April 2010).

Edelman, B., Ostrovsky, M. and Schwarz, M. (2007) Internet Advertising and the Generalized Second-price Auction: Selling Billions of Dollars Worth of Keywords, *American Economic Review*, 97(1), 242–259.

Fain, D. and Pedersen, J. (2006) Sponsored Search: A Brief History, *Bulletin of the American Society for Information Science and Technology*, 32(2).

Feng, J. and Xie, J. (2007) Performance-based Advertising: Price and Advertising and Signals of Product Quality, Working Paper. Available at SSRN http://ssrn.com/abstract=1027296 (accessed) 7 April 2010.

Ganchev, K., Kulesza, A., Tan J., Gabbard, R., Liu, Q. and Kearns, M. (2007) Empirical Price Modeling for Sponsored Search, *Lecture Notes in Computer Science*, 4858, 541–548.

Ghose, A. and Yang, S. (2009) An Empirical Analysis of Search Engine Advertising: Sponsored Search in Electronic Markets, *Management Science*, 55(5), 1605–1622.

Grappone, J. and Couzin, G. (2006) *Search Engine Optimization: An Hour a Day*. Indianapolis: Wiley Publishing.

Jansen, J. B. and Mullen, T. (2008) Sponsored Search: An Overview of the Concept, History and Technology, *International Journal of Electronic Business*, 6(2), 114–131.

Muthukrishnan, S., Pal, M. and Svitkina, Z. (2006) Stochastic Models for Budget Optimization in Search-based Advertising, *Algorithmica*, published online at http://www.cs.rutgers.edu/~muthu/mps07.pdf (accessed 7 April 2010).

Özlük, O. and Cholette, S. (2007) A Framework for Optimizing Bid Prices for Maximal Customer Response to Keyword Ads, *Journal of Revenue and Pricing Management*, 6(4), 347–356.

Regelson, M. and Fain, D. (2006) Predicting Clickthrough Rate Using Keyword Clusters. SSA'06.

Richardson, M., Dominowska E. and Ragno. R. (2007) Predicting Clicks: Estimating the Click-through Rate for New Ads. *Proceedings of WWW*. Available at http://portal.acm.org/citation.cfm?id=1242643 (accessed 7 April 2010).

Rusmevichientong, P. and Williamson, D. P. (2006) An Adaptive Algorithm for Selecting Profitable Keywords for Search-based Advertising Services, *ACM Conference on Electronic Commerce*, Vancouver, British Columbia, Canada, pp. 260–269.

Shin, W. (2009) The Company That You Keep: When to Buy a Competitor's Keyword, Working paper. Duke University, Durham, NC.

Zhou, Y., Chakrabarty, D. and Lukose, R. (2008) Budget Constrained Bidding in Keyword Auctions and Online Knapsack Problems, *Lecture Notes in Computer Science*, 5385, 566–576.

12
Revenue Management and Air Cargo

Raja Kasilingam

Introduction

Air cargo is the second largest mode of transportation in terms of traffic and value of goods transported. The maritime industry, as measured in ton-kilometers of goods transported, is much larger than the air cargo industry. In 2007, the world maritime industry generated a total of 60.9 trillion Revenue Ton Kilometers (RTK) of traffic compared to 193 billion RTKs of traffic for the air cargo industry (Boeing, 2008). Air cargo plays a vital role in the global logistics supply chain for transporting goods such as medical supplies and legal documents in a fast and reliable manner. Air cargo has been displacing other modes of transportation in almost all regions and for all goods except for very short distances and for very large size cargo.

A simplified view of the air cargo supply chain is shown in Figure 12.1. The air cargo supply chain starts with cargo originating from a shipper and then to a forwarder who consolidates it and ships it through one or more air carriers to the final destination to be delivered to the consignee. An air carrier may ship cargo directly from origin to destination on a non-stop flight or move it through one or more terminals using connections depending upon space availability and service time commitments. Either the shipper or the carrier may pick up or deliver the cargo from/to the door.

Air cargo Revenue Management is concerned with the integrated management of cargo rates and available inventory in terms of belly space, payload and containers. It focuses on two main aspects: determining available capacity for sale and controlling inventory. Determining available capacity for sale is driven by knowing the physical capacity and understanding the show-up behavior. In simple terms, show up behavior is defined as the actual amount of cargo tendered for a flight compared to the amount of cargo booked. Some of the cargo booked may be cancelled before flight departure, others may never be tendered, and some may be over or under-tendered. For instance, over-tendering occurs when a 1,000 kg booking is tendered at 1,100 kg. Controlling inventory can be accomplished using nested bucket

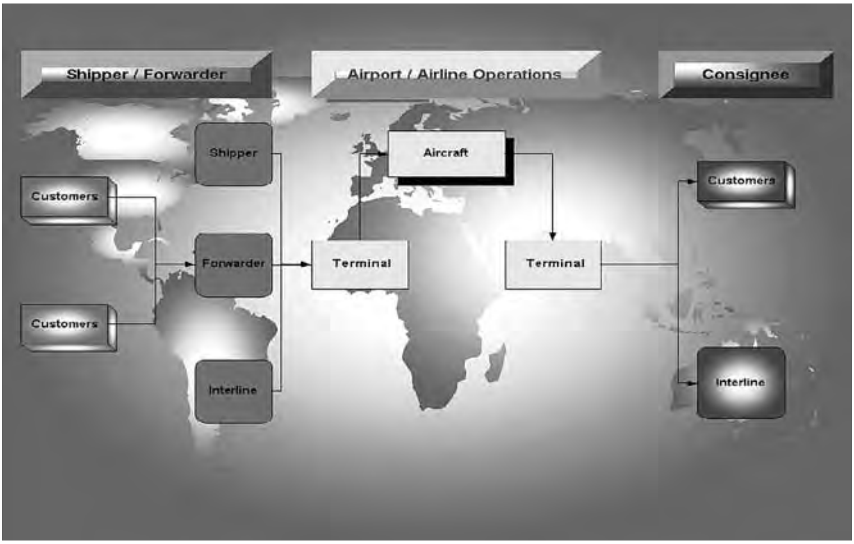

Figure 12.1 Air cargo supply chain.

allocations and/or hurdle prices or bid prices. The purpose of this chapter is to present the basic concepts of air cargo Revenue Management, outline the various components that make up air cargo Revenue Management, discuss some of the quantitative models in air cargo Revenue Management and the implementation challenges related to air cargo Revenue Management.

Air cargo Revenue Management

In practice, passenger airlines apply the concepts of Revenue Management in a hierarchical manner (Kasilingam and Ong, 1996). For instance, a plane can take off with a certain weight or payload which is available for carrying passengers, passenger bags, mail and cargo. Similarly, the belly space or containers is available for bags, mail and cargo. The weight consumed by a passenger toward payload is the sum of passenger weight and passenger bag weight and the volume consumed by a passenger toward total belly space is the volume of bags checked in by the passenger. Hence, ideally passengers should compete with cargo for payload and belly space. However, airlines do not Revenue Manage capacity (payload, belly space and containers) or optimize the allocation of capacity to cargo and passengers based on the profitability or value of cargo versus passengers. Instead, assume that passenger profitability is higher than cargo profitability for the equivalent weight and volume. This means that the capacity available for managing the revenue of cargo is based on number of passengers onboard which is driven by the passenger Revenue Management system and the available payload and volume.

Passenger Revenue Management vs air cargo Revenue Management

Air cargo Revenue Management differs from passenger Revenue Management in a number of key aspects. Four important differences are discussed below (Kasilingam, 1996).

Uncertain capacity

For passenger flights, the capacity available for cargo depends on payload and the number of passengers onboard and their bags. In general, cargo capacity depends on anything else that has a higher boarding priority than cargo. Payload by itself depends on a number of factors such as weather, fuel weight, air route path and so on. This makes cargo capacity a stochastic variable. In passenger Revenue Management, the number of seats is known and fixed for the most part.

Three-dimensional capacity

Cargo capacity can be three-dimensional, that is, weight, volume and number of positions. It is two-dimensional for narrow body aircraft or aircraft that cannot carry unit load devices (ULDs). It is three-dimensional for wide body aircraft or aircraft that can carry ULDs. ULDs can be pallets or containers and there are different types of pallets and containers. In passenger Revenue Management, capacity is in a single dimension, seats.

Routings or itinerary control

Passengers prefer to follow their own planned itinerary. On the other hand, cargo may be shipped along any route as long as it is available at the destination within the promised delivery time. While this gives the opportunity to truly maximize the revenue opportunity, it does increase the complexity of the network optimization models used to solve for allocations and bid prices.

Number of customers

The number of cargo customers or freight forwarders that an airline does business with is finite and relatively small. This necessitates considering the value of customers while making Revenue Management decisions. This also creates the need to optimally determine the split between allotments and free space on flights. Allotments are blocked space allocated to customers for a longer period of time on a flight for certain days of the week.

Basic controls in air cargo Revenue Management

Airlines use air cargo Revenue Management systems in one or more of the following ways to generate additional revenue and profitability:

- Capacity planning – knowing the physical capacity and capacity available for sale accurately at the very beginning of the booking period is very important so that demand is not spilled or turned away.
- Allotment management – determining the split between allotments and free sale space on flights and allocating space to the right station or customer and considering the possibilities of satisfying allocations among multiple routes is critical for improving overall revenue.
- Pricing guidelines – determining minimum acceptable prices (or hurdle prices) to sell cargo based on flight capacity, demand, and rate and density of cargo. Carrying the right freight mix in terms of rate and density maximizes the revenue and contribution from the three-dimensional cargo capacity.

The extent of revenue benefits from using a Revenue Management solution depends on a number of key factors such as the level of sophistication of current Revenue Management method, business process alignment with Revenue Management, data quality and availability, Revenue Management solution acceptance at all levels within the cargo organization, and users believing and using the solution. In addition to the financial benefits from using a Revenue Management solution, airlines have realized additional benefits such as increase in productivity, up-to-date availability of data, consistency in decision making and improved response time.

Data requirements

There are about five major categories of data required to support a cargo Revenue Management solution.

- *Reference data*. This includes information on aircraft, ULD, cities served, products, costs and so on. For example, aircraft reference data will include all the aircraft types operated by the airline and basic information on each aircraft type such as default payload, belly volume and configuration. ULD reference data may contain volume, weight and dimension for each ULD type.
- *Schedule*. Passenger flight schedule data include three basic types. The first one is seasonal schedule which is available at the beginning of each season. This provides information on all flights that operate during the season. Flight information includes flight number, leg origin, leg destination, equipment, days of operations and so on. The second one is changes

to seasonal schedule and this may be available on a weekly or monthly basis and it overrides the existing seasonal schedule. The third one is operational schedule changes that usually occur within the last 48–24 hours. Schedule and schedule changes are the primary data as all the Revenue Management controls are calculated or forecasted for the flights that are in the current active schedule. Seasonal schedule and changes to seasonal schedule are generally available from the flight scheduling system. Operational schedule changes are available from flight operations system. In addition to flight schedule, freighter and truck schedule is also needed. Freighter and truck schedule are generally obtained from the cargo reservations system.
- *Post departure flight data.* Post departure flight information is actual data for a flight when it departed and it includes data such as payload, underload, cargo, mail, bag, passenger and so on. This information is required to forecast payload, mail and other components that are required for calculating cargo capacities. Post departure flight data are generally available from departure control systems or load planning systems.
- *Passenger forecasts.* This includes passenger forecasts by cabin class for future flight departures. Passenger forecasts are used in calculating expected passenger weight and bag weight onboard, bag volume occupied in belly and bag containers at departure. This is then used in cargo capacity calculations. Passenger forecasts are provided by the passenger Revenue Management system.
- *Air waybill data.* There are three categories of air waybill data: booked, tendered and flown. Booked and tender data are used for calculating the show-up behavior. Booked information is also used for demand forecasting purposes. Flown air waybill data are used for reporting purposes. Air waybill data include shipment data such as origin, destination, commodity, weight, volume and pieces; customer data such as customer ID; flight data such as flight number, departure date, and flight origin and destination; and other information such as product and rate.

Air cargo Revenue Management solution overview

An air cargo Revenue Management solution should ideally have the following high level features:

- Automatically process key Revenue Management modules at night for up-to-date flight capacities, overbooking levels, demand forecasts, allocations and bid prices.
- Interactively run Revenue Management modules and options to review and modify model outputs as well as change model inputs.
- Ability to create weekly, monthly and yearly management reports on service failures, load factors and revenues.

- Proactively manage flights by alerting users when certain conditions are met or not met in terms of potential service failures or revenue opportunities.
- Manage flights in a simple and more efficient way with user-friendly interactive screens.

A Revenue Management solution for air cargo will have the following major components:

- *Capacity management*. This includes forecasting physical capacity available for cargo after accounting for everything that has a higher boarding priority than cargo, estimating the show-up behavior, and combining the two to optimally set overbooking levels. The overbooking levels or percentages when multiplied by the physical capacity provide the capacity available for sale or authorized capacities.
- *Allotment management*. Allotment management focuses on two main aspects. It optimally determines the split between allotment and free sale space on flights based on allotment requests, free sale demand forecasts, flight capacities, and routing options and costs. It also determines the allotment requests to be accepted and the amount to be granted.
- *Network management*. This determines the allocations for different categories of free sale demand based on free sale demand forecasts, free capacity forecasts, and routing options and costs. It also optimally determines the weight and volume hurdle prices for the flight departures.

In air cargo Revenue Management, there are two general planning horizons. The first one is known as "flight period" and this is typically associated with seasonal schedule. Allotment management is performed at the flight period level; however, there may be ad hoc allotment requests during the flight period. The second planning horizon is known as "booking period" and is typically associated with the period when flights are open for booking. Most airlines open the flights for booking about 30 days before departure and some open only 14 days before departure. In general, a significant percentage of cargo bookings occur within two to five days of departure. Capacity and network management are performed during the booking period.

In summary, an air cargo Revenue Management solution addresses the following business functions:

Capacity forecasting – determine available cargo space by flight for future departures.

Show-up rate forecasting – predict flight leg-level booking behavior in terms of no-shows, cancellations and over-/under-tendering.

Overbooking – determine the amount of additional capacity to be made available for booking, to offset the impact of no-shows, cancellations and over-/under-tendering.

Allotment management – determine the mix between permanent bookings and free sale as well as the allocations among various stations and customers.

Demand forecasting – project origin/destination demand based on historical data and current bookings.

Bid pricing – determine minimum acceptable price (“bid price”) for a shipment considering network demand and capacity.

Cost model – calculate route costs considering handling, fuel, trucking, interline and so on.

Router – generate operationally feasible routes considering shipment, aircraft and network characteristics.

Customer value determination – ability to assign values to customers based on certain criteria such as volume of business, revenue, type of cargo and usage.

The relationship among the above business functions or an overview of a Revenue Management business solution is shown in Figure 12.2. The booking evaluation function shown in Figure 12.2 is not part of a core air cargo

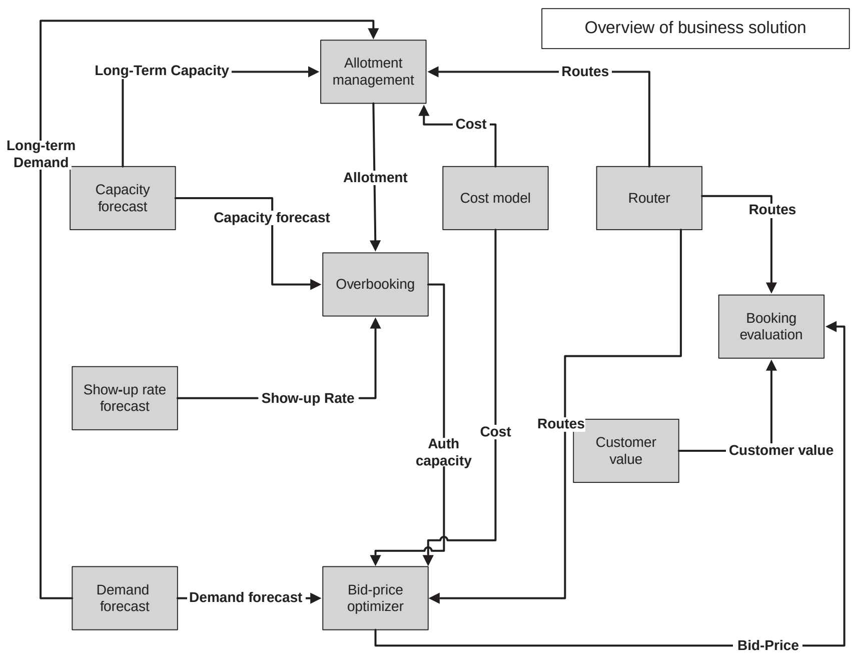

Figure 12.2 Relationship among Revenue Management solution components.

Revenue Management system but is supported by outputs from a Revenue Management system.

Capacity forecasting

The amount of freight that can be carried on an aircraft is not known with certainty. It depends on the payload, expected passengers onboard, passenger bags, mail and all other type of freight such as catering and company material that has a higher boarding priority than cargo. Revenue Management computes the available cargo capacity for each departing flight in terms of weight, volume and containers. The weight capacity for cargo is computed as payload forecast less weight taken up by passengers, bags, mail and other items that have a higher priority than cargo. Volume capacity for narrow body flight is based on total belly volume adjusted by stacking loss less volume used by bags, mail and other items. The number of containers available for cargo for wide body flights is calculated as total available containers minus containers used up by bags, mail and others. The number of containers used for bags is based on passenger forecasts. Some airlines may use separate containers for bags for different classes of service and this needs to be considered while estimating containers needed for bags. The volume capacity for cargo for wide body flights is generally computed using the capacity in containers times the volume of a container. Cargo capacity forecast for narrow body aircrafts considers ground time limitations. Narrow body flights have ground times between one inbound flight and its next outbound flight that might constrain the time available to load cargo on the inbound flight. The ground time capacity constraint is estimated using applicable load/unload exchange rates, narrow body belly volume and available ground time. There are a few other important aspects that need to be taken into account while forecasting cargo capacity.

Show-up rate forecasting

The objective of show-up rate forecasting is to predict flight leg-level booking behavior in terms of no-shows, cancellations and over-/under-tendering. Show-up behavior is computed from historical bookings and tender data. A shipment is not considered as no-show as long as it is tendered by certain specified cut-off time and is ready for carriage. The forecasting model combines the effect of cancellations, no-shows and over-/under-tendering and determines the percentage of cargo that shows up compared to the booked amount in terms of weight and volume. There are different types of approaches used for show-up rate forecasting. The first approach is to directly forecast show-up rate at flight level. The second approach is to forecast the traffic mix on a flight and the show-up rate for each type of traffic mix and combine them to obtain the flight show-up rate. While the argument is that the first approach does not capture changing traffic mix, it is questionable if the second approach does react fairly quickly when the mix changes. Also, second approach results in less accurate show-up rate forecasts due to combining two forecasts and the fact that data gets sparser at traffic mix level than flight level.

Overbooking

Overbooking is the practice of intentionally selling more cargo space than the available capacity. Overbooking level is the ratio of the virtual or authorized capacity to the physical capacity expressed in percentage. The key difference between airline passenger overbooking and air cargo overbooking is that in air cargo capacity is stochastic in nature. There are a couple of different approaches to overbook cargo capacity: economic and service level based. There are two types of approaches within economic overbooking: the first one maximizes the total net revenue for a flight. Total net revenue is defined as revenue minus offload costs. The second one seeks a tradeoff between expected offload costs and spoilage costs or minimizes the sum of offload and spoilage costs. In both cases, an additional service level constraint can be added so that the model selects the minimum of economic overbooking level and service-based overbooking level. The service level-based overbooking approach does not consider any revenue or costs but determines overbooking level solely based on desired level of service level or the acceptable level of service failure.

The unit cost of spoilage can be estimated using the average rate of shipments on a flight. The offload cost is estimated as a sum of service level refund, additional handling and storage costs, and lost good will. It is not essential to have the absolute values of spoilage or offload costs, but a ratio of the two is sufficient. Also, the optimization models that consider costs are quite robust with respect to costs.

The overbooking models overbook flight capacities separately for the different dimensions. The overbooking models assume some type of distribution for show-up rates. There has been some research conducted in overbooking based on discrete show-up rate distribution (Popescu et al., 2006) as well as performing overbooking along the weight and volume dimensions simultaneously (Luo et al., 2008). In addition, basic research has been conducted in overbooking at shipment level considering the key characteristics of a given shipment.

Some airlines overbook only free sale capacity which is total cargo capacity minus allotments; while others may choose to overbook the entire flight or overbook free sale capacity and allotments separately.

Allotment management

Allotment management supports the following core business requirements:

- *Allotment maintenance*. Includes creating and updating allotment requests, reviewing and overriding allotment recommendations, and release of allotments based on usage monitoring.
- *Allotment optimization*. Provides decision support capability to determine the split between allotments and free sale at flight level and recommend allotment requests to be accepted. The output from this model also provides hurdle prices to decide on acceptance of ad hoc allotment requests.
- *Allotment usage tracking*. Calculates allotment usage in terms of space and revenue and flags certain conditions. These conditions trigger reduction or adjustment to existing allotment.

Allotments can be for stations, customers, products or interline. The model should be configurable to address some of the following business rules:

- Confirm allocation to a particular station or customer or forced acceptance.
- All or nothing allocation for a request or any amount that is meaningful based on revenue and usage.
- Same allotment amount granted during an allotment period or varying amounts.
- Allocating along only one route or splitting allocations requests on multiple routes.
- Consider or not consider allotment usage.

Demand forecasting

Demand forecasting and bid price optimization can be performed at leg level, segment level, or true origin and destination level. It is recommended to forecast demand by origin and destination level (market level) and calculating hurdle prices or setting allocations using a network optimization model yields the maximum financial benefit in terms of network level contribution. It truly captures the effect of long-haul versus short-haul, shifting of cargo from high- to low-load factor flights and route selection. Forecasting air cargo demand is quite challenging due to lumpiness in cargo demand and data sparseness. Cargo demand forecasting is generally accomplished in two steps.

Step 1: Defining rate classes for cargo demand or defining demand forecasting unit

This phase includes analysing cargo demand and clustering them into meaningful groups. The clustering is based on rate and density of the shipments. The objective is to partition cargo demand into groups such that the *within group* variability is minimized, and at the same time, the *between group* variability is maximized. This step accomplishes *demand segmentation* – one of the required conditions for a successful Revenue Management implementation.

Step 2: Forecasting market-rate class demand

The system forecasts cargo demand using historical booking and flown air waybill data as well as current booking information. Historical data are grouped based on clusters for each market. The dependency of demand on variables such as day of week and month are analysed during this phase. The type, form and parameters of the model may vary by market and rate class. Demand forecasts are based on booking requests including rejected bookings (if available). The demand forecasts can be adjusted (increased or decreased) to take care of special situations related to business conditions such as reduction or increase in capacity by competition or by the airline.

Bid pricing/network optimization

Considering the authorized capacities, availability of multiple routes and costs, and demand forecasts, the model provides bid prices and gradients for various legs. The bid price for a leg indicates the minimum attractive rate required to use the available leg capacity. The gradient indicates the value by which the bid price increases when capacity decreases by one unit. For a given booking request, the bid price is the sum of the bid prices along all the legs in the selected route. Under bid pricing origin and destination Revenue Management controls, a request is accepted if the rate is higher than the bid price for the selected route and if capacity is available in all legs. The network optimization model for air cargo bid pricing is quite complicated and challenging as it considers the stochastic nature of demand and capacities and multiple routes. Real life implementations of bid pricing relax some of these constraints or address them with a combination of heuristic and optimal methods.

Route, cost and customer valuation

The router generates alternative routes which meet the operational entry conditions such as connect times, connecting stations, shipment available time, service level, trucking and type of cargo (bulk or container) to transport shipment from its origin to the desired destination. Routes generated by the router are used in allotment optimization, bid price optimization and booking evaluation.

The cost model determines the route costs considering handling costs at station and ramp, fuel cost, trucking and interline costs, and other costs such as General Sales Agent (GSA) commission.

The customer value model determines the value of customers based on certain criteria and criteria weights. The criteria may include tonnage, revenue, usage and type of cargo.

Air cargo Revenue Management implementation

The implementation approach, data requirements, interfaces to other systems and the critical success factors for implementing a cargo Revenue Management solution are discussed in this section (Becker and Kasilingam, 2008). In addition, a brief discussion on approaches to measuring the benefits from Revenue Management is also presented.

Critical success factors

The success of implementing an air cargo Revenue Management solution depends on several key factors. The definition of success is not limited to installing the solution on time and within budget. It goes beyond successful installation. An implementation is considered successful only when the users trust the system, continue to use the system, and the system delivers the results and value as originally defined in the business case. This can only be accomplished if all of the following factors are addressed during the implementation process at some point in time.

- *Organizational alignment.* It is important to ensure that people at various levels across the organization that are impacted by the Revenue Management solution in some form or other are completely aligned. Alignment implies that everyone understands the reason for implementing a Revenue Management solution, their roles and responsibilities in the solution and the impact of the solution on their work. In simple terms, everyone involved/impacted is bought into the solution. This also includes any reorganization required in order to fully benefit from the use of a Revenue Management solution.
- *Process fit.* A Revenue Management solution may not be in alignment with the existing business process. This means some parts of the business process may have to be modified or eliminated and new processes may have to be introduced. This step needs to be completed before the solution is made available for use.
- *Technology fit.* This focuses on two main aspects. The first one ensures that the architecture of the new solution is in line with the IT standards

or direction of the company. This includes IT standards for hardware, software and communication. The second one ensures that the Revenue Management solution is integrated with the existing systems to support transfer or exchange of data in batch and real time between the Revenue Management solution and other external systems that send/receive data.

- *Data availability.* A Revenue Management system is only as good as the data that is fed into the system. It is important to ensure that both historical as well new data on an ongoing basis are available. Data analysis needs to be done to ensure availability and accuracy of data. Alternate approaches have to be put in place to capture missing data or correct invalid data.
- *Resources.* Implementing a Revenue Management system requires resources from the vendor and the airline. It is very important to ensure that resources are available to support the various activities such as requirements analysis, interface design, data collection, training and testing.
- *Partnership.* Revenue Management implementations are quite different from implementing other projects due to the very nature of the project. Surprises and challenges are always expected. This implies that both vendor and airline have to work together as a partner to resolve the challenges together to ensure success.

Implementation approach

Implementing air cargo Revenue Management is quite challenging and it typically takes anywhere from nine months to two years for a full solution. The duration for implementation is primarily driven by four key aspects: integration/interfaces with other airline systems, data collection, business process alignment/changes and customization requirements. The recommended approach is to implement the solution in three phases: capacity management first, followed by allotment management, and finally bid price management. The reasons for implementing the Revenue Management solution in this order are as follows:

- This approach ensures that simple and easy to understand modules are implemented first to increase the level of comfort and confidence in Revenue Management among the users.
- The effort and duration required for the first phase or capacity management is relatively short and the benefits are typically significant.
- The extent of business process changes required is relatively small or almost nothing.
- Data required for the first phase are generally available without much of a challenge and the interfaces to other systems are in a batch mode.

The above four aspects become more challenging as implementation proceeds from first to second and third phases.

Conclusion

Air cargo Revenue Management is a relatively new field and is still evolving in terms of concepts, models and implementation aspects. This is evident from the lack or the minimal number of publications in air cargo Revenue Management. Only a handful of airlines have actually implemented air cargo Revenue Management solutions and one of the main reasons is the lack of awareness of the impact of Revenue Management to the air cargo business. This is partly due to the fact that air cargo business units in most airlines are still not viewed as separate business units with their own profit and loss structure. However, more and more airlines are now feeling the pressure to get the most out of their cargo operations. This is creating the need and awareness and has been pushing the adoption rate of air cargo Revenue Management. The solutions available in the market place have also reached a level of maturity to address the unique Revenue Management business needs of the air cargo industry. Airlines that have implemented air cargo Revenue Management have actually realized significant revenue benefits. We will certainly see more and more airlines starting to use cargo Revenue Management solutions over the next decade.

References

Becker, B. and Kasilingam, R. (2008) Success Factors for the Implementation of Revenue Management Solutions, *International Journal of Revenue Management*, 2(3), 254–271.

Boeing World Air cargo Forecast (2008–2009) Available at http://www.boeing.com/commercial/cargo/wacf.pdf (accessed 5 February 2010).

Kasilingam, R. (1996) Air Cargo Revenue Management: Characteristics and Complexities, *European Journal of Operational Research*, 96, 36–44.

Kasilingam, R. and Ong, C. (1996) Maximizing Total Airplane Profitability Through Joint Yield Management, *Journal of the Academy of Business Administration*, 2(1), 69–77.

Luo, S., Cakanyildirim, M. and Kasilingam, R. (2008) Two Dimensional Cargo Overbooking Models, *European Journal of Operational Research*, 197(3), 862–883.

Popescu, A., Keskinocak, P., Johnson, E., Kasilingam, R. and La Due, M. (2006) Estimating Air Cargo Overbooking Based on a Discrete Show Up Rate Distribution. *Interface*, 36(3), 248–258.

13

Practical Pricing for the Hotel Industry

Warren H. Lieberman

Introduction

As illustrated in the following example, pricing decisions can exert extraordinary, but easily overlooked leverage on a hotel's profitability. Consider a hotel with 300 rooms; we'll call it Veritec Lodge. Veritec Lodge generally has an annual occupancy percentage of 65 percent. As shown in Table 13.1, small increases in occupancy percentage have a relatively modest effect on the hotel's annual revenue; increasing the occupancy percentage from 65 percent to 66 percent, an increase of almost 1100 room nights, results in a revenue gain of about 1.5 percent.

As seen in Table 13.2, however, the impact of such a revenue increase on Veritec Lodge's profitability might be quite substantial. Assuming the hotel has an average daily rate of $125, a 5 percent profit margin at the 65 percent annual occupancy rate, and that 80 percent of the incremental revenue generated from the additional room nights is profit, the incremental gain in the hotel's annual profitability is a whopping 24.6 percent!

That the financial leverage is so high might actually best be seen toward the top of Table 13.2. Increasing the hotel's occupancy rate from 65 percent to just 65.1 percent, an increase of slightly more than 100 room nights on a base of over 70,000, leads to a 2½ percent increase in the hotel's profitability, although the incremental revenue gain is a paltry 0.15 of 1 percent. Similarly, an increase of half a percent in annual occupancy leads to an incremental revenue gain of less than 1 percent, but an increase in profitability that exceeds 12 percent. The financial leverage is truly quite staggering.

How can a hotel achieve these gains? This chapter considers five opportunity areas:

1. Improved pricing and demand management during peak demand periods.
2. Communications: among hotel staff and with prospective customers.

3. Market segmentation: general discounting strategies and tactics versus those that are targeted to specific market segments.
4. Opaque pricing.
5. Performance measurement.

To better frame the material in this chapter, we note that with respect to managing demand, pricing has three objectives: stop, steer or stimulate. Also, pricing and revenue management (for example, optimizing revenue by setting controls on room availability) are highly intertwined.

Stop demand. Using forecasts of future room supply and demand at alternative price levels and then optimizing the number of reservations to accept at each length of stay, effective pricing recognizes which types of demand are the most profitable for the situation at hand and establishes rates to encourage or accept such demand while discouraging less profitable demand. This is the goal to which hotels generally aspire; how close they come to that vision significantly influences the extent to which their revenues and profits are maximized. For example, during peak periods an effective pricing structure generally discourages shorter stays while simultaneously allowing for longer stays, *even* when lower daily rates are required to capture the longer stays. The incremental revenue produced from guests who have longer stays, especially if those stays span dates on which the hotel is not full, is generally much greater than the amount of revenue the hotel could have received from shorter stays at higher daily rates.

Table 13.1 Impacts of increasing occupancy percentage

Increase occupancy percentage from 65% to:	**Increase in room nights**	**Incremental revenue gain (%)**
65.1%	109	0.15
65.5%	548	0.75
66%	1095	1.5

Table 13.2 Impacts of increasing occupancy percentage

Annual occupancy (%)	**Annual revenue ($ million)**	**Incremental revenue gain (%)**	**Annual net revenue ($000)**	**Incremental gain in profits (%)**
65	8.90	n.a.	445	n.a.
65.1	8.91	0.15	456	2.5
65.5	8.97	0.77	500	12.3
66	9.03	1.5	554	24.6

Steer. An effective pricing program also steers demand to the right dates. Some potential guests have flexibility in their schedules. For those guests, an effective pricing structure enables them to choose dates where they can receive lower rates, helping the hotel to build occupancy where it is needed.

Stimulate. Finally, there are those dates for which natural demand may be relatively low and lower rates and promotional prices can be used to stimulate additional demand. When discounted prices are offered, the incremental demand stimulated by these prices must make up for the reduction in revenue from guests who pay the lower rate, but who would have stayed at the higher rate. As higher occupancy levels generally imply higher variable costs (for example, housekeeping, utilities and so on), broad discounting efforts need to stimulate a more than proportional increase in revenue in order that the discounted rates not be dilutionary, leading to reduced profits.

With that background, we now discuss some of the actions that a hotel can take to achieve pricing success.

Peak period revenue opportunities

Length of stay controls versus increasing price

A situation commonly faced by hotels is how to set prices when there is sufficient demand to fill every room. One pricing tactic is to charge a significant premium for that particular night. A second tactic is to limit or even prohibit short-stay reservations. A third tactic is to set pricing levels to encourage longer stays. Some reservation requests will need to be turned down. Which ones?

While it is a popular tactic, increasing the daily rate on a peak night is not always the best route to increased profitability. When shorter stays can be replaced by longer stays, resulting in additional room nights on shoulder dates, the incremental revenue and profits resulting from those additional room nights typically far outweigh the revenue gains obtained by increasing the daily rate on shorter stays.

Let's demonstrate. As shown in Table 13.3, there is sufficient demand for Veritec Lodge to sell out on Wednesday night. If Veritec Lodge increases its average daily rate (ADR) from \$125 to \$175 on Wednesday, a 40 percent increase, 1155 rooms are occupied during the week and the weekly revenue is \$159,375. Further, every room is occupied on Wednesday night.

Conversely, if Veritec Lodge implements length of stay (LOS) controls so that more of the reservations it accepts include the surrounding days, and does not increase its average rate on Wednesday, the number of rooms occupied during the week increases by 145. The weekly revenue for Veritec Lodge increases to \$162,500, about a 2 percent revenue increase. In this scenario, not all of the hotel rooms are occupied on Wednesday night, reflecting the uncertainty associated with holding back rooms for longer

Table 13.3 Comparison of impacts from LOS controls versus increasing price

	Mon	Tue	Wed	Thur	Fri	Total
Available rooms	300	300	300	300	300	1500
Occupied rooms if Wed ADR increased to $175	200	235	300	230	190	1155
Revenue if Wed ADR increased to $175 ($000)	25	29.375	52.5	28.75	23.75	159.375
Occupied rooms with LOS controls and ADR of $125	230	280	290	275	225	1300
Revenue with LOS controls and ADR of $125 ($000)	28.75	35	36.25	34.375	28.125	162.5

stay reservation requests. In actual implementation of LOS controls, some hotels have claimed revenue increases of 8–10 percent or even more when compared to increasing rates on peak nights (Aeronomics, 1992).

Accepting reservation requests beyond hotel capacity

Although not strictly an element of pricing, another component of a successful pricing program is determining how many reservation requests to accept beyond the hotel's capacity. As the number of future cancellations and no-shows are not known with certainty, this reflects the level of risk the hotel is willing to take to ensure that every room is occupied on a sold-out night.

Unoccupied rooms on a sold-out night are termed *spoiled rooms*. These are rooms that could have been sold but are not, because the hotel decided to stop taking reservations, effectively turning away demand in advance of the check-in date. Unoccupied rooms on dates that are not sold out are not spoiled rooms, as there was insufficient demand to fill them. Spoilage can be measured as a percentage of available rooms or as an absolute number.

Many hoteliers take a conservative approach to managing spoilage. That is, they are cautious about the number of bookings taken in excess of the hotel's capacity. They are willing to let a few rooms go empty on a sold-out night in order to avoid the situation where guests with reservations show up to check-in, but the hotel does not have rooms to accommodate them.

While this is reasonable, it is also costly. Hoteliers frequently fail to realize that this forces potential guests to stay at competitor properties, rather than allowing them to stay at their most preferred location. If the hotel does have empty rooms on the sold-out night, then not only did the hotel give up revenue it could have received, but the hotel also ends up falling short on customer satisfaction. Although it may seem a bit harsh, it can be argued that the hotel's unwillingness or inability to manage the risk associated with a more aggressive booking level forces it into making decisions that ultimately inconvenience its potential customers more than necessary; often, this is the opposite of what the hotel was trying to do when it adopted a conservative limit on its booking level.

In working with a variety of hotel companies, we have found that the potential financial benefits of optimally managing the risk of "walking" customers are not always fully appreciated, resulting in limited efforts to capture these benefits. When a hotel is full, or nearly so, the focus tends to be on the revenue earned rather than on the opportunity cost of the revenue foregone.

The following example illustrates why this foregone revenue can be significant and worth pursuing. In addition, the example provides some insight into why we call this *invisible revenue*.

Consider a hotel with 250 rooms, a 70 percent annual occupancy rate, an ADR of $150 and 30 sold-out nights during the year. Further, assume a two-night average length of stay and that the average occupancy on sold-out nights is 97.6 percent. That means that on average, six rooms are empty on dates that the hotel stopped accepting reservations.

What is the financial impact of reducing the number of empty rooms on sold-out dates to three? Before going further, it may be worth noting that with 97.6 percent occupancy on sold-out nights, there may not be strong pressure for analysing why the occupancy rate was not higher. Reducing spoilage by 50 percent to three rooms, that is, increasing the occupancy rate from 97.6 percent to 98.8 percent on a relatively small number of nights per year may not be deemed worthy of significant effort. As you will soon see, however, this reaction may be shortsighted and lead to more foregone profits than your intuition might lead you to expect.

When approached from an annual revenue or occupancy perspective, the impacts seem minor. Annual occupancy rate would increase by approximately 2/10 of 1 percent. That level of increase might not even make its way onto an occupancy report. Also, annual revenue would increase by approximately ¼ of a percent. While no revenue increase might be too small to be of interest, I suspect it's hardly at a level that would generate much interest.

Although we don't present the calculations here, the impact of the incremental revenue on the hotel's profitability is much larger. Indeed, if the hotel's profits were 5 percent of gross revenue and if 80 percent of the incremental room revenue from selling these three additional rooms on the 30 sold-out nights goes to the bottom line, the hotel's annual profits might increase by more than 4 percent! Now that probably would attract the attention of many hotel executives.

When more aggressive booking policies are adopted, a hotel also needs to adopt policies and procedures that enable staff to deal effectively with guests with reservations wanting to check-in when the hotel does not have rooms available. There are many ways for hotels to do this; the most appropriate ways depend on a hotel's specific business environment. Although we do not discuss this issue in more detail in this chapter, it is important to recognize its importance. Also, it is worth noting that in our experience, it has always been possible for hotels to design and adopt policies that work well for both the guests and the hotel.

And that's why we frequently refer to the revenue that comes from decreasing spoilage as invisible revenue. No one may pay attention to its absence, but when the additional revenue has the potential to increase the hotel's profits by several percentage points, everyone appreciates its presence.

Communications

Sometimes, it is not about what you charge, but rather how you present it to the customer. Consider the following two offerings made by a hotel reservations agent to a prospective guest:

1. A room for $169 but for an additional $20 the guest can have an ocean view.
2. An ocean view room for $189, but the guest can stay in a room where the view is not guaranteed for $20 less.

Does the order in which the choices are presented affect the likelihood that customers reserve the more expensive room?

In a word, yes. This has been confirmed by research and actual experiments (Shoemaker, 2005). At one hotel it was found that customers were 50 percent more likely to purchase the more expensive room when a higher rate was quoted first (Lieberman and Shoemaker, 1995).

Does this mean that more expensive rates should always be quoted first? In our experience, it does not. We have found that it can be more effective to vary the script used by a reservations agent based on customer keywords or phrases. For example, when a customer enquires about the lowest rate available, it may simply be best to start with that rate rather than force the customer to first listen to the wonderful options that come with more expensive rooms.

As discussed in Chapter 3, hotels with the most successful pricing programs have also recognized the value of obtaining input from multiple departments. For these hotels, weekly interdepartmental meetings to discuss price opportunities are a fairly common practice. When a pricing department operates in isolation from other departments, opportunities are missed.

Market segmentation

To discuss the benefits and opportunities available through market segmentation techniques, it is convenient to consider the following case study. EZStay is a regional, limited service, midrange hotel chain in the USA. With a number of locations, its primary customer segments include budget-minded salespersons, corporate staff from small businesses, overnight travelers and budget-minded groups such as club sport teams. Weekday hotel occupancy tends to be low, although weekend occupancy rates are quite high. Competitor chains tend to have stronger brand equity and loyal followings due to their loyalty programs. Thus far, EZStay has not initiated a loyalty program.

Less than 10 percent of EZStay's guests pay the full rack rate. These rates vary by hotel, ranging from $69 to $129. More than 60 percent of the guests receive a discount of at least $20.

Although EZStay's rates are generally similar to its competitors, perhaps slightly lower, its physical product is equal to and probably better than most of its competitors. Many corporate travelers, however, tend to stay at competitor properties. This may be due in part to EZStay's regional rather than national presence and also due to its lack of a loyalty program.

The pricing department has organized a meeting to discuss what actions it might take to improve the financial position of EZStay. What should be done?

Prior to considering this issue, it's worth reviewing two questions simultaneously: which market segments currently provide customers and which segments are not currently providing many customers but could be? Considering these questions jointly provides a framework for evaluating how to prioritize deeper penetration into the customer segments that currently provide customers versus stimulating demand from other customer segments, as this helps frame the challenges with stimulating additional demand from different sources.

Generally, two approaches can be taken. A rather common tactic is to take a broad and relatively untargeted pricing action. Frequently, this translates into offering a discounted price. An alternative approach is to take a more directed action that is targeted to reach a specific set of customer segments. These customer segments may or may not be ones that currently provide the hotel with many guests. In our experience, this second approach tends to be a far more effective way of increasing revenues and profits.

To illustrate the potential risks of a broad discounting program, consider a hotel that receives an average price of $70 for its rooms and has an occupancy rate of 55 percent. To stimulate demand, suppose the hotel reduces its price to $56, approximately a 20 percent reduction. How much additional business does the hotel need to generate to ensure that the discount increases its revenues and profits?

To earn the same amount of revenue without regard to any potential increase in variable costs due to increased occupancy levels, the hotel's occupancy rate would have to increase to about 69 percent, a 25 percent increase in guest nights. So, the potential for the discount to be dilutionary, that is, to generate less revenue than what was earned at the higher rate, is rather high. Demand for the hotel has to increase quite significantly for the discount to be profitable. It's a risky financial proposition.

As increased occupancy levels result in additional variable costs, the occupancy level required to break even is higher. Figure 13.1 illustrates the potential for the discounted price of $56 to result in lower revenues for the hotel, assuming it has 100 rooms. As you can see if the discounted price fails to stimulate demand, the hotel risks losing almost $400,000 per year. Even if demand increases by 15 percent, the hotel's annual revenues would decline by 8 percent and its profits would likely decline even more.

With these understandings, let's return to the situation faced by EZStay. Relative to its competitors, EZStay's competitive disadvantages appear to be that competitor hotel chains are better known and their loyalty programs are likely attracting many corporate travelers who, while on a budget, are having their bills paid by the company. If that is true, this customer segment may consist of people who are not too price sensitive so long as the cost of the hotel room is consistent with their travel budget.

Corporate travelers seem to be a customer segment worth pursuing. These travelers are generally less price sensitive, so discounting the hotel's rate would not be the best way to attract them to an EZStay hotel. EZStay's potential competitive advantage, that is, its physical product is equal to or better than what is offered by the competition, may be something to build on.

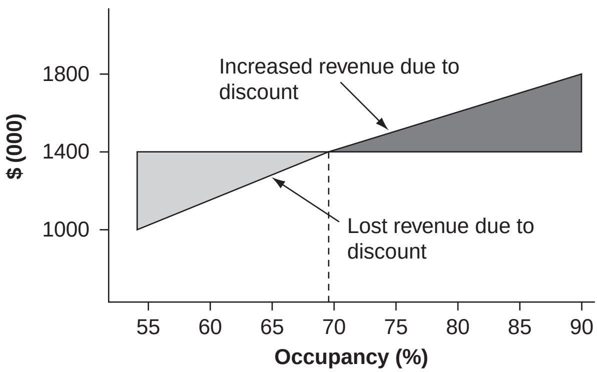

Figure 13.1 Potential annual financial impact of price reduction.

One way to attract corporate travelers in the absence of a loyalty program is to offer guests who arrive on a weekday and pay the full non-discounted rate, a small amenity on the first night of their stay. Additional and potentially more significant amenities can be offered on each subsequent night of the stay. In this way, an EZStay hotel would be more attractive to those who are currently staying at competitor hotels for multi-night stays and are less price sensitive. As so few of the current guests staying at an EZStay hotel pay the non-discounted rate, the potential for revenue dilution is extremely small. It is worth noting that this new product is specifically not designed to appeal to price sensitive leisure travelers, a market segment that EZStay appears to currently do well with.

The new product might be termed a frequent traveler package or perhaps a business traveler package, as it is primarily designed to appeal to those who have multi-night stays. For guests who travel frequently, the package offers benefits if they give up the opportunity to collect additional loyalty points at competitor hotels.

Under a variety of reasonable assumptions, a graph of the potential impact of the business traveler package for an EZStay hotel might look something like Figure 13.2. Note that the potential for revenue dilution is very small. Revenue dilution occurs when guests who would have paid the full rate without receiving an amenity now do so. This reduces the net revenue to EZStay.

For this particular EZStay hotel, the frequent traveler package is estimated to be dilutionary only if it attracts less than one incremental guest per night. Under the circumstances described, the hotel's net revenues decrease when guests who would have stayed at the hotel and pay full rate now receive an amenity when they do so. As so few guests currently pay the full rate, the risk is small, but it must be considered. The good news is that even if only

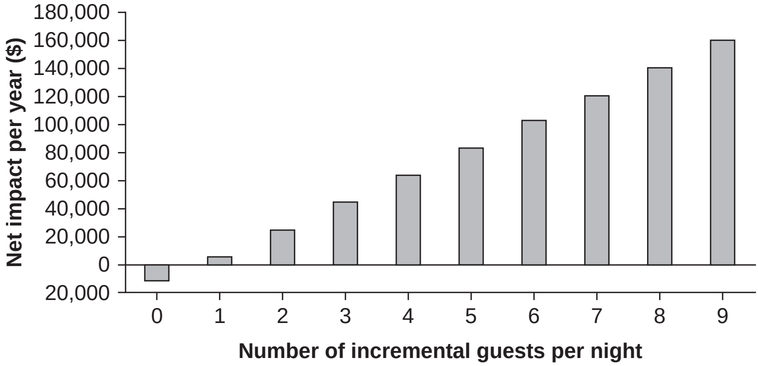

Figure 13.2 Potential impact of business traveler package.

a modest amount of new demand results, the program will be a financial success.

It is also possible that the program will be financially beneficial if it induces some guests to “buy up.” That is, instead of choosing to stay at an EZStay hotel on a discounted rate, some guests may choose to pay the higher rate in order to receive the amenity. The estimates presented here assume that customers who usually pay a discounted rate continue to do so and do not choose to pay the higher rate in exchange for receiving an amenity; this yields a more conservative benefits estimate.

Offering this targeted product, aimed at attracting less price sensitive guests who stay at competitor hotels for multi-night stays, carries less risk than a broad discounting program. Depending on the types of amenities offered (for example, airline frequent flyer miles, credit card points that can be redeemed for gifts, a small gift card or something else that the guest values), EZStay has incentivized travelers to try one of their properties rather than stay at a competitor property, but has done so in a way that minimizes the risk of revenue dilution. And, if EZStay hotels are better than competitor hotels, some of these frequent travelers may be tempted to stay at an EZStay hotel in the future, regardless of whether or not the frequent traveler package is offered.

Opaque pricing

The use of opaque websites such as Priceline and Hotwire has increased dramatically over the past decade. These distribution channels allow customers to receive discounted prices in exchange for having flexibility with regards to the product they receive. Customers do not know the exact hotel they will be staying at until after their purchase is confirmed, but they can specify conditions that restrict the type of hotel they get. These distribution channels enable hotels to receive incremental business and incremental revenues and profits, but also carry some risk.

A hotel is best able to benefit from an opaque distribution channel when it is a relatively small provider in a larger market and consumers cannot craft their request in a way that results in a high likelihood of their staying at that property. These conditions make it far more likely that the business a hotel receives through the opaque distribution channel is incremental.

When customers are able to craft their requests in ways that give them confidence that their accommodations will be at one of only a few properties, the potential for revenue dilution can be quite high. Faced with the prospect of staying at the property of their choice and paying perhaps 50 percent less than publicly available rates, guests will be more willing to take a chance. And this behavior, in the long run, can prove to be financially harmful to the hotel.

Performance measurement

As noted earlier, capacity control and pricing decisions are highly intertwined. Consider a somewhat simplified situation where you have only one room left to sell in a hotel for an upcoming Tuesday night. You receive a request for a one-night stay from someone who is willing to pay $120 for that night. If you turn down the request, you believe there is a 50 percent chance that you will receive a request for a four-night stay from someone else who is willing to pay $120 per night. But, if you turn down the request you believe there is a 50 percent chance that the room will go empty on Tuesday night.

1. What should you do?
2. Does the hotel's reservation system support what you want to do?
3. How do you demonstrate that you made the right decision?

The importance of the third question is well illustrated by the scenario in which you refuse the one-night stay reservation request in anticipation of receiving a four-night stay request, but that demand does not materialize and you end up with an empty room. You may need to convince your general manager that your action was appropriate even though the result was not what you hoped for. In short, you may have taken the action that in the long term would maximize the hotel's profits, but not necessarily have done so in this particular instance. Performance measurement tools become absolutely essential.

Having suitable performance measures, quantifying the impacts of your pricing decisions and providing feedback to staff on the impacts of their pricing decisions are critical for estimating the level of success of a hotel's pricing program and justifying investments to further enhance it. As the saying goes, "you get what you measure." Choose the wrong performance measures and your hotel is likely to be led down paths that are not as financially productive. Performance measures such as occupancy and average daily rate are only part of what's important. Revenue per available room, or REVPAR, provides a way of combining both of those measures into a single performance measurement. While that's better, it's still not enough as REVPAR also reflects the impact of factors external to price.

It is important to define measures that estimate the impacts of pricing decisions. In some cases you can use narrowly defined performance measures, such as those that focus on spoilage levels. In other cases, more elaborate methods such as the method of comparable challenges may be needed. This method enables making quantitative estimates of the impacts of pricing decisions by normalizing for market conditions existing at the time of the decision (Lieberman and Raskin, 2005). By doing so, this method provides greater insight and accuracy than more standard approaches such as year-over-year comparisons or comparisons to competitive sets.

Conclusion

As discussed in this chapter, pursuing profit maximization through enhanced pricing capabilities requires a combination of advanced pricing analytics and adopting appropriate internal business processes. Although the financial benefits of improved pricing may be as great, if not greater, than those resulting from changes in operations or purchasing supplies (Marn et al., 2004), the benefits are not nearly as obvious; implementing performance metrics and establishing feedback mechanisms designed to measure, illuminate and communicate these benefits are essential to establishing an effective pricing program. Otherwise, a hotel's scarce resources of staff time, as well as money for investing in business improvements, are likely to be prioritized for other areas.

References

Aeronomics (1992) Celebrating in Munich, *Scorecard*, 1(1), 5.

Lieberman, W. and Shoemaker, S. (1995) Revenue Management Workshop for Guatemalan Hotels, Presentation made to Guatemalan Hotel Executives, Guatemala.

Lieberman, W. and Raskin, M. (2005) Comparable Challenges: A New Approach to Performance Measurement, *Journal of Revenue and Pricing Management*, 4(2), 174–184.

Marn, M., Roegner, R. and Zawada, C. (2004) *The Price Advantage*. Hoboken, NJ: John Wiley & Sons.

Shoemaker, S. (2005) Pricing and the Consumer, *Journal of Revenue and Pricing Management*, 4(3), 228–236.

14

Practical Pricing and the Airline Industry

Stefan Poelt

Introduction

Airline pricing and Revenue Management has a long history starting with the deregulation of the airline markets in the late 1970s. This chapter focuses on practical aspects from a traditional carrier's point of view. Beside the basic concepts of market segmentation, demand forecasting, overbooking and availability optimization two main developments, from leg- to network-based Revenue Management and from independent to dependent demand structures are also described. As an example of airline-specific challenges some restrictions of legacy systems used in global distribution channels are mentioned. It is pointed out that most Revenue Management developments can be seen in the light of removing or relaxing wrong assumptions on which the first leg optimization methods have been based on.

A famous definition of Revenue Management was given by American Airlines in its 1987 annual report (American Airlines, 1987):

> *Selling the right seats to the right customers at the right prices and the right time.*

This definition contains some key aspects of Revenue Management like "seats" (product), "right customers" (market segmentation), "right prices" (pricing) and "right time" (availability decision) which will be discussed in more detail in the remaining part of this chapter.

Market segmentation

Market segmentation is one of the key conditions for an efficient application of pricing and Revenue Management. Airline customers differ with respect to their willingness to pay and their travel needs. A simple but important segmentation divides the market into business and leisure travellers as shown in Figure 14.1.

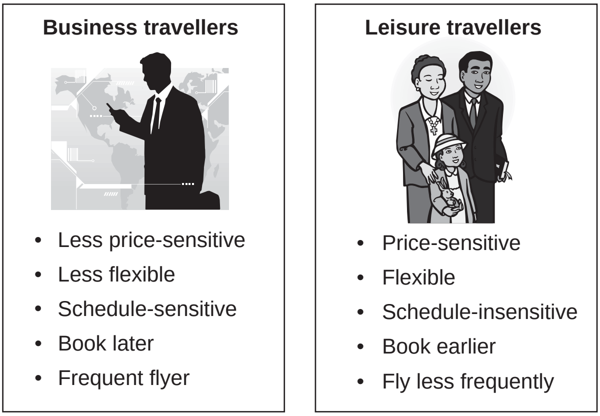

Figure 14.1 Market segmentation.

Business travellers are less price-sensitive and have a higher willingness to pay. They are less flexible with respect to their flight dates and times. Usually they fly to a meeting and don't want to spend too much extra time at the destination. A high frequency of flights in the airline's schedule is important for them. They tend to book close to departure as many business meetings are planned at short notice. Business travellers fly regularly, and expect a certain degree of service. Many of them are members of a frequent flyer programme. Leisure travellers in contrast are more price-sensitive and less schedule-sensitive. They are more flexible and accept alternative travel dates and times to get a cheaper fare. Usually, they plan their journey well in advance and book earlier than business travellers. They fly less often and have less specific airline preferences. Of course, not all customers are typical business or typical leisure travellers and airlines try to segment the market into much more than only two groups.

Offering several products and prices at the same time leads to more revenues if market segmentation is effective, that is, if passengers with higher willingness to pay are prevented from buying lower fares. A Saturday night stay restriction, for example, forces a passenger to stay a weekend at the destination – a requirement that most business travellers don't like.

Airline distribution process

Some Revenue Management aspects can be explained by looking at the distribution process. Airlines use two main distribution channels, global distribution systems (GDS) and the Internet. GDS, like Amadeus and Sabre, have been developed by airlines back in the 1970s to allow an electronic booking process for travel agents. During the 1990s the Internet became more important and airlines have built up own websites and sell via several distribution channels simultaneously. Nowadays, general travel websites like Expedia, Opodo and Orbitz compare the prices of many airlines and increase the price transparency for the customers.

There are several challenges in the GDS distribution process. First, it requires that the airline publishes all its fares to all relevant GDS. Second, GDS rely on booking classes for product availability. Booking classes are designated by a character and the alphabet allows for 26 price points only. Booking and ticketing, respectively payment, are decoupled processes in the GDS. This opens up room for cheating by ticketing a different product than booked before. Married segments control and journey data are two GDS functionalities that aim to prevent cheating, but they are costly to maintain. A good overview of GDS challenges is given by Isler and D'Souza (2009). The main advantage of GDS is that they cover many airlines and support booking of interline journeys.

Availabilities

Revenue Management optimizes product availability in three steps as shown in Figure 14.2. The first step is forecasting. Two things have to be predicted: Passenger demand and no-show rates. No-shows are passengers that have a reservation but do not show up at departure. Both types of forecasts are fed into the next step, the optimization. The overbooking optimizer calculates how many bookings above capacity should be accepted based on no-show forecasts and on other input data. The fare-mix optimizer determines how many bookings should be accepted for each product based on demand forecasts and fares which are set by the pricing department. Forecasting and

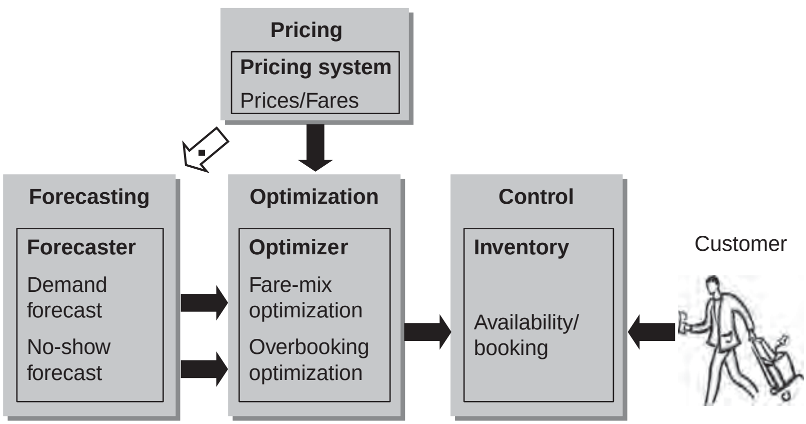

Figure 14.2 Revenue Management modules.

optimization are part of the Revenue Management system. The optimizer calculates availability control parameters like booking limits or bid prices that are sent to the airline's inventory system in order to calculate product availability.

Forecasting

It is worth noting that airline passenger demand is far from being a stationary process. Airline demand shows a lot of variations due to several factors. Beside a long-term trend there are seasonal patterns at different levels of detail. Schedule changes cause some additional disturbances. Moving flight times makes some itineraries more attractive due to better connections while others break up. Also price changes affect the demand as well as special events like fairs and the Olympic Games.

The dynamics of demand require that good forecast methods react quickly to those changes as time series methods like exponential smoothing do. Even better forecast methods try to explain and incorporate part of the dynamics into their model. It improves, for example, forecast quality if seasonal patterns are explicitly modelled into the forecaster. Also robustness is an important aspect in airline demand forecasting. The more unexplainable random variation is in the input data the simpler and more robust the forecast method has to be. Very complex models like multilayer neural networks tend to learn some of the random variations and fail on new data because they are over-trained. A fairly good forecast of tomorrow's weather, for example, is: "The same as today!"

A forecasting system needs several input data for its calculations. Some of them are system automated input data streams; others are user interventions as displayed in Figure 14.3. The users have to feed in information that isn't contained in the historical booking data.

The schedule is used to determine which flights and itineraries have to be forecast. Historical booking curves are the main input data to generate the

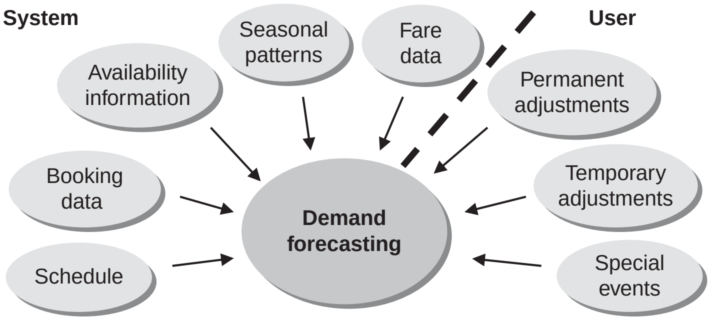

Figure 14.3 Input data for demand forecasting.

demand forecasts. Current bookings of future flights are used to constantly readjust the forecasts to the observed market behaviour. The availability information is used in the unconstraining (also called de-truncation) step that estimates demand based on constrained bookings. Seasonal patterns can either be provided from an external data source or they can be extracted from historical bookings over the last years. Fare data should be used in demand forecasting but many commercial Revenue Management tools don't use it. They let the user translate price changes into demand forecast user influences.

The specific options of manual user interventions depend on the forecasting system in place. The three items in Figure 14.3 serve as an example only. In case of a market change the forecast levels have to be adjusted permanently. Market changes happen, for example, if a new competitor enters a market. Other situations, like a special sale for some weeks, require a temporary adjustment of forecasts in the class of the sale. And finally, there are special events, like the Detroit motor show or public holidays that show completely different demand behaviour than the rest of the year.

The vast majority of Revenue Management literature has been published on optimization methods and not on forecasting. A description and comparison of some basic demand forecast methods can be found in Poelt (1998) and a recent overview is given by Cleophas et al. (2009).

Overbooking

Airlines are faced with the problem that 5–10 per cent of all booked passengers don't show up at departure. Flexible full fare tickets, for example, aren't restricted to a specific flight departure. Business passengers often book several return flights if they aren't sure when their meeting ends and they get no-show for at least one of those flights. Overbooking compensates for no-shows by allowing more bookings than there are physical seats in the aircraft. Overbooking can also compensate for excessive cancellations. Figure 14.4 shows a typical booking curve from start of the booking period until departure.

At the end the net booking curve begins to drop since there are more cancellations than new bookings. At departure the no-shows form an additional drop. Without overbooking the bookings reach capacity at a certain point in time. When later on cancellations and no-shows appear the flight departs with empty spoiled seats that could have been filled with demand. A perfect overbooking limit, in the graph the dotted grey line, allows as many additional bookings as the sum of net demand drop and no-shows. If overbooking is overdone then not all passengers at the gate fit into the aircraft and the airline has to deny boarding some of them.

A simple deterministic overbooking rule calculates the overbooking limit as the capacity divided by the expected show-up rate. If capacity is 100 and

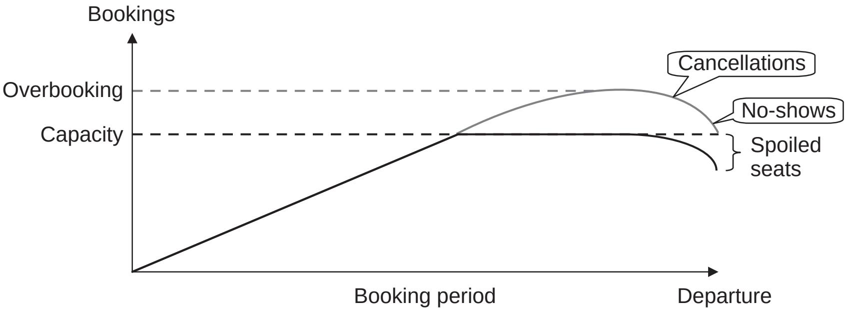

Figure 14.4 Overbooking.

show-up rate is 90 per cent this rule would allow 111 bookings. This simple rule does neither consider the variation in show-up behaviour nor the different risks of spoiled seats and oversales. Sophisticated overbooking methods take spoilage costs, oversales costs and the distribution of the show-up rates into account to come up with a cost-minimizing or revenue maximizing overbooking limit. Beside revenue optimization the capability of the check-in staff to handle lots of denied boardings also have to be considered in overbooking. A good tutorial on probabilistic airline overbooking was written by Netessine and Shumsky (2002) while Klophaus and Poelt (2007) simulate and compare different overbooking models on real airline data.

Optimization

All published Revenue Management optimization methods are based on several simplifying assumptions like "low books before high", which means that demand arrives in increasing fare order. Another important assumption is that demand for a product is independent of the availability of other products. It means that no sell-up or buy-down are going on and that passengers don't choose between competing airlines and products. It also means that rejected demand is lost to the airline and can't be recaptured at other flights. It is clear that this central assumption of traditional Revenue Management is unrealistic, but it helped researchers to tackle the problem and to come up with a solution.

Furthermore, the methods assume that there are no group bookings, no cancellations and no no-shows. In practice those effects are handled in separate modules like a group Revenue Management system and an overbooking module. All these assumptions are wrong and don't hold in practice! Some of them have been relaxed by more enhanced algorithms but practitioners should be careful if a research paper or a vendor presents an "optimum" solution. You should always ask: optimum – based on what assumptions?

Revenue Management optimization methods have been improved over time. They started with Littlewood's rule (Littlewood, 2005) for one leg and two booking classes which was extended by Belobaba's "expected marginal seat revenue" (EMSR) heuristic (Belobaba, 1989) to more than two classes. Later on, other authors (for example, Wollmer, 1992) have formulated an exact solution for the calculation of "optimum booking limits" (OBL).

Interestingly enough, commercial leg-based Revenue Management systems have implemented EMSR instead of OBL. There are several reasons for it. First, an "optimum" method that is based on unrealistic assumptions might not perform better than a heuristic and simulations have shown that the results of EMSR and OBL don't differ too much (Talluri and Van Ryzin, 2004). And second, EMSR is more transparent to the users. The calculated expected revenue for each seat and the resulting EMSR curve can easily be interpreted by flight analysts. A "black box" optimizer like OBL incorporates a high risk that users will destroy the optimization results by overrides and adjustments because they don't trust them.

A more recent and sophisticated revenue optimization method is called dynamic programming (DP). The model is based on the theory of Markov decision processes. The advantage over static methods like EMSR is that DP explicitly takes the demand arrival order into account and does not rely on the "low books before high" assumption. Another advantage is that DP calculates so-called "bid prices" (BP) that can be used for network control which we will discuss next.

Network Revenue Management

Network Revenue Management, also called O&D (Origin and Destination) control became popular during the 1990s when increasing computer power allowed solving bigger and bigger optimization problems. It is especially attractive to network carriers that have a hub and spoke network with a large portion of connecting traffic. The fare structure of network carriers isn't additive. Within the same booking class two different tickets from A to B and from B to C usually are more expensive than a ticket for the connecting itinerary from A to C. It has been proven in many simulations that O&D Revenue Management achieves 1–2 per cent revenue gains over leg Revenue Management. Several network optimization methods have been published in the past (for example, Belobaba et al., 2009).

On the other hand, network Revenue Management is more complex and has significantly higher IT costs. O&D control has to be secured in the GDS by additional costly functions like "married segments control" and "journey data". And the step from leg to O&D is much more than replacing some IT tools. It requires a change of mindset and business processes. If the involved people don't understand and accept the network Revenue

Table 14.1 Demand situations for connecting traffic

Leg 1 demand	**Leg 2 demand**	**Revenue Management control**
Low	Low	Leg control is sufficient
Low	High	O&D control prefers connecting traffic
High	High	O&D control prefers local traffic

Management principles they can destroy the whole benefits by taking wrong actions.

The main drawback of leg control is that it cannot distinguish between local (one-leg) and connecting traffic. Table 14.1 summarizes the benefits of O&D control for two connecting legs and three different demand situations.

If there is low demand at both legs then there is no need for O&D Revenue Management. There is enough space to carry all demand and leg control is sufficient. If there is low demand at one leg and high demand at the other Revenue Management should prefer connecting traffic at the bottleneck leg. Connecting traffic has higher fares and in this situation it doesn't displace other demand at the empty first leg. If there is high demand at both legs Revenue Management should prefer local traffic since two locals in general pay more than one connecting passenger. Leg control can't distinguish between local and connecting traffic within a booking class. It gives the same availability to both.

The main benefits of O&D control are more differentiated availabilities for O&Ds containing a bottleneck leg. The level of control is O&D, itinerary, fare class and point of sale (ODIFPos) that is much more detailed than the leg class level of leg control. The reported 1–2 per cent revenue gains of O&D over leg control depend on several factors including the fraction of high demand flights in the network, the fraction of connecting traffic and the spread within the fare structure.

The enhancement from leg to O&D Revenue Management is a complex task. It is a good idea to break it up into several steps. In general all three steps of Revenue Management, forecasting, optimization and booking control can be either at the leg or the O&D level as shown in Figure 14.5. But not all combinations make sense.

O&D network optimization, for example, needs O&D forecasts. It is necessary to enhance the forecaster before the optimizer. And if you have already implemented O&D optimization it would be bad practise not using it for O&D control. An interesting option is using leg forecasting and leg optimization for O&D control which is possible if the leg optimization algorithm calculates so-called "bid prices". O&D control already achieves about half of

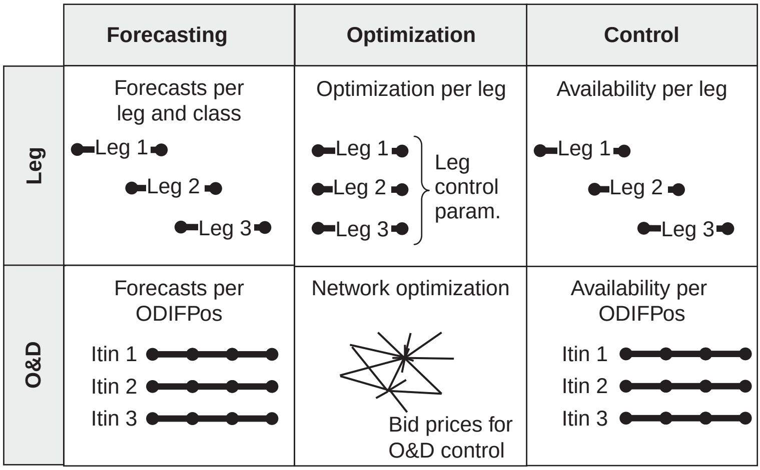

Figure 14.5 Leg and O&D options for the three Revenue Management steps.

the revenue gains of a full network Revenue Management implementation. So a reasonable order is first enhancing the booking control, second the forecaster and as the last step, the optimizer.

Since the GDS can store leg class availabilities only, some enhancements have to be done in order to allow bid price O&D control. Figure 14.6 shows the data flow for an O&D booking request.

First, all availability and booking requests have to be routed to the inventory system. This connection is called "seamless link". In the inventory O&D fares and leg bid prices have to be stored which are provided by the Revenue Management and pricing systems. An O&D booking request can be

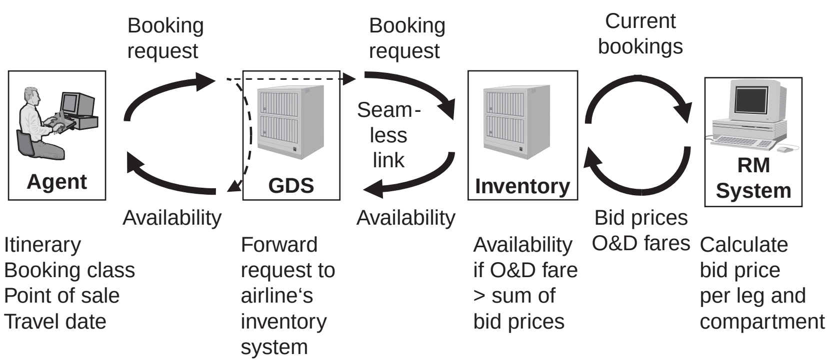

Figure 14.6 Data flow for O&D control.

evaluated by the corresponding O&D fares. Only if the O&D fare of a class is greater than the sum of the bid prices of the concerned legs is this class available.

It is worth noting that the data flow for bid price control consists of two separate loops. The response to a booking request has to be provided within a few seconds. That is the data loop from the agent via the GDS to the inventory system and back. The data loop between the Revenue Management and the inventory system is decoupled and has different triggers for re-optimization like fixed days prior to departure, schedule changes and user activities.

Many connecting O&Ds have little demand due to long connecting times or big deviations in the routing. Only a few passengers that want to fly from London to Oslo, for example, accept a deviation via the hub Frankfurt. In Figure 14.7 all O&Ds have been sorted by decreasing traffic volume of a larger European network carrier. The graph shows that 20 per cent of all O&Ds already cover 90 per cent of all passengers.

It isn't worth forecasting the remaining 80 per cent of low demand O&Ds at the lowest level for two reasons. First, forecasting ten thousands of O&Ds at the ODIFPos level requires substantial investment in hardware and IT infrastructure. And second, forecasting low demand O&Ds runs into the so-called "small numbers problem". If most departures have zero demand it is hard to forecast exactly for which next departure we can expect a booking request. And an average forecast close to zero is wrong for all departures. It is a good idea to aggregate low demand O&Ds to a higher level. This can be done by aggregating overbooking classes and points of sale or by breaking the connecting O&Ds up into their legs.

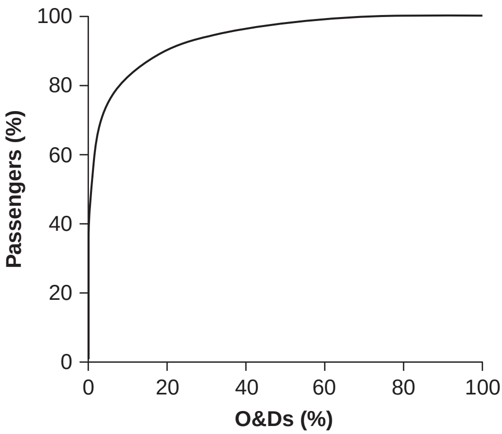

Figure 14.7 Distribution of O&D sizes.

Price-sensitive Revenue Management

The simple price concept of low cost airlines has put pressure on the traditional network carriers to remove or relax some of their fare restrictions. This process can start a revenue spiral down loop as shown in Figure 14.8.

With less fare restrictions lower fares get more attractive even to business passengers that need flexibility. Hence business passengers start buying the lowest available fare instead of the most flexible full fare. The forecaster observes fewer bookings in high fare classes and reacts by lowering the high fare forecasts. The optimizer reacts on the lower forecasts and protects fewer seats in high classes. That increases availability in low classes and the buy-down gets worse and worse.

Without intervention this negative feedback loop leads to a spiral down of revenues and yields. It can be stopped, for example, by manually closing down low fare classes even if the Revenue Management system wouldn't do so. But the better option is to enhance the Revenue Management system in a way that it recognizes and prevents buy-down automatically.

Traditional forecasting in Revenue Management is based on the assumption that each booking class represents a different product and that demand is independent between those products. With this assumption it generates a demand forecast per class based on the historical bookings of the same class.

The left side of Figure 14.9 displays six independent booking classes with Y being the highest one. Y-fare passengers buy Y-class only. They never consider buying cheaper classes M or H. An enhanced price-sensitive forecaster knows that customers choose among different products and that price is one

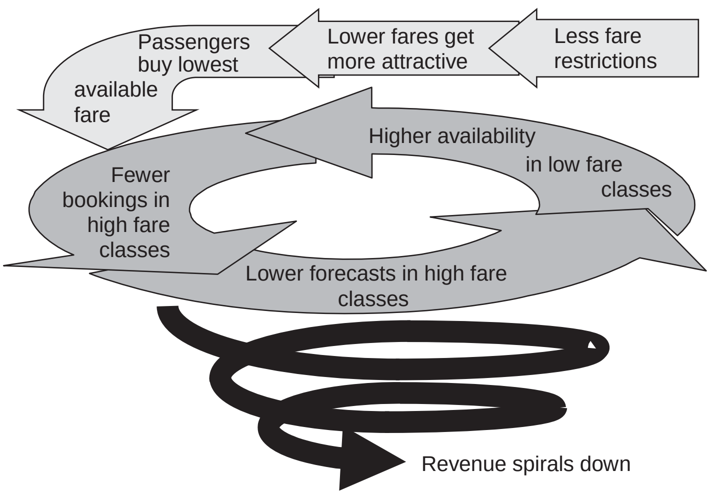

Figure 14.8 Revenue spiral down by inefficient fare restrictions.

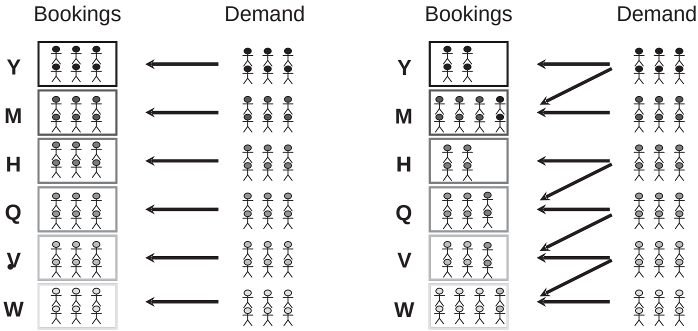

Figure 14.9 Independent versus dependent demand.

of the important choice criteria. It models sell-up to higher classes and buy-down to lower classes. While such a model is more realistic it is also more complex since all those relationships between classes have to be forecast. A price-sensitive forecaster has to predict some form of price elasticity that changes with the mix of leisure and business demand towards departure.

The right side of Figure 14.9 shows dependent class demand. Some passengers who are willing to buy H-class would also buy the cheaper Q-class if it is available and some of Q-class demand considers buying V-class. This example is a very moderate one. In reality more severe potential buy-down can be observed.

More detailed information about Revenue Management methods for less restricted fare structures can be found in Fiig et al. (2010).

Revenue Management and pricing

While the total capacity is relatively fixed at an airline level, passenger demand shows a lot of variation. At a global airline level demand has a seasonal pattern. There are times during the year where total demand is above capacity. During a peak period Revenue Management is most effective by rejecting low fare demand and cherry picking high fare bookings. In low seasons there is excess capacity and Revenue Management is less effective. The goal in low demand situations is to stimulate additional demand by lower fares and special sales, which is a typical pricing task.

Pricing is less researched in the airline operations research literature. One reason is that pricing is the more difficult optimization problem. Revenue Management is simpler because it is myopic in the sense that it is focused on the own airline and more or less ignores competition. Pricing has to take information about the market and about competition into account in order to find the best fare structure. Some airlines and vendors have started pricing simulation projects to predict the impact of fare changes on demand

and revenues, but so far such models have not been really successful and have not been built into commercial pricing systems. First, because the necessary input data about other airlines schedules, fares and availabilities are incomplete and have poor quality. And second, because they require a prediction of the competitors' reaction. If an airline reduces a fare it will observe more demand for it. But if all competitors match the lower fare, then most of the demand increase goes away and only some market stimulation effects remain. Pricing is still mainly based on experience and market knowledge and not so much on automated decision support. Also legal issues prevent an open exchange between airlines on pricing research. Airlines have to avoid any suspicion of price agreements that violates the anti-trust laws. And last but not least, pricing automation increases the risk of price wars.

Table 14.2 summarizes some of the differences between pricing and Revenue Management.

Pricing is focused on fares, fare restrictions and tariffs while Revenue Management deals with bookings (passenger name records, PNRs) and availabilities.

Pricing has the market view and considers competition while Revenue Management is looking at own airline data and capacity restrictions. There is also a difference in the definition of an "O&D". For pricing an O&D is a market – all people that want to fly from A to B and back to A. Revenue Management focuses on itineraries instead of markets. It always has to come down to the specific flight number in order to apply availability parameters. Automated decision support in Revenue Management is done with the help of forecasting and optimization methods as we have seen before. Decision support in pricing has to be based on customer choice models that take all possible travel options into account. Although it is meaningful that pricing and Revenue Management come closer together and merge, they are still two separate departments at many airlines. Integration of both is forced by removing fare restrictions. Without fare restrictions the original pricing task of market segmentation can be achieved only by product availability decisions that are a Revenue Management task.

Table 14.2 Pricing versus Revenue Management

	Pricing	**Revenue Management**
Entities	Fares and restrictions, tariffs, tickets	Bookings, PNRs, availabilities
Focus	Market, competition	Own airline network, capacities
O&D	Market, round trip, point of sale	Itineraries, one-way, directed
Models	Consumer choice model	Forecast and optimization

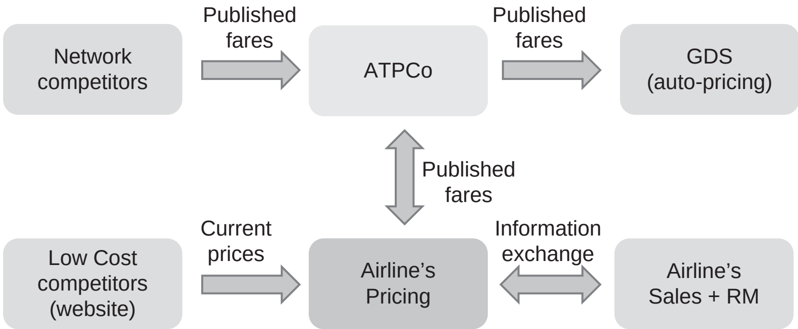

Figure 14.10 Pricing data flow.

Airline pricing can be categorized into active and reactive pricing. Active pricing is mainly applied in the home markets of an airline where it puts a lot of effort into market research, market segmentation and the definition of products that are tailored to different customer groups. The pricing analysts define the price structure with up-sell steps and fare restrictions. They are in constant communication with sales about the markets and are involved in negotiation of corporate deals. Reactive pricing, on the other hand, is common in markets where other carriers dominate and the most important question is: should we match a competitor's fare change? Figure 14.10 shows the fare data flow.

Network carriers that sell via GDS file their fares to a company called "Airline Tariff Publishing Company" (ATPCo). ATPCo collects the published fares and provides them to all GDS for auto-pricing and ticketing. ATPCo also sells the fares back to the airlines which load them into their pricing systems. So the pricing analysts always have a pretty good overview of all published fares in the market. Most low cost carriers don't file fares via ATPCo. They sell exclusively via their website. To get at least some information about their low cost, competition airlines are using web robots that collect current prices from competitors websites. And finally, the sales people can provide the pricing analysts with some information about recent market trends and unpublished market fares of competitors.

Revenue Management developments – summary

Most Revenue Management developments can be seen in the context of relaxing some wrong assumptions of traditional leg-based models as shown in Figure 14.11.

One assumption is independence of demand between booking classes. Price-sensitive approaches remove this assumption and explicitly model

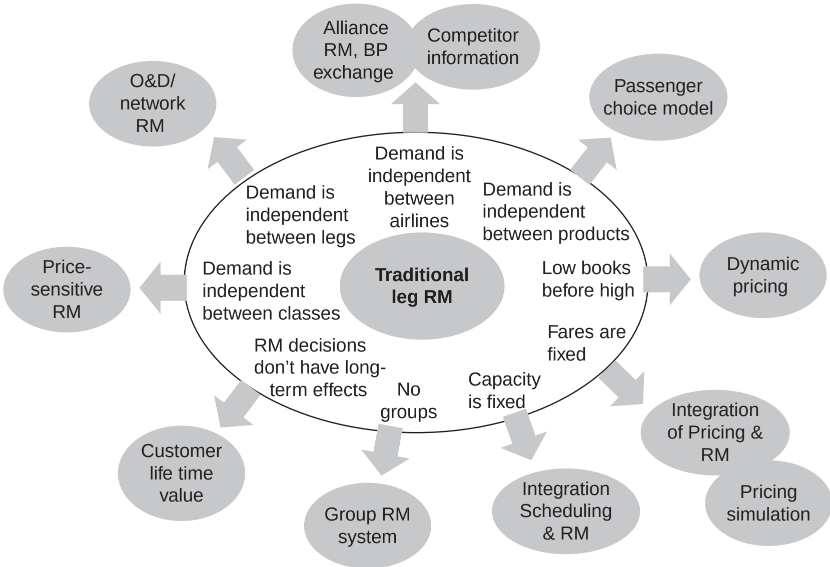

Figure 14.11 Revenue Management developments.

class dependencies. The assumption of independence between legs is relaxed by O&D or network Revenue Management. The "independence between airlines" assumption describes the myopia of Revenue Management that often ignores competition. Some improvements can be achieved by alliance Revenue Management and the incorporation of competitor information. In the future, passenger choice models – as widely used in schedule optimization – might overcome the overall assumption that demand is independent between products.

The assumption that demand arrives in low to high fare order can be removed by optimization methods based on dynamic programming. Most Revenue Management systems optimize on given fares and capacities. A step towards the integration of pricing and Revenue Management could be done by further research on pricing simulation. One example of the integration of scheduling and Revenue Management is continuous fleeting that reoptimizes the fleet assignment several times during the booking period and relaxes the assumption of fixed capacities. The "no groups" assumption can be relaxed by dedicated group Revenue Management tools that should be integrated with the general Revenue Management system. Finally, the assumption that Revenue Management decisions don't have long-term effects on demand could be relaxed by customer lifetime evaluation and customer specific availabilities.

References

American Airlines (1987) *American Airlines Annual Report*. American Airlines, Dallas.

Belobaba, P. (1989) Application of a Probabilistic Decision Model to Airline Seat Inventory Control, *Operations Research*, 37, 183–197.

Belobaba, P., Odoni, A. and Barnhart, C. (2009) *The Global Airline Industry*. New York: Wiley, pp. 102–108.

Cleophas, C., Frank, M. and Kliewer, N. (2009) Recent Developments in Demand Forecasting for Airline Revenue Management, *International Journal of Revenue Management*, 3(3), 252–269.

Fiig, T., Isler, K., Hopperstad, C. and Belobaba, P. (2010) Optimization of Mixed Fare Structures: Theory and Applications, *Journal of Revenue and Pricing Management*, 9(1–2), 152–170.

Isler, K. and D'Souza, E. (2009) GDS Capabilities, OD control and Dynamic Pricing, *Journal of Revenue and Pricing Management*, 8(2–3), 255–266.

Klophaus, R. and Poelt, S. (2007) Airline Overbooking with Dynamic Spoilage Costs, *Journal of Revenue and Pricing Management*, 6(1), 9–18.

Littlewood, K. (2005) Forecasting and Control of Passenger Bookings, *Journal of Revenue & Pricing Management*, 4(2), 111–123.

Netessine, S. and Shumsky, R. (2002) Introduction to the Theory and Practice of Yield Management, *INFORMS Transactions on Education*, 3(1), 34–44.

Poelt, S. (1998) Forecasting is Difficult – Especially if Refers to the Future, *Proceedings of the AGIFORS Reservations and Yield Management Study Group*, Melbourne, Australia, pp. 235–252.

Talluri, K. and Van. Ryzin, G. (2004) *The Theory and Practice of Revenue Management*. Boston: Kluwer Academic Publishers.

Wollmer, R. (1992) An Airline Seat Management Model for a Single Leg Route When Lower Fare Classes Book First, *Operations Research*, 40, 26–37.

15
Setting Optimal Rents for Apartment Firms

Jian Wang

Introduction

Everyday apartment operators have to set rental rates for apartment units. How the rents are determined will have a significant impact on an apartment firm's value, revenue and profits. In this chapter, we introduce an approach to setting the optimal rents based on the theory of Revenue Management. The chapter is organized as follows. We start with an introduction of basic concepts in the apartment industry, followed by a description of a methodology by which the optimal rents can be derived. We then outline the procedure for setting optimal rents, followed by an illustration of a case study. Finally, we conclude this chapter with the implication of this procedure in the practical application of Revenue Management for apartment operators.

Concept

To understand how rents are set in the apartment industry one needs to be familiar with some relevant concepts. In this section, we first introduce the concepts of unit, unit type, base rent, concession, base effective rent, new lease and renewal lease. Then, we describe the Fair Housing Law which prevails in the setting of rents in the USA.

Unit and unit type

An apartment community appears similar to a hotel, but it distinguishes itself in many aspects. An apartment community consists of one or more buildings, each of which has dozens to hundreds of units, depending on the size of the apartment community. A unit is the fundamental product that the apartment company can provide to its prospective tenants.

The units in an apartment can be classified into different types according to their common attributes. For example, the units can be classified by the attribute of the number of bedrooms. For each unit type, its units can be further differentiated with their associated amenities such as pool view, washer/dryer, fireplace and so on.

Base rent, concession and base effective rent

An apartment unit is often rented on a monthly basis. The monthly rent for each unit is determined individually based on the base rent, amenities and concession. A base rent represents the fundamental rent. Every individual unit within a unit type has the same base rent. On top of the base rent, the monthly rent for each unit is derived by taking into account its own amenities.

An apartment often offers concessions as discount incentives to attract prospective tenants or retain existing residents. There are two types of concessions: upfront and recurring. An upfront concession is a one-time discount. It is frequently presented in the form of "free-rent for the first month." A recurring concession, on the other hand, is a multi-time compensation. For example, a recurring concession can be offered as "$50 off each month's rent."

When a concession is in place, the monthly rent that a tenant actually pays might be much less than what was advertised. As a consequence, the base rent from which the monthly rent was derived becomes lower. Therefore, the term of base effective rent is used to define the net value of base rent, which is the base rent adjusted by the concessions.

In this chapter, the optimal rent will be set for the base effective rent only. The terms of rent or rental rate will be used to represent the base effective rent interchangeably hereafter.

New lease and renewal lease

Before a prospective tenant moves into an apartment, he is required to sign a new lease. A new lease is in essence a contract between the tenant and the apartment company. Besides standard legal terms, a new lease specifies the information relevant to the stay of a tenant. For instance, it records the move-in date, lease term in months, unit number, rental rate and so on.

Around 45 to 60 days before a lease expires, a tenant is required to notify the apartment about his decision. He can choose to move out as planned or to stay for additional months. If the tenant decides to stay, a renewal lease will then need to be signed. The content of a renewal lease is similar to that of a new lease.

It is worthwhile pointing out that each lease, new or renewal, ties up a large portion of revenue in an apartment's total revenue inventory. This is because a lease often lasts for months, during which it continues contributing to the revenue inventory from its monthly rent. Therefore, setting the rents becomes risky since the rents to be decided will remain effective for months.

Fair housing law

In the apartment industry, the setting of rents has to comply with relevant laws. The Fair Housing Act is one of such laws in the USA. This law was passed in 1968. It attempts to protect the dwelling seekers from landlord discrimination. When applied to the apartment industry, this law requires that the same rent be quoted whenever two prospective tenants are enquiring about the same product at the same time. A product here is defined in terms of unit number, lease term and move-in date.

In the hotel industry, such regulations do not exist. Same hotel products can be priced differently. Customers are often segmented explicitly by being offered different room rates for the same room. In the apartment industry, however, this kind of customer segmentation becomes prohibitive because of this Fair Housing Act. Prospective tenants are instead “segmented” implicitly by their willingness to pay. Specifically, all of the prospective tenants are offered the same rent. The amount of rent is leveraged such that the undesired prospective tenants are filtered out according to their valuations of the product. This kind of rent setting allows the apartment operators to sell the right products to the right prospective tenants.

Methodology

We focus our discussion on setting the optimal rents for new leases. The determination of optimal rents takes into account the factors of competitive influence, market condition and capacity limitation. In this section, three determining variables are first identified, followed by an analysis of the relationship between the variables and the optimal rent. An illustration is then given on how optimal rents can be optimized.

Variable identification

Many variables can be used to determine the optimal rents. Some of these variables may be known, but most of them are unknown. To apply the principle of Revenue Management, we identify three such variables as reference rent, demand and supply.

The variable of reference rent defines the “economic value” of an apartment unit in the market. This variable is identified based on a belief that there exists an average rent in the market, by which the rents are often set. In reality, such existence of reference rent is not observable. The use of reference rent, however, prevails among apartment operators when they set rents. Thus, the value of reference rent to be used has a significant impact on the revenue to be realized.

The variable of demand reflects the market conditions. This variable represents the possible number of leases that an apartment may expect. Two kinds of demand are normally defined: unconstrained demand and constrained demand. Unconstrained demand is defined as the number of leases that could be realized at the reference rent under the assumption that the apartment had infinite capacity. Constrained demand, on the other hand, is defined as the number of leases that can be realized at the optimal rent in the consideration of capacity limitation.

Finally, the variable of supply represents the number of units available for rent. This variable indicates the number of units that can be used to satisfy the demand.

Relationship between variables

The variables of reference rent, demand and supply do not work alone. They interact with each other to determine the optimal rent. We briefly discuss the relationship among the variables and the optimal rent.

Demand and rent

It is widely believed that a strong relation exists between demand and rent. The assumption of a monopoly market is often used to describe such a relationship. In a monopoly market, demand is expected to decrease as rent increases. How demand changes over rent depends on the rent elasticity of demand.

The rent elasticity of demand is defined as the ratio of the percentage change in demand to the percentage change in rent. Denote β is constant for all rents. This assumption of constant elasticity may not be suitable when rent can vary in a wide range. However, when rent only changes within a small range, this assumption is justifiable. It will soon become apparent that the optimal rent will be optimized around a small range of the reference rent. This use of constant elasticity, therefore, seems appropriate.

From the definition of β, it can be derived that the demand of d and the rent of p satisfy the function of $d(p) = Cp^{-\beta}$, where C is an unknown parameter. As an example, Figure 15.1 illustrates this function with $C = 2$ and $\beta = 0.125$. It can be seen that demand is decreasing as rent increases.

Demand and supply

Demand is assumed to vary over rent, but its realization will be subject to many factors. As previously assumed, the realization of unconstrained demand was not limited by the apartment capacity. In reality, however, such an assumption is unrealistic. The realization of demand is always limited by the capacity. In other words, the apartment capacity limits the total number of units that can be occupied by the demand. In particular, the total number of units to be occupied by the constrained demand at the optimal rent must be less than or equal to the supply.

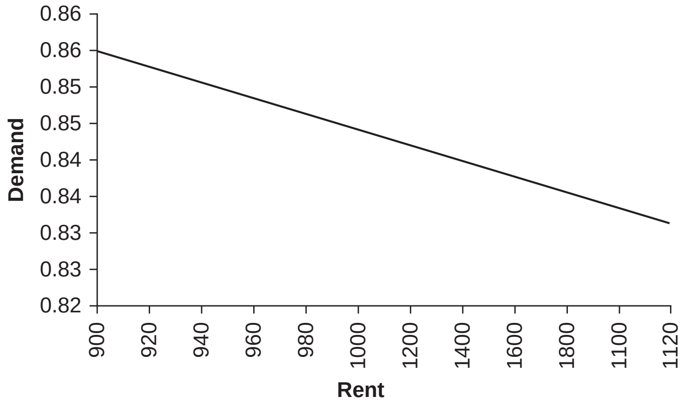

Figure 15.1 Function of $d(p) = Cp^{-\beta}$ with $C = 2$ and $\beta = 0.125$.

Reference rent and optimal rent

Reference rent is defined as the representation of average rent in the market. Therefore, the optimal rent should be determined within a small range of the reference rent. If this is not the case, the optimal rent that is otherwise determined would become unrealistic in reflecting the market condition. The range of reference rent can be expressed as a rent interval. The lower bound and upper bound of the rent interval represent the minimum rent and maximum rent between which the optimal rent can be set. Accordingly, by the relationship between demand and rent, a demand interval can be mapped from the rent interval. The demand interval defines a range within which the constrained demand will vary. The lower bound and upper bound of this demand interval will correspond to the upper bound and lower bound of the rent interval, respectively.

How optimal rent is set

The relationship between the variables and the optimal rent can be illustrated as in Figure 15.2.

In Figure 15.2, the x-axis denotes rent and the y-axis demand. The solid line depicts a segment of the function of $d(p) = Cp^{-\beta}$, where d represents demand and p rent. The horizontal dashed line represents the supply. On the x-axis of rent, the labels of *ref*, min and max denote the reference rent, the lower bound and upper bound of the rent interval, respectively. On the y-axis of demand, the labels of *unc*, min and max denote the unconstrained demand, the upper bound and lower bound of the demand interval, correspondingly.

The revenue to be gained at the rent of p can be expressed as $R(p) = pd(p)$. The optimal rent will be determined within the rent interval of [min, max]

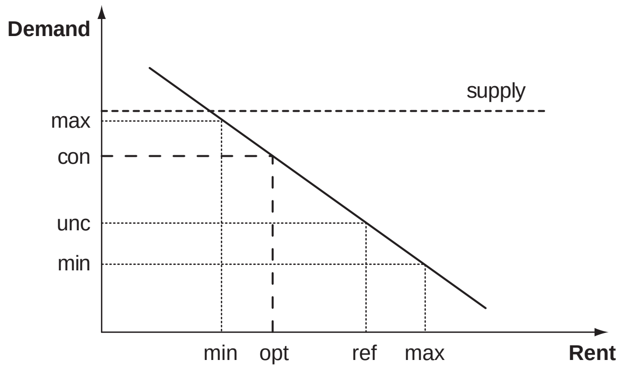

Figure 15.2 Relationship between the variables and the optimal rent.

such that the revenue of $R(p)$ is maximized under the limitation of supply. In the example of Figure 15.2, the unconstrained demand at reference rent is less than the supply. In an attempt to maximize the revenue of $R(p)$, the optimal rent of *opt* on the x-axis is optimized to be less than the reference rent. As a result, the corresponding constrained demand of *con* on the y-axis is increased above the unconstrained demand.

Procedure

The preceding analysis gives us a better understanding of how the optimal rent can be determined using the variables of reference rent, demand and supply. Since the values of these variables are not known, they need to be estimated. In this section, we describe a procedure to estimate the reference rent, forecast the demand and predict the supply. We then solve the optimal rent by formulating an optimization problem.

Estimate reference rent

As pointed out previously, the reference rent variable is an abstract notion. Its value can never be observed in reality. This situation creates a dilemma. It makes the estimation of reference rent and its accuracy measurement almost impossible.

Several methods have been proposed to estimate the reference rent. Rent surveying is one of such methods. This method estimates the reference rent based on the survey results from the participants of apartment operators and experts. The use of this method is costly and time-consuming. Also, the resulting estimate of the reference rent tends to be biased. This is because the survey participants may have very different perspective and experience.

To circumvent this dilemma, we opt to adopt a heuristic method. This method is built based on business rules. It is simple to understand and easy to implement. A variant of this method has been used in practice for several years, and the results seem satisfactory.

This method starts with the identification of business indicators, which are believed to account for the determination of reference rent. A set of business rules is then specified according to the possible outcomes of the indicators. Each rule formulates how the reference rent should be estimated from the current rent, where the current rent represents the average base effective rent that the tenants have paid recently. In the following, two business indicators of market composite and leasing velocity are explained.

The indicator of market composite gives a representation about what competitors are pricing. Nowadays very few apartments can afford pricing without considering competition. This indicator helps an apartment operator understand its competitive position in the market. The estimation of market composite starts with the selection of the right competitors. Relative to the apartment, each competitor is assigned with a weight based on its importance. The competitor rents are collected and then adjusted by the feature difference between the competitors and the apartment. The estimation of this indicator will result from the weighted average of adjusted competitor rents.

The indicator of leasing velocity, on the other hand, measures the speed by which the units have been leased recently. Intuitively, a "normal" speed of leasing velocity is preferred. If this indicator shows that the units have been leased too fast or too slow, it is likely that the current rents might have been set too low or too high. The estimation of this indicator can be derived based on the observations of ratios converting requests to actual leases.

The use of this heuristic method can be illustrated with a simple example. Suppose that an apartment's current rent is \$1000. Assume that it has identified two competitors A and B, each of which has identical features as the apartment. This means that no rent adjustment is needed. Furthermore, assume that the competitors have equal importance, resulting in the same weight of 50 percent each. If the competitors of A and B are now offering the rents of \$800 and \$1000, respectively, then the value of market composite will be estimated as $\$900 (= \$800 * 50\% + \$1000 * 50\%)$.

In addition, assume that the indicator of leasing velocity is estimated as "fast," meaning that the units have been leased too fast. In this case, a business rule can be formulated to maintain the reference rent the same as the current rent. The estimate of reference rent will thus become \$1000. This means that the reference rent will continue staying the same as the current rent regardless of the situation that the competitor of A is somehow dropping its rent dramatically.

Forecast demand

The variable of demand is defined as the unconstrained demand at the reference rent. Similar to the variable of reference rent, this variable is also a theoretical notion. This again makes forecasting and justifying the demand difficult. The accuracy of the resulting demand forecast has a direct impact on the setting of optimal rent, thus affecting the realization of revenue gain.

A number of methods are available to forecast the unconstrained demand. Each method has its own strengths and weaknesses. For instance, the exponential smoothing method is often used in practice because of its simplicity. We will not discuss how to forecast the unconstrained demand in detail here. Instead, we focus our attention on "correcting" the number of leases observed, based on which forecasting models will be built.

In practice, the number of leases are often realized under the restrictions of capacity and rent. The capacity restriction caps the number of leases to be realized up to the capacity, whereas the rent restriction materializes the leases at the rental rates other than at the reference rent.

To forecast the unconstrained demand, the observed number of leases needs to be "corrected" or "unconstrained" by relaxing the two restrictions. The correction can be done in two sequential steps. The first step is to unconstrain the number of leases by removing the capacity restriction. The second step is to estimate the number of leases by relaxing the rent restriction, based on the corrected number of leases from the first step. In any Revenue Management textbooks, many methods, including expectation-maximization (EM), can be found to accomplish the first step. We now illustrate a method to fulfill the second step.

Denote $\mathrm{d}(p)$ and $\mathrm{d}(r)$ as the numbers of leases at the rent of p and at the reference rent of r, respectively. Assume that both of them satisfy the functions of $d(p) = Cp^{-\beta}$ and of $d(r) = Cr^{-\beta}$, where C is an unknown parameter, and β is a constant rent elasticity of demand. It can be derived that

$$\frac{d(r)}{d(p)} = \left(\frac{p}{r}\right)^{\beta} \tag{15.1}$$

Arranging the above equation results in the following expression:

$$d(r) = d(p) * G(r, p) \tag{15.2}$$

where $G(r, p) = \left(\frac{p}{r}\right)^{\beta}$ denotes the price elasticity factor. This factor relates $d(r)$ to $\mathrm{d}(p)$ in a desired manner. Specifically, when $p = r$, the value of $\mathrm{G}(r, p)$ becomes one, resulting in $\mathrm{d}(p) = d(r)$. This means that the demand at the rental rate is equal to that at the reference rent when the rental rate is equal to the reference rent. When $r > p$, the value of $G(r, p)$ becomes less than one, resulting in $d(r) < \mathrm{d}(p)$. This means that the demand at the reference rent is less than that at the rental rate when the reference rent is larger than the rental rate. This result complies with the monotonic property as expected. In a similar manner, $G(r, p)$ behaves as anticipated when $r < p$.

Now, denote $\hat{d}(r)$ as the estimate of d(r) from the first step where the capacity restriction is unconstrained. From equation (15.2), d(r) can be estimated from $\hat{d}(\hat{r})$ via the use of $G(\hat{r}, p)$ as follows:

$$\hat{d}(\hat{r}) = d(p) * G(\hat{r}, p) \tag{15.3}$$

where $\hat{r}$ denotes the estimate of r, and $G(\hat{r}, p) = \left(\frac{p}{\hat{r}}\right)^{\beta}$. Here r is replaced by $\hat{r}$ because r is unknown.

It is noted that $G(\hat{r}, p)$ involves the use of an unknown price elasticity of β. The β can be estimated using statistical or surveying methods. Its estimation is beyond the scope of this chapter.

Forecast supply

Supply forecast represents the number of units to be available for rent. It can be expressed as follows:

$$\text{supply forecast} = \text{vacant units} + \text{early terminations}$$

where the term of vacant units represents the number of units currently vacant, and the term of early terminations is the possible number of units to be available due to early move-outs.

In this forecasting of the supply forecast, we only take into account the possible number of units due to the early move-outs. One may wonder why we do not consider the possibility of late move-outs. The reason is that the scenario of possible late move-outs rarely happen in practice. As pointed out previously, before a tenant's lease expires, he is required to notify the apartment office about his decision typically 45–60 days in advance. This tenant has two choices: move out of the apartment as leased or renew his lease for another term. In either case, the likelihood of late move-outs is eliminated.

Optimize rent

Now that we have estimated the reference rent, and forecasted the demand and the supply, we can now find the optimal rents. The optimal rents can be solved by formulating an optimization problem. An optimization problem consists of two parts: objective and constraint. The objective part specifies the total revenue from the constrained demands, which needs to be maximized. The constraint part, on the other hand, specifies a set of conditions that the constrained demands need to satisfy.

For illustration purpose, the optimal rents will be solved for one unit type, a single lease term of 12 months, and a planning horizon of 13 weeks. The determination of optimal rents can be easily extended to multiple unit types, various lease terms and different lengths of planning horizon.

Denote p_t as the optimal rent, and d_t as the corresponding constrained demand for the week of t. According to equation (15.3), we have the relationship of $\hat{d}(\hat{r}_t) = \mathrm{d}(p_t) * G(\hat{r}_t, p_t)$, where $\hat{r}_t$ represents the estimate of reference rent r for the week of t, and $\hat{d}(\hat{r}_t)$ the forecast of unconstrained demand at $\hat{r}_t$. Therefore, the optimal rent of p_t can be expressed as follows:

$$p_t = \hat{r}_t \left(\hat{d}(\hat{r}_t)\right)^{\frac{1}{\beta}} (d_t)^{-\frac{1}{\beta}} \tag{15.4}$$

where d_t denotes the corresponding forecast of constrained demand at p_t.

In contrast to equation (15.3), equation (15.4) expresses the optimal rent of p_t as the function of the constrained demand of d_t. In this way, the optimal rent of p_t can be derived once the constrained demand of d_t is determined.

We now build an optimization problem to solve the constrained demand of d_t. The objective part is formulated as follows:

$$\max \text{Revenue} = \sum_{t=1}^{13} p_t * d_t \tag{15.5}$$

By substituting the p_t from equation (15.4) into (15.5), we then have:

$$\max \text{Revenue} = \sum_{t=1}^{13} \hat{r}_t \left(\hat{d}(\hat{r}_t)\right)^{\frac{1}{\beta}} (d_t)^{1-\frac{1}{\beta}} \tag{15.6}$$

The constraint part consists of two groups of equations. The first group of equations is formulated as follows:

$$\sum_{\tau=1}^{t} d_\tau \leq s_t, \quad \text{for } t = 1, \ldots, 13 \tag{15.7}$$

where s_t denotes the supply forecast for the week of t. This group of equations indicates that the numbers of units to be occupied by the constrained demands of d_t must be less than or equal to the supply forecast.

The second group of equations is formulated as follows:

$$\mathrm{LB}_t \leq d_t \leq \mathrm{UB}_t, \quad \text{for } t = 1, \ldots, 13 \tag{15.8}$$

where LB_t and UB_t denote the lower and upper bounds of the demand interval of the constrained demands of d_t. They can be derived from the rent range of p_t via equation (15.4), where the rent range can be specified according to practical business requirements.

The equations (15.6) to (15.8) build a non-linear optimization problem. The constrained demand of d_t can be solved with any optimization solvers.

After d_t is solved, the corresponding optimal rent of p_t can be derived easily from equation (15.4).

A case study

In this section, we illustrate how the above procedure is applied to an apartment in Atlanta, USA. This apartment has 183 units of one-bedroom unit type. The optimal rents are set on 26 November 2008 for a planning horizon of 13 weeks.

Figure 15.3 displays the demand forecast and the supply forecast. In this graph, the dots represent the unconstrained demand forecast at the reference rent. The solid line denotes the numbers of units to be occupied from these unconstrained demand forecasts, whereas the dashed line indicates the supply forecast.

It can be seen that the supply forecast is much higher than the units to be occupied by the unconstrained demand. One reason is that this planning horizon of 13 weeks happens to cover a season of low demand. This horizon includes the holidays of Thanksgiving, Christmas and New Year. Very few people are interested in moving in Atlanta during this time of year.

Because of the excessive supply during this horizon, a natural response might be to decrease the rents in an attempt to stimulate some additional demand to fill in the vacant units. The question becomes now, how much to decrease the rents? In Figure 15.4, the optimal rents and the reference rent are displayed for the lease terms of 8 and 12 months, respectively. The

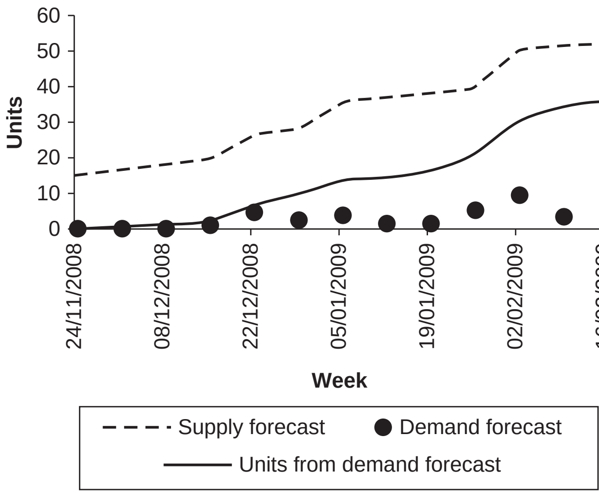

Figure 15.3 Demand and supply forecast.

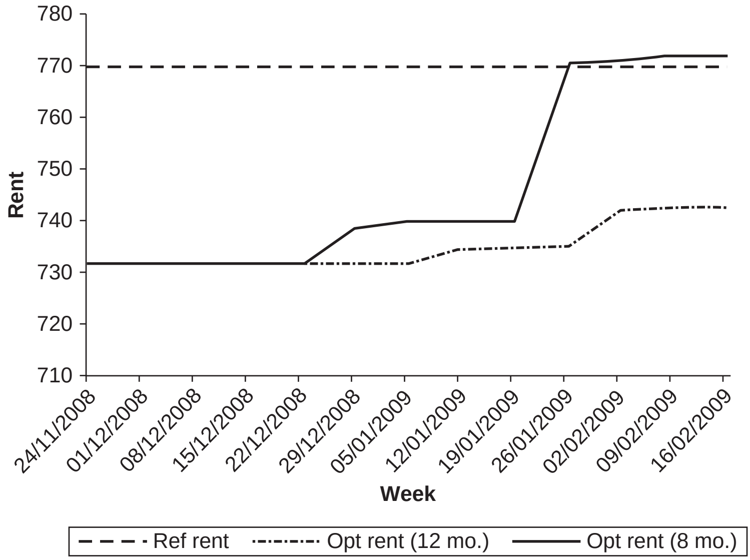

Figure 15.4 Optimal rents by lease terms.

dashed line denotes a constant reference rent for both of the lease terms, while the two solid lines each represent their optimal rents.

This planning horizon can be viewed as two periods, each of which demonstrates a different behavior of the optimal rents. During the period of the first five weeks, the optimal rents for both lease terms have been set \$40 lower than the reference rents. The attempt to set such lower rents is to stimulate demand to fill in the vacant units. During the period of the last eight weeks, the optimal rents have been set as increasing. In particular, the optimal rents for the lease term of eight months are set above the reference rents during the last three weeks. The reason is that the demand from the first period might have been filling the vacant units, and thus less demand needs to be encouraged.

Corresponding to the optimal rents, the optimal demand forecasts or constrained demand forecasts can be derived accordingly. The realization of these optimal demand forecasts will fill in the vacant units from the supply forecast.

Figure 15.5 displays the units to be occupied by the unconstrained demand forecasts versus those by the constrained demand forecasts. In this graph, the triangular symbols represent the optimal demand forecasts, whereas the solid line denotes the numbers of units to be filled in by these optimal demand forecasts. In addition, the dashed line represents the number of units to be occupied by the unconstrained demand forecasts. It can

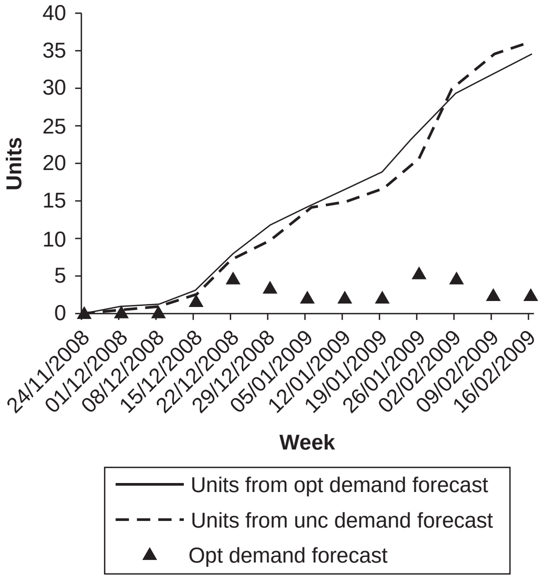

Figure 15.5 Optimal demand forecast versus unconstrained demand forecast.

be seen that for the first ten weeks, the number of units to be occupied by the optimal demand forecasts are more than those by the unconstrained demand forecasts. This is because the optimal rents are set below reference rents to encourage the demand. For the last three weeks, the number of units to be occupied by the optimal demand forecasts become less than those by the unconstrained demand forecasts. This is because some optimal rents, say, for lease term of eight months, are set above the reference rents to discourage the demand.

Conclusion

We have described an approach to setting the optimal rents for apartment firms based on the theory of Revenue Management. This approach has been favored to be a better alternative to the traditional methods in practice. In the case study above, the optimal rents are set by Lease Rent Options (LRO). The LRO is the first Revenue Management system in the apartment industry. Provided by the Rainmaker Group in Atlanta in the USA, this system implements a variant of the procedure as described, but it is more sophisticated. This system has been used by a handful of leading apartment companies in the USA for several years. The outcome appears promising. It is reported that an average of 3 percent of revenue has been increased over the traditional approaches.

16

Practical Pricing and the Restaurant Industry: Application of Revenue Management Principles to Pricing Menus and Services

Sunmee Choi

Introduction

Pricing is an important strategic lever for a firm's profitability. The bottom line impact of pricing is well demonstrated by the fact that a mere 1 percent increase in price can lead to 15–20 percent increase in the bottom line when no increase in cost and no decrease in demand can be assumed. For example, for a product the current price of which is $10.00 and profit margin is 5 percent ($0.50), when the price of this product increases 1 percent from $10.00 to $10.10, the price increase of $0.10 goes directly to the profit since no cost increase is assumed. This 1 percent increase in price results in an increase in profit by 20 percent ($0.10/$0.50).

Pricing has a significant impact not only on bottom line profit but also on top line revenue. As illustrated by the relationship curve between price and the amount of demand, the pricing level influences the amount of revenue generated. When variable or multiple pricing is used, the number of different prices offered and the spread between those multiple prices also can have a significant impact on the amount of revenue generated.

Pricing is also an effective means to influence consumer choice decisions among alternative products offered by a firm and among alternative times of usage of service provided by a firm to help a firm maximize revenue. Specifically, when multiple products of a similar nature are offered simultaneously, pricing can be used to drive consumer purchase decisions from a less profitable product to a more profitable one. Further, when the amount of demand varies substantially between different time periods, pricing can be used to trigger demand to move from strong demand periods to weak demand periods so that firms can capture as much demand as possible.

In this chapter, Revenue Management perspectives will used in discussing how the restaurant industry can use this power strategic lever of pricing in order to increase both top line revenue and bottom line profit and also to influence consumer choice decisions among alternative product offerings and among alternative times of usage.

Revenue Management and the restaurant industry

Revenue Management is a tool for a capacity-constrained service firm to balance time-perishable supply and time-variable demand toward the goal of maximizing revenue (Kimes, 1989). What is meant by a capacity-constrained service firm is that a firm that sells services is limited in its capability to change the size of capacity. For example, a hotel with 100 rooms always has 100 rooms as its capacity no matter how strong or weak demand might be. The same is true for restaurants. For example, if a restaurant has 100 seats, it is difficult at large to increase the number of seats as demand increases or decrease it as demand decreases. Hence, in order to match supply and demand, capacity-constrained service firms should focus on managing demand rather than capacity. Pricing is known as a very effective tool to manage demand.

What is meant by time-perishable supply is that what a firm has available to sell disappears as time passes by. Airline seats are a good example. When an airplane takes off with an empty seat, the seat itself does not disappear but the opportunity to sell that seat and generate revenue disappears forever. The same applies for an empty seat in a restaurant. When time passes by with a seat empty, the opportunity to generate revenue from that seat during that time disappears. When this is the case, in order to maximize revenue, it is important for the firm to stimulate demand for the seat, which would otherwise go unsold and generate no revenue, as long as at least the following three conditions are satisfied. First, the selling price is higher than the variable cost of selling that seat. Second, this new price, usually lower than the regular price, does not allow regular customers to trade down and pay this new low price rather than the regular price. Third, this new price does not lower the customer perceived value of the service.

Time-variable demand means that the amount of demand varies significantly by different times of day, week or month. For example, the amount of demand for a restaurant typically varies substantially by time of day. Demand is usually strong around meal time periods and weak or none outside these period. When this is the case, it is very challenging for a capacity-constrained firm to match supply and demand. In order to maximize revenue, different strategies need to be employed depending on the amount of demand relative to supply. Further, management attention needs to be paid to moving demand from peak periods to slow periods. Again, pricing can be a very useful tool for moving demand.

Since Revenue Management is a tool to help firms balance supply and demand, for a better understanding of how Revenue Management approaches firms to help maximize revenue, it first needs to be defined what supply is for a given industry and for a discussion about the two scenarios where the balance is broken.

Supply can be defined as what firms sell in return for price. From the perspective of matching supply and demand for capacity-constrained firms whose opportunity to generate revenue from selling its offering disappears as time passes by, supply needs to be defined in consideration of capacity and time factor. In other words, the definition of supply needs to include the factor that most limits the firm from generating more revenue and outside the immediate control of the management. For restaurants, it might be the number of seats (seating capacity), rather than the amount of food available (kitchen capacity) or the number of workers (staffing capacity). When the most constraining factor, seat, is combined with the time factor, the supply of restaurants is seat hour. Therefore, the goal of restaurant Revenue Management should be maximizing revenue per available seat hour (Kimes et al., 1998).

Now let's think about the two scenarios where the balance between supply and demand is broken. One is where demand exceeds capacity and the other is where there is no sufficient demand to fill the capacity. Revenue Management recommends that a differentiated set of strategies be employed between the two scenarios.

In the former scenario, since not all demand can be accepted, when assuming not all demand is equally profitable, management needs to decide which mix of demand should be accepted versus turned away. In restaurants, for example, management needs to study their customers and assess the profitability of different segments of customers and try to accept only the most profitable mix of customers. One way to make this possible is to use pricing. Specifically, by pricing menus higher during peak periods or by making only high profit margin menu items available during this period, restaurant managers can encourage customers who are willing to pay higher prices to come during peak periods and discourage those who are not and try to move them to slow periods when menu prices are lower or lower price menu items are available.

In the latter scenario when there is no sufficient demand to fill the capacity, all demand needs to be accepted. Further, management should focus on stimulating more demand for their excess supply whose revenue potential disappears as time passes by. Again pricing can be a very effective tool to stimulate demand. Specifically, by offering lower prices or additional value for the given price, demand from segments which are more price-sensitive can be stimulated. Early bird specials are a good example. Restaurant customers do not usually want to dine for dinner earlier than 6 pm. Consequently, restaurants are empty before 6 pm. To stimulate demand during this period, early bird specials are offered in the form of discounts such as a certain percentage off the total bill or in the form of added value such as free appetizers or drinks.

In this section, what Revenue Management is has been discussed and how pricing relates to this definition. Further, how the definition applies to the general service industry and specifically to the restaurant industry with particular attention paid to pricing strategies has been explained. In the next section, it will be illustrated how Revenue Management can be applied to the restaurant industry, and what types of the various restaurant industry specifically, and which Revenue Management-driven pricing strategies can be used.

Restaurant Revenue management and Revenue Management-driven pricing

Restaurant Revenue management is defined as selling the right menu and/or seat to the right customer, at the right price, at the right time so as to maximize revenue (or contribution) (Kimes et al., 1998). "Right" in this definition means maximizing revenue for restaurants and maximizing value for customers. Maintaining the balance between these two is critical for the long-term success of restaurant Revenue Management. Further, what is "right" for the firm can be very different between busy periods and slow periods. During busy periods, the best strategy to increase revenue is to increase table turns so that as many customers as possible are served. During slow periods, however, table turnover is not a concern at all and rather encouraging customers that are already in the restaurant to spend as much as possible, and creating more demand is the major concern. Menu offering decisions and menu pricing decisions should be made with these differentiated goals and strategies in mind.

There exist diverse approaches in pricing menus. The cost-plus-margin approach is the most basic and most widely accepted approach. This approach is simple and easy, but is driven only by internal operations perspectives and does not consider the price the market is willing to bear. The customer or market-driven approach, which recommends pricing according to what customers are willing to pay, is another approach recently being explored. This approach assumes that different segments of customers have different needs and wants, and therefore the perceived value of essentially the same product or service can be largely different between segments. Hence, it is suggested that pricing decisions reflect such differences in perceived values. The demand-dynamics-driven approach, which considers the dynamics in the amount of demand among different menus as the price of a certain menu item changes, has also been explored, particularly in the chain restaurants (Rougie, 2007). According to this approach, a particular entrée can be priced in a way to drive some of its demand toward another target, usually a more profitable, entrée item.

The goal of this chapter is to explain the Revenue Management-driven pricing approach. This approach embraces the three previously mentioned pricing approaches, but takes a much broader view of pricing and considers in pricing not only demand itself but also capacity and tries to balance the two toward the goal of maximizing revenue. The Revenue Management-driven pricing approach consists of at least three dimensions: optimal pricing, menu re-engineering and variable pricing. Optimal pricing guides the question of whether each menu is priced at its best possible price to help a restaurant maximize revenue. Menu re-engineering guides the question of whether the best mix of menu items is being offered from revenue maximization perspectives. Variable pricing guides the question of whether menus are priced to capitalize the differences in willingness to pay price across different segments of customers.

Pricing strategies of restaurant Revenue Management

In this section, each dimension of the Revenue Management-driven pricing approach will be explored.

Optimal Pricing

Think of a pricing experiment (Kelly et al., 1994). Currently, a fish entrée is priced at $8.95. Management wonders whether $8.95 is the right price to charge. In order to experiment with different prices for the fish entrée, management kept the prices of all other entrée items the same and varied the price of this fish entrée alone. As shown in Table 16.1, the results look interesting.

From pricing perspectives alone, it seems that the price of the fish entrée on Friday could be raised to $10.95 with no negative impact on the amount of demand for it. When price increased by $2 from $8.95 to $10.95, demand (proportion of demand) increased from 34 (14 percent) to 47 (24 percent). Demand for the fish entrée seems to have rather increased as a result of the

Table 16.1 Results from a pricing experiment in a restaurant[1]

		$8.95	**$9.50**	**$9.95**	**$10.95**	**Total**
Friday	Fish	34	58	31	47	170
	Total entrée	240	242	184	200	866
	Proportion	0.14	0.24	0.17	0.24	0.20
Saturday	Fish	16	10	9	10	45
	Total entrée	199	143	138	175	655
	Proportion	0.08	0.07	0.07	0.06	0.07
Total	Fish	50	68	40	57	215
	Total entrée	439	385	322	375	1521
	Proportion	0.11	0.18	0.12	0.15	0.14

[1]Adopted from Kelly et al. (1994).

price increase on Fridays. The picture seems slightly different for Saturdays. The overall picture across Fridays and Saturdays is, however, consistent with the picture for Fridays. This experiment outcome should surely challenge the management as to whether the current fish entrée price of $8.95 is right. If the pricing was based on costs, it might be time to consider the price customers are willing to pay.

Caution should be taken in implementing the seemingly ideal change in prices based on the result of this experiment however. A few questions need to be asked. First, is it desirable to increase demand for the fish entrée? From which entrée did the demand move from? If the fish entrée is a more profitable menu item than the other item from which the demand moved, the answer might be yes. If contrary, the answer might be no. Second, what is the impact of such a price increase on the other meal courses? When charged a higher price for the fish entrée, do people not order as many appetizers or desserts anymore? If not, the increase in price could mean decreased total revenue for the restaurant. Most importantly, did such a price increase cause any impact on customer value perceptions of the restaurant service? In other words, will customers return to restaurants just as much as before even after the price increase? If not, the long-term revenue impact of such a price increase might be detrimental.

Menu Re-engineering

What might be as important as pricing each menu item right is offering an optimal mix of menu items. The most commonly used management tool for determining such a mix is menu engineering. According to menu engineering, all menu items are evaluated on two criteria of sales volume and contribution margin. Menu items with high sales volume and high contribution margin are considered as star items and should definitely continue to be offered. For items with high contribution but low sales volume, management faces the challenge of creating selling strategies to stimulate demand. For items with high volume but with low contribution margin, management needs to decide when to offer them and by how much. Items that are low in both measures are considered as undesirable and therefore should be removed from the menu.

When viewed from Revenue Management perspectives, two additional critical dimensions are missing in this menu engineering framework: the time factor and the impact on other courses of the meal. The former factor matters during busy periods while the latter does during slow periods.

As briefly explained in the previous section on Revenue Management and the restaurant industry, the supply for restaurants is seat hours. Hence, it is important that the evaluation of menu items considers the item's impact on seat hours, particularly during busy periods. The items that cause a long occupation of seat hours (meal duration) might not be desirable during busy periods. The best strategy to increase revenue during this period is through turning tables as quickly as possible so that as many customers as possible are accommodated. A particular menu item can cause long meal duration in two ways: through the long time it takes for customers to consume the item and the long time it takes to prepare the item in the kitchen. Therefore, when assessing the profitability of a menu item to be offered in the busy periods, its contribution margin needs to be adjusted by its average meal duration.

During slow periods when there is access capacity, seat hour is no longer a concern but the impact on other courses is. The best strategy to maximize revenue during slow periods is to generate as much revenue as possible from customers who are already dining in the restaurant. Accordingly, menu items which do not stimulate demand for additional items in other courses may not be as desirable as items which do. Therefore, when evaluating the profitability of a menu item to be offered in the slow periods, its sales volume needs to be adjusted by its average impact on other courses. As a result, the revised menu engineering or so-called menu re-engineering framework is as shown in Figure 16.1.

In order to better understand menu re-engineering, let's think about a management decision on what the menu of the day should be. Should it be a menu item that uses ingredients which are soon to perish? If your answer is yes, you are probably a cost-driven manager. From Revenue Management perspectives, the answer is no and the right answer is "it depends on the time period!" For busy periods, it should be a menu item with a high contribution margin per seat hour. In other words, the item should produce a high contribution margin and at the same it should be quick to prepare and quick to consume. This way, restaurants can maximize revenue from the rich demand. For slow periods, however, it should be an item which can stimulate demand for the restaurant and also for additional demand for

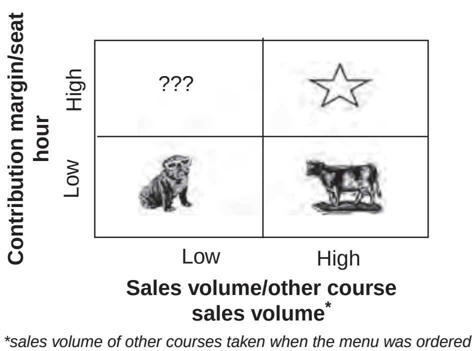

Figure 16.1 Menu re-engineering framework.
Note: * sales volume of other courses taken when the menu was ordered.

items in other courses. Since the restaurant has excess capacity during this time period, it should be an item which customers are willing to come to the restaurant for even at slow times in order to enjoy it and also it should be an item that can stimulate customers to consume additional items such as desserts.

The basic principles under menu re-engineering can be expanded further to restaurant operation strategies and can be illustrated by the following pizza parlor example. In a popular pizza parlor, pizza menus offered during busy periods and slow periods are different. During busy periods, only a limited menu is available and no customization is allowed. The pizzas offered during this period produce high contribution per seat hour. During slow periods, however, not only is an extensive list of menu items available but also customers can get their pizzas in the way they want them. Hence, customers who want some particular pizzas or some special style pizzas will be encouraged to come in during slow periods and they do. For these customers, getting the pizza in the way they want it can be more important than the time period during which they want to dine. From restaurants' perspectives, this is an effective way to move excess demand from busy periods to slow periods. Some pizza restaurants go further and offer special events such as "cook your own pizza," targeting children and housewives to stimulate demand during slow periods.

Variable Pricing

The driving principle of variable pricing is the same as that for the customer- or market-driven approach, which is charging different prices to different segments of customers for essentially the same product or service since the perceived value of the product or service is different across different customer segments. The revenue enhancement potential of variable pricing, compared to fixed pricing where one price is charged to all customers, is well illustrated in Figure 16.2. The shaded area under the price-demand curve corresponds to the amount of revenue generated.

In order for variable pricing to lead to intended revenue enhancement, it is crucial that there are rate fences between different rate categories to ensure that the customers willing to pay high prices cannot take advantage of the lower prices intended for customers who are not willing to pay the high prices. A great example of such a rate fence is the Saturday night stayover requirement for lower prices in the airline industry. Airline customers can be segmented largely into business travelers and leisure travelers by the criterion of the willingness to pay price. The former type of customer is willing to pay more than the latter type of customer. When an airplane is expected not to sell out with high rate paying business travelers only, the airline makes seats available to leisure travelers as well but at lower prices due to their lower level of willingness to pay.

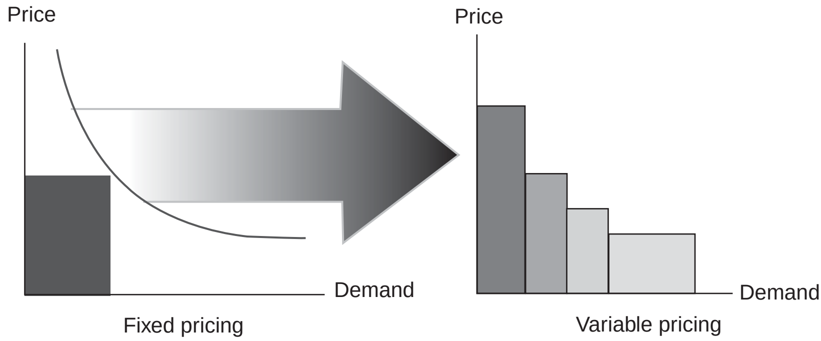

Figure 16.2 Fixed pricing versus variable pricing.

In order to prevent business travelers from taking advantage of this lower price, airlines require a Saturday night stayover with the lower prices. In other words, customers should stay at their travel destination on Saturday night in order to qualify for the lower price. Since staying over on Saturday means returning from the trip on Sunday, which is the end of the week, and therefore means foregoing the weekend away from home, business travelers are not likely to be willing to satisfy this requirement. On the contrary, leisure travelers usually travel on weekends and want to return home after the weekend and therefore have no problem satisfying this requirement. Consequently, requiring a Saturday night stayover with the lower prices works effectively to ensure the availability of the lower prices only to leisure travelers. The intended effect of variable pricing is to select only the most profitable mix of customers during the busy period when demand exceeds capacity and to move excess demand from busy periods to slow periods so as to maximize revenue.

Restaurants can also apply variable pricing principles not only to menu pricing but also to service pricing. Essentially, what a restaurant sells is not just food but dining services. In other words, what customers pay at a restaurant is not only for food but also for the dining services provided by the restaurant. That is why a particular bottle of wine costs more in a restaurant than in a wine shop.

When applying variable pricing, restaurant management needs to think about ways to charge higher prices during busy periods and how to price the menu and services so as to attract more demand or to move demand from busy periods to slow periods. When doing so, managers should be very careful to ensure customers do not perceive such pricing practices as unfair. That is, there have to be rational reasons for the differences in price and customers should be informed of the variable pricing practice itself and different prices offered.

In a restaurant setting, thinking strictly in menu pricing, it may initially seem difficult to sell the same menu item at different prices to different customers who are dining at the same restaurant during the same time period. However, this is already happening. For example, when a table is reserved for a party of large size, a certain amount of service charge is usually added to the total meal price. Sometimes, some tables are reserved as chef tables so that those who are seated at these tables will be personally greeted by the chef and will have to pay an extra fee. In these two examples, it was not the menu prices that differed but the amount of money customers paid for the same menu items differed indeed. In other words, restaurants have used slightly modified and creative variable pricing practices.

Let's now discuss specifically how the variable pricing notion can be applied differently to different demand periods in order to maximize revenue. During busy periods, if all customers are assumed equally profitable, restaurants can accept customers on a first-come first-served basis. However, it is commonly known that not all customers are equally profitable. How much they spend and how long they occupy seats tends to vary across segments of customers (Kimes and Robson, 2004). For instance, party size, purpose of meal and types of seats taken tend to affect average check amount and meal duration. Hence, when demand exceeds capacity and therefore not all demand could be accepted, management should choose the most profitable mix of customers.

One possible approach toward accepting only a profitable mix of customers is designing the table mix in such a way that customers of a more profitable party size are given priority in seating. Another possible approach is to sell only profitable menu items during busy periods. It is not uncommon for restaurants to offer only a set menu during busy periods. The set menu is usually composed of menu items that are quick to prepare and consume but produce a high contribution margin. If it is unfeasible to offer only a set menu, restaurants can try to limit the menu items available during busy periods so that only high profit margin items that can be prepared and consumed quickly are available for sale.

Pricing can be a very powerful tool for maximizing revenue during slow periods, particularly in stimulating demand. It is an economics 101 concept that when price goes down demand tends to go up. This concept needs to be taken with caution however. The easiest way to interpret this concept is that prices should be lowered (discounted) in order to stimulate demand. Given the seriously detrimental impact of discounting on the bottom line profit, discounting should always be the last resort.

A careful examination of how discounting stimulates demand reveals that what really matters to consumer purchase decisions is the value perception. Customer value is the function of what customers receive from a firm in return for what they give to the firm. There are two ways to increase this value. One is to decrease what customers give (price discounting) and the other is to increase what customers receive (additional products or services offered). It might be a lot more profitable for a firm to increase what customers receive than to decrease what customers give.

For example, instead of offering a $5 discount, offering a dessert priced at $5 free of charge is more profitable to the restaurant. From the customer's perspective, the two offers are indifferent. However, from the restaurant's perspective, the loss from the former might be the whole $5 in profit but the loss from the latter might only be $2 (the food cost of the dessert). This might not necessarily be the case all the time however. If the customer was willing to buy a dessert for $5 anyway but was given the dessert free of charge, what the restaurant lost is not just $2 but also the profit opportunity from selling the dessert for $5. Therefore, when restaurants offer something free in order to increase the value perception, it always has to be something customers would have not bought otherwise.

This notion can be very well explained by the McDonald example. One of the management challenges for a fast food restaurant like McDonalds, which produces and inventories products (hamburgers) in advance of orders, is to accurately forecast demand so that the right quantity is produced and no waste occurs. As a creative approach for not losing as much profit from overstock, McDonald decided to suggestive sell the burgers that are about to expire at a discounted price to the next customer waiting to order in line. However, they did not suggestive sell those items before the customer finished placing orders. It was only after the customer ordered everything she wanted that they suggestive sold the soon-to-expire items at a discounted price. This was to ensure that they do not displace full price item orders with discounted price item orders and also that the sale of the soon-to-expire items creates truly incremental revenue.

When using these pricing approaches for the purpose of stimulating demand, it is important to carefully think about when these special prices or promotions are available for customers to benefit. Take an early bird special as an example. This is a traditional approach restaurants have used to stimulate demand for the time period right before the busy period. A restaurant whose busy period for dinner starts at 6 pm might offer an early bird special for the time period between 4 pm and 6 pm. Specials might be all appetizers at half price or free drinks. Should this special be available to those who arrive at the restaurant ten minutes before 6 pm? Let's say on average customers stay in the restaurant for one hour. This customer might stay only for ten minutes during the slow period and occupy a limited seat for 50 minutes during the busy period. The restaurant might end up making customers willing to pay the full price wait, or turned away, while this customer is enjoying specials at a lower price. Therefore, the specials should be offered in a way that restaurants do not end up displacing higher revenue opportunities with lower revenue outcome.

Conclusion

The opportunity for restaurants to increase revenue through Revenue Management principles-driven pricing of menus and services is big. In order to enjoy this opportunity, restaurant managers need to move away from cost-driven pricing approaches toward market-driven approaches. They should charge the price the market is willing to bear. In order to find this price, managers need to understand their market, that is, its customers, competitors and market conditions. In order to help managers understand market-driven Revenue Management pricing approaches, what Revenue Management is in general and what restaurant Revenue Management is in particular was discussed. Then, introduced was three dimensions of Revenue Management-driven pricing, that is, optimal pricing, menu re-engineering and variable pricing.

One topic that was not discussed but could be just as important as pricing strategy is selling strategy. Selling strategy should also be designed according to the Revenue Management principles so that it can help restaurants reap the benefits intended with the right pricing. Selling strategy should also be different between busy periods and slow periods. Specifically, should restaurant staff suggestive sell a certain course? During busy periods, considering the best way to maximize revenue during busy periods is to turn tables quickly and accommodate as many customers as possible, suggestive selling coffee or dessert might not be a good idea. Customers can easily occupy the limited seat for another 20–30 minutes to wait for and consume them, when those seats could have been occupied by the next party producing more revenue or profit from the main dishes. During slow periods, however, staff should do the best they can to suggestive sell all courses since seats are no more constrained.

This chapter by no means offers a complete set of principles, strategies and tactics on practical pricing in the restaurant industry. Rather, this chapter is intended to stimulate further thought and dialog among restaurant management scholars and practitioners toward creating breakthrough strategies on practical pricing in the restaurant industry. You are invited to come aboard in such endeavors.

References

Kelly, T. J., Kiefer, N. M. and Burdett K. (1994) A Demand-based Approach to Menu Pricing, *Cornell Hotel and Restaurant Administration Quarterly*, 35(1), 48–52.

Kimes, S. E. (1989) Yield Management: A Tool for Capacity Constrained Service Firms, *Journal of Operations Management*, 8(4), 348–363.

Kimes, S. E., Chase, R. B., Choi, S., Lee P. and Ngonzi, E. (1998) Restaurant Revenue Management: Applying Yield Management to the Restaurant Industry, *Cornell Hotel and Restaurant Administration Quarterly*, 39(3), 32–39.

Kimes, S. E. and Robson, S. (2004) The Impact of Restaurant Table Characteristics on Meal Duration and Spending, *Cornell Hotel and Restaurant Administration Quarterly*, 45(4), 333–346.

Rougie, O. (2007) Revenue Management Solutions, Guest Lecture to MBA IMHI-ESSEC Class on Restaurant Revenue Management, Paris, 31 January.

17
Practical Pricing for the Car Park Industry

José Guadix

Introduction

Revenue Management is about trying to sell the correct inventory units, to the appropriate customer, at the most opportune time. In this chapter a new application of Revenue Management is proposed that helps to manage the inventory units of car parks, that is, the parking spaces. An application model is suggested and, based on occupation data, a forecast is made of likely future drivers. The forecasts are then used to distribute the car parks' available capacity. For this, the model is divided into different categories, using different time slot rates. It also takes into account different promotional offers to drivers, which would mean lower prices for these services and a reduction of parking uncertainty. In addition, a pattern of behaviour in the sales of the car parks is provided and, for this, various heuristics for allocating inventory is simulated based on the arrival of the drivers. This approach is introduced in a series of problems and the results obtained are shown, measured in terms of incomes, efficiency and occupation.

Novelty application in car parks

In recent years within the service sector, car park companies have grown in number and attention is now being directed to the ways in which they can maximize revenue (Guadix et al., 2008). Indeed, whilst the motor car has now become the means of transport of choice in many countries, it is recognized that space for car parks in central urban areas has become scarce. To enable the implementation of Revenue Management techniques, car parks need to meet six requirements, as described by Kimes (2000):

- Car parks operate with fixed capacity: they cannot adapt their capacity quickly to face sudden changes in demand. If all the parking spaces are occupied, new cars cannot be admitted until capacity frees up.

- Demand can be clearly segmented in different customer groups: car parking companies may be able to identify customers according to their degree of sensitivity to a change in the price due; for example, in relation to a change in the parking timetable and they should be able to develop different strategies in relation to this criterion.
- Inventory is perishable: empty parking spaces each hour means money not earned during that time.
- The product can be sold in advance: a reservation system will permit the car park to plan capacity utilization in advance.
- Demand fluctuates sufficiently: in an urban car park there will be a difference between working days and holidays. Within a single day there will also be a lot of variation in demand in relation to daytime and night time hours.
- The marginal sales costs are low and the possible additional costs of extra capacity are high: the comparison of an additional sale of an hour of parking is low compared with the investment to increase the size of the car park.

To apply Revenue Management in car parks a system divided into four related modules is proposed (see Figure 17.1). The first one is a forecast of the demand, where with the actual level of past occupation is used to help predict the level of future parking customers. These forecasts are used as data for the application of capacity models, so the forecasted quantity is distributed among the various categories subject to the hourly capacity of

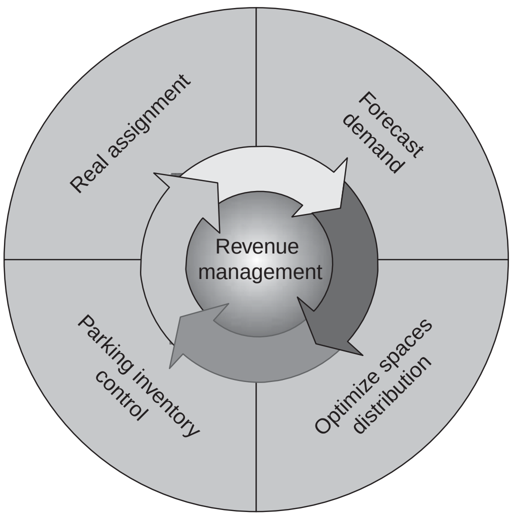

Figure 17.1 Revenue Management scheme applied to car parks.

the car park. This is identified as module two, optimize spaces distribution. The third module concerns the reservation system. A methodology has to be defined to the sales manager to determine, before the possible arrival of a driver, whether to accept or reject the request. Finally, with drivers that come and are accepted an actual level of real occupancy can be obtained. This is module four in Figure 17.1 below, the real assignment.

The goal of these Revenue Management techniques is to increase the profits generated by these drivers. Determining the best prices for each category is difficult due to the lack of information about the flexibility of the different prices that also depend on the pricing policies of the competition.

Forecast demand

The protocol used in the forecast of the drivers is important in terms of Revenue Management. It has a direct impact on the process of allocation of inventory, so the more accurate the forecast, the greater the advantage will be obtained in the application of the Revenue Management techniques in car parks. The first studies to forecast demand in the service sector in a disaggregated way (that is, predicting the demand by units of time and types of customers) were done in the airline sector (Lee, 1990). However, these methods can be extrapolated to other sectors, like hotels (Kimes and Weatherford, 2003), or in our case car parks.

Optimize spaces distribution model

After obtaining a forecast, a distribution model based on the capacity of the lot and the different categories of drivers is developed. This will determine the number of parking spaces in each category and the number of car park users that are required to obtain the maximum profit. This model is based on the work of De Boer et al. (2002) in the airline industry.

Groups of subscribers need different treatments. A group is a set of drivers that have rented a parking spot for the same period of time, for the same number of hours. For this reason they should be considered differently than individual drivers. Besides, the way to hire the service is often by telephone or by reserving the parking space on the Internet. Three kinds of subscribers have been worked with:

1. Daily subscriber, renting a parking space for just a day.
2. Five working day subscriber (Monday to Friday), renting the parking space for five days.
3. Monthly subscriber, renting a parking space for 30 days.

The data parameters necessary to think about the problem of resource management are:

- H: the temporary horizon, measured in the number of hours which are aimed to optimize.
- b_i: the hourly capacity of the car park, where i varies between 1 and H.
- C: the number of individual categories that the car park is segmented into. These categories with different prices are: normal drivers, residents and workers.
- p_j: the prices for the different individual categories of the car park, where j varies between 1 and C.
- E_j: the maximum number of hours of a car in the car park for each hour slot for individual drivers j.
- d_{ijk}: the expected demands for each hour i, category j and number of hours of a stay k, where i varies between 1 and H, and k varies between 1 and E_j.

Also it is considered as a starting point that the following additional data are available for the groups of subscribers:

- N_g: the number of subscribers that the car park offers. It can be: daily, five weekdays and monthly subscribers.
- c_g: the total price by component of each kind of subscriber group, where g varies between 1 and N_g.
- λ_g: the duration in days of the stay of each kind of subscriber group.
- μ_g: the size of each group of subscribers.
- i^*: the reservation date of each subscriber group.

This way the unknowns, that is, variables, of the problem are the parking spaces to be rented each hour in each category and for each number of hours the subscriber stays (x_{ijk}). There will be a determined price p_{ijk} for each category. The said variables must be whole numbers, since the entire space can be sold, not part of it. Afterwards, this restriction will be relaxed and the variables will be allowed to be continuous, thus yielding a mixed linear problem.

Discrete variables, which are binary, will be x_g and indicate whether or not to accept a subscriber of the above characteristics.

In order to maximize the profits generated by the sale of the parking spaces to individual drivers and subscribers, one needs to meet the conditions attached to the restrictions of the car park capacity and drivers forecast. Since the number of drivers is uncertain, two problems are raised (see Figure 17.2): the deterministic group problem (DGP) for a scenario of drivers that arrive is equal to the forecasted and the stochastic group problem (SGP) with different possible scenarios, $r = 1, \ldots, S$, being that the demand is greater than the forecasted, $D_{ijk} \geq d_{ijk,r}$.

The presence of groups of subscribers has a lesser degree of uncertainty than the individual reservations. A subscriber often reserves a parking space

$$\begin{aligned}
\max \quad & \sum_{i,j,k} k p_j x_{ijk} + \sum_{g=1}^{Ng} \lambda_g c_g \mu_g x_g \\
\text{s.t.} \quad & \sum_{l \le i} \sum_{i<j} \sum_{k} x_{ljk} \le b_i \qquad \forall i \notin \left\{ i^*, \ldots, i^* + \lambda_g \right\} \\
& \sum_{l \le i} \sum_{i<j} \sum_{k} x_{ljk} + \mu_g x_g \le b_i \qquad \forall i \in \left\{ i^*, \ldots, i^* + \lambda_g \right\} \\
& 0 \le x_{ijk} \le d_{ijk} \\
& x_{ijk} \quad \text{integer (or continuous)} \\
& x_g \in \{0,1\} \qquad \text{(DGP)}
\end{aligned}$$

$$\begin{aligned}
\max \quad & \sum_{r=1}^{S} \sum_{i,j,k} k \cdot p_j \cdot \Pr(D_{ijk} \ge d_{ijk,r}) \cdot x_{ijk,r} + \sum_{g=1}^{Ng} \lambda_g c_g \mu_g x_g \\
\text{s.t.} \quad & \sum_{r=1}^{S} \sum_{l \le i} \sum_{i<j} \sum_{k} x_{ljk,r} \le b_i \qquad \forall i \notin \left\{ i^*, \ldots, i^* + \lambda_g \right\} \\
& \sum_{r=1}^{S} \sum_{l \le i} \sum_{i<j} \sum_{k} x_{ljk,r} + \mu_g x_g \le b_i \qquad \forall i \in \left\{ i^*, \ldots, i^* + \lambda_g \right\} \\
& x_{ijk,1} \le d_{ijk,1} \\
& x_{ijk,r} \le d_{ijk,r} - d_{ijk,r-1} \qquad \forall\, r = 2, \ldots, S \\
& x_{ijk,r} \ge 0 \quad \text{integer (or continuous)} \\
& x_g \in \{0,1\} \qquad \text{(SGP)}
\end{aligned}$$

Figure 17.2 Optimize spaces distribution models.

well in advance. This way, a subscriber is a “sure value” in the management of parking spaces reservations, that is, he is a confirmed source of income and brings invaluable economic benefits.

Parking inventory control

Once the distribution of the capacity is set between the different categories, it is accepted that drivers will have different behaviour patterns. In reality, what often happens is that a number of forecasted drivers within each category do not use the parking lot as predicted. In addition, reservations are made according to behaviour patterns if the category is cheap or expensive. Because of these two important characteristics, it is necessary to allocate different ways to assign the inventory before the simulated drivers arrive. To simulate the arrival of drivers, opt for non-homogeneous arrivals described by a Poisson distribution, as they can assimilate more realistically.

Once the inventory distribution has been guessed and a few driver arrival simulations using the non-homogeneous Poisson process are made, the priority that is assigned to each category will also influence the income. In a previous study by Teodoric and Lucic (2006) it was shown that the assignment algorithms influence the profits obtained in the car parks. Previously, in the airline industry, this relationship between pricing policy and the manner of the customers’ assignment was studied (Botimer and Belobaba, 1999). Another approach by Morris et al. (2000) relates the method of assignment with the offers made by the drivers at a determined time through auctions. Before bidding, the distribution method has determined the minimum price for each instant and all other lower bids should be rejected.

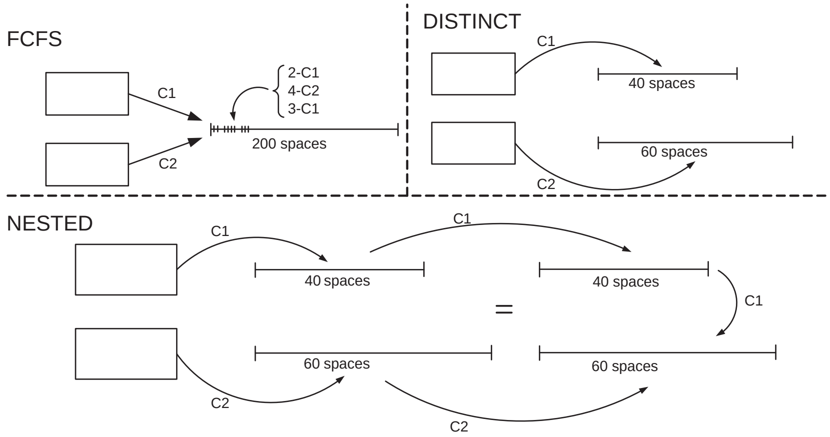

Figure 17.3 Parking inventory control algorithms.

For this work, three algorithms have been used as arrival allocations (see Figure 17.3).

A. FCFS (first come first serve)

This first method will assign to each inventory unit a driver according to the order in which they arrive, the first to arrive is the first to be attended. This way the different inventory units will be sold until the daily capacity is reached. Since this is independent from the capacity distribution already done, this method is used as a reference in respect to the ones that follow.

B. DISTINCT

This algorithm is the number of units for each category and length of stay, x_{ijk} obtained from the capacity model. This will divide the total daily capacity in different categories. Each one of these categories can only be occupied by one driver with these characteristics. If the maximum number of forecasted reservations is reached, said category runs out and closes.

C. NESTED

This allocation method is often used in the practice of airlines. To nest the inventory, the different categories should be classified by their contribution to the total revenues of the car park. After this classification, a category can use its inventory and that of an inferior.

Computer Experiences

The methodology described in the previous sections was implemented in the case of a car park with 150 spaces and three categories of individual drivers.

These individual categories are: normal drivers, residents and workers in that area. The residents or workers are individual drivers that live or work close to the car park and that have applied for a card that identifies them as residents or workers. This allows them to get a lower price than normal drivers, but doesn't mean that they have rented a parking space. Renting a parking space is obtained by paying for a day, five days or 30 days. In the case that a driver possesses a subscription, the customers are considered subscriptioners.

To resolve the different problems the following parameters are known beforehand: the number of days of the study is 30, the daily capacity of the car park is equal to 150, the number of individual categories is three and the hourly price of the different categories of the individual drivers is indicated in Table 17.1.

In Table 17.1 you can see how the prices are different between the different categories and according to the timeslot in which the parking space is being occupied. The car park operates with two timeslots, expensive and cheap. The expensive timeslot is from 08:00 until 14:00 hours and from 16:00 until 19:00 hours which corresponds with the hours where the parking spaces are in greater demand. The cheap timeslot is made up of the remaining hours, from 00:00 until 08:00 hours, from 14:00 until 16:00 hours and from 19:00 until 24:00 hours, as shown in Table 17.2. The cost associated with a driver that parks in two different timeslots is proportional to the use of each one. For example, a resident that is parked from 17:00 until 19:00 hours will pay two hours at the expensive timeslot rate, €2.40. On the other hand, a normal driver that is parked from 18:00 until 20:00 hours will pay an hour in the expensive timeslot and another hour in the cheap timeslot, in total €2.70.

Table 17.1 Prices of the different categories

Individual driver categories	**Timeslot**	**Price (€)**
Normal	Expensive	1.50
	Cheap	1.20
Resident	Expensive	1.20
	Cheap	0.96
Workers	Expensive	0.96
	Cheap	0.60

Table 17.2 Timeslots

Timeslot	**Timetable**
Expensive	08:00–14:00 and 16:00–19:00 hours
Cheap	00:00–08:00, 14:00–16:00 and 19:00–24:00 hours

Other parameters of the problem are the prices of the subscribers. At the present time there are three subscriptions offered: €12.50 for daily, €45 for five working days and €160 for monthly.

After the forecast of the number of drivers in the different categories that appear each hour, this flow is optimized to the capacity available in the car park, using the model considered, that is, deterministic demand (DGP) or stochastic (SGP). These models have been implemented in the optimization software CPLEX 8.0 (IBM ILOG ©). As the forecasted values will not be exactly the real ones and all the drivers will not arrive at the same time, an analysis of three different methods of assignment were included (Law, 2006). These simulations have been done with Arena 3DPlayer (Rockwell Software ©). The simulation scenario consists of a surface parking on three floors, each one of them equipped with 50 spots, as shown in Figure 17.4.

When cars enter the lot, they head for the spaces on the same level as the entrance. If this floor is full, users will go up the ramps to the first floor, where the simulation logic is equivalent. The system works similarly on the second floor, except that in this case if the car goes up it is because there is at least one spot free where it can park. Cars will remain parked for a time that will give a normal distribution, whose mean and standard deviation value will either category depending on the user concerned.

Once a car leaves the spot in which it was parked, it will go directly to the exit of the car park, but it will always respect the direction of traffic. On the ramps and at the rail front, there will be two-way traffic, as seen in Figure 17.5.

Cars stop at the "payment" point before leaving the parking, where the driver pays the amount that has been applied to their category of user. Table 17.1 shows the rates per minute that are charged. Table 17.3 shows, in short, the average monthly results, according to the model of availability distribution applied and the method of allocating drivers, for the same non-homogeneous Poisson arrivals.

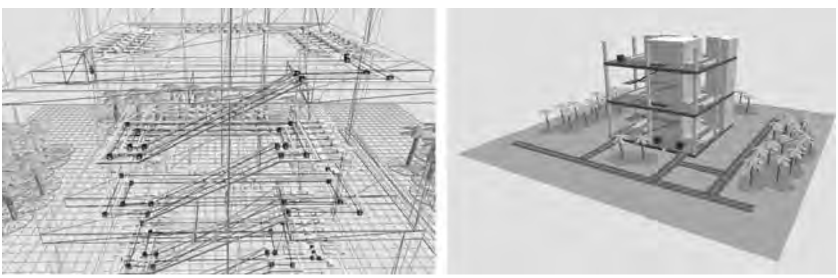

Figure 17.4 View of the parking construction and final presentation.

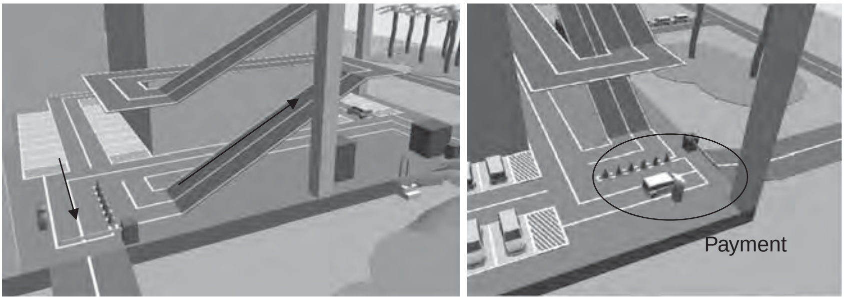

Figure 17.5 Direction of traffic and "payment" point.

This results table can be analysed, first comparing the method of capacity distribution. Two new methods have been added, denominated deterministic problem (DP) and stochastic problem (SP). These are the particular car park cases that don't offer subscriptions to drivers, meaning that they will only sell to individual drivers. If car parks offer subscriptions they will obtain greater revenue as these models are open to subscriber group categories. Indeed, the results indicate that deterministic and stochastic models with groups with similar incomes are always higher than those with no groups. As the income of the deterministic and stochastic model is similar this means that the uncertainty associated with future drivers is low, and that the forecast methods used are obtaining good estimations.

The efficiency outcome (number of drivers accepted to the total number of drivers) has some very elevated values, this being better with subscriptions. The occupancy results (occupied parking spaces in reference to the total capacity) present similar results.

Looking at the table in terms of heuristic inventory allocation, revenue is greater if the inventory is available through a distribution nested model. This is because in times of high demand, all higher-priced drivers are eligible for services, even in a lower category.

However, in certain circumstances, where on a particular day the demand is low and the forecast isn't correct, that is, the capacity distribution isn't appropriate for the final demand, the total number of drivers is lower than the capacity. In this case, the simulations results obtained from applying the heuristic FCFS are greater than the other two. This situation is very particular, and in the long run the opportunity cost of this method will always be lower than the nested method.

With regard to the daily results, it should be noted that in particular situations the distinct method obtained better revenue than the nested method. Looking at the final drivers' distribution for each assignment, you will notice the nested method doesn't distinguish in any way the duration of stay for the drivers. This means that it deals equally with drivers that stay one hour

Table 17.3 Summary of the monthly result averages

	FCFS			Distinct			Nested			ROD
	Incomes	**Efficiency (%)**	**Occupation**	**Incomes**	**Efficiency (%)**	**Occupation**	**Incomes**	**Efficiency (%)**	**Occupation**	**Incomes**
DP	62,813	79.9	0.50	66,699	84.8	0.53	69,458	88.3	0.55	72,319
DGP	67,694	86.1	0.54	71,920	91.4	0.57	75,291	95.7	0.60	78,150
SP	62,813	79.9	0.50	67,122	85.3	0.53	70,026	89.0	0.56	72,319
SGP	67,694	86.1	0.54	72,623	92.3	0.58	75,292	95.7	0.60	78,150

and those with who stay several hours and therefore there may be periods of the same stay with more or less demand. To avoid this shortcoming, I suggest using the daily constraints' shadow price as the price in order to differentiate the major categories. In doing this, the fare that is paid is compared with the mean value of the shadow prices of the days that the stay implies. The revenue obtained is 5 per cent below the real optimum distribution (ROD), the income earned if we knew first the real drivers that we would have by category.

From these results a model with greatest revenue forecasts is obtained, that is, the stochastic model which includes subscriber groups and nested inventory. However, if certain periods of the year with low demand for car parking spaces can be clearly determined and reproduced in a reliable way, then it is suggested that the same model with a FCFS assignment method be used.

Conclusions

This chapter has examined the application of Revenue Management to car parks. Car parks have perishable units of inventory, that is, the car parking spaces, and drivers are used to buying these spaces within specific behaviour parameters and using specific sales channels. One of the keys to success in the use of Revenue Management is to promote the use of the service in periods of low demand.

In applying Revenue Management to car parks three areas were examined: demand forecasting, capacity distribution and inventory control. It was noted that traditional methods of forecasting can be used. Regarding capacity distribution, two models were proposed that accept individual drivers and groups of subscribers. Systems of allocation of inventory units in companies that are in the service sector are necessary due to the variable behaviour pattern that the drivers present when they consume the service. In this chapter I have modelled their arrival through the Poisson non-homogeneous process and with three different algorithms to see the total revenue obtained. The results show the gap in revenue between the deterministic and stochastic models and the possibility of accepting and rejecting requests of subscriber groups in relation to individual drivers who would be displaced.

References

Botimer, T. C. and Belobaba, P. P. (1999) Airline Pricing and Fare Product Differentiation: A New Theoretical Framework, *Journal of the Operational Research Society*, 50(11), 1085–1097.

De Boer, S. V., Freling R. and Piersma, N. (2002) Mathematical Programming for Network Revenue Management Revisited, *European Journal of Operational Research*, 137, 72–92.

Guadix, J., Cortés, P., Muñuzuri, J. and Onieva, L. (2008) Parking Revenue Management, *Journal of Revenue and Pricing Management*, 8, 343–356.

Kimes, S. (2000) A Strategic Approach to Yield Management. In A. Ingold, U. McMahon-Beattie and I. Yeoman (eds) *Yield Management: Strategies for the Service Industries*. London: Contiuum, pp. 3–14.

Kimes, S. and Weatherford, L. (2003) A Comparison of Forecasting Methods for Hotel Revenue Management, *International Journal of Forecasting*, 19(3), 401–415.

Law, A. M. (2006) *Simulation Modeling and Analysis*. New York: McGraw-Hill.

Lee, A. O. (1990) *Airline Reservations Forecasting: Probabilistic and Statistical Models of the Booking Process*, Unpublished PhD Thesis, Massachusetts Institute of Technology, Cambridge.

Morris, J., Ree, P. and Maes, P. (2000) Sardine: Dynamic Seller Strategies in an Auction Marketplace, *Proceedings of the 2nd ACM Conference on Electronic Commerce (EC'00)*, Minneapolis, Minnesota, United States, ACM, New York, NY, USA, ISBN: 1–58113–272–7, pp. 128–134.

Teodoric, D. and Lucic, P. (2006) Intelligent Parking Systems, *European Journal of Operational Research*, 175, 1666–1681.

18
Golf Course Revenue Management

Lila Rasekh and Yihua Li

Introduction

Golf is one of the greatest sports of the world and is played in many countries. It is enthusiastically followed by millions more on television who, though they have never teed off nor sunk a putt themselves, can still appreciate the game from the comfort of their home.

Golf was established in Great Britain by the seventeenth century. In 1860 the first British Open was played. Soon after, the first golf club in North America – Canada's Royal Montreal Club – was founded in 1873. The first course in the USA was the Chicago Golf Club and this was founded near Wheaton in 1893. The leading association for current golf tournaments, the Professional Golf Association of America (PGA), was founded in 1916. Tournament golf had become a well-established sport in the USA by the 1920s and has been gaining popularity ever since. In 2006, there were 16,052 facilities in the USA with 11,680 open to the public. A facility is a complex containing at least one golf course. According to the National Golf Foundation, the number of people in the USA in 2005 who played golf 25 times or more per year was 4.6 million, with 26 million claiming that they had played golf at some time over the same period (Vitello, 2008).

Considering the large number of players and golf courses, in recent years, many golf management companies like Troon Golf – the world's leading luxury golf course management introduced a Golf Revenue Management System that allows each Troon Golf facility to more efficiently manage tee time inventory and maximize revenues (http://www.golftransactions.com).

Golf course tee-time assignment is a typical Revenue Management problem. Golf course operations are identified with perishable inventory, predictable demand, limited capacity and varying customer price sensitivity (Kimes and Schruben, 2002). The tremendous growth of the demand in the service industry in recent years has brought the term product perishability to their attentions. In the case of the golf course, an available capacity that is not sold on a specific tee-time cannot be inventoried for future sale, it merely vanishes. Coupled with the perishability problem, golf courses face capacity constraint. Perishable inventory and fixed capacity are characteristic of the available room type inventory in hotels and seat inventory in the airline industry. For example, in the hotel industry the number of available rooms for a particular service day is fixed. Similarly, for the airlines, the number of seats for a particular flight is fixed. Given a fixed capacity, we have the classic challenge of Revenue Management, which American Airlines defined as "maximize passenger revenue by selling the right seats to the right customers at the right time," and "for the right price." Therefore the challenge to golf course Revenue Management is to maximize revenue by selling the right tee-time to the right customer at the right time and for the right price within a price discrimination model.

Moreover, varying customer price sensitivity in the golf course industry enables market segmentation. The scientific foundation of pricing relies on segmenting the customers and deals by price sensitivity, and using each price segment's unique sensitivity to set prices on future deals. This in golf management can be interpreted as less price-sensitive players generally play in the early morning at a regular price. On the other hand, more price-sensitive players may wait for a later time of day or special discounts. Therefore, in this Revenue Management problem, time of day and rate category at which the reservation is made segments the potential customers.

With respect to this revenue problem, a set of tee-times are predetermined for each golf course. The maximum capacity for each tee-time is four, and the number of demand for each tee-time can be forecasted. Each demand type has potential revenue for the golf course. Demand is assumed to come from groups or individuals, the size of which ranges from one to four. The objective in solving this problem is to assign the demand to tee-times so as to maximize the total revenue.

The goal of the golf course Revenue Management system is to maximize profits by developing the best reservation policy. In this chapter, we assume such a reservation policy, for which the booking limit for a particular tee-time/discount category is periodically evaluated. Each time a new reservation occurs, the algorithm is applied once assuming the demand forecast is made ready at that moment. These booking limits can be used as the maximum number of booking requests to accept for each tee-time and rate category during the booking period. The algorithm we introduce is based on a linear deterministic model that balances the supply and demand. This linear model is repeatedly applied over time, and provides an update of booking limits as demand is being realized. This model is a typical Revenue Management method used in practice by the airlines and other industries, the essence of which is to optimally allocate rate buckets to the discount categories. Therefore, the fundamental Revenue Management decision would be to accept or reject a reservation.

An additional explanation may help to better articulate the problem. Optimization is conducted by using the forecasted demand – the demand for each tee-time interval between 7:30 am and 3:00 pm. Three rate categories are available for the tee-times, depending on the time of the day, for example, early morning tee-times are more expensive. The prices in each rate category include discount and regular prices, which are used to differentiate the demand with different profit potentials. The Revenue Management System is focused on forecasting, optimization and pricing. It ignores overbooking.

In our studies we consider several golf courses under the same management. The forecast model predicts the demand for each individual golf course. Then it is redistributed to the demand for different times of the day, different rate categories and variable party sizes. There is price discrimination among the following time windows during a day: 7:30 am–9:00 am, 9:00 am–1:00 pm and 1:00 pm–3:00 pm. Therefore, the forecasted demand is distributed to the demand for each of the three time windows. Moreover, within each time window the forecasted demand is distributed as regular and discounted categories. In the last level of the forecast the demand is distributed to party size, which ranges from one to four.

Literature review

Currently, Revenue Management is applied extensively to transportation, hotel, media, restaurant and hospital management. Generally speaking, the methodologies can be classified into two classes according to dynamic (Feng and Xiao, 2000) versus static (Bertsimas and Popescu, 2003) or single leg (Liang, 1999) versus network of two or more legs (Barnhart et al., 2002; Barnhart et al., 2009; Wang and Meng, 2008). Usually, static models treat demand deterministically and resort to a repeated application of a static capacity allocation model called "out rollout policy" (Bertsimas and Popescu, 2003). Optimal models are generally dynamic and dictate the threshold price change whenever the remaining inventory changes or a substantial amount of time elapses. An interesting paper by Gallego and van Ryzin (1997) shows that a repeated application of a simple linear programming (LP) model gives an asymptotically optimal policy on a network. Bertsimas and Popescu (2003) also discuss the performance of repeatedly using the LP model in the airlines' network seat inventory control. We follow a similar process to develop LP models for golf course Revenue Management. Particularly, for the first time, our models address the special features of this Revenue Management problem in the golf course industry.

Similar approaches to the early practices used for Revenue Management in the airline industry were also developed for hotel Revenue Management to balance the expected revenue from sold rooms and the cost of "walking away" customers who fail to honor their reservations (Bitran and Gilbert, 1996; Bitran and Mondschein, 1995). In a recent paper by (Li et al. 2010) the authors used a similar approach to address the table top reservation in a restaurant. Their innovative model enables table combinations to satisfy demand from large groups in restaurants. The management of golf course tee-time reservations through assigning a set of sequential reservations shares similarities with the problem of vehicle routing using time windows. Vehicle routing and scheduling problems with time windows are time-constrained network optimization problems in which a set of trips satisfying demand requirements are assigned to a set of vehicles. The cost of assignment is the total cost on all the routes. The objective is to minimize the assignment cost (Hadjer et al., 2006). Similarly, in the golf course assignment problem, a set of sequential reservations – each covering the entire time period of a service day – are assigned to a set of tee-times. Each golf course serves a sequence of reservations in a day. The objective is to maximize the assignment revenue. In this sense, the golf course reservation management problem shares great similarity with the vehicle routing and scheduling problem. In a general sense, the golf course reservation management falls into a large class of assignment problems, such as the assignment of jobs to machines. The assignment problem can address complex problems from the traveling salesman problem (Held and Karp, 1970) to vehicle routing problems (Li and Wang, 2005; Li et al., 2009).

The remainder of this chapter is organized as follows: the next section describes the problem formulation for the golf course assignment problem; this is followed by a section which presents the numerical results; and the final section is devoted to our concluding remarks.

Problem formulation

As demand increases, the golf course management must make decisions about how to optimally allocate their resources for future demand. The Golf Revenue Optimization (GRO) model is an assignment problem to optimally allocate the reservations for tee-times. GRO is a revenue maximization problem that takes into account the business rules and constraints defined by regular golf courses.

In this problem, a set of tee-times is deterministic at each golf course. The maximum capacity for each tee-time is four, and the number of reservations (demands) for each tee-time each day is forecastable. Each demand type has a deterministic potential with respect to the revenue of the golf course. Demand is assumed to come as groups or individuals, the size of which ranges from one to four. The objective in this problem is to assign the reservations to tee-times so to maximize the total revenue.

Here x_{ij} is defined as a binary variable where $x_{ij} = 1$ if reservation i is assigned to tee-time j; 0, otherwise. Similarly $z_j = 1$ if there is at least one reservation assigned to tee-time j; 0, otherwise. The variable z_j is defined so that the model assigns as many reservations to a tee-time as possible. For example, this strategy forces three parties of size one to reserve one tee-time instead of three different tee-times. The variables y_i^+ and y_i^- are integer variables indicating the time deviation from the customer's requested tee-time T_i. Therefore, the mathematical model for the GRO can be formulated as:

$$[\text{GRO}]\text{Maximize} \sum_{i\in I}\sum_{j\in T} r_{ij}x_{ij} - \sum_{j\in T} c_j z_j - \sum_{i\in I} p_i^+ y_i^+ - \sum_{i\in I} p_i^- y_i^-$$

subject to:

$$\sum_{j\in T} x_{ij} \le 1 \quad \forall i \in I \tag{18.1}$$

$$\sum_{i\in I} s_i x_{ij} \le 4 \quad \forall j \in T \tag{18.2}$$

$$t_j \cdot x_{ij} \ge t_{is} \quad \forall i \in I, \quad \forall j \in T \tag{18.3}$$

$$t_j \cdot x_{ij} \le t_{ie} \quad \forall i \in I, \quad \forall j \in T \tag{18.4}$$

$$z_j \ge x_{ij} \quad \forall j \in T \tag{18.5}$$

$$t_j \cdot x_{ij} + y_i^+ - y_i^- = T_i \quad \forall i \in I, \quad \forall j \in T \tag{18.6}$$

$$x_{ij}, z_j = 0, 1 \quad \forall i \in I, \forall j \in T \tag{18.7}$$

$$y_i^+, y_i^- \ge 0, \quad \text{Integer} \quad \forall i \in I, \forall j \in T \tag{18.8}$$

where

- I is the set of all reservations (parties)
- T is the set of all tee-time intervals in a day
- s_i is the size of party
- r_{ij} is a revenue associated with booking i assigned to tee-time j
- p_i^+ and p_i^- are the penalties associated with the time deviation from the customer's requested tee-time
- c_j is the cost associated with tee-time j, if there is any assignment to this tee-time
- t_j is the time at tee-time j
- party i is allowed to be assigned to a tee-time j in a time window between t_{is} and t_{ie}
- T_i is the tee-time requested by a customer
- $x_{ij} = 1$ if reservation i is assigned to tee-time j; otherwise, the value = 0
- $z_j = 1$ if at least one reservation is assigned to tee-time j; otherwise, the value = 0
- y_i^+ is time-deviation up to 1 hour after the customer's requested tee-time
- y_i^- is time-deviation up to 1 hour before the customer's requested tee-time.

In GRO, constraint (18.1) specifies that each party can be covered at most once. Constraint (18.2) refers to the capacity constraint for each tee-time. The constraints (18.3) and (18.4) specify that a reservation for a requested tee-time must occur within a specified time window. Constraint (18.5) enforces the model to have as many reservations as possible in one tee-time. Note that constraint (18.5) forces variable z_j to be one if there is an assignment to tee-time j. Constraint (18.6) minimizes the time-deviation from the customer's requested tee-time T_i by penalizing the deviation in the objective function. In our experiments, we considered 2 hours as the time window for a reservation, which is up to 1 hour before or 1 hour after the requested time. For example, if a customer asks for an 8:48 am tee-time, GRO allows the assignment of this request to occur at a tee-time between 7:48 am and 9:48 am. Meanwhile constraint (18.6) guarantees a minimum time-deviation from requested 8:48 am tee-time.

The objective function in GRO maximizes the total revenue from the assignment of parties to a tee-time, and minimizes the number of tee-times that are not at full capacity. Moreover, it minimizes the time-deviation from the customer's requested tee-time. The minimization is a secondary priority for this objective function of GRO. Therefore, the value of parameter c_j, p_i^+, and p_i^- should be very small compared to r_{ij}. This cost can be an arbitrarily small value associated with variable z_j, y_i^+, and y_i^-. In our test, the value of c_j is empirically set at \$5. Similarly, p_i^+ and p_i^- are set at \$3.

Three rate categories exist for the tee-times, depending on the time of day; for example, early morning tee-times are more expensive. The prices in each rate category include discount and regular prices, which are used to differentiate the demand with different profit potentials. Therefore, the 2 hours time window allows the GRO to move the discount category to the tee-times with a lower rate or a lower demand.

Solution approach

The GRO model is a linear model. This model can be directly solved by the branch-and-bound (B&B) algorithm. However, our empirical results show that the direct application of B&B to this problem takes about 10 hours for each run – due to the large size of the problem – using a built-in algorithm of the B&B in the SAS-OR software. To reduce the computational time, we propose a heuristic to find an initial feasible solution to the GRO. The rationale is that the computational efficiency of the B&B algorithms can be greatly improved by having a quality initial solution (Geoffrion and Marsten, 1972).

In the following algorithm, we introduce the proposed heuristic in the form of a pseudo code. Its solution is used in the B&B method as a lower bound called Algorithm one.

Algorithm one: golf tee-time assignment

Initialization

Sort reservations in a non-decreasing order of arrival for tee-time and a decreasing order of party size;

Set all $x_{ij} = 0$. ($x_{ij} = 1$ if booking *i* is assigned to tee time *j*; otherwise the value = 0).

Iterations

Step one: Find a feasible assignment, x_{ij}, with the maximum revenue; if a feasible assignment is not identified, go to *Step two*; and then go to *Step three*.

Step two: Set $x_{ij} = 1$ and go back to *Step one*.

Step three: Stop when an integer-feasible solution of the assignment is found.

Step four: Enter the solution as a low bounder to a Mixed Integer Programming (MIP) solver to obtain an optimal solution for the problem.

The resulting solution obtained from Algorithm one is used as a lower bound to GRO during the B&B process. This lower bound reduces the CPU time from hours to a few minutes.

Computational results

For the computational experiments, we implemented the GRO on SAS Enterprise Guide 4.0 software. We conducted the experiments using forecasted demand for a typical golf course with 9-minute tee-time intervals, which allows for approximately 60 different tee-times between 7:30 am and 3:00 pm. The one-day problem size for this particular golf course contains 46,500 variables and 1081 constraints. Our empirical results show that the direct application of B&B to this problem takes about 10 hours for each run (due to the large problem size) using a built-in algorithm of B&B in the SAS-OR software. For the 60-day forecast, we performed the assignments daily for 60 days in the advance base. Therefore, the 10-hour optimization is impractical for the industry.

Later, we used the heuristic explained in Algorithm one to find the initial integer-feasible solution to the GRO. This initial solution improved the performance of the algorithm and cut the CPU time to a few minutes. Table 18.1 shows that for a particular set of data, the heuristic solution assigned 69 reservations to the tee-times and generated \$15,857 of revenue. By using this lower bound in the GRO, Table 18.2 presents the optimal solution with 88 assignment and \$17,267 of revenue.

The demand data of different sized parties are established from the simulated historical data. The demand is forecast for all incremental time

Table 18.1 Heuristic solution

Total revenue	Assigned demand
$15,857	69

Table 18.2 Optimal solution

Total revenue	Assigned demand
$17,267	88

Table 18.3 Forecasted demands

Index No.	Party size	Forecasted demand	Capacity	Tee-time
1	1	1	4	7:36
2	2	2	4	7:36
3	1	1	4	7:45
4	2	2	4	7:45
5	1	1	4	7:54
6	2	2	4	7:54
7	1	1	4	8:03
8	2	2	4	8:03
9	1	1	4	8:12
10	2	2	4	8:12
11	1	1	4	8:21
12	2	2	4	8:21
13	1	1	4	8:30
14	2	2	4	8:30
15	2	3	4	8:39
16	2	3	4	8:48
....	....	....	....	....
456	4	1	4	13:54

intervals (tee-time intervals) of 9 minutes, according to the party size as shown in Table 18.3. The first row of Table 18.3 shows that the demand forecast for a party of size one at 7:36 am is one. Similarly, the forecast for a party of size two at 7:36 am is two.

Table 18.4 shows the assigned reservations for the tee-times. The capacity for each tee-time is a maximum of four reservations. Therefore, for each tee-time, we are able to take up to four reservations as is shown in Table 18.4. For example, this means that at 7:36 am, three reservations are assigned – one with ID B001D1S2 and the other two with reservation ID B003D1S2.

Table 18.4 Tee-time assignments

Tee-Time	**Booking1**	**Booking 2**	**Booking 3**	**Booking 4**
7:36	B001D1S2	B003D1S2	B003D1S2	
7:45	B002D1S2			
7:54	B004D1S2			
8:03	B017D1S2	B017D1S2	B017D1S2	
8:12	B008D1S2			
8:21				
8:30	B015D1S2			
8:39	B006D1S2	B006D12S2		
8:48	B010D1S2	B010D1S2		
8:57	B021D1S2	B021D1S2		
13:27	B085D1S4	B096D1S4		
13:36	B099D1S4			
13:45	B101D1S4			
13:54	B103D1S4			
13:27	B085D1S4	B096D1S4		
13:36	B099D1S4			
13:45	B101D1S4			
13:54	B103D1S4			

Conclusion

Golf courses sell the same tee-times to different players at different prices. The price discrimination is either due to the time of day, for example, early morning tee-times are more expensive; or it is due to discount and promotional prices. While the golf course management would like to sell the tee-time to highly profitable players as much as possible, it is necessary to allow the lower profitable players to prevent tee-times from remaining vacant. Allocating the tee-times to the right combinations of players such that the revenues are maximized is the topic of Revenue Management. The history of Revenue Management goes back to major airlines in the USA. The early effort in reservation control in the air industry is focused on overbooking. The overbooking is computed based on the forecast of bookings, passengers' cancellation, no-shows and go-shows. A similar approach to overbooking for hotel Revenue Management balances the expected loss of revenue from unsold rooms against the cost of "walking" the customer by failing to honor the reservation. Later the development of the Revenue Management system extends to four key areas including forecasting, overbooking, seat (room) inventory and pricing. In our golf Revenue Management system we ignored the overbooking and focused on forecasting, tee-time inventory and pricing. This could be interpreted as a decision on what inventory should be sold at what price.

The forecast model predicts the demand for each golf course/time of day/rate category/party size. The optimization part provides a linear model that optimally allocates booking limits to a specific golf course/time of the day/rate category/party size. These booking limits can be used as the maximum number of booking requests to accept for each tee-time and rate category during the booking period. This model is a typical Revenue Management method used in practice by the airline and other industries, the essence of which is to optimally allocate rate buckets to the discount categories. Therefore, the fundamental Revenue Management decision would be to accept or reject a reservation.

In this chapter, we studied a special Revenue Management problem in the golf course industry, as compared to the Revenue Management problems in the airline and hotel industries. A unique feature of this golf reservation problem is that the resources are provided in blocks; for example, a golf tee-time with a capacity of maximum four. This resource block can accommodate up to four reservations (if all the reservations are of size one). These unique features distinguish this problem from those in the hotel and airline industries. We propose an Mixed Integer Programming (MIP) model to solve this problem.

With respect to the methodologies adopted in this study, the linear models in the GRO can be implemented directly and solve the problem with the B&B algorithm. To overcome the complexity of the algorithm and to solve the problem more efficiently, we propose a heuristic algorithm to find a quality-feasible solution that can serve as a lower bound in the B&B algorithm. This heuristic solution substantially reduces the CPU time for solving the problem.

References

Barnhart, C., Farahat, A. and Lohatepanont, M. (2009) Airline Fleet Assignment with Enhanced Revenue Modeling, *Operations Research*, 57, 231–244.

Barnhart, C., Kniker, T. and Lohatepanont, M. (2002) Itinerary-based Airline Fleet Assignment, *Transportation Science*, 36, 199–217.

Bertsimas, D. and Popescu, I. (2003) Revenue Management in a Dynamic Network Environment, *Transportation Science*, 37, 257–277.

Bitran, G. R. and Gilbert, S. M. (1996) Managing Hotel Reservations with Uncertain Arrivals, *Operations Research*, 44, 35–49.

Bitran, G. R. and Mondschein, S. V. (1995) An Application of Yield Management to the Hotel Industry Considering Multiple Day Stays, *Operations Research*, 43, 427–443.

Feng, Y. and Xiao, B. (2000) A Continuous-time Yield Management Model with Multiple Prices and Reversible Price Changes, *Management Science*, 46, 644–657.

Gallego, G. and van Ryzin, G. (1997) A Multi-product Dynamic Pricing Problem and Its Applications to Network Yield Management, *Operations Research*, 45, 24–41.

Geoffrion, A. M. and Marsten, R. E. (1972) Integer Programming Algorithms: A Framework and State-of-the-Art Survey, *Management Science*, 18(9), 465–491.

Hadjer, A., Marcotte, O. and Soumis, F. (2006) A Branch-and-Cut Algorithm for the Multiple Depot Vehicle Scheduling Problem, *Operations Research*, 54, 130–149.

Held, M. and Karp, R. M. (1970) Traveling Salesman Problem and Minimal Spanning Trees, *Operations Research*, 18, 1138–1162.

Kimes, S. E. and Schruben, L. W. (2002) Golf Course Revenue Management: A Study of Tee Time Intervals, *Journal of Revenue and Pricing Management*, 1(2), 111–120.

Li, Y. and Wang, X. (2005) Integration of Fleet Assignment and Aircraft Routing, *Transportation Research Record*, 1915, 79–84.

Li, Y., Rasekh, L. and Wang, X. (2010) A Revenue Management Approach to Restaurant's Table Top Reservation, forthcoming in *European Journal of Operations Research*.

Li, Y., Wang, X. and Adams, T. (2009) Ride Service Outsourcing for Profit Maximization, *Transportation*, 45, 138–148.

Liang, Y. (1999) Solution to the Continuous Time Dynamic Yield Management Model, *Transportation Science*, 33, 117–123.

Vitello, P. (2008) More Americans are Giving Up Golf, *New York Times*. Available online at http://www.nytimes.com/2008/02/21/nyregion/21golf.html?em&ex=1203829200&en=9c9070c4064e72a7&ei=5087%0A (last accessed May 2010).

Wang, X. and Meng, Q. (2008) Continuous Time Revenue Management with Demand Driven Dispatch in the Airlines Industry, *Transportation Research Part E*, 44(6), 1052–1073.

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