How to Price

A Guide to Pricing Techniques and Yield Management

Over the past four decades, business and academic economists, operations researchers, marketing scientists, and consulting firms have increased their interest in and research on pricing and revenue management. This book attempts to introduce the reader to a wide variety of research results on pricing techniques in a unified, systematic way at varying levels of difficulty. The book contains a large number of exercises and solutions and therefore can serve as a main or supplementary course textbook, as well as a reference guide for pricing consultants, managers, industrial engineers, and writers of pricing software applications. Despite a moderate technical orientation, the book is accessible to readers with a limited knowledge in these fields as well as to readers who have had more training in economics. Most pricing models are first demonstrated by numerical and calculus-free examples and then extended for more technically oriented readers.

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For Sarah, Daniel, and Tianlai

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Preface

What This Book Will NOT Teach You

The key to successful profit-maximizing pricing is *knowing your potential customers*. If a firm does not manage to learn the characteristics of all its potential customer types, such as consumers' willingness to pay, the firm will not be able to properly price its products and services.

This book will *not* teach you how to identify the characteristics of your consumers. Although several econometric techniques for identifying these characteristics are described in Chapter 2, a comprehensive analysis of this subject is beyond the scope of this book. The two main reasons for not attempting to include these techniques in this book are (a) consumers' preferences in general, and willingness to pay in particular, vary all the time when new competing products, services, and brands are introduced to the market, which means that (b) the most efficient way of learning about customers is by *trial and error*, or simply experimenting with different tariffs while recording how consumers respond. That is, as this book shows, successful pricing techniques should not only be profitable, they should also induce consumers to *reveal* their characteristics.

What This Book Attempts to Teach You

Revenue and profit are affected by a wide variety of observable and unobservable parameters. Therefore, even if various pricing techniques are well chosen and properly used, there is still no guarantee that the firm will be profitable. However, despite the high degree of uncertainty, if one takes the approach that pricing with some reasoning cannot be inferior (profitwise) to implementing arbitrary pricing strategies, then it is hoped this book will provide you with the right intuition and with a wide variety of tools under which sellers can enhance their profits. During the past 40 years, business and academic economists, operations researchers, marketing scientists, and consulting firms have increased their interest in and research on pricing and revenue management. This book attempts to introduce the reader to a wide variety of their research results in a unified systemic way, but at varying levels of difficulty. Traditionally, the different disciplines manifested different views on pricing techniques; however, recently the attitudes toward pricing in these

disciplines have exhibited a sharp convergence that recognizes price discrimination and market segmentation as an important part of the design of profitable pricing techniques. It is hoped that the present book contributes to this convergence process.

Motivation for Writing This Book

Yield and revenue management (or profit management, as it should be called) is commonly taught in business schools, where very often teachers simply combine it with a marketing course. Revenue management is also taught in special courses and seminars for employees of the airline and hotel industries. Most of these special courses tend to be nontechnical. All this means that the analytical work on yield management, which was written mainly by scientists in the field of operations research, cannot be diffused to the general audience. Such a diffusion is not always needed, however, given that large companies tend to rely on software packages and automated reservation systems.

On the other side of the campus, the economics profession has managed over the years to develop a large number of theories on profitable pricing techniques. Most of these techniques are based on price discrimination. Other theories come from extensive research conducted by economists during the 1970s and 1980s on optimal regulation and deregulation of public utilities. Often, the economics approach goes somewhat further than the operations research approach by considering the strategic response of rival firms competing in the same market.

The purpose of this book is to combine the relevant theories from economics (mainly from microeconomics, industrial organization, and regulation) with some operations research, and to make it accessible to students and practitioners who have limited knowledge in these fields. On the other hand, readers who have had more training in economics will easily find more advanced material. Knowledge of calculus is not needed for the major part of this book, because calculus techniques are not very useful for handling discrete data, which a computer can manipulate. However, more mathematically trained readers should be able to find various topics and extensions that are based on calculus. To summarize, this book attempts to introduce the formal analysis of revenue management and pricing techniques by bridging the knowledge gained from economic theory and operations research. This book is also designed as a reference guide for pricing consultants and managers as well as computer programmers who are equipped with the appropriate technical knowledge.

Computer Applications

Professional price practitioners may want to simulate the studied pricing techniques on a computer to ultimately bring these techniques to practical use. For this reason, I have attempted to sketch some algorithms according to which programmers can write simple macros. These macros can be easily written using popular spreadsheet software and thus do not always require sophisticated programming. Of course, some readers may feel more comfortable writing in formal programming languages. The reader is invited to visit the Web site `www.how-to-price.com` to observe how these short macros can be implemented on the Web using the JavaScript language. Clearly, limited space does not allow me to write complete algorithms. But I hope that the logic behind the suggested algorithms would benefit the potential programmer by serving as a benchmark for more sophisticated pricing software. For convenience, the algorithms in this book are written to resemble algorithms in Pascal (a computer programming language designed in 1970 for teaching students structured programming).

To the Instructor

The instructor will find sufficient material to fill at least a one-semester course, if not an entire year. This book uses lots of calculus-free models, so it can be used without calculus if needed. An instructor's manual is provided in Chapter 12, where I also provide abbreviated solutions for all exercises. I urge the instructor to read this manual before writing the course syllabus because for each chapter, I provide some suggestions regarding which topics should suit students with different backgrounds.

Basically, the book can be divided into three parts. Although topics from all chapters are interrelated, Chapters 2 through 5 may be classified as pricing techniques (mostly for static and stationary markets). Chapters 6 through 9 roughly fall under the category of yield and revenue management as they analyze dynamic markets under capacity constraints. Chapters 10 and 11 offer a variety of topics related to both pricing and revenue management.

Each chapter ends with several exercises. These exercises attempt to motivate students to understand and memorize the basic definitions associated with the various theories developed in that chapter. The solution to all these exercises are provided in Chapter 12. Providing all the solutions to students has its pros and cons. However, I have found that students who go over these solutions perform much better on the exams than do students who are not exposed to the solutions. As a result, instead of placing the solution manual on the Internet (as I have done for my other books), I have integrated the solutions into the book itself.

This book is clearly on the technical side. However, most topics in this book are covered at multiple levels of difficulty. Hence, numerical examples should appeal to the less technical reader, whereas the general formulations and computer algorithms should appeal to more technical readers and researchers. Topics from this book can be arranged as a one-semester course for advanced undergraduate and graduate students in economics, as well as for those in some advanced MBA programs that go beyond the purely descriptive case-based method. Students of industrial engineering should also be able to grasp most of the material.

Errors, Typos, and Errata Files

My experience with my first two books (Shy 1996, 2001) has been that it is nearly impossible to publish a completely error-free book. Writing a book very much resembles writing a large piece of software because literally all software packages contain some bugs that the author could not predict. In addition, 80% of the time is devoted to debugging the software after the basic code has been written. I will therefore make an effort to publish all errors known to me on my Web site: `www.ozshy.com`.

Typesetting and Acknowledgments

This book was typeset by the author using the LaTeX 2_ε document preparation software developed by Leslie Lamport (a special version of Donald Knuth's TeX program) and modified by the LaTeX3 Project Team. For most parts, I used MikTeX, developed by Christian Schenk, as the main compiler.

Staffan Ringbom, Swedish School of Economics at Helsinki and HECER, has offered many suggestions, ideas, and comments that greatly improved the exposition and the content of this book. In addition, Staffan was the first to teach this book in a university environment and to collect some comments directly from students. I also would like to thank the Social Science Research Center Berlin (WZB) for providing me with the best possible research environment, which enabled me to complete this book in only two years.

During the preparation of the manuscript, I was very fortunate to work with Scott Parris of Cambridge University Press, to whom I owe many thanks for managing the project in the most efficient way. Scott has been fond of this project for several years, and his interest in this topic encouraged me to go ahead and write this book. Finally, I thank Barbara Walthall of Aptara, Inc. and the entire Cambridge University Press team for the fast production of this book.

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