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SURESH P. SETHI
School of Management, University of Texas at Dallas, Richardson, TX, USA

HOUMIN YAN
The Chinese University of Hong Kong, Hong Kong, China

HANQIN ZHANG
Academy of Mathematics and Systems Science, Academia Sinica, China

Suresh P. Sethi
University of Texas @ Dallas
Richardson, TX, USA

Houmin Yan
The Chinese University of Hong Kong
China

Hanqin Zhang
Academia Sinica
China

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Preface

Supply chain management research has attracted a great deal of attention over the last ten years. This research covers an enormous territory involving multiple disciplines. It is carried out in the academia as well as by practitioners. A number of interesting topics that are examined are coordination of supply chains, supply chain design and re-engineering, competition of supply chain players, information dynamics, and contracts and incentive design.

From cottage industries and corner stores to today's search-engines in internet commerce, obtaining information and sourcing merchandise have been a major issue. Over the last 20 years, modern information technology has greatly changed the landscape of acquisition and distribution of both product and demand information. Companies have recognized the importance of learning about their customers needs and obtaining advance information. In addition, the progress in manufacturing technology, logistics services, and globalization makes it possible for companies to satisfy their customers from sources with different prices and lead times. Therefore, investigating ways to effectively distribute and obtain information, and to efficiently make use of different sources of production and transportation have been and are important foci of supply chain research.

With a careful analysis of real data collected from industry, we demonstrate the dynamics of information in the forecasting process. Our approach considers the forecasting process as one analogous to peeling away the layers of an onion—that is, the information at any given time has a number of sources of uncertainties that are resolved one by one in successive periods. We study the problem of supply chain decision making with such an information-updating process. The models considered in this book are inventory decisions with multiple delivery modes, supply-contract design and evaluation, and a two-player competitive supply chain. We formulate mathematical description of real problems, develop approaches for analysis of these models, and gain insights into better supply chain management. Much attention is given to characterization of

the solutions—that is, inventory decisions prior and subsequent to information updates and the impact of the quality of information on these decisions.

Mathematical tools employed in this book involve dynamic programming and game theory. This book is written for students, researchers, and practitioners in the areas of Operations Management and Industrial Engineering. It can also be used by those working in the areas of Operations Research and Applied Mathematics.

The models and applications of supply chain decision making with information updates presented in this book are in their early stages of development. There have been a series of advances, but there is still much to be done. Therefore, many of the models addressed in the book could be further extended to capture more realism.

We wish to thank Qi Feng, Xiang-Hua Gan, Art Hsu, Hong-Yan Huang, Ke Liu, Ruihua Liu, Si-Tong Tan, and Hua Xiang, who have worked with us in the area of inventory and supply chain decision making with information updates. For their careful reading of the manuscript and able assistance at various stages in the writing of this book, we also want to thank our students Yumei Hou, Hui Li, Lijun Ma, Jun Wu, Jiankui Yang, and Haibo Yu. In addition we express our appreciation to Barbara Gordon and Joyce Xu for their assistance in the preparation of the various drafts of the manuscript.

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Richardson, TX, USA, January, 2005 — Suresh P. Sethi
Hong Kong, China, January, 2005 — Houmin Yan
Beijing, China, January, 2005 — Hanqin Zhang

To the memory of my brothers Champalal, Pannalal, and Sripal
To the memory of my sister Mohini
To my brothers Mahipal, Laxmipal, and Shantipal
To my sisters Mena, Kamalsri, and Sulochana — *Suresh P. Sethi*

To my wife Joyce and sons Ron and Justin — *Houmin Yan*

To my parents Shu-Ping Zhang and Yu-Jie Song — *Hanqin Zhang*

Notation

This book is divided into eight chapters. In any given chapter, say Chapter 2, sections are numbered consecutively as 2.1, 2.2, 2.3, 2.4, and so on. Subsections and sub-subsections are also numbered consecutively as 2.4.1, 2.4.2, ... and 2.4.3.1, 2.4.3.2, ..., respectively. Similarly, mathematical expressions such as equations, inequalities, and conditions, are numbered consecutively as (2.1), (2.2), (2.3), ... Figures, tables and propositions are numbered consecutively as Figure 2.1, Figure 2.2, ..., Table 2.1, Table 2.2, ..., and Proposition 2.1, Proposition 2.2,.... The same numbering scheme is used for theorems, lemmas, corollaries, definitions, remarks, and examples.

We provide clarification of some frequently-used terms in this book. The terms "surplus", "inventory/shortage", and "inventory/backlog" are used interchangeably. The terms "control", "policy", and "decision" are used interchangeably.

We make use of the following notation in this book:

$w.p.1$	with probability one
i.i.d.	independent, identically distributed
$\Longrightarrow$	denotes "implies"
$\Phi(x)$	$= \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{-\frac{t^2}{2}} dt$
$\Phi^{-1}(\cdot)$	the inverse function of $\Phi(\cdot)$
$\delta(x)$	$= \begin{cases} 1, & x > 0 \\ 0, & x \leq 0 \end{cases}$
I_D	the indicator function of a set D
$\emptyset$	the empty set
$\square$	end of a proof

$(\Omega, \mathcal{F}, \mathsf{P})$	the probability space
$\mathsf{P}(\xi \in \cdot)$	the probability distribution of a random variable ξ
$\mathsf{E}\xi$	the expectation of a random variable ξ
$\mathsf{Var}\xi$	the variance of a random variable ξ
$(a_1, \ldots, a_l) > 0$	means $a_1 > 0, \ldots, a_l > 0$
$(a_1, \ldots, a_l) \geq 0$	means $a_1 \geq 0, \ldots, a_l \geq 0$
$a \geq b$	means $a - b \geq 0$ for any vectors a and b
$a_1 \wedge \cdots \wedge a_l$	$= \min\{a_1, \ldots, a_l\}$ for any real numbers $a_i, i = 1, \ldots, l$
$a_1 \vee \cdots \vee a_l$	$= \max\{a_1, \ldots, a_l\}$ for any real numbers $a_i, i = 1, \ldots, l$
x^+	$= \max\{x, 0\}$ for a real number x
x^-	$= \max\{-x, 0\}$ for a real number x
$\lfloor x \rfloor$	the largest integer smaller than or equal to a real number x