CENGAGE Learning

INDIA EDITION

EDITION 9

OPERATIONS MANAGEMENT

NORMAN GAITHER
GREG FRAZIER

This edition is licensed for sale only in India, Pakistan, Bangladesh, Nepal and Sri Lanka. Circulation of this edition outside of these countries is UNAUTHORIZED AND STRICTLY PROHIBITED

INDIA EDITION

OPERATIONS MANAGEMENT 9E

NORMAN GAITHER GREG FRAZIER

The ninth edition of **OPERATIONS MANAGEMENT** helps students build the strong foundation they need to master production and operations management - both in services and manufacturing. It is revised with new or updated features throughout, from new problems and examples to timely coverage of e-business to the integration of Excel.

Key features include:

Operations Management in Services. The application of operations strategy, process planning, automation, and quality-to-service operations is specifically discussed. Examples, problems, and cases are cast in the setting of transportation, retailing and wholesaling, banking, and other service industries.

E-Business. The impact of e-business on business operations is discussed in depth in Chapter 11.

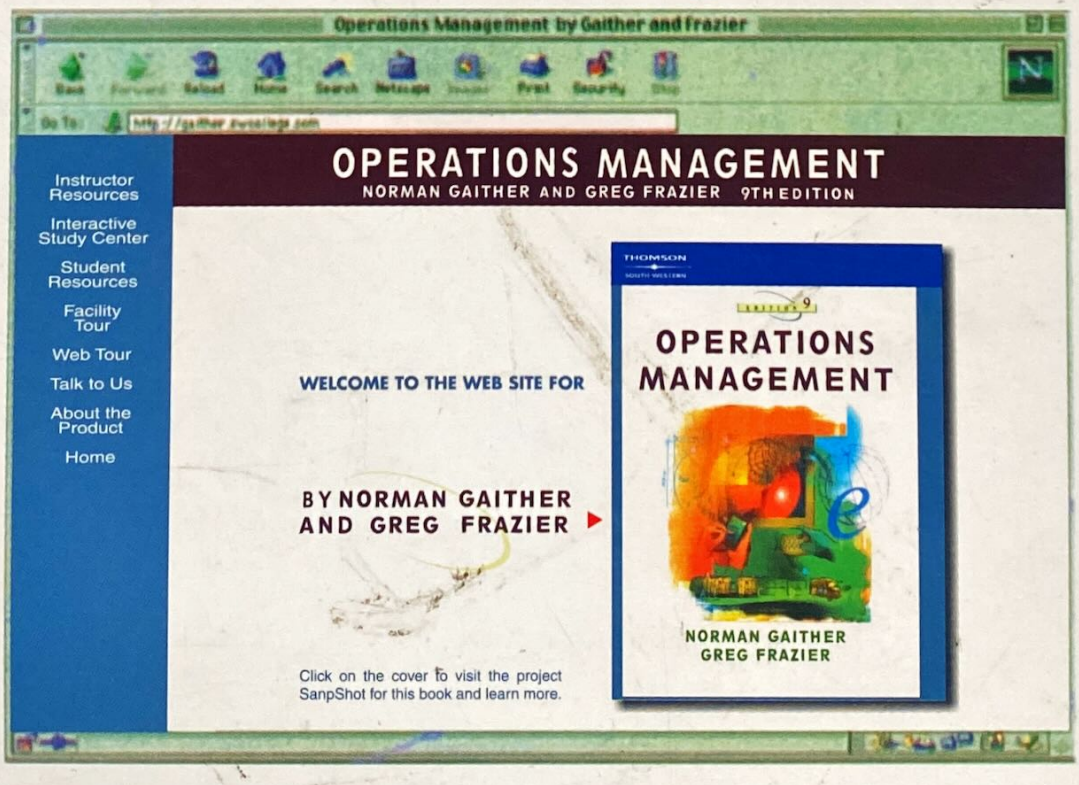
New Problems and Cases with Microsoft® Excel. Over 150 new problems that enrich this edition encourage the use of Excel spreadsheet applications.

POW Software Library. Included on a CD-ROM, this specialized software allows students to solve computer-based problems and cases found in the text.

Example Problems. The book's example problems are a text hallmark, and each one helps students build essential problem-solving and decision-making skills.

Web Site. Explore the array of on-line teaching and learning resources at the Gaither/Frazier Web site.

http:// gaither.swcollege.com



CENGAGE Learning™
For product information, visit **www.cengage.co.in**

This edition is licensed for sale only in India, Pakistan, Bangladesh, Nepal and Sri Lanka. Circulation of this edition outside of these countries is UNAUTHORIZED AND STRICTLY PROHIBITED

ISBN 978-81-315-0048-4
ISBN 81-315-0048-9
9 788131 500484

EDITION 9

Operations Management

Norman Gaither
Texas A&M University

Greg Frazier
The University of Texas at Arlington

CENGAGE Learning™

Australia · Canada · Mexico · Singapore · Spain · United Kingdom · United States

Brief Contents

PART 1

MANAGING OPERATIONS IN A GLOBAL ENVIRONMENT 2

Chapter 1
Introduction to Operations Management 5

Chapter 2
Operations Strategies in a Global Economy 26

PART 2

PLANNING THE STRATEGIC USE OF RESOURCES 60

Chapter 3
Demand Forecasting 62

Chapter 4
Product, Process, and Service Design 113

Chapter 5
Facility Capacity, Location, and Layout 163

Chapter 6
Operations Technologies 229

Chapter 7
Operations Quality Management 265

Chapter 8
Strategic Allocation of Resources 297

Chapter 9
Service Operations Planning and Scheduling

Chapter 10
Project Management 375

PART 3

MANAGING OPERATIONS IN THE SUPPLY CHAIN 422

Chapter 11
Supply Chain Management and E-Business 424

Chapter 12
Just-in-Time and Lean Manufacturing 462

Chapter 13
Production Planning 491

Chapter 14
Inventory Management 535

Chapter 15
Resource Requirements Planning: MRP and CRP 582

Chapter 16
Manufacturing Operations Scheduling 622

PART 4

MAINTAINING EFFECTIVE AND EFFICIENT OPERATIONS 660

Chapter 17
Quality Control 662

Chapter 18
Employee Productivity 696

Chapter 19
Maintenance Management 741

Appendices

A Normal Probability Distribution 774

B Student's t Probability Distribution 776

C Answers to Odd-Numbered Problems 778

D Glossary 783

Author Index 795

Subject Index 799

Photo Credits 813

Operations Management, 9e
Norman Gaither & Greg Fraizer

© 2004 Cengage Learning India Pvt. Ltd.

This edition is reprinted with license from South-Western, a part of Cengage Learning, for sale in India, Pakistan, Bangladesh, Nepal and Sri Lanka only. Circulation of this edition outside of these countries is strictly prohibited.

ALL RIGHTS RESERVED. No part of this work covered by the copyright herein may be reproduced, transmitted, stored or used in any form or by any means graphic, electronic, or mechanical, including but not limited to photocopying, recording, scanning, digitizing, taping, Web distribution, information networks, or information storage and retrieval systems, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without the prior written permission of the publisher

ISBN-13: 978-81-315-0048-4
ISBN-10: 81-315-0048-9

Cengage Learning India Private Limited
418 F.I.E. Patparganj
New Delhi-110092

Tel: 91-11- 43641111
Fax: 91-11- 43641100

Cengage Learning products are represented in Canada by Nelson Education, Ltd.

For product information, visit www.cengage.co.in

Printed in India
Ninth Indian Reprint 2009

Contents

PART 1

MANAGING OPERATIONS IN A GLOBAL ENVIRONMENT 2

Chapter 1
Introduction to Operations Management 5

Historical Milestones in POM 8
- The Industrial Revolution 8
- Post–Civil War Period 10
- Scientific Management 10
- Human Relations and Behavioralism 13
- Operations Research 13
- The Service Revolution 15
- The Computer Revolution 16

Factors Affecting Operations Management Today 16

Studying Operations Management 17
- Operations as a System 17
- Decision Making in POM 20

Business Snapshot:
1.1 Scientific Management at Ford's Rouge Plant 12

Chapter 2
Operations Strategies in a Global Economy 26

Today's Global Business Conditions 29
- Reality of Global Competition 29
- Quality, Customer Service, and Cost Challenges 35
- Advanced Technologies 37
- Continued Growth of the Service Sector 37
- Scarcity of Operations Resources 38
- Social-Responsibility Issues 39

Operations Strategy 43
- Competitive Priorities 45
- Elements of Operations Strategy 46
- Operations Strategy in Services 50

Forming Operations Strategies 52
- Evolution of Positioning Strategies 52
- Linking Operations and Marketing Strategies 52
- A Variety of Strategies Can Be Successful 53

Business Snapshots:
2.1 Opening China's Markets to Foreign Firms 31
2.2 Strategic Alliances 33
2.3 GM's New Brazilian Auto Complex 36
2.4 Cleaning Up Medical Waste 40
2.5 Recycling and Conservation in Industry 41
2.6 Environmental Efforts at Compaq 42

PART 2

PLANNING THE STRATEGIC USE OF RESOURCES 60

Chapter 3
Demand Forecasting 62

Qualitative Forecasting Methods 66

Quantitative Forecasting Models 67
- Forecast Accuracy 67
- Long-Range Forecasts 68
- Short-Range Forecasts 81

How to Have a Successful Forecasting System 92
- How to Select a Forecasting Method 92
- How to Monitor and Control a Forecasting Model 95

Computer Software for Forecasting 97

Forecasting in Small Businesses and Start-Up Ventures 97

Business Snapshots:
3.1 Forecasting Telephone Calls at L. L. Bean 79
3.2 Using a Forecasting Expert System at Xerox 93
3.3 Forecasting Flare Sales at Olin Corporation 94
3.4 Focus Forecasting at American Hardware Supply 95

Chapter 4
Product, Process, and Service Design 113

Designing and Developing Products and Services 114
- Sources of Product Innovation 115
- Developing New Products 115
- Getting New Products to Market Faster 116
- Improving the Designs of Existing Products 119
- Designing for Ease of Production 119
- Designing for Quality 120
- Designing and Developing New Services 120

Process Planning and Design 121

Major Factors Affecting Process Design Decisions 122
Nature of Product/Service Demand 122
Degree of Vertical Integration 123
Production Flexibility 123
Degree of Automation 124
Product/Service Quality 125

Types of Process Designs 125
Product-Focused 125
Process-Focused 127
Group Technology/Cellular Manufacturing 128

Interrelationships among Product Design, Process Design, and Inventory Policy 131

Process Design in Services 132

Deciding among Processing Alternatives 134
Batch Size and Product Variety 134
Capital Requirements for Process Designs 136
Economic Analysis 136
Assembly Charts 140
Process Charts 140

Plant Tours 140
A Product-Focused, Dedicated Factory: Safety Products Corporation, Richmond, Virginia 140
A Process-Focused Factory: R. R. Donnelley & Sons, Willard, Ohio 147
A Service Operation: Wal-Mart Regional Distribution Center, New Braunfels, Texas 150

Business Snapshots:
4.1 Applied Research Pays Off with Cool Sound 115
4.2 Developing the Prodigy at Ford 117
4.3 Virtual Reality Simulations in the Product Design Process at Boeing 118
4.4 Strategic Outsourcing—From Vertical to Virtual Integration 124
4.5 Compaq Changes to Produce-to-Order 132

Chapter 5
Facility Capacity, Location, and Layout 163

Long-Range Capacity Planning 165
Definition of Production Capacity 165
Measurements of Capacity 166
Forecasting Capacity Demand 166
Ways of Changing Capacity 168
Economies of Scale 168
Analyzing Capacity-Planning Decisions 173
Decision Tree Analysis 174

Facility Location 176
Factors Affecting Location Decisions 177
Types of Facilities and Their Dominant Locational Factors 177
Data, Politics, Incentives, and Preemptive Tactics 182
Analyzing Retailing and Other Service Locations 184
Analyzing Industrial Facility Locations 184
Integrating Quantitative and Qualitative Factors into Location Decisions 185

Facility Layout 186

Manufacturing Facility Layouts 187
Materials Handling 187
Process Layouts 188
Product Layouts 189
Cellular Manufacturing Layouts 190
Fixed-Position Layouts 191
Hybrid Layouts 192
New Trends in Manufacturing Layouts 192

Analyzing Manufacturing Facility Layouts 194
Software for Analyzing Facility Layouts 194
Planning Process and Warehouse Layouts 194
Planning Product Layouts 195
Planning Cellular Manufacturing Layouts 204

Service Facility Layouts 207
Types of Service Facility Layouts 207
Analyzing Service Facility Layouts 208

Business Snapshots:
5.1 Automakers Facing Overcapacity in Asia 167
5.2 Too Little and Too Much Capacity 169
5.3 Intel Delays Opening of New Plant 170
5.4 Outsourcing Provides Additional Capacity 173
5.5 Global Facility Location at DEC 179
5.6 Texas Incentives Not Enough for Intel 183
5.7 Boeing Factory Saves Space 193

Chapter 6
Operations Technologies 229

Types of Manufacturing Automation 231
Machine Attachments 232
Numerically Controlled Machines 232
Robots 233
Automated Quality Control Inspection 234
Automatic Identification Systems 235
Automated Process Controls 235

Automated Production Systems 235
Automated Flow Lines 236
Automated Assembly Systems 236

Flexible Manufacturing Systems 237
Automated Storage and Retrieval Systems 238

Software Systems for Automation 239
CAD/CAM 239
Computer-Integrated Manufacturing 240
Enterprise Resource Planning 240

Automation in Services 242

Automation Issues 246
Use of Automation 246
Building Manufacturing Flexibility 247
Justifying Automation Projects 248
Managing Technological Change 248
Worker Displacement, Training, and Retraining 249

Deciding among Automation Alternatives 250
Rating Scale Approach 251
Relative-Aggregate-Scores Approach 252

Business Snapshots:
6.1 Northrop Grumman Searches for New Production Technology 231
6.2 One of the First N/C Machines 233
6.3 ASRS in Hospital Pharmacies 239
6.4 Managing a Company with SAP's ERP Software 241
6.5 Automated Checkout at Kroger Grocery Store 244
6.6 Communications Technology Demolishes Time and Distance 245
6.7 Automated Technologies at Countrywide 245

Chapter 7
Operations Quality Management 265

Nature of Quality 267
Dimensions of Quality 267
Determinants of Quality 267
Costs of Quality 268

Traditional Quality Management 269

Modern Quality Management 270
Quality Gurus 270
Quality Drives the Productivity Machine 272
Other Aspects of the Quality Picture 273

Quality Management Recognition 274
Malcolm Baldrige National Quality Award 274
The Deming Prize 275
ISO 9000 Standards 277

Total Quality Management (TQM) Programs 277
Top Management Commitment and Involvement 278
Customer Involvement 278
Designing Products for Quality 279
Designing and Controlling Production Processes 283
Developing Supplier Partnerships 284
Customer Service, Distribution, and Installation 285
Building Teams of Empowered Employees 285
Benchmarking and Continuous Improvement 288

Quality Management in Services 289

Business Snapshots:
7.1 Deming's 14 Points 271
7.2 The Malcolm Baldrige National Quality Award 275
7.3 Radio and Laser Technology Improves Steel Operations 286
7.4 Empowered Work Teams at Square D Corporation 287
7.5 Benchmarking at Sprint 289
7.6 Examples of TQM in Services 291

Chapter 8
Strategic Allocation of Resources 297

Recognizing LP Problems 302

Formulating LP Problems 303

Solving LP Problems 307
Graphical LP Solutions 307
Overview of Other LP Solution Methods 312

Real LP Problems 318

Interpreting Computer Solutions of LP Problems 320

Business Snapshots:
8.1 Operations Research in U.S. Corporations 299
8.2 Linear Programming Cutting Costs at American Airlines 301

Chapter 9
Service Operations Planning and Scheduling 333
Nature of Services Revisited 334
Operations Strategies for Services 336
Types of Service Operations 337
Scheduling Challenges in Services 337

Scheduling Quasi-Manufacturing Service Operations 340
Product-Focused Operations 340
Process-Focused Operations 340
Work-Shift Scheduling in Service Operations 341

Scheduling Customer-as-Participant Service Operations 345
Nature of These Operations 345
Waiting Lines in Service Operations 346

Scheduling Customer-as-Product Service Operations 355
Nature of These Operations 356
Using Computer Simulation in Service Operations 358

Business Snapshot:
9.1 Taco Bell Uses Simulation to Develop Employee Schedules 358

Chapter 10
Project Management 375

Project Management 376

Project-Planning and Control Techniques 379
Scheduling and Control Charts 379
Critical Path Method (CPM) 384
Program Evaluation and Review Technique (PERT) 394
Project Cost Control Systems 398
CPM/PERT in Practice 400

Computer Software for Project Management 404

An Evaluation of CPM/PERT 406

Business Snapshot:
10.1 Project Management Professionals 380

PART 3

MANAGING OPERATIONS IN THE SUPPLY CHAIN 422

Chapter 11
Supply Chain Management and E-Business 424

Supply Chain Management 425

Purchasing 427
Importance of Purchasing Today 428
Mission of Purchasing 429
What Purchasing Managers Do 430
Purchasing Departments in Organizations 430
Purchasing Processes 431
Buyers and Their Duties 433
Make-or-Buy Analysis 433
Ethics in Buying 435
Purchasing: The International Frontier 436

Logistics 437
Production Control: Movement of Materials within Factories 437
Shipments to and from Factories 438
Innovations in Logistics 440

Warehousing 441
Warehousing Operations 441
Methods of Inventory Accounting 443
Contemporary Developments in Warehousing 445

Expediting 446

Benchmarking the Performance of Materials Managers 446

Third-Party Logistics Management Providers 447

E-Business and Supply Chain Management 448

Business Snapshots:
11.1 Allegations of Improper Behavior by Buyers 435
11.2 Guidelines for Ethical Behavior in Purchasing 436
11.3 Trucking on the Web 441
11.4 Top-Selling Supply Chain Management Software 442

Chapter 12
Just-in-Time and Lean Manufacturing 462

The Just-in-Time Manufacturing Philosophy 464

Prerequisites for JIT Manufacturing 468

Elements of JIT Manufacturing 470
Eliminating Waste 470
Enforced Problem Solving and Continuous Improvement 471
People Make JIT Work 472
Total Quality Management 472
Parallel Processing 472
Kanban Production Control 473
JIT Purchasing 476
E-Commerce and JIT Purchasing 477
Reducing Inventories through Setup Reduction 478
Working toward Repetitive Manufacturing 480

Benefits of JIT Manufacturing 481

Success and JIT Manufacturing 482

JIT in Service Companies 484

Business Snapshots:
12.1 Using Queuing Theory to Achieve Time-Based Competition 467
12.2 JIT Purchasing at Waterville TG, Inc. 477

12.3 JIT at Perlos 481
12.4 Maturing JIT Implementation at Amadas 483

Chapter 13
Production Planning 491

Production-Planning Hierarchy 492

Aggregate Planning 493
Aggregate Demand 494
Dimensions of Production Capacity 495
Sources of Medium-Range Production Capacity 497
Some Traditional Aggregate Plans 497
Criteria for Selecting Aggregate Plans 504
Aggregate Plans for Services 506
Mathematical Models for Aggregate Planning 508
Preemptive Tactics 510

Master Production Scheduling 511
Objectives of Master Production Scheduling 511
Time Fences in Master Production Schedules 511
Procedures for Developing Master Production Schedules 512
Demand Management 516
Weekly Updating of the MPS 516
MPS in Produce-to-Stock and Produce-to-Order Firms 517
Length of Planning Horizons 518
Computerized MPS 518

Types of Production-Planning and Control Systems 520
Pond-Draining Systems 520
Push Systems 521
Pull Systems 522
Focusing on Bottlenecks 523

Business Snapshot:
13.1 Aggregate Planning at Sherman-Brown Chemical Company 495

Chapter 14
Inventory Management 535

Opposing Views of Inventories 536
Why We Want to Hold Inventories 536
Why We Do Not Want to Hold Inventories 537

Nature of Inventories 539

Fixed Order Quantity Systems 540
Determining Order Quantities 541
Determining Order Points 550

Fixed Order Period Systems 559

Other Inventory Models 561
Hybrid Inventory Models 561
Single-Period Inventory Models 562

Some Realities of Inventory Planning 565
ABC Classification of Materials 565
EOQ and Uncertainty 567
Dynamics of Inventory Planning 568
Other Factors Affecting Inventory Planning 568
Vendor-Managed Inventories 568
Computers and Inventory Planning 569

Business Snapshots:
14.1 Improved Inventory Management at 3M 569
14.2 Computer Manufacturers Adopt Produce-to-Order Strategies 572

Chapter 15
Resource Requirements Planning: MRP and CRP 582

Material Requirements Planning (MRP) 584
Objectives of MRP 586
Elements of MRP 588
Green Thumb Water Sprinkler Company 591
Lot-Sizing in MRP 598
Issues in MRP 600
From MRP I to MRP II to ERP 602
How MRP Adapts to Change 603
Evaluation of MRP 604

Capacity Requirements Planning (CRP) 605
Load Schedules 607

Business Snapshot:
15.1 Green Thumb Water Sprinkler Company 591

Chapter 16
Manufacturing Operations Scheduling 622

Scheduling Process-Focused Manufacturing 623
Shop-Floor Planning and Control 626
Order-Sequencing Problems 630
Assignment Problems 638

Scheduling Product-Focused Manufacturing 638
Batch Scheduling 639
Delivery Schedules: Line-of-Balance Method 642

Computerized Scheduling Systems 645

Business Snapshots:
16.1 Input–Output Control at Boeing 628
16.2 Finite Loading at SMC 630
16.3 One Company's Experience with *OPT* Software 646
16.4 *OPT*—The Logical Solution 647

PART 4

MAINTAINING EFFECTIVE AND EFFICIENT OPERATIONS 660

Chapter 17
Quality Control 662

Statistical Concepts in Quality Control 665
Sampling 665
Central Limit Theorem and Quality Control 666

Control Charts 666
Control Charts for Attributes 667
Control Charts for Variables 670

Acceptance Plans 673
Single, Double, and Sequential Samples 674
Single-Sample Acceptance Plans for Attributes 675
Estimating Acceptance Criteria 680
Single-Sample Acceptance Plans for Variables 685

Computers in Quality Control 686

Quality Control in Services 687

Business Snapshot:
17.1 SPC at Georgia-Pacific 668

Chapter 18
Employee Productivity 696

Productivity and Human Behavior 698
Multifactor Approach to Measuring Productivity 699
Labor Productivity 701

Designing Workers' Jobs 705

Empowering Workers 707

Work Methods Analysis 708
How to Do Methods Analysis 708

Work Measurement 712
Labor Standards 712
Time Study 713
Work Sampling 714
Predetermined Time Standards 717

Learning Curves 720
Arithmetic Analysis 722
Logarithmic Analysis 722
Learning-Curve Tables 723
Selecting a Learning Rate 725
Uses and Limitations of Learning Curves 725

Employees' Health and Safety 726

Business Snapshots:
18.1 Productivity Improvements in the United States 701
18.2 Smarter and Better-Trained Employees 703
18.3 Dramatic Safety Improvements at Georgia-Pacific 728

Chapter 19
Maintenance Management 741

Repair Programs 745
Repair Crews, Standby Machines, and Repair Shops 746
Breakdowns Trigger Repairs and Corrective Actions 747
Early Parts-Replacement Policies 748
Letting Workers Repair Their Own Machines 748

Preventive Maintenance (PM) Programs 752
PM and Operations Strategies 752
Automation and the Prominence of PM 752
Scheduling PM Activities 752
PM Database Requirements 753
Modern Approaches to PM 753

Machine Reliability 760

Secondary Maintenance Department Responsibilities 760

Trends in Maintenance 760

Maintenance Issues in Service Organizations 761

Business Snapshots:
19.1 Total Productive Maintenance at Asten, Inc. 754
19.2 Decision Support System for Aircraft Maintenance Planning at American Airlines 762

Appendices

A Normal Probability Distribution 774

B Student's t Probability Distribution 776

C Answers to Odd-Numbered Problems 778

D Glossary 783

Author Index 795

Subject Index 799

Photo Credits 813

PEARSON

Statistics for Management

Seventh Edition

Richard I. Levin
David S. Rubin

PEARSON Education 13 14 58 16

This edition is manufactured in India and is authorized for sale only in India, Bangladesh, Bhutan, Pakistan, Nepal, Sri Lanka and the Maldives. Circulation of this edition outside of these territories is UNAUTHORIZED.

Statistics for Management

Seventh Edition

Richard I. Levin
David S. Rubin

With *Statistics for Management*, Levin and Rubin have provided a non-intimidating business statistics textbook that students can easily read and understand. Like its predecessors, the *Seventh Edition* includes the absolute minimum of mathematical/statistical notation necessary to teach the material.

Concepts are fully explained in simple, easy-to-understand language as they are presented, making the text an excellent source from which to learn *and* teach. After each discussion, readers are guided through real-world examples to show how textbook principles work in professional practice.

ISBN 978-81-7758-584-1

9 788177 585841

PEARSON

This edition is manufactured in India and is authorized for sale only in India, Bangladesh, Bhutan, Pakistan, Nepal, Sri Lanka and the Maldives.

www.pearsoned.co.in

STATISTICS FOR MANAGEMENT

Richard I. Levin

The University of North Carolina at Chapel Hill

David S. Rubin

The University of North Carolina at Chapel Hill

Prentice Hall
is an imprint of

PEARSON

MINITAB is a registered trademark of Minitab,Inc.

Copyright © 1998 by Pearson Education, Inc.
This edition is published by arrangement with Pearson Education, Inc. and Dorling Kindersley Publishing Inc.

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, resold, hired out, or otherwise circulated without the publisher's prior written consent in any form of binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser and without limiting the rights under copyright reserved above, no part of this publication may be reproduced, stored in or introduced into a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording or otherwise), without the prior written permission of both the copyright owner and the above-mentioned publisher of this book.

Pearson Prentice Hall™ is a trademark of Pearson Education, Inc.
Pearson® is a registered trademark of Pearson Plc.
Prentice Hall® is a registered trademark of Pearson Education, Inc.

ISBN 978-81-7758-584-1

First Impression, 2006
Second Impression, 2006
Third Impression, 2006
Fourth Impression, 2007
Fifth Impression, 2007
Sixth Impression, 2008
Seventh Impression, 2008
Eighth Impression, 2009
Nineth Impression, 2009

This edition is manufactured in India and is authorized for sale only in India, Bangladesh, Bhutan, Pakistan, Nepal, Sri Lanka and the Maldives. Circulation of this edition outside of these territories is UNAUTHORIZED.

Published by Dorling Kindersley (India) Pvt. Ltd., licensees of Pearson Education in South Asia.

Head Office: 482, F.I.E., Patparganj, Delhi 110 092, India.
Registered Office: 14 Local Shopping Centre, Panchsheel Park, New Delhi 110 017, India.

Printed in India by Lakshmi Offset Printers.

Contents

Preface xiii

Chapter 1 Introduction *1*

1.1 Why Should I Take This Course and Who Uses Statistics Anyhow? 2
1.2 History 3
1.3 Subdivisions within Statistics 3
1.4 A Simple and Easy-to-Understand Approach 4
1.5 Features That Make Learning Easier 5

Chapter 2 Grouping and Displaying Data to Convey Meaning: Tables and Graphs *7*

2.1 How Can We Arrange Data? 8
2.2 Examples of Raw Data 11
2.3 Arranging Data Using the Data Array and the Frequency Distribution 13
2.4 Constructing a Frequency Distribution 21
2.5 Graphing Frequency Distributions 33
Statistics at Work 47
Computer Database Exercise 49
Terms Introduced in Chapter 2 51
Equations Introduced in Chapter 2 51
Review and Application Exercises 52
Chapter Concepts Test 64
Flow Chart: Arranging Data to Convey Meaning 68

Chapter 3 Measures of Central Tendency and Dispersion in Frequency Distributions *69*

3.1 Summary Statistics 70
3.2 A Measure of Central Tendency: The Arithmetic Mean 73
3.3 A Second Measure of Central Tendency: The Weighted Mean 83
3.4 A Third Measure of Central Tendency: The Geometric Mean 87

3.5 A Fourth Measure of Central Tendency: The Median 91
3.6 A Final Measure of Central Tendency: The Mode 99
3.7 Dispersion: Why It Is Important 105
3.8 Ranges: Useful Measures of Dispersion 108
3.9 Dispersion: Average Deviation Measures 113
3.10 Relative Dispersion: The Coefficient of Variation 126
3.11 Exploratory Data Analysis (EDA) 132
Statistics at Work 136
Computer Database Exercise 136
Terms Introduced in Chapter 3 137
Equations Introduced in Chapter 3 138
Review and Application Exercises 142
Chapter Concepts Test 148
Flow Charts: Measures of Central Tendency and Dispersion 154

Chapter 4 Probability I: Introductory Ideas *159*

4.1 Probability: The Study of Odds and Ends 160
4.2 Basic Terminology in Probability 161
4.3 Three Types of Probability 164
4.4 Probability Rules 170
4.5 Probabilities under Conditions of Statistical Independence 176
4.6 Probabilities under Conditions of Statistical Dependence 185
4.7 Revising Prior Estimates of Probabilities: Bayes' Theorem 193
Statistics at Work 200
Computer Database Exercise 202
Terms Introduced in Chapter 4 203
Equations Introduced in Chapter 4 204
Review and Application Exercises 205
Chapter Concepts Test 214
Flow Chart: Probability I: Introductory Ideas 219

Chapter 5 Probability Distributions *221*

5.1 What Is a Probability Distribution? 222
5.2 Random Variables 226
5.3 Use of Expected Value in Decision Making 232
5.4 The Binomial Distribution 237
5.5 The Poisson Distribution 249
5.6 The Normal Distribution: A Distribution of a Continuous Random Variable 257
5.7 Choosing the Correct Probability Distribution 273
Statistics at Work 274
Computer Database Exercise 275
Terms Introduced in Chapter 5 277
Equations Introduced in Chapter 5 277

Review and Application Exercises 279
Chapter Concepts Test 287
Flow Chart: Probability Distributions 292

Chapter 6 Sampling and Sampling Distributions *295*

6.1 Introduction to Sampling 296
6.2 Random Sampling 298
6.3 Design of Experiments 305
6.4 Introduction to Sampling Distributions 309
6.5 Sampling Distributions in More Detail 313
6.6 An Operational Consideration in Sampling: The Relationship between Sample Size and Standard Error 324
Statistics at Work 329
Computer Database Exercise 330
Terms Introduced in Chapter 6 331
Equations Introduced in Chapter 6 332
Review and Application Exercises 333
Chapter Concepts Test 338
Flow Chart: Sampling and Sampling Distributions 342

Chapter 7 Estimation *345*

7.1 Introduction 346
7.2 Point Estimates 349
7.3 Interval Estimates: Basic Concepts 354
7.4 Interval Estimates and Confidence Intervals 358
7.5 Calculating Interval Estimates of the Mean from Large Samples 361
7.6 Calculating Interval Estimates of the Proportion from Large Samples 367
7.7 Interval Estimates Using the *t* Distribution 371
7.8 Determining the Sample Size in Estimation 378
Statistics at Work 384
Computer Database Exercise 385
From the Textbook to the Real World 386
Terms Introduced in Chapter 7 388
Equations Introduced in Chapter 7 388
Review and Application Exercises 389
Chapter Concepts Test 394
Flow Chart: Estimation 398

Chapter 8 Testing Hypotheses: One Sample Tests *401*

8.1 Introduction 402
8.2 Concepts Basic to the Hypothesis-Testing Procedure 403
8.3 Testing Hypotheses 407

8.4 Hypothesis Testing of Means When the Population Standard Deviation Is Known 416
8.5 Measuring the Power of a Hypothesis Test 424
8.6 Hypothesis Testing of Proportions: Large Samples 427
8.7 Hypothesis Testing of Means When the Population Standard Deviation Is Not Known 433
Statistics at Work 438
Computer Database Exercise 439
From the Textbook to the Real World 440
Terms Introduced in Chapter 8 441
Review and Application Exercises 441
Chapter Concepts Test 446
Flow Chart: One-Sample Tests of Hypotheses 451

Chapter 9 Testing Hypotheses: Two-Sample Tests *453*

9.1 Hypothesis Testing for Differences between Means and Proportions 454
9.2 Tests for Differences between Means: Large Sample Sizes 456
9.3 Tests for Differences between Means: Small Sample Sizes 462
9.4 Testing Differences between Means with Dependent Samples 468
9.5 Tests for Differences between Proportions: Large Sample Sizes 476
9.6 Prob Values: Another Way to Look at Testing Hypotheses 485
9.7 Using the Computer to Test Hypotheses 489
Statistics at Work 492
Computer Database Exercise 493
From the Textbook to the Real World 495
Terms Introduced in Chapter 9 496
Equations Introduced in Chapter 9 496
Review and Application Exercises 498
Chapter Concepts Test 504
Flow Chart: Two-Sample Tests of Hypotheses 509

Chapter 10 Quality and Quality Control *511*

10.1 Introduction 512
10.2 Statistical Process Control 514
10.3 $\bar{x}$ Charts: Control Charts for Process Means 516
10.4 R Charts: Control Charts for Process Variability 527
10.5 p Charts: Control Charts for Attributes 532
10.6 Total Quality Management 539
10.7 Acceptance Sampling 544
Statistics at Work 552
Computer Database Exercise 553
From the Textbook to the Real World 555
Terms Introduced in Chapter 10 556

Equations Introduced in Chapter 10 557
Review and Application Exercises 558
Chapter Concepts Test 562
Flow Chart: Quality and Quality Control 566

Chapter 11 Chi-Square and Analysis of Variance *567*

11.1 Introduction 568
11.2 Chi-Square as a Test of Independence 569
11.3 Chi-Square as a Test of Goodness of Fit: Testing the Appropriateness of a Distribution 584
11.4 Analysis of Variance 591
11.5 Inferences about a Population Variance 608
11.6 Inferences about Two Population Variances 615
Statistics at Work 623
Computer Database Exercise 624
From the Textbook to the Real World 625
Terms Introduced in Chapter 11 626
Equations Introduced in Chapter 11 627
Review and Application Exercises 629
Chapter Concepts Test 639
Flow Chart: Chi-Square and Analysis of Variance 644

Chapter 12 Simple Regression and Correlation *647*

12.1 Introduction 648
12.2 Estimation Using the Regression Line 654
12.3 Correlation Analysis 677
12.4 Making Inferences about Population Parameters 687
12.5 Using Regression and Correlation Analyses: Limitations, Errors, and Caveats 695
Statistics at Work 697
Computer Database Exercise 698
From the Textbook to the Real World 699
Terms Introduced in Chapter 12 699
Equations Introduced in Chapter 12 700
Review and Application Exercises 702
Chapter Concepts Test 710
Flow Chart: Regression and Correlation 714

Chapter 13 Multiple Regression and Modeling *717*

13.1 Multiple Regression and Correlation Analysis 718
13.2 Finding the Multiple-Regression Equation 719
13.3 The Computer and Multiple Regression 728
13.4 Making Inferences about Population Parameters 738
13.5 Modeling Techniques 753

Statistics at Work 768
Computer Database Exercise 769
From the Textbook to the Real World 770
Terms Introduced in Chapter 13 771
Equations Introduced in Chapter 13 771
Review and Application Exercises 773
Chapter Concepts Test 783
Flow Chart: Multiple Regression and Modeling 788

Chapter 14 Nonparametric Methods *791*

14.1 Introduction to Nonparametric Statistics 792
14.2 The Sign Test for Paired Data 795
14.3 Rank Sum Tests: The Mann-Whitney *U* Test and the Kruskal-Wallis Test 801
14.4 The One-Sample Runs Test 813
14.5 Rank Correlation 821
14.6 The Kolmogorov-Smirnov Test 832
Statistics at Work 837
Computer Database Exercise 837
From the Textbook to the Real World 838
Terms Introduced in Chapter 14 839
Equations Introduced in Chapter 14 840
Review and Application Exercises 841
Chapter Concepts Test 853
Flow Chart: Nonparametric Methods 858

Chapter 15 Time Series and Forecasting *861*

15.1 Introduction 862
15.2 Variations in Time Series 863
15.3 Trend Analysis 865
15.4 Cyclical Variation 877
15.5 Seasonal Variation 883
15.6 Irregular Variation 891
15.7 A Problem Involving All Four Components of a Time Series 892
15.8 Time Series Analysis in Forecasting 901
Statistics at Work 902
Computer Database Exercise 903
From the Textbook to the Real World 904
Terms Introduced in Chapter 15 905
Equations Introduced in Chapter 15 906
Review and Application Exercises 907
Chapter Concepts Test 914
Flow Chart: Time Series 919

Chapter 16 Index Numbers *921*

16.1 Defining an Index Number 922
16.2 Unweighted Aggregates Index 926
16.3 Weighted Aggregates Index 930
16.4 Average of Relatives Methods 939
16.5 Quantity and Value Indices 945
16.6 Issues in Constructing and Using Index Numbers 950
Statistics at Work 952
Computer Database Exercise 952
From the Textbook to the Real World 953
Terms Introduced in Chapter 16 954
Equations Introduced in Chapter 16 955
Review and Application Exercises 956
Chapter Concepts Test 963
Flow Chart: Index Numbers 967

Chapter 17 Decision Theory *969*

17.1 The Decision Environment 970
17.2 Expected Profit under Uncertainty: Assigning Probability Values 972
17.3 Using Continuous Distributions: Marginal Analysis 980
17.4 Utility as a Decision Criterion 989
17.5 Helping Decision Makers Supply the Right Probabilities 993
17.6 Decision-Tree Analysis 997
Statistics at Work 1010
From the Textbook to the Real World 1011
Terms Introduced in Chapter 17 1013
Equations Introduced in Chapter 17 1014
Review and Application Exercises 1014
Chapter Concepts Test 1022

Appendix Tables

Appendix Table 1
Standard Normal Probability Distribution A-1
Appendix Table 2
Student's *t* Distribution A-2
Appendix Table 3
Binomial Probabilities A-3
Appendix Table 4(a)
Values of 2l for Computing Poisson Probabilities A-12
Appendix Table 4(b)
Direct Values for Determining Poisson Probabilities A-13
Appendix Table 5
Chi-Square Distribution A-18

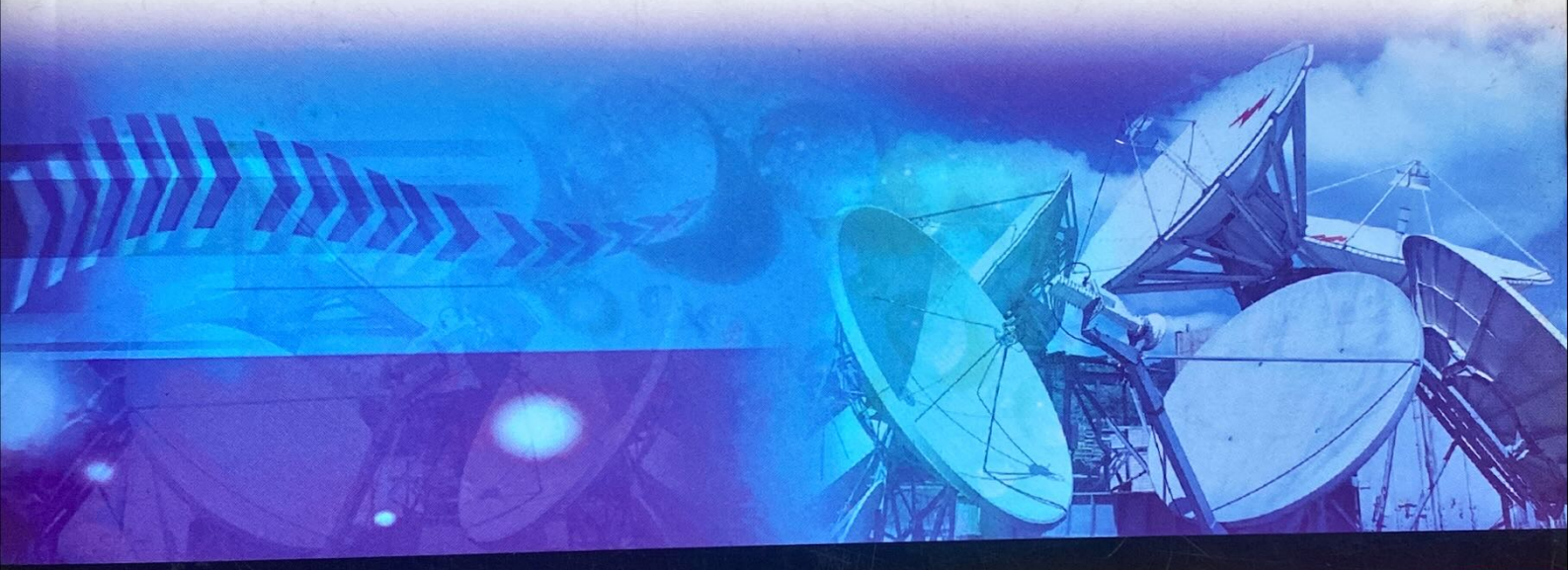
Appendix Table 6(a)
F Distributions with 0.05 of Area in Right Tail A-20
Appendix Table 6(b)
F Distributions with 0.01 of Area in Right Tail A-21
Appendix Table 7
Spearman's Rank Correlation A-22
Appendix Table 8
Critical Values of *D* in Kolmogorov-Smirnov Test A-23
Appendix Table 9
Control Chart Factors A-23
Appendix Table 10
Student Records for Computer Examples A-24
Appendix Table 11
Company Earnings Data for Computer Examples A-24

Answers to Chapter Concepts Tests A-25
Answers to Selected Even-Numbered Exercises A-29
Bibliography B-1
Index I-1

SPECIAL INDIAN EDITION

With CD-ROM. For details see Preface inside.

Frederick S. Hillier
Gerald J. Lieberman



INTRODUCTION TO

EIGHTH EDITION

OPERATIONS RESEARCH

CONCEPTS AND CASES

For sale in India, Pakistan, Nepal, Bangladesh, Sri Lanka & Bhutan only.

INTRODUCTION TO

OPERATIONS RESEARCH

CONCEPTS AND CASES

EIGHTH EDITION

This eighth edition of a pioneering work has the following distinctive features:

- ✓ Substantial coverage of recent developments, including metaheuristics, constraint programming, multiechelon inventory models for supply chain management, and spreadsheet modeling.
- ✓ Up-to-date treatment of techniques, real-world applications, research trends, and end-of-chapter references.
- ✓ Unique tutorial software, including OR Tutor for illustrating various algorithms in action and an enhanced Interactive Operations Research (IOR) Tutorial for efficiently learning and executing algorithms interactively.
- ✓ A wealth of software options, including MPL/CPLEX, LINDO, LINGO, various Excel add-ins and templates, Crystal Ball Professional Edition, Queueing Simulator, and Solver Table.

Frederick S. Hillier is Professor Emeritus of Operations Research at Stanford University. He took early retirement from his faculty responsibilities in 1996 in order to focus on textbook writing.

The late **Gerald J. Lieberman** was Professor Emeritus of Operations Research and Statistics at Stanford University. He was one of Stanford's most eminent leaders in recent decades.

The authors received the honorable mention award for the 1995 Lanchester Prize (best English-language publication of any kind in the field of operations research), which was awarded by the Institute of Operations Research and the Management Sciences (INFORMS) for the 6th editon of this book.

URL: http://highered.mcgraw-hill.com/sites/0070600929

The McGraw·Hill Companies

Visit us at : www.tatamcgrawhill.com

ISBN-13: 978-0-07-060092-8
ISBN-10: 0-07-060092-9

9 780070 600928

McGraw Hill Higher Education

SPECIAL INDIAN EDITION

INTRODUCTION TO OPERATIONS RESEARCH

Eighth Edition

FREDERICK S. HILLIER,
Stanford University

GERALD J. LIEBERMAN,
Late of Stanford University

Tata McGraw Hill Education Private Limited
NEW DELHI

McGraw-Hill Offices

New Delhi New York St Louis San Francisco Auckland Bogotá Caracas
Kuala Lumpur Lisbon London Madrid Mexico City Milan Montreal
San Juan Santiago Singapore Sydney Tokyo Toronto

Tata McGraw-Hill

Introduction to Operations Research

Indian Adaptation done by arrangement with The McGraw-Hill Companies, Inc., New York

Sales territories: India, Pakistan, Nepal, Bangladesh, Sri Lanka and Bhutan

Eleventh reprint 2009
RQCLCRQFDDDXL

Copyright © 2005, 2001, 1995, 1990, 1986, 1980, 1974, 1967, by The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020. All rights reserved. No part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written consent of The McGraw-Hill Companies, Inc., including, but not limited to, in any network or other electronic storage or transmission, or broadcast for distance learning

ISBN-13: 978-0-07-060092-8
ISBN-10: 0-07-060092-9

Published by Tata McGraw Hill Education Private Limited, 7 West Patel Nagar, New Delhi 110 008, typeset in Times at Script Makers, 19, A1-B, DDA Market, Pashchim Vihar, New Delhi 110 063 and printed at Krishna Offset, 618-B/3, Pandav Road, Vishwas Nagar, Delhi 110032

Cover Printer: SDR Printers

Cover Design: K Anoop

The McGraw·Hill Companies

TABLE OF CONTENTS

PREFACE xxv

CHAPTER 1
Introduction 1

1.1 The Origins of Operations Research 1
1.2 The Nature of Operations Research 2
1.3 The Impact of Operations Research 3
1.4 Algorithms and OR Courseware 5
Selected References 6
Problems 7

CHAPTER 2
Overview of the Operations Research Modeling Approach 8

2.1 Defining the Problem and Gathering Data 8
2.2 Formulating a Mathematical Model 12
2.3 Deriving Solutions from the Model 15
2.4 Testing the Model 17
2.5 Preparing to Apply the Model 19
2.6 Implementation 21
2.7 Conclusions 22
Selected References 23
Problems 23

CHAPTER 3
Introduction to Linear Programming 25

3.1 Prototype Example 26
3.2 The Linear Programming Model 32
3.3 Assumptions of Linear Programming 37
3.4 Additional Examples 44
3.5 Some Classic Case Studies 60
3.6 Formulating and Solving Linear Programming Models on a Spreadsheet 65
3.7 Formulating Very Large Linear Programming Models 73
3.8 Conclusions 80
Appendix 3.1 The LINGO Modeling Language 81
Selected References 90
Learning Aids for This Chapter on CD-ROM 90
Problems 91
Case 3.1 Auto Assembly 100
Previews of Added Cases on CD-ROM 102
Case 3.2 Cutting Cafeteria Costs 102
Case 3.3 Staffing a Call Center 102
Case 3.4 Promoting a Breakfast Cereal 102

CHAPTER 4
Solving Linear Programming Problems: The Simplex Method 103

4.1 The Essence of the Simplex Method 103
4.2 Setting Up the Simplex Method 108
4.3 The Algebra of the Simplex Method 111
4.4 The Simplex Method in Tabular Form 117
4.5 Tie Breaking in the Simplex Method 121
4.6 Adapting to Other Model Forms 124
4.7 Postoptimality Analysis 142
4.8 Computer Implementation 150
4.9 The Interior-Point Approach to Solving Linear Programming Problems 153
4.10 Conclusions 158
Appendix 4.1 An Introduction to Using LINDO 158
Selected References 161
Learning Aids for This Chapter on CD-ROM 161
Problems 162
Case 4.1 Fabrics and Fall Fashions 170
Previews of Added Cases on CD-ROM 172
Case 4.2 New Frontiers 172
Case 4.3 Assigning Students to Schools 172

CHAPTER 5
The Theory of the Simplex Method 173

5.1 Foundations of the Simplex Method 173
5.2 The Revised Simplex Method 184
5.3 A Fundamental Insight 193
5.4 Conclusions 201
Selected References 201
Learning Aids for This Chapter on CD-ROM 201
Problems 202

CHAPTER 6
Duality Theory and Sensitivity Analysis 209

6.1 The Essence of Duality Theory 210
6.2 Economic Interpretation of Duality 217
6.3 Primal-Dual Relationships 220
6.4 Adapting to Other Primal Forms 225
6.5 The Role of Duality Theory in Sensitivity Analysis 229
6.6 The Essence of Sensitivity Analysis 231
6.7 Applying Sensitivity Analysis 239
6.8 Performing Sensitivity Analysis on a Spreadsheet 259
6.9 Conclusions 275
Selected References 275
Learning Aids for This Chapter on CD-ROM 276
Problems 276
Case 6.1 Controlling Air Pollution 289
Previews of Added Cases on CD-ROM 290
Case 6.2 Farm Management 290
Case 6.3 Assigning Students to Schools (Revisited) 291
Case 6.4 Writing a Nontechnical Memo 291

CHAPTER 7
Other Algorithms for Linear Programming 292

7.1 The Dual Simplex Method 292
7.2 Parametric Linear Programming 295
7.3 The Upper Bound Technique 300
7.4 An Interior-Point Algorithm 303
7.5 Conclusions 314
Selected References 314
Learning Aids for This Chapter on CD-ROM 315
Problems 315

CHAPTER 8
The Transportation and Assignment Problems 320

8.1 The Transportation Problem 321
8.2 A Streamlined Simplex Method for the Transportation Problem 335
8.3 The Assignment Problem 350
8.4 A Special Algorithm for the Assignment Problem 359
8.5 Conclusions 363
Selected References 363
Learning Aids for This Chapter on CD-ROM 364
Problems 364
Case 8.1 Shipping Wood to Market 372
Previews of Added Cases on CD-ROM 373
Case 8.2 Continuation of the Texago Case Study 373
Case 8.3 Project Pickings 373

CHAPTER 9
Network Optimization Models 374

9.1 Prototype Example 375
9.2 The Terminology of Networks 376
9.3 The Shortest-Path Problem 380
9.4 The Minimum Spanning Tree Problem 384
9.5 The Maximum Flow Problem 388
9.6 The Minimum Cost Flow Problem 396
9.7 The Network Simplex Method 404
9.8 A Network Model for Optimizing a Projects Time-Cost Trade-Off 414
9.9 Conclusions 426
Selected References 427
Learning Aids for This Chapter on CD-ROM 427
Problems 428
Case 9.1 Money in Motion 437
Previews of Added Cases on CD-ROM 439
Case 9.2 Aiding Allies 439
Case 9.3 Steps to Success 439

CHAPTER 10
Dynamic Programming 440

10.1 A Prototype Example for Dynamic Programming 440
10.2 Characteristics of Dynamic Programming Problems 445
10.3 Deterministic Dynamic Programming 447

10.4 Probabilistic Dynamic Programming 466
10.5 Conclusions 471
Selected References 472
Learning Aids for This Chapter on CD-ROM 472
Problems 472

CHAPTER 11
Integer Programming 478

11.1 Prototype Example 479
11.2 Some BIP Applications 482
11.3 Innovative Uses of Binary Variables in Model Formulation 487
11.4 Some Formulation Examples 493
11.5 Some Perspectives on Solving Integer Programming Problems 501
11.6 The Branch-and-Bound Technique and Its Application to Binary Integer Programming 505
11.7 A Branch-and-Bound Algorithm for Mixed Integer Programming 515
11.8 The Branch-and-Cut Approach to Solving BIP Problems 521
11.9 The Incorporation of Constraint Programming 527
11.10 Conclusions 533
Selected References 533
Learning Aids for This Chapter on CD-ROM 534
Problems 534
Case 11.1 Capacity Concerns 544
Previews of Added Cases on CD-ROM 546
Case 11.2 Assigning Art 546
Case 11.3 Stocking Sets 546
Case 11.4 Assigning Students to Schools (Revisited Again) 546

CHAPTER 12
Nonlinear Programming 547

12.1 Sample Applications 548
12.2 Graphical Illustration of Nonlinear Programming Problems 552
12.3 Types of Nonlinear Programming Problems 556
12.4 One-Variable Unconstrained Optimization 561
12.5 Multivariable Unconstrained Optimization 567
12.6 The Karush-Kuhn-Tucker (KKT) Conditions for Constrained Optimization 572
12.7 Quadratic Programming 576
12.8 Separable Programming 583
12.9 Convex Programming 589
12.10 Nonconvex Programming (with Spreadsheets) 597
12.11 Conclusions 602
Selected References 603
Learning Aids for This Chapter on CD-ROM 603
Problems 604
Case 12.1 Savvy Stock Selection 615
Previews of Added Cases on CD-ROM 616
Case 12.2 International Investments 616
Case 12.3 Promoting a Breakfast Cereal (Revisited) 616

CHAPTER 13
Metaheuristics 617

13.1 The Nature of Metaheuristics 618
13.2 Tabu Search 625
13.3 Simulated Annealing 635
13.4 Genetic Algorithms 644
13.5 Conclusions 652
Selected References 654
Learning Aids for This Chapter on CD-ROM 654
Problems 655

CHAPTER 14
Game Theory 659

14.1 The Formulation of Two-Person, Zero-Sum Games 659
14.2 Solving Simple Games—A Prototype Example 661
14.3 Games with Mixed Strategies 666
14.4 Graphical Solution Procedure 667
14.5 Solving by Linear Programming 670
14.6 Extensions 673
14.7 Conclusions 674
Selected References 674
Learning Aids for This Chapter on CD-ROM 675
Problems 675

CHAPTER 15
Decision Analysis 680

15.1 A Prototype Example 681
15.2 Decision Making without Experimentation 682
15.3 Decision Making with Experimentation 687
15.4 Decision Trees 693
15.5 Using Spreadsheets to Perform Sensitivity Analysis on Decision Trees 698
15.6 Utility Theory 708
15.7 The Practical Application of Decision Analysis 715
15.8 Conclusions 718
Selected References 718
Learning Aids for This Chapter on CD-ROM 719
Problems 719
Case 15.1 Brainy Business 729
Preview of an Added Case on CD-ROM 731
Case 15.2 Smart Steering Support 731

CHAPTER 16
Markov Chains 732

16.1 Stochastic Processes 732
16.2 Markov Chains 734
16.3 Chapman-Kolmogorov Equations 739
16.4 Classification of States of a Markov Chain 742
16.5 Long-Run Properties of Markov Chains 744
16.6 First Passage Times 750

16.7 Absorbing States 752
16.8 Continuous Time Markov Chains 755
Selected References 759
Learning Aids for This Chapter on CD-ROM 760
Problems 760

CHAPTER 17
Queueing Theory 765

17.1 Prototype Example 766
17.2 Basic Structure of Queueing Models 766
17.3 Examples of Real Queueing Systems 771
17.4 The Role of the Exponential Distribution 774
17.5 The Birth-and-Death Process 780
17.6 Queueing Models Based on the Birth-and-Death Process 784
17.7 Queueing Models Involving Nonexponential Distributions 796
17.8 Priority-Discipline Queueing Models 804
17.9 Queueing Networks 809
17.10 The Application of Queueing Theory 813
17.11 Conclusions 817
Selected References 818
Learning Aids for This Chapter on CD-ROM 818
Problems 819
Case 17.1 Reducing In-Process Inventory 831
Preview of an Added Case on CD-ROM 832
Case 17.2 Queueing Quandary 832

CHAPTER 18
Inventory Theory 833

18.1 Examples 834
18.2 Components of Inventory Models 836
18.3 Deterministic Continuous-Review Models 838
18.4 A Deterministic Periodic-Review Model 848
18.5 Deterministic Multiechelon Inventory Models for Suply Chain Management 852
18.6 A Stochastic Continuous-Review Model 870
18.7 A Stochastic Single-Period Model for Perishable Products 875
18.8 Larger Inventory Systems in Practice 886
18.9 Conclusions 889
Selected References 890
Learning Aids for This Chapter on CD-ROM 891
Problems 891
Case 18.1 Brushing Up on Inventory Control 900
Previews of Added Cases on CD-ROM 902
Case 18.2 TNT: Tackling Newsboy's Teachings 902
Case 18.3 Jettisoning Surplus Stock 902

CHAPTER 19
Markov Decision Processes 903

19.1 A Prototype Example 903
19.2 A Model for Markov Decision Processes 906
19.3 Linear Programming and Optimal Policies 908

19.4 Policy Improvement Algorithm for Finding Optimal Policies 912
19.5 Discounted Cost Criterion 917
19.6 Conclusions 924
Selected References 925
Learning Aids for This Chapter on CD-ROM 925
Problems 926

CHAPTER 20
Simulation 930

20.1 The Essence of Simulation 930
20.2 Some Common Types of Applications of Simulation 942
20.3 Generation of Random Numbers 946
20.4 Generation of Random Observations from a Probability Distribution 950
20.5 Outline of a Major Simulation Study 954
20.6 Performing Simulations on Spreadsheets 959
20.7 Optimizing with OptQuest 978
20.8 Conclusions 991
Selected References 993
Learning Aids for This Chapter on CD-ROM 993
Problems 994
Case 20.1 Reducing In-Process Inventory (Revisited) 1001
Case 20.2 Action Adventures 1001
Previews of Added Cases on CD-ROM 1002
Case 20.3 Planning Planers 1002
Case 20.4 Pricing under Pressure 1002

APPENDIXES
1. Documentation for the OR Courseware 1003
2. Convexity 1006
3. Classical Optimization Methods 1011
4. Matrices and Matrix Operations 1014
5. Table for a Normal Distribution 1019

PARTIAL ANSWERS TO SELECTED PROBLEMS 1021

INDEXES
Author Index 1035
Subject Index 1038

SUPPLEMENTS ON THE CD-ROM AND THE ONLINE LEARNING CENTER

ADDITIONAL CASES

Case 3.2 Cutting Cafeteria Costs
Case 3.3 Staffing a Call Center
Case 3.4 Promoting a Breakfast Cereal
Case 4.2 New Frontiers
Case 4.3 Assigning Students to Schools
Case 6.2 Farm Management
Case 6.3 Assigning Students to Schools (Revisited)
Case 6.4 Writing a Nontechnical Memo
Case 8.2 Continuation of the Texago Case Study
Case 8.3 Project Pickings
Case 9.2 Aiding Allies
Case 9.3 Steps to Success
Case 11.2 Assigning Art
Case 11.3 Stocking Sets
Case 11.4 Assigning Students to Schools (Revisited Again)
Case 12.2 International Investments
Case 12.3 Promoting a Breakfast Cereal (Revisited)
Case 15.2 Smart Steering Support
Case 17.2 Queueing Quandary
Case 18.2 TNT: Tackling Newsboy's Teachings
Case 18.3 Jettisoning Surplus Stock
Case 20.3 Planning Planers
Case 20.4 Pricing under Pressure

SUPPLEMENT TO APPENDIX 3.1
More about LINGO

SUPPLEMENT TO CHAPTER 7
Linear Goal Programming and Its Solution Procedures

Problems
Case 7S.1 A Cure for Cuba
Case 7S.2 Airport Security

SUPPLEMENT TO CHAPTER 8
A Case Study with Many Transportation Problems

SUPPLEMENT 1 TO CHAPTER 18
Derivation of the Optimal Policy for the Stochastic Single-Period Model for Perishable Products

Problems

SUPPLEMENT 2 TO CHAPTER 18
Stochastic Periodic-Review Models
Problems

SUPPLEMENT 1 TO CHAPTER 20
Variance-Reducing Techniques
Problems

SUPPLEMENT 2 TO CHAPTER 20
Regenerative Method of Statistical Analysis
Problems

CHAPTER 21
The Art of Modeling with Spreadsheets
21.1 A Case Study: The Everglade Golden Years Company Cash Flow Problem
21.2 Overview of the Process of Modeling with Spreadsheets
21.3 Some Guidelines for Building "Good" Spreadsheet Models
21.4 Debugging a Spreadsheet Model
21.5 Conclusions
Selected References
Learning Aids for This Chapter on CD-ROM
Problems
Case 21.1 Prudent Provisions for Pensions

CHAPTER 22
Project Management with PERT/CPM
22.1 A Prototype Example—The Reliable Construction Co. Project
22.2 Using a Network to Visually Display a Project
22.3 Scheduling a Project with PERT/CPM
22.4 Dealing with Uncertain Activity Durations
22.5 Considering Time-Cost Trade-Offs
22.6 Scheduling and Controlling Project Costs
22.7 An Evaluation of PERT/CPM
22.8 Conclusions
Selected References
Learning Aids for This Chapter on CD-ROM
Problems
Case 22.1 "School's out forever . . ."

CHAPTER 23
Additional Special Types of Linear Programming Problems
23.1 The Transshipment Problem
23.2 Multidivisional Problems
23.3 The Decomposition Principle for Multidivisional Problems
23.4 Multitime Period Problems
23.5 Multidivisional Multitime Period Problems
23.6 Stochastic Programming
23.7 Chance-Constrained Programming
23.8 Conclusions
Selected References
Problems

CHAPTER 24
Probability Theory

24.1 Sample Space
24.2 Random Variables
24.3 Probability and Probability Distributions
24.4 Conditional Probability and Independent Events
24.5 Discrete Probability Distributions
24.6 Continuous Probability Distributions
24.7 Expectation
24.8 Moments
24.9 Bivariate Probability Distribution
24.10 Marginal and Conditional Probability Distributions
24.11 Expectations for Bivariate Distributions
24.12 Independent Random Variables and Random Samples
24.13 Law of Large Numbers
24.14 Central Limit Theorem
24.15 Functions of Random Variables
Selected References
Problems

CHAPTER 25
Reliability

25.1 Structure Function of a System
25.2 System Reliability
25.3 Calculation of Exact System Reliability
25.4 Bounds on System Reliability
25.5 Bounds on Reliability Based upon Failure Times
25.6 Conclusions
Selected References
Problems

CHAPTER 26
The Application of Queueing Theory

26.1 Examples
26.2 Decision Making
26.3 Formulation of Waiting-Cost Functions
26.4 Decision Models
26.5 The Evaluation of Travel Time
26.6 Conclusions
Selected References
Learning Aids for This Chapter on CD-ROM
Problems

CHAPTER 27
Forecasting

27.1 Some Applications of Forecasting
27.2 Judgmental Forecasting Methods
27.3 Time Series
27.4 Forecasting Methods for a Constant-Level Model
27.5 Incorporating Seasonal Effects into Forecasting Methods

27.6 An Exponential Smoothing Method for a Linear Trend Model
27.7 Times Series Forecasting with CB Predictor
27.8 Forecasting Errors
27.9 Box-Jenkins Method
27.10 Causal Forecasting with Linear Regression
27.11 Forecasting in Practice
27.12 Conclusions
Selected References
Learning Aids for This Chapter on CD-ROM
Problems
Case 27.1 Finagling the Forecasts

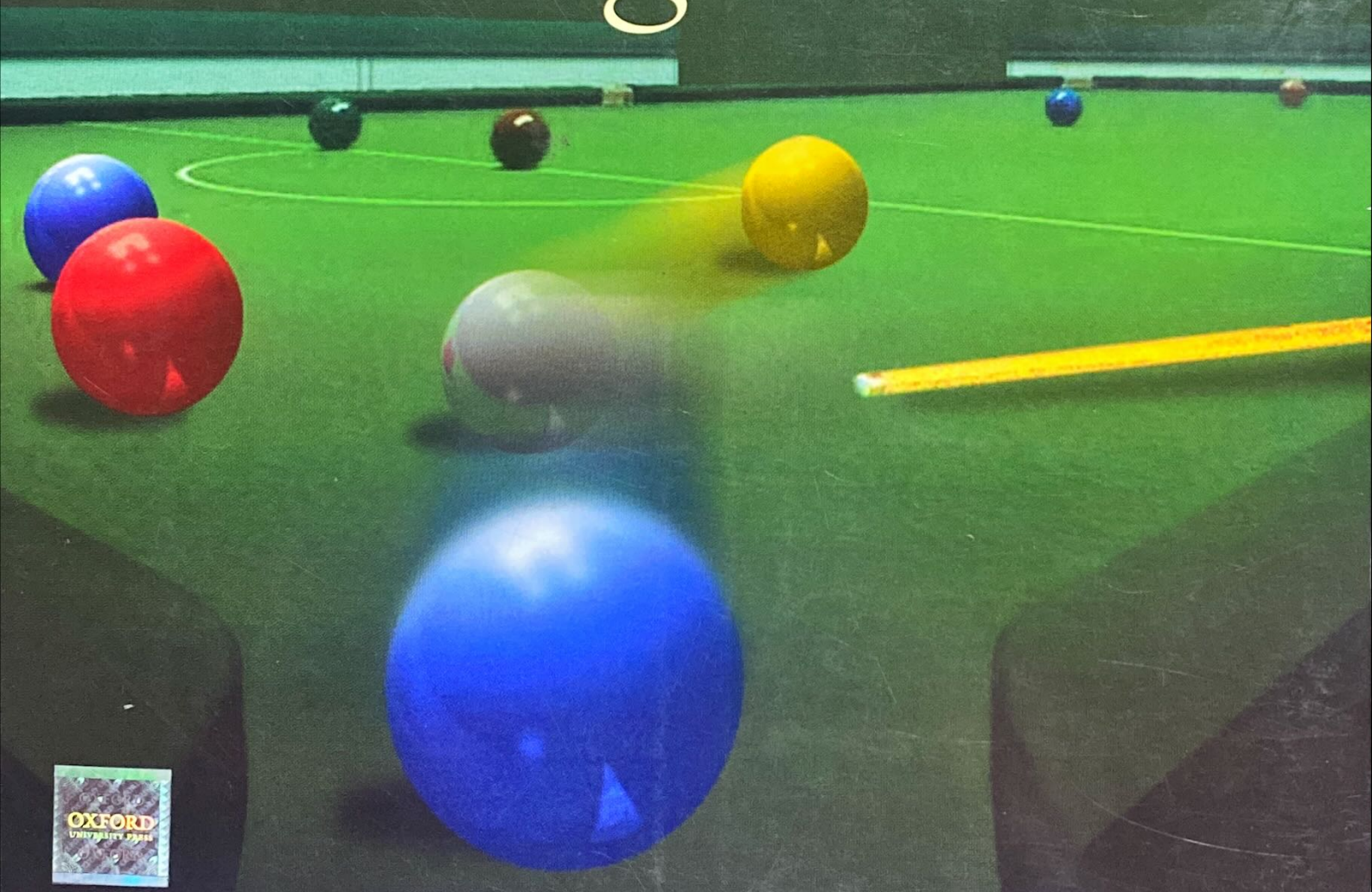
CHAPTER 28
Examples of Performing Simulations on Spreadsheets with Crystal Ball

28.1 Bidding for a Construction Project
28.2 Project Management
28.3 Cash Flow Management
28.4 Financial Risk Analysis
28.5 Revenue Management in the Travel Industry
28.6 Choosing the Right Distribution
28.7 Decision Making with Decision Tables
28.8 Conclusions
Selected References
Learning Aids for This Chapter on CD-ROM
Problems

APPENDIX 6
Simultaneous Linear Equations

Oxford
HIGHER EDUCATION

Sales and Distribution Management



TAPAN K. PANDA • SUNIL SAHADEV

Sales and Distribution Management

Sales and Distribution Management is a composite and comprehensive textbook specially designed to meet the requirements of MBA students specializing in marketing. It explores the key concepts of sales and distribution management through several managerial examples, caselets, and detailed case studies. All the important topics of sales and distribution management, such as sales and sales force management, the sales organization and territory management, designing a distribution system, and distribution channel management, have been covered in detail.

Beginning with an overview of the key concepts of sales management, the book discusses the basics of sales skills and strategies. Further, it goes on to explore the issues and challenges faced by business organizations in sales and channel distribution. Among important topics discussed in detail are: the selling process, the management of sales territories and quotas, the recruitment, training, compensation and evaluation of the sales force, and the management of channel member behaviour and international channels of distribution. The strength of the text is in its inclusion of detailed discussions on the impact of product innovation, managing sales information, customer-oriented marketing channels, and logistics management.

Users shall find this textbook useful for its applications of theoretical concepts explained through illustrative examples, relevant caselets, clear illustrations, flowcharts, and data tables

Key Features

- contains classroom-tested cases from Indian as also international business organizations
- includes examples and caselets in key areas of sales and distribution management
- Provides chapter-end concept review questions, exercises with critical thinking elements, and classroom and field projects such as group discussion and analytical reporting

Tapan K. Panda, Professor in Marketing, Indian Institute of Management Indore, has more than 14 years of teaching experience, of which three years were spent as faculty at the Indian Institute of Management Lucknow. Formerly a faculty of marketing at the Indian Institute of Management Kozhikode, he is active in research and consultancy and has authored numerous papers published in international journals.

Sunil Sahadev, Assistant Professor in Marketing, Indian Institute of Management Kozhikode, has eight years of teaching experience in distribution channel management at the postgraduate level. A post-doctoral fellow from the Asian Institute of Technology (AIT), Bangkok, he is also a Member of the Board of Studies, University of Calicut, Kerala. He is active in research and consulting and has authored numerous papers published in international journals.

OXFORD
UNIVERSITY PRESS

ISBN 0-19-567390-5

9 780195 673906

Rs 350

www.oup.com

Sales and Distribution Management

TAPAN K. PANDA
Professor in Marketing
Indian Institute of Management Indore

SUNIL SAHADEV
Assistant Professor in Marketing
Indian Institute of Management Kozhikode

OXFORD
UNIVERSITY PRESS

OXFORD
UNIVERSITY PRESS

YMCA Library Building, Jai Singh Road, New Delhi 110001

Oxford University Press is a department of the University of Oxford.
It furthers the University's objective of excellence in research, scholarship,
and education by publishing worldwide in

Oxford · New York
Auckland Cape Town Dar es Salaam Hong Kong Karachi
Kuala Lumpur Madrid Melbourne Mexico City Nairobi
New Delhi Shanghai Taipei Toronto

With offices in
Argentina Austria Brazil Chile Czech Republic France Greece
Guatemala Hungary Italy Japan Poland Portugal Singapore
South Korea Switzerland Thailand Turkey Ukraine Vietnam

Oxford is a registered trade mark of Oxford University Press
in the UK and in certain other countries.

Published in India
by Oxford University Press

© Oxford University Press 2005

The moral rights of the author/s have been asserted.

Database right Oxford University Press (maker)

First published 2005
Fifteenth impression 2009

All rights reserved. No part of this publication may be reproduced,
stored in a retrieval system, or transmitted, in any form or by any means,
without the prior permission in writing of Oxford University Press,
or as expressly permitted by law, or under terms agreed with the appropriate
reprographics rights organization. Enquiries concerning reproduction
outside the scope of the above should be sent to the Rights Department,
Oxford University Press, at the address above.

You must not circulate this book in any other binding or cover
and you must impose this same condition on any acquirer.

ISBN-13: 978-0-19-567390-6
ISBN-10: 0-19-567390-5

Typeset in Baskerville MT
by Star Compugraphics, Delhi
Printed in India by Saurabh Printers Pvt. Ltd, Noida 201301
and published by Oxford University Press
YMCA Library Building, Jai Singh Road, New Delhi 110001

Contents

Preface v

Part A Sales Management

1. Introduction to Sales Management 3
Introduction 3
Evolution of Sales Management 4
The Nature and Role of Sales Management 12
The Importance of Sales Management 13
Types of Personal Selling 14
Types of Selling 17
Difference between Selling and Marketing 19
The Marketing Management Process 21
The Modern-Day Sales Activity 25
The Sales Management Process 26
Emerging Trends in Sales Management 32
Case Studies 39

2. Selling Skills and Selling Strategies 44
Introduction 44
Selling and Buying Styles 45
Selling Situations 49
Selling Skills 51
Case Studies 107

3. The Selling Process 113
Introduction 113
The Selling Process 114
Pre-sale Preparation 116
Prospecting 119
Pre-approach Before Selling 125
Approach to the Customer 127
Sales Presentation 129
Handling Customer Objections 136
Closing the Sale 140
Follow-up Action 141
Case Studies 152

4. Managing Sales Information 161
Introduction 161
Forecasting Market Demand 162
Trend Projections 176
Factors Affecting Selection of a Forecasting Method 193
Case Study 199

5. Sales Organization 202
Introduction 202
Sales Organization 202
Organizational Principles 208
Organizational Design 211
Key Account Sales 224
Sales Process Automation 225
Emerging Organizational Designs 225
Number of Salespeople 228
Case Studies 234

6. Management of Sales Territory 249
Introduction 249
Sales Territory 249
Size of Sales Territories 253
Allocation of Sales Territories 254
Designing a Sales Territory 255
Use of Information Technology 263
Case Studies 267

7. Management of Sales Quota 273
Introduction 273
Sales Quota 273
Organization of the Sales Job 277
Defining Annual Objectives 278
Procedure for Setting Quota 279

Types of Sales Quota 281
Methods of Setting Sales Quota 284
Problems in Setting Sales Quota 286
Case Studies 290

8. Recruitment and Selection of the Sales Force 301
Introduction 301
Hiring Process 302
Challenges in Sales Force Selection 302
Planning for Recruitment 305
Sales Force Recruitment 311
Selection of a Salesperson 319
Socialization 328
Case Studies 334

9. Training the Sales Force 337
Introduction 337
Objectives of Sales Training 338
Challenges in Sales Training 339
Theories and Principles of Sales Training 340
Role of a Trainer 343
The Training Process 344
Training Methods 356
Designing a Sales Training Programme 364
The Process of Socialization 370
Case Studies 374

10. Sales Force Motivation 380
Introduction 380
Nature of Motivation 382
Importance of Motivation 383
The Process of Motivation 385
Theories of Motivation 389
Factors Influencing the Motivation of the Salesperson 400
Designing a Motivational Programme 402
Case Studies 411

11. Sales Force Compensation 417
Introduction 417
Types of Compensation Plan 421
Trends in Compensation Management 433
Steps in Designing a Compensation Plan 434
Case Studies 440

12. Evaluation of the Sales Force 446
Introduction 446
Performance Appraisal Process 447
Case Studies 466

Part B Distribution Management

13. Distribution Channel Management—an Introduction 475
Introduction 475
Distribution Channels: Why are they Required? 477
Activities that a Typical Distribution Channel Performs 479
Intermediation: Is it Really Needed? 484
Value Enhancement Through the Distribution Function 486
Distribution Channel Strategy 487
Distribution Channel Management 490
Case Study 500

14. Designing Customer-oriented Marketing Channels 503
Introduction 503
Designing a Customer-oriented Channel 504
Capturing the Customer Requirements 506
Conceiving the Channel Flows 512
Linking the Service Output Objectives to the Flows 521
Conducting Cost Analysis 523
Designing the Ideal Channel 525
Comparing the Ideal with the Reality 526
Comparing the Channel Designs 528
The Channel Establishment Plan 529
Case Study 534

15. Customer-oriented Logistics Management 537
Introduction 537
Objectives of Logistics 538
Logistics Planning 540
Inventory Management Decisions 553
Transportation Decisions 567
Case Study 574
16. Managing Channel Member Bahaviour 577
Introduction 577
Channel Relationships 578
Channel Control 581
Channel Power 585
Channel Positioning 589
Channel Influence Strategies 593
Channel Conflict 598
Case Studies 611
17. Retail Management 622
Introduction 622
Retail Marketing Mix and Retail Positioning 624
Developing and Implementing Merchandise Strategies 626
Deciding on the Customer Service Levels 643
Trading Format 647
Customer Communication Strategy in Retail Outlets 658
Case Study 662
18. Managing the International Channels of Distribution 667
Introduction 667
Differences in Customer Expectations Across Countries 669
International Orientation of Companies 672
The Mode of Entry Decision 673
Implications of Entry Modes 680
Case Study 691
Index 693

IILM

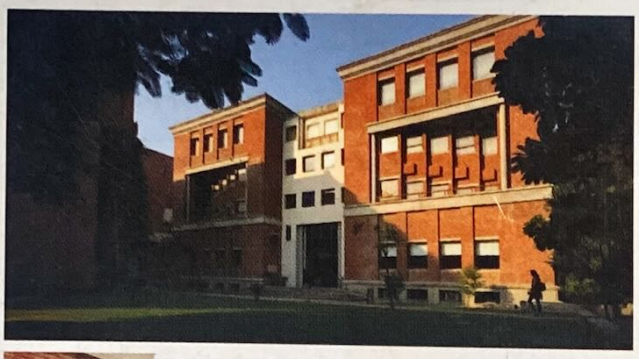
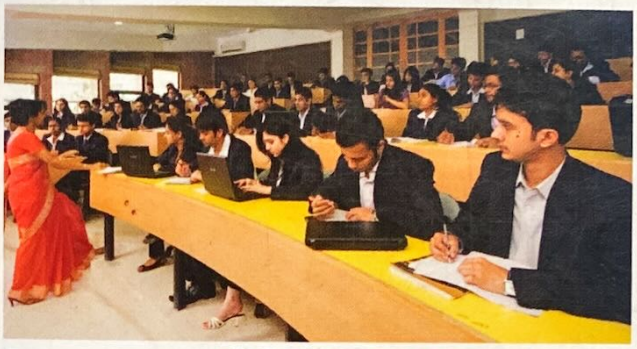
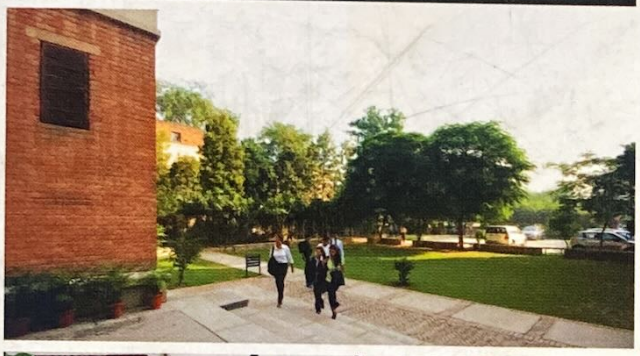
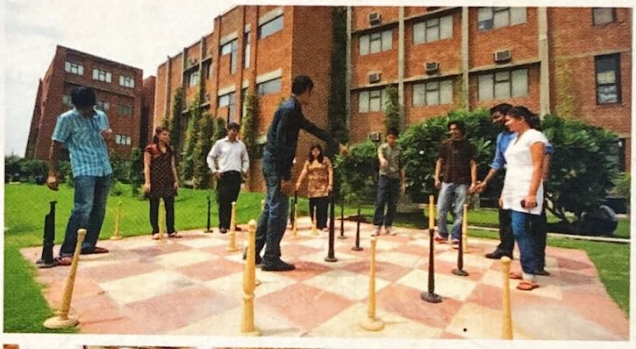
Crafting and Executing Strategy

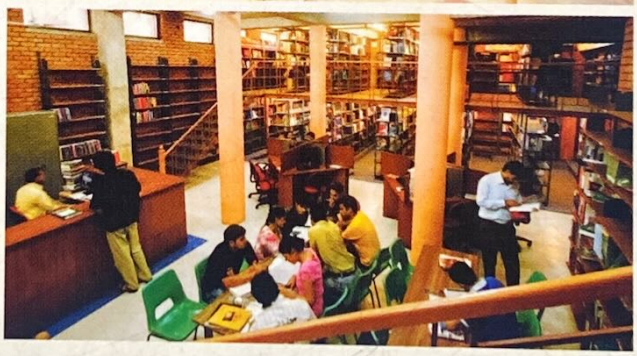
- Arthur A. Thompson, Jr.
- A. J. Strickland III
- John E. Gamble
- Arun K. Jain

For IILM only

Not for sale in the open market

Crafting and Executing Strategy



IILM

The McGraw·Hill Companies

Mc Graw Hill Custom Publishing

Visit us at : www.tatamcgrawhill.com

ISBN-13: 978-0-07-068222-1
ISBN-10: 0-07-068222-4

9 780070 682221

IILM

Crafting and Executing Strategy

The Quest for Competitive Advantage

CONCEPTS AND CASES

Arthur A. Thompson, Jr.
The University of Alabama

A. J. Strickland III
The University of Alabama

John E. Gamble
University of South Alabama

Arun K. Jain
Indian Institute of Management-Lucknow (India), and EM Strasbourg School of Business, France

Tata McGraw Hill Education Private Limited
NEW DELHI

McGraw-Hill Offices
New Delhi New York St Louis San Francisco Auckland Bogotá
Caracas Kuala Lumpur Lisbon London Madrid Mexico City Milan Montreal
San Juan Santiago Singapore Sydney Tokyo Toronto

Tata McGraw Hill

Crafting and Executing Strategy

Indian Adaptation done by arrangement with The McGraw-Hill Companies, Inc., New York

Not for open market sale. Customised for IILM Institute for Higher Education.

Copyright © 2008, by The McGraw-Hill Companies, Inc. All Rights reserved. No part of this publication may be reproduced or distributed in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise or stored in a database or retrieval system without the prior written permission of The McGraw-Hill Companies, 1221 Avenue of the Americas, New York, NY, 10020 including, but not limited to, in any network or other electronic storage or transmission, or broadcast for distance learning.

Tata McGraw Hill Edition 2010

ISBN (13): 978-0-07-068222-1
ISBN (10): 0-07-068222-4

Managing Director: *Ajay Shukla*
Head—Higher Education Publishing: *Vibha Mahajan*
Publishing Manager—B&E/HSSL: *Tapas K Maji*
Deputy Manager—Sponsoring: *Surabhi Khare*
Assistant Manager (Editorial Services): *Anubha Srivastava*
Senior Production Manager: *Manohar Lal*
Production Executive: *Atul Gupta*
General Manager—Marketing (Higher Ed): *Michael J Cruz*
Product Manager: *Vijay S Jagannathan*
General Manager—Production: *Rajender P Ghansela*
Assistant General Manager—Production: *B L Dogra*

Information contained in this work has been obtained by Tata McGraw Hill, from sources believed to be reliable. However, neither Tata McGraw Hill nor its authors guarantee the accuracy or completeness of any information published herein, and neither Tata McGraw Hill nor its authors shall be responsible for any errors, omissions, or damages arising out of use of this information. This work is published with the understanding that Tata McGraw Hill and its authors are supplying information but are not attempting to render engineering or other professional services. If such services are required, the assistance of an appropriate professional should be sought.

Published by the Tata McGraw Hill Education Private Limited, 7 West Patel Nagar, New Delhi 110 008, typeset at Script Maker, 19, A 1-B, DDA Market, Paschim Vihar, New Delhi 110 063 and printed at Pashupati Printers Pvt. Ltd., 1/429/16, Gali No. 1, Friends Colony, Industrial Area, G.T. Road, Shahdara, Delhi – 110 095

Cover Design: K Anoop

Cover Printer: SDR Printers

RZZDCDDZDRYCB

The McGraw·Hill Companies

Table of Contents

Introduction v
Course Outline xix

1. What Is Strategy and Why Is It Important? 1

What Do We Mean by *Strategy?* 2
Strategy and the Quest for Competitive Advantage 3
Identifying a Company's Strategy 6
Why a Company's Strategy Evolves over Time 6
A Company's Strategy Is Partly Proactive and Partly Reactive 8
Strategy and Ethics: Passing the Test of Moral Scrutiny 9
The Relationship between a Company's Strategy and Its Business Model 10
What Makes a Strategy a Winner? 11
Why Are Crafting and Executing Strategy Important? 15
Good Strategy + Good Strategy Execution = Good Management 16

Illustration Capsules

1.1. Comcast's Strategy to Revolutionize the Cable Industry 4
1.2. Microsoft and Red Hat: Two Contrasting Business Models 12

Strategic Thinking Capsule

Innovating the Business Model at Wipro – Realigning Strategy 13

2. The Managerial Process of Crafting and Executing Strategy 19

What Does the Strategy-Making, Strategy-Executing Process Entail? 20
Developing a Strategic Vision: Phase 1 of the Strategy-Making, Strategy-Executing Process 20
A Strategic Vision Covers Different Ground than the Typical Mission Statement 23
Communicating the Strategic Vision 26
Linking the Vision/Mission with Company Values 27
Setting Objectives: Phase 2 of the Strategy-Making, Strategy-Executing Process 31
What Kinds of Objectives to Set: The Need for a Balanced Scorecard 32
Crafting a Strategy: Phase 3 of the Strategy-Making,

Strategy-Executing Process 38
Who Participates in Crafting a Company's Strategy? 39
A Company's Strategy-Making Hierarchy 41
Uniting the Strategy-Making Effort 43
A Strategic Vision + Objectives + Strategy = A Strategic Plan 44
Implementing and Executing the Strategy:
Phase 4 of the Strategy-Making, Strategy-Executing Process 45
Evaluating Performance and Initiating Corrective Adjustments:
Phase 5 of the Strategy-Making, Strategy-Executing Process 46
Corporate Governance: The Role of the Board of Directors
in the Strategy-Making, Strategy-Executing Process 47

Illustration Capsules

2.1. Examples of Strategic Visions—How Well Do They Measure Up? 24
2.2. Intel's Two Strategic Inflection Points 28
2.3. The Connection between Yahoo's Mission and Core Values 30
2.4. Examples of Company Objectives 34

Strategic Thinking Capsule

Indian Companies and Their Vision 35

3. Evaluating a Company's External Environment 51

The Strategically Relevant Components of a Company's
External Environment 53
Thinking Strategically about a Company's Industry
and Competitive Environment 54
Question 1: What Are the Industry's Dominant Economic Features? 55
Question 2: What Kinds of Competitive Forces Are
Industry Members Facing? 57
Competitive Pressures Associated with Jockeying among Rival Sellers 58
Competitive Pressures Associated with the Threat of New Entrants 62
Competitive Pressures from the Sellers of Substitute Products 66
Competitive Pressures Stemming from Supplier Bargaining Power and Supplier–Seller Collaboration 68
Competitive Pressures Stemming from Buyer Bargaining Power and Seller–Buyer Collaboration 71
Is the Collective Strength of the Five Competitive Forces Conducive to Good Profitability? 74
Question 3: What Factors Are Driving Industry Change and
What Impacts Will They Have? 76

The Concept of Driving Forces 76
Identifying an Industry's Driving Forces 77
Assessing the Impact of the Driving Forces 82
Developing a Strategy That Takes the Impacts of the Driving Forces into Account 82
Question 4: What Market Positions Do Rivals Occupy—Who Is Strongly Positioned and Who Is Not? 83
Using Strategic Group Maps to Assess the Market Positions of Key Competitors 83
What Can Be Learned from Strategic Group Maps? 84
Question 5: What Strategic Moves Are Rivals Likely to Make Next? 88
Identifying Competitors' Strategies and Resource Strengths and Weaknesses 88
Predicting Competitors' Next Moves 89
Question 6: What Are the Key Factors for Future Competitive Success? 90
Question 7: Does the Outlook for the Industry Present the Company with an Attractive Opportunity? 93

Illustration Capsules

3.1. Comparative Market Positions of Selected Retail Chains: A Strategic Group Map Application 85

Strategic Thinking Capsule

Cheaper Steel may be Radioactive 86

4. Evaluating a Company's Resources and Competitive Position 97

Question 1: How Well Is the Company's Present Strategy Working? 98
Question 2: What Are the Company's Resource Strengths and Weaknesses, and Its External Opportunities and Threats? 100
Identifying Company Resource Strengths and Competitive Capabilities 100
Identifying Company Resource Weaknesses and Competitive Deficiencies 107
Identifying a Company's Market Opportunities 107
Identifying the External Threats to a Company's Future Profitability 109
What Do the SWOT Listings Reveal? 109
Question 3: Are the Company's Prices and Costs Competitive? 112
The Concept of a Company Value Chain 112
Why the Value Chains of Rival Companies Often Differ 114
The Value Chain System for an Entire Industry 115
Activity-Based Costing: A Tool for Assessing a Company's Cost Competitiveness 117
Benchmarking: A Tool for Assessing Whether a Company's Value Chain Costs Are in Line 118

Strategic Options for Remedying a Cost Disadvantage 120
Translating Proficient Performance of Value Chain Activities into Competitive Advantage 124
Question 4: Is the Company Competitively Stronger or Weaker Than Key Rivals? 125
Interpreting the Competitive Strength Assessments 128
Question 5: What Strategic Issues and Problems Merit Front-Burner Managerial Attention? 129

Illustration Capsules

4.1. Estimated Value Chain Costs for Recording and Distributing Music CDs through Traditional Music Retailers 117
4.2. Benchmarking and Ethical Conduct 120

Strategic Thinking Capsule

Subhiksha – A Role Model Falls from Pedestal 121

5. The Five Generic Competitive Strategies: Which One to Employ? 135

The Five Generic Competitive Strategies 136
Low-Cost Provider Strategies 137
The Two Major Avenues for Achieving a Cost Advantage 138
The Keys to Success in Achieving Low-Cost Leadership 144
When a Low-Cost Provider Strategy Works Best 145
The Pitfalls of a Low-Cost Provider Strategy 146
Broad Differentiation Strategies 146
Types of Differentiation Themes 147
Where along the Value Chain to Create the Differentiating Attributes 147
The Four Best Routes to Competitive Advantage via a Broad Differentiation Strategy 148
The Importance of Perceived Value and Signaling Value 149
When a Differentiation Strategy Works Best 150
The Pitfalls of a Differentiation Strategy 151
Best-Cost Provider Strategies 152
When a Best-Cost Provider Strategy Works Best 153
The Big Risk of a Best-Cost Provider Strategy 153
Focused (or Market Niche) Strategies 153
A Focused Low-Cost Strategy 155
A Focused Differentiation Strategy 155
When a Focused Low-Cost or Focused Differentiation Strategy Is Attractive 156
The Risks of a Focused Low-Cost or Focused Differentiation Strategy 157
The Contrasting Features of the Five Generic Competitive Strategies: A Summary 161

Illustration Capsules

5.1. Nucor Corporation's Low-Cost Provider Strategy 139
5.2. How Wal-Mart Managed Its Value Chain to Achieve a Huge Low-Cost Advantage over Rival Supermarket Chains 143
5.3. Toyota's Best-Cost Producer Strategy for Its Lexus Line 154
5.4. Motel 6's Focused Low-Cost Strategy 156
5.5. Progressive Insurance's Focused Differentiation Strategy in Auto Insurance 157

Strategic Thinking Capsule

India's Alternative to Expensive Motor Fuel 158

6. Supplementing the Chosen Competitive Strategy: *Other Important Strategy Choices* 164

Collaborative Strategies:Alliances and Partnerships 165
Why and How Strategic Alliances Are Advantageous 168
Capturing the Benefits of Strategic Alliances 169
Why Many Alliances Are Unstable or Break Apart 171
The Strategic Dangers of Relying Heavily on Alliances and Collaborative Partnerships 171
Merger and Acquisition Strategies 171
Vertical Integration Strategies: Operating across More Stages of the Industry Value Chain 175
The Advantages of a Vertical Integration Strategy 175
The Disadvantages of a Vertical Integration Strategy 177
Outsourcing Strategies: Narrowing the Boundaries of the Business 178
When Outsourcing Strategies Are Advantageous 179
The Big Risk of an Outsourcing Strategy 180
Offensive Strategies: Improving Market Position and Building Competitive Advantage 181
Blue Ocean Strategy: A Special Kind of Offensive 183
Choosing Which Rivals to Attack 184
Choosing the Basis for Competitive Attack 185
Defensive Strategies: Protecting Market Position and Competitive Advantage 185
Blocking the Avenues Open to Challengers 185
Signaling Challengers that Retaliation Is Likely 186
Web Site Strategies 186
Product Information–Only Web Strategies: Avoiding Channel Conflict 187
Web Site e-Stores as a Minor Distribution Channel 187

Brick-and-Click Strategies 188
Strategies for Online Enterprises 188
Choosing Appropriate Functional-Area Strategies 190
First-Mover Advantages and Disadvantages 191
The Potential for Late-Mover Advantages or First-Mover Disadvantages 192
To Be a First-Mover or Not 192

Illustration Capsules

6.1. Clear Channel Communications: Using Mergers and Acquisitions to Become a Global Market Leader 174
6.2. Brick-and-Click Strategies in the Office Supplies Industry 189
6.3. The Battle in Consumer Broadband: First-Movers versus Late-Movers 194

Strategic Thinking Capsule

Kotak Mahindra – Fighting New Turf Battles 195

7. Tailoring Strategy to Fit Specific Industry and Company Situations 200

Strategies for Competing in Emerging Industries 201
The Unique Characteristics of an Emerging Industry 201
Strategy Options for Emerging Industries 202
Strategies for Competing in Rapidly Growing Markets 204
Strategies for Competing in Maturing Industries 205
How Slowing Growth Alters Market Conditions 205
Strategies that Fit Conditions in Maturing Industries 206
Strategic Pitfalls in Maturing Industries 208
Strategies for Competing in Stagnant or Declining Industries 208
End-Game Strategies for Declining Industries 210
Strategies for Competing in Turbulent, High-Velocity Markets 211
Ways to Cope with Rapid Change 211
Strategy Options for Fast-Changing Markets 213
Strategies for Competing in Fragmented Industries 215
Reasons for Supply-Side Fragmentation 215
Competitive Conditions in a Fragmented Industry 216
Strategy Options for Competing in a Fragmented Industry 216
Strategies for Sustaining Rapid Company Growth 217
The Risks of Pursuing Multiple Strategy Horizons 220
Strategies for Industry Leaders 220
Strategies for Runner-Up Firms 223
Obstacles for Firms with Small Market Shares 223
Offensive Strategies to Build Market Share 224

Other Strategic Approaches for Runner-Up Companies 225
Strategies for Weak and Crisis-Ridden Businesses 226
Turnaround Strategies for Businesses in Crisis 226
Harvest Strategies for Weak Businesses 228
Liquidation: The Strategy of Last Resort 231
10 Commandments for Crafting Successful Business Strategies 232

Illustration Capsules

7.1. Exertris's Focus Strategy in the Fragmented Exercise Equipment Industry 218
7.2. ESPN's Strategy to Dominate Sports Entertainment 222
7.3. Sony's Turnaround Strategy—Will It Work? 229

Strategic Thinking Capsule

Rs 1 Lakh Nano is the Sum Total of Its Components 230

8. Diversification: *Strategies for Managing a Group of Businesses* 236

When to Diversify 238
Building Shareholder Value: The Ultimate Justification for Diversifying 239
Strategies for Entering New Businesses 240
Acquisition of an Existing Business 240
Internal Start-Up 240
Joint Ventures 241
Choosing the Diversification Path: Related versus Unrelated Businesses 241
The Case for Diversifying into Related Businesses 243
Identifying Cross-Business Strategic Fits along the Value Chain 244
Strategic Fit, Economies of Scope, and Competitive Advantage 246
The Case for Diversifying into Unrelated Businesses 248
The Merits of an Unrelated Diversification Strategy 250
The Drawbacks of Unrelated Diversification 252
Combination Related–Unrelated Diversification Strategies 254
Evaluating the Strategy of a Diversified Company 254
Step 1: Evaluating Industry Attractiveness 256
Step 2: Evaluating Business-Unit Competitive Strength 259
Step 3: Checking the Competitive Advantage Potential of Cross-Business Strategic Fits 263
Step 4: Checking for Resource Fit 265

Step 5: Ranking the Performance Prospects of Business Units and Assigning a Priority for Resource Allocation 268
Step 6: Crafting New Strategic Moves to Improve Overall Corporate Performance 269
After a Company Diversifies: The Four Main Strategy Alternatives 270
Strategies to Broaden a Diversified Company's Business Base 270
Divestiture Strategies Aimed at Retrenching to a Narrower Diversification Base 272
Strategies to Restructure a Company's Business Lineup 275
Multinational Diversification Strategies 277

Illustration Capsules

8.1. Related Diversification at L'Oréal, Johnson & Johnson, PepsiCo, and Darden Restaurants 247
8.2. Unrelated Diversification at General Electric, United Technologies, American Standard, and Lancaster Colony 251
8.3. Managing Diversification at Johnson & Johnson: The Benefits of Cross-Business Strategic Fits 272
8.4. Lucent Technology's Retrenchment Strategy 274
8.5. The Global Scope of Four Prominent Diversified Multinational Corporations 278

Strategic Thinking Capsule

Diversification at Tatas: "Treat the World as Your Market" 279

9. Building an Organization Capable of Good Strategy Execution 286

A Framework for Executing Strategy 288
The Principal Managerial Components of the Strategy Execution Process 289
Building an Organization Capable of Good Strategy Execution 291
Staffing the Organization 292
Putting Together a Strong Management Team 292
Recruiting and Retaining Capable Employees 293
Building Core Competencies and Competitive Capabilities 296
The Three-Stage Process of Developing and Strengthening Competencies and Capabilities 296
The Strategic Role of Employee Training 299
From Competencies and Capabilities to Competitive Advantage 299
Execution-Related Aspects of Organizing the Work Effort 303
Deciding Which Value Chain Activities to Perform Internally and Which to Outsource 303

Making Strategy-Critical Activities the Main Building Blocks of the Organization Structure 306
Determining the Degree of Authority and Independence to Give Each Unit and Each Employee 307
Providing for Internal Cross-Unit Coordination 310
Providing for Collaboration with Outside Suppliers and Strategic Allies 312
Current Organizational Trends 312

Illustration Capsules

9.1. How General Electric Develops a Talented and Deep Management Team 294
9.2. Toyota's Legendary Production System: A Capability That Translates into Competitive Advantage 300

Strategic Thinking Capsule

Mumbai's Dabbawalas: Beyond Six-Sigma through Simplicity and Success 301

10. Strategy, Ethics, and Social Responsibility 316

What Do We Mean by *Business Ethics?* 317
Where Do Ethical Standards Come From—Are They Universal or Dependent on Local Norms and Situational Circumstances? 317
The School of Ethical Universalism 318
The School of Ethical Relativism 318
Ethics and Integrative Social Contracts Theory 322
The Three Categories of Management Morality 323
Evidence of Managerial Immorality in the Global Business Community 325
Do Company Strategies Need to Be Ethical? 327
What Are the Drivers of Unethical Strategies and Business Behavior? 329
Approaches to Managing a Company's Ethical Conduct 333
Why Should Company Strategies Be Ethical? 338
The Moral Case for an Ethical Strategy 338
The Business Case for an Ethical Strategy 338
Linking a Company's Strategy to Its Ethical Principles and Core Values 340
Strategy and Social Responsibility 344
What Do We Mean by Social Responsibility? 344
Crafting a Social Responsibility Strategy: The Starting Point for Demonstrating a Social Conscience 347
The Moral Case for Corporate Social Responsibility 349
The Business Case for Socially Responsible Behavior 349

The Well-Intentioned Efforts of Do-Good Executives Can Be Controversial 351
How Much Attention to Social Responsibility Is Enough? 353
Linking Social Performance Targets to Executive Compensation 354

Illustration Capsules

10.1. Marsh & McLennan's Ethically Flawed Strategy 328
10.2. Philip Morris USA's Strategy for Marlboro Cigarettes: Ethical or Unethical? 334
10.3. A Test of Your Business Ethics 341

Strategic Thinking Capsule

SUZLON - The Rise of Indian Wind Power 342

11. Managing Internal Operations: Actions That Promote Good Strategy Execution 359

Marshaling Resources Behind the Drive for Good Strategy Execution 360
Instituting Policies and Procedures That Facilitate Good Strategy Execution 361
Adopting Best Practices and Striving for Continuous Improvement 364
How the Process of Identifying and Incorporating Best Practices Works 365
Business Process Reengineering, Six Sigma Quality Programs, and TQM: Tools for Promoting Operating Excellence 366
Capturing the Benefits of Initiatives to Improve Operations 371
Installing Information and Operating Systems 372
Instituting Adequate Information Systems, Performance Tracking, and Controls 374
Exercising Adequate Controls over Empowered Employees 375
Tying Rewards and Incentives to Good Strategy Execution 375
Strategy-Facilitating Motivational Practices 376
Striking the Right Balance between Rewards and Punishment 377
Linking the Reward System to Strategically Relevant Performance Outcomes 379

Illustration Capsules

11.1. Granite Construction's Short-Pay Policy: An Innovative Way to Drive Better Strategy Execution 363
11.2. Whirlpool's Use of Six Sigma to Promote Operating Excellence 369
11.3. What Companies Do to Motivate and Reward Employees 378
11.4. Nucor and Bank One: Two Companies That Tie Incentives Directly to Strategy Execution 381

Strategic Thinking Capsule

SCM @ Indian Oil – Using Technology for Competitive Advantage 382

12. Corporate Culture and Leadership: Keys to Good Strategy Execution 387

Instilling a Corporate Culture That Promotes Good Strategy Execution 388
Identifying the Key Features of a Company's Corporate Culture 389
Strong versus Weak Cultures 393
Unhealthy Cultures 394
High-Performance Cultures 397
Adaptive Cultures 397
Culture: Ally or Obstacle to Strategy Execution? 399
Changing a Problem Culture 401
Grounding the Culture in Core Values and Ethics 408
Establishing a Strategy–Culture Fit in Multinational and Global Companies 411
Leading the Strategy Execution Process 412
Staying on Top of How Well Things Are Going 413
Putting Constructive Pressure on the Organization to Achieve Good Results and Operating Excellence 414
Leading the Development of Better Competencies and Capabilities 416
Displaying Ethical Integrity and Leading Social Responsibility Initiatives 417
Leading the Process of Making Corrective Adjustments 419

Illustration Capsules

12.1. The Corporate Cultures at Google and Alberto-Culver 390
12.2. Changing the Culture in Alberto-Culver's North American Division 406

Strategic Thinking Capsule

Warne's Leadership Leads Underdogs to Cricket Win 407

Cases

1. Costco Wholesale Corporation: Mission, Business Model, and Strategy C-03
Arthur A. Thompson, The University of Alabama
2. AXIS Bank: Banking on Technology and Market Segments for Competitive Space C-22
Arun Kumar Jain, Affiliate Professor of Strategy, IB and Corporate Governance, EM Strasbourg School of Business (France) and Nidhi Jain, Research Associate, CALIC – Germany
3. HT Media: Facing Competitive and Technological Convergence Challenges in 21st Century C-34
Arun Kumar Jain, Affiliate Professor of Strategy, IB and Corporate Governance, EM Strasbourg School of Business (France) and Nidhi Jain, Research Associate, CALIC – Germany

4. Hewitt Associates: Attempting to be different in a Crowd C-53
Arun Kumar Jain, Affiliate Professor of Strategy, IB and Corporate Governance, EM Strasbourg School of Business (France) and Nidhi Jain, Research Associate, CALIC – Germany

5. Indian Hotels Company: Attempting a Broad Competitive Niche Without Diluting Brand C-66
Arun Kumar Jain, Affiliate Professor of Strategy, IB and Corporate Governance, EM Strasbourg School of Business (France) and Nidhi Jain, Research Associate, CALIC – Germany

6. Zune: Microsoft's Entry into the Digital Music Player Market C-82
Lou D. Marino, The University of Alabama

7. Toyota's Strategy and Initiatives in Europe: The Launch of the Aygo C-101
Kazuo Ichijo, International Institute for Management Development
George Rädler, International Institute for Management Development

8. PepsiCo in 2007: Strategies to Increase Shareholder Value C-118
John E. Gamble, University of South Alabama

9. Spectrum Brands' Diversification Strategy: A Success or a Failure? C-136
Arthur A. Thompson, The University of Alabama
John E. Gamble, University of South Alabama

10. Sara Lee Corporation: Retrenching to a Narrower Range of Businesses C-154
Arthur A. Thompson, The University of Alabama
John E. Gamble, University of South Alabama

11. Manpower Australia: Using Strategy Maps and the Balanced Scorecard Effectively C-169
Suresh Guganesan, Macquarie Graduate School of Management
Guy Ford, Macquarie Graduate School of Management
Haider Khan, Macquarie Graduate School of Management

12. Abercrombie & Fitch: An Upscale Sporting Goods Retailer Becomes a Leader in Trendy Apparel C-186
Janet L. Rovenpor, Manhattan College

13. Ryanair: European Pioneer of Budget Airline Travel C-205
Eleanor R. E. O'Higgins, University College Dublin and London School of Economics and Political Science

14. Pantaloon Retail (India) Ltd.: Fighting for New Space as Global Competition Comes Home C-228
Arun Kumar Jain, Affiliate Professor of Strategy, IB and Corporate Governance, EM Strasbourg School of Business (France) and Nidhi Jain, Research Associate, CALIC – Germany

15. Monitoring Foreign Suppliers: The Challenge of Detecting Unethical Practices C-239
Arthur A. Thompson, The University of Alabama

Oxford
HIGHER EDUCATION

MANAGERIAL ECONOMICS

Principles and Worldwide Applications

SIXTH EDITION
Adapted Version

DOMINICK SALVATORE

Adapted by

RAVIKESH SRIVASTAVA

MANAGERIAL ECONOMICS

This adapted version of ***Managerial Economics: Principles and Worldwide Applications, 6e***, is designed for the standard undergraduate and graduate courses in managerial economics in most business and some economic programs. It offers a complete coverage of all concepts usually encountered in actual managerial decision making.

This text uses the theory of the firm to integrate and link economic theory (microeconomics and macroeconomics), decision sciences (mathematical economics and econometrics), and the functional areas of business (accounting, finance, marketing, personnel or human resource management, and production) and shows how all of these are crucial components of managerial decision making.

Though applied in nature, the text rests on sound analytical foundations. It covers the full range of optimization techniques used in managerial decision making. The book offers extensive end-chapter material in the form of the summary, discussion questions, problems, chapter appendixes along with problems, supplementary readings, and Internet site addresses.

This sixth edition includes new sections, new case studies, over 30 of which are India based, and two new longer integrated case studies. In addition, the existing case studies, supplementary readings, and Internet site addresses have been thoroughly revised.

Key Features

- Introduces a global view into the subject to reflect concepts in today's rapidly globalizing world
- Provides a unifying theme of managerial decision making around the theory of the firm
- Contains over hundred real-world case studies and six extensive integrated case studies
- Provides mathematical appendixes with several chapters, along with appendix problems, as well as appendixes at the end of the book on the time value of money, statistical and interest factor tables, and answers to selected problems

The Author

Dominick Salvatore is Professor of Economics and Business at Fordham University. He was chairman of the New York Academy of Sciences and is consultant to the Economic Policy Institute in Washington, the United Nations, and various multinational banks and corporations. He is the author, co-author, or editor of 44 books, among which are *Income Distribution* (2006), *Introduction to International Economics* (2005), *International Economics* (8e, 2004), *Microeconomics—Theory and Applications* (5e, 2003), *The Dollarization Debate* (2003), *Protectionism and World Welfare* (1993), and *The Japanese Competitive Challenge and the U.S. Response* (1990). His research has been published in more than 100 journal articles in leading business and economics journals and presented at numerous national and international conferences.

The Adaptor

Ravikesh Srivastava is Associate Professor, Economics and Business Policy, and Programme Director, Working Managers' Group, at the FORE School of Management, New Delhi. He has more than 18 years of experience in teaching, research, consultancy, and training, including five years at Indian Institute of Management Lucknow, and has conducted several management development programs. He has worked as a consultant for leading companies like Hindustan Petroleum Corporation Ltd, Gujrat Heavy Chemicals Ltd, Hindware Sanitaryware and Industries Ltd, and Maruti Suzuki and has published 20 research papers in leading journals.

OXFORD
UNIVERSITY PRESS

www.oup.com

ISBN 0-19-569618-2

9 780195 696189

Rs 375

MANAGERIAL ECONOMICS

Principles and Worldwide Applications

SIXTH EDITION

Adapted version

DOMINICK SALVATORE
Professor
Fordham University
New York

Adapted by

RAVIKESH SRIVASTAVA
Associate Professor
FORE School of Management
New Delhi

OXFORD
UNIVERSITY PRESS

OXFORD
UNIVERSITY PRESS

YMCA Library Building, Jai Singh Road, New Delhi 110001

Oxford University Press is a department of the University of Oxford.
It furthers the University's objective of excellence in research, scholarship,
and education by publishing worldwide in

Oxford New York
Auckland Cape Town Dar es Salaam Hong Kong Karachi
Kuala Lumpur Madrid Melbourne Mexico City Nairobi
New Delhi Shanghai Taipei Toronto

With offices in
Argentina Austria Brazil Chile Czech Republic France Greece
Guatemala Hungary Italy Japan Poland Portugal Singapore
South Korea Switzerland Thailand Turkey Ukraine Vietnam

Oxford is a registered trade mark of Oxford University Press
in the UK and in certain other countries.

Adapted from a work
originally published by and © Oxford University Press Inc., USA,
198 Madison Avenue, New York, NY 10016 USA

© Oxford University Press, 2008

The moral rights of the author have been asserted.

Database right Oxford University Press (maker)

First published 2008
Fifth impression 2009

For sale in India, Nepal, Bangladesh, Bhutan, Myanmar,
Malaysia, and Sri Lanka only and not for export therefrom.

All rights reserved. No part of this publication may be reproduced,
stored in a retrieval system, or transmitted, in any form or by any means,
without the prior permission in writing of Oxford University Press,
or as expressly permitted by law, or under terms agreed with the appropriate
reprographics rights organization. Enquiries concerning reproduction
outside the scope of the above should be sent to the Rights Department,
Oxford University Press, at the address above.

You must not circulate this book in any other binding or cover
and you must impose this same condition on any acquirer.

Third-party website addresses mentioned in this book are provided
by Oxford University Press in good faith and for information only.
Oxford University Press disclaims any responsibility for the material contained therein.

ISBN-13: 978-0-19-569618-9
ISBN-10: 0-19-569618-2

Typeset in Times New Roman
by The Composers, New Delhi 110063
Printed in India by Adage Printers (P) Ltd, Noida 201301 U.P.
and published by Oxford University Press
YMCA Library Building, Jai Singh Road, New Delhi 110001

CONTENTS

Preface xxvii

PART ONE **Introduction** 1

CHAPTER 1 The Nature and Scope of Managerial Economics 3

1-1 The Scope of Managerial Economics 4
Definition of Managerial Economics 4
Relationship to Economic Theory 6
Relationship to the Decision Sciences 6
Relationship to the Functional Areas of Business Administration Studies 7

1-2 The Basic Process of Decision Making 7
CASE STUDY 1-1 *The Man Who Invented Management* 9
CASE STUDY 1-2 *The Management Revolution* 10

1-3 The Theory of the Firm 11
Reasons for the Existence of Firms and Their Functions 12
The Objective and Value of the Firm 12
Constraints on the Operation of the Firm 14
Limitations of the Theory of the Firm 15

1-4 The Nature and Function of Profits 16
Business versus Economic Profit 16
Theories of Profit 17
Function of Profit 18
CASE STUDY 1-3 *Profits in the Personal Computer Industry* 19

1-5 Business Ethics 20
CASE STUDY 1-4 *Business Ethics at Boeing* 21
CASE STUDY 1-5 *Competition and Ethical Behavior* 22
CASE STUDY 1-6 *Enron Disaster in India* 23

1-6 The International Framework of Managerial Economics 24
CASE STUDY 1-7 *The Rise of the Global Corporation* 25
CASE STUDY 1-8 *The Indian Global Business Leader* 26
CASE STUDY 1-9 *Global Most Admired Companies* 27

1-7 Managerial Economics and the Internet 28
CASE STUDY 1-10 *The Most Important Internet Site Addresses for Managerial Economics* 29

Summary 30
Discussion Questions 30
Problems 31

Appendix to Chapter 1: The Basics of Demand, Supply, and Equilibrium 33
The Demand Side of the Market 33
The Supply Side of the Market 34
The Equilibrium Price 34
Shift in the Demand Curve and Equilibrium 35
Shift in the Supply Curve and Equilibrium 35
CASE STUDY 1-11 *Changes in Demand and Supply and the Price of PCs* 37
CASE STUDY 1-12 *Changes in Demand and Supply and Coffee Prices* 38

Appendix Problems 38
Supplimentary Readings 39
Internet Site Addresses 40

CHAPTER 2 Optimization Techniques and New Management Tools **41**

2-1 Methods of Expressing Economic Relationships 42

2-2 Total, Average, and Marginal Relationships 44
Total, Average, and Marginal Cost 44
Geometric Derivation of the Average- and Marginal-Cost Curves 46

2-3 Optimization Analysis 47
Profit Maximization by the Total-Revenue and Total-Cost Approach 47
Optimization by Marginal Analysis 48
CASE STUDY 2-1 *Optimal Pollution Control* 49

2-4 Constrained Optimization 50
CASE STUDY 2-2 *Pursuing Multiple Objectives under Constraints by Global Corporations* 50

2-5 New Management Tools for Optimization 51
Benchmarking 52
Total Quality Management 52

CASE STUDY 2-3 *Benchmarking at Xerox, Ford, and Mobil* 53
Reengineering 54
CASE STUDY 2-4 *Total Quality Management in the Real World* 55
CASE STUDY 2-5 *Reengineering at GE* 56
The Learning Organization 57
CASE STUDY 2-6 *Applying Learning-Organization Principles at Ford and Southwest Airlines* 58

2-6 Other Management Tools for Optimization 59

2-7 New Management Tools and Functional Specialization 60
CASE STUDY 2-7 *The Indian Business Model* 61
CASE STUDY 2-8 *Enron Fallout in India—Governance Rules Fail* 62

Summary 63
Discussion Questions 63
Problems 64
Supplementary Readings 65
Internet Site Addresses 66

INTEGRATING CASE STUDY 1: *The Education of Michael Dell* 67

PART TWO Demand Analysis 71

CHAPTER 3 Demand Theory 73

3-1 The Demand for a Commodity 75
An Individual's Demand for a Commodity 75
From Individual to Market Demand 78
The Demand Faced by a Firm 79
CASE STUDY 3-1 *The Demand for Big Macs* 80

3-2 Price Elasticity of Demand 83
Point Price Elasticity of Demand 83
Arc Price Elasticity of Demand 85
Price Elasticity, Total Revenue, and Marginal Revenue 86
Factors Affecting the Price Elasticity of Demand 89
CASE STUDY 3-2 *Price Elasticities of Demand in the Real World* 91

3-3 Income Elasticity of Demand 92
CASE STUDY 3-3 *Income Elasticities of Demand in the Real World* 94

3-4 Cross-Price Elasticity of Demand 95
CASE STUDY 3-4 *Cross-Price Elasticities of Demand in the Real World* 97
CASE STUDY 3-5 *Substitution between Domestic and Foreign Goods* 98

3-5 Using Elasticities in Managerial Decision Making 98

3-6 International Convergence of Tastes 101
CASE STUDY 3-6 *Gillette Introduces the Sensor and Mach3 Razors—Two Truly Global Products* 101
CASE STUDY 3-7 *Ford's World Car(s)* 102

3-7 Electronic Commerce 103
CASE STUDY 3-8 *E-Commerce at Amazon.com* 106
CASE STUDY 3-9 *eBay and Some Internet Veterans Are Cashing In* 107

Summary 108
Discussion Questions 109
Problems 110

Appendix to Chapter 3: Behind the Market Demand Curve—The Theory of Consumer Choice 113
The Consumer's Tastes: Indifference Curves 113
The Consumer's Constraints: The Budget Line 114
The Consumer's Equilibrium 115
Derivation of the Consumer's Demand Curve 115
Income and Substitution Effects of a Price Change 116
The Theory of Consumer Choice Mathematically 118

Appendix Problems 118
Supplimentary Readings 119
Internet Site Addresses 119

CHAPTER 4 Demand Estimation 120

4-1 The Identification Problem 122

4-2 Marketing Research Approaches to Demand Estimation 124
Consumer Surveys and Observational Research 124
Consumer Clinics 125
Market Experiments 125
CASE STUDY 4-1 *Micromarketing: Marketers Zero In on Their Customers* 126
Virtual Shopping and Virtual Management 127
CASE STUDY 4-2 *Estimation of the Demand for Oranges by Market Experiment* 128
CASE STUDY 4-3 *Reaching Consumers in the Vanishing Mass Market* 129

4-3 Introduction to Regression Analysis 130

4-4 Simple Regression Analysis 133
The Ordinary Least-Squares Method 133
Tests of Significance of Parameter Estimates 135

Other Aspects of Significance Tests and Confidence Intervals 137
Test of Goodness of Fit and Correlation 138

4-5 Multiple Regression Analysis 142
The Multiple Regression Model 142
The Coefficient of Determination and Adjusted R^2 144
Analysis of Variance 145
Point and Interval Estimates 146

4-6 Problems in Regression Analysis 147
Multicollinearity 147
Heteroscedasticity 147
Autocorrelation 149

4-7 Demand Estimation by Regression Analysis 150
Model Specification 150
Collecting Data on the Variables 151
Specifying the Form of the Demand Equation 151
Testing the Econometric Results 153
CASE STUDY 4-4 *Estimation of the Demand for Air Travel over the North Atlantic* 153

4-8 Estimating the Demand for U.S. and India Imports and Exports 154
CASE STUDY 4-5 *Price and Income Elasticities of Imports and Exports in the Real World* 155
CASE STUDY 4-6 *The Major Commodity Exports and Imports of India* 156
CASE STUDY 4-7 *India's Share in Global Export* 157

Summary 158
Discussion Questions 159
Problems 160

Appendix to Chapter 4: Regression Analysis with Excel 163
Simple Regression 163
Multiple Regression Analysis 166

Supplementary Readings 167
Internet Site Addresses 168

CHAPTER 5 Demand Forecasting 169

5-1 Qualitative Forecasts 171
Survey Techniques 171
Opinion Polls 172
Soliciting a Foreign Perspective 173
CASE STUDY 5-1 *Forecasting the Number of McDonald's Restaurants Worldwide* 174

5-2 Time-Series Analysis 174
Reasons for Fluctuations in Time-Series Data 175
Trend Projection 177
Seasonal Variations 179
CASE STUDY 5-2 *Forecasting Demand of Industrially Produced Tea in India with Time-Series Analysis* 182

5-3 Smoothing Techniques 183
Moving Averages 183
Exponential Smoothing 185
CASE STUDY 5-3 *Forecasting Electricity Consumption in Delhi with Smoothing Technique* 187

5-4 Barometric Methods 188
CASE STUDY 5-4 *Forecasting the Level of Economic Activity with Composite and Diffusion Indexes* 191
CASE STUDY 5-5 *The Index of Leading Indicators Goes Global* 192

5-5 Econometric Models 192
Single-Equation Models 193
CASE STUDY 5-6 *Forecasting the Demand for Air Travel over the North Atlantic* 193
Multiple-Equation Models 194
CASE STUDY 5-7 *India Economic Forecast with Macro Indicators* 196
CASE STUDY 5-8 *Risks in Demand Forecasting* 197

5-6 Input-Output Forecasting 198

Summary 198
Discussion Questions 199
Problems 200

Appendix to Chapter 5: Forecasting Fluctuations in Time-Series Analysis Using Excel 203
Forecasting Tea Consumption in India: 2001.1–2005.5 203
Adjusting the Trend Forecasts of Tea Consumption for Seasonal Variations by the Ratio-to-Trend Method 205
Adjusting the Trend Forecasts of Tea Consumption for Seasonal Variations by Using the Seasonal Dummies 207

Supplementary Readings 207
Internet Site Addresses 208

INTEGRATING CASE STUDY 2: *Estimating and Forecasting the U.S. Demand for Electricity* 209

PART THREE **Production and Cost Analysis** 213

CHAPTER 6 Production Theory and Estimation 215

6-1 The Organization of Production and the Production Function 217
The Organization of Production 217
The Production Function 218

6-2 The Production Function with One Variable Input 220
Total, Average, and Marginal Product 221
The Law of Diminishing Returns and Stages of Production 223

6-3 Optimal Use of the Variable Input 225

6-4 The Production Function with Two Variable Inputs 228
Production Isoquants 228
Economic Region of Production 228
Marginal Rate of Technical Substitution 230
Perfect Substitutes and Complementary Inputs 232

6-5 Optimal Combination of Inputs 233
Isocost Lines 234
Optimal Input Combination for Minimizing Costs or Maximizing Output 235
Profit Maximization 237
Effect of Change in Input Prices 237
CASE STUDY 6-1 *Substitutability between Gasoline Consumption and Driving Time* 238

6-6 Returns to Scale 240
CASE STUDY 6-2 *Returns to Scale in U.S. Manufacturing Industries* 241
CASE STUDY 6-3 *Bajaj Auto Limited—Small Is Better* 242

6-7 Empirical Production Functions 243
CASE STUDY 6-4 *Output Elasticities in U.S. Manufacturing Industries* 244

6-8 The Innovation Process 246
Meaning and Importance of Innovations 246
CASE STUDY 6-5 *How Do Firms Get New Technology?* 247
The Open Innovation Model 248

6-9 Innovation and Global Competitiveness 249
Innovations and the International Competitiveness of U.S. Firms 249
CASE STUDY 6-6 *How Xerox Lost and Regained International Competitiveness and Became a Leader in Information Technology* 250
CASE STUDY 6-7 *The New U.S. Digital Factory* 251

CASE STUDY 6-8 *The Euro and the International Competitiveness of European Firms* 252
The New Computer-Aided Production Revolution and the International Competitiveness of U.S. Firms 253

Summary 253
Problems 255
Discussion Questions 255

Appendix to Chapter 6: Production Analysis with Calculus 258
Constrained Output Maximization 258
Constrained Cost Minimization 259
Profit Maximization 259

Appendix Problems 260
Supplementary Readings 261
Internet Site Addresses 261

CHAPTER 7 Cost Theory and Estimation 262

7-1 The Nature of Costs 263

7-2 Short-Run Cost Functions 265
Short-Run Total and Per-Unit Cost Functions 265
Short-Run Total and Per-Unit Cost Curves 266

7-3 Long-Run Cost Curves 269
Long-Run Total Cost Curves 269
Long-Run Average and Marginal Cost Curves 271
CASE STUDY 7-1 *The Long-Run Average Cost Curve in Electricity Generation* 273

7-4 Plant Size and Economies of Scale 274
CASE STUDY 7-2 *The Shape of the Long-Run Average Cost Curve* 276

7-5 Learning Curves 277
CASE STUDY 7-3 *To Reduce Costs, Firms Often Look Far Afield* 279

7-6 Minimizing Costs Internationally—The New Economies of Scale 280
International Trade in Inputs 280
CASE STUDY 7-4 *The IBM PC and the Boeing 777 and 787 Are All but American!* 281
The New International Economies of Scale 282
Immigration of Skilled Labor 283

7-7 Logistics or Supply-Chain Management 284
CASE STUDY 7-5 *Logistics at National Semiconductors, Saturn, and Compaq* 285

7-8 Cost–Volume–Profit Analysis and Operating Leverage 285
Cost–Volume–Profit Analysis 286
Operating Leverage 288
CASE STUDY 7-6 *Breakeven Analysis for Tata Motors' Nano Car* 290

7-9 Empirical Estimation of Cost Functions 291
Data and Measurement Problems in Estimating Short-Run Cost Functions 291
The Functional Form of Short-Run Cost Functions 292
CASE STUDY 7-7 *Estimates of Short-Run and Long-Run Cost Functions* 294
Estimating Long-Run Cost Functions with Cross-Sectional Regression Analysis 295
Estimating Long-Run Cost Functions with Engineering and Survival Techniques 296

Summary 298
Discussion Questions 299
Problems 300

Appendix to Chapter 7: Cost Analysis with Calculus 303
Appendix Problems 304
Supplementary Readings 305
Internet Site Addresses 305

INTEGRATING CASE STUDY 3: *Production and Cost Functions in the Petroleum Industry* 307

PART FOUR **Market Structure and Pricing Practices 311**

CHAPTER 8 Market Structure: Perfect Competition, Monopoly, and Monopolistic Competition 313

8-1 Market Structure and Degree of Competition 314

8-2 Perfect Competition 315
Meaning and Importance of Perfect Competition 315
Price Determination under Perfect Competition 316
CASE STUDY 8-1 *Competition in the Stock Market* 317
Short-Run Analysis of a Perfectly Competitive Firm 319
Short-Run Supply Curve of the Competitive Firm and Market 322
Long-Run Analysis of a Perfectly Competitive Firm 322
CASE STUDY 8-2 *Long-Run Adjustment in the U.S. Cotton Textile Industry* 324

8-3 Competition in the Global Economy 324
Domestic Demand and Supply, Imports, and Prices 324
The Dollar Exchange Rate and the International Competitiveness of U.S. Firms 326
CASE STUDY 8-3 *The Exchange Rate of the U.S. Dollar and the Profitability of U.S. Firms* 328

8-4 Monopoly 329
Sources of Monopoly 329
CASE STUDY 8-4 *Barriers to Entry and Monopoly by Alcoa* 330
Short-Run Price and Output Determination under Monopoly 331
Long-Run Price and Output Determination under Monopoly 333
Comparison of Monopoly and Perfect Competition 334
CASE STUDY 8-5 *Monopoly in the Mumbai City Taxi Industry* 335

8-5 Monopolistic Competition 337
Meaning and Importance of Monopolistic Competition 337
CASE STUDY 8-6 *The Monopolistically Competitive Restaurant Market* 338
Short-Run Price and Output Determination under Monopolistic Competition 339
Long-Run Price and Output Determination under Monopolistic Competition 340
CASE STUDY 8-7 *Advertiser Competition in India* 341
Product Variation and Selling Expenses under Monopolistic Competition 342

Summary 343
Discussion Questions 344
Problems 345

Appendix to Chapter 8: Profit Maximization with Calculus 348

Appendix Problems 349
Supplementary Readings 350
Internet Site Addresses 351

CHAPTER 9 Oligopoly and Firm Architecture 352

9-1 Oligopoly and Market Concentration 353
Oligopoly: Meaning and Sources 353
Concentration Ratios, the Herfindahl Index, and Contestable Markets 354
CASE STUDY 9-1 *Brands: Thrive or Die* 355
CASE STUDY 9-2 *Industrial Concentration for Two-wheeler Industry in India* 356

9-2 Oligopoly Models 357
The Cournot Model 358

The Kinked Demand Curve Model 360
Cartel Arrangements 362
CASE STUDY 9-3 *The Organization of Petroleum Exporting Countries (OPEC) Cartel* 363
Price Leadership 364

9-3 Profitability and Efficiency Implications of Oligopoly 366
Porter's Strategic Framework 366
Efficiency Implications of Oligopoly 367
CASE STUDY 9-4 *Firm Size and Profitability* 368
CASE STUDY 9-5 *Measuring the Pure Efficiency of Operating Units* 369

9-4 The Sales Maximization Model 370

9-5 The March of Global Oligopolists 372
CASE STUDY 9-6 *The Globalization of the Automobile Industry* 373
CASE STUDY 9-7 *Rising Competition in Global Banking* 374
CASE STUDY 9-8 *The Globalization of the Pharmaceutical Industry* 376

9-6 The Architecture of the Ideal Firm and the Creative Company 378
The Architecture of the Ideal Firm 378
The Evolution of the Creative Company 380
CASE STUDY 9-9 *Firm Architecture and Organizational Competitiveness* 381
CASE STUDY 9-10 *The Top Innovative Companies in the World* 382

9-7 The Virtual Corporationand Relationship Enterprises 383
The Virtual Corporation 383
Relationship Enterprises 384
CASE STUDY 9-11 *Relationship Enterprises in Aerospace, Airlines, Telecommunications, and Automobiles* 385

Summary 386
Discussion Questions 387
Problems 387

Appendix to Chapter 9: Oligopoly Theory Mathematically 389
The Cournot Model 390
The Kinked Demand Curve Model 392
The Centralized Cartel Model 393
The Market-Sharing Cartel 394
The Sales Maximization Model 395

Appendix Problems 397
Supplementary Readings 397
Internet Site Addresses 398

■ CHAPTER 10 Game Theory and Strategic Behavior 400

10-1 Strategic Behavior and Game Theory 401
CASE STUDY 10-1 *Military Strategy and Strategic Business Decisions* 402

10-2 Dominant Strategy and Nash Equilibrium 404
Dominant Strategy 404
Nash Equilibrium 405
CASE STUDY 10-2 *Dell Computers and Nash Equilibrium* 406

10-3 The Prisoners' Dilemma 407

10-4 Price and Nonprice Competition, Cartel Cheating, and Prisoners' Dilemma 408
Price Competition and the Prisoners' Dilemma 408
Nonprice Competition, Cartel Cheating, and the Prisoners' Dilemma 409
CASE STUDY 10-3 *The Airlines' Fare War in India and the Prisoners' Dilemma* 410

10-5 Repeated Games and Tit-for-Tat Strategy 411

10-6 Strategic Moves 412
Threat, Commitments, and Credibility 412
Entry Deterrence 413
CASE STUDY 10-4 *Wal-Mart's Preemptive Expansion Marketing Strategy* 414

10-7 Strategic Behavior and International Competitiveness 415
CASE STUDY 10-5 *Companies' Strategic Mistakes and Failures* 417

10-8 Sequential Games and Decision Trees 418
CASE STUDY 10-6 *Airbus's Decision to Build the A380 and Boeing's Sonic Cruiser Response and the 747-8* 420

Summary 421
Discussion Questions 421
Problems 422
Internet Site Addresses 425

■ CHAPTER 11 Pricing Practices 427

11-1 Pricing of Multiple Products 428
Pricing of Products with Interrelated Demands 428
Plant Capacity Utilization and Optimal Product Pricing 430
Optimal Pricing of Joint Products Produced in Fixed Proportions 431
Optimal Pricing and Output of Joint Products Produced in Variable Proportions 433
CASE STUDY 11-1 *Optimal Pricing and Output by Gillette* 435

11-2 Price Discrimination 436
Meaning of and Conditions for Price Discrimination 436
First- and Second-Degree Price Discrimination 437
Third-Degree Price Discrimination Graphically 439
Third-Degree Price Discrimination Algebraically 440
CASE STUDY 11-2 *Price Discrimination by BSES in India* 441

11-3 International Price Discrimination and Dumping 443
CASE STUDY 11-3 *Kodak Antidumping Disputes with Fuji* 444
CASE STUDY 11-4 *Antidumping Disputes with India* 445

11-4 Transfer Pricing 446
Meaning and Nature of Transfer Pricing 446
Transfer Pricing with No External Market for the Intermediate Product 447
Transfer Pricing with a Perfectly Competitive Market for the Intermediate Product 448
Transfer Pricing with an Imperfectly Competitive Market for the Intermediate Product 450
CASE STUDY 11-5 *Transfer Pricing by Multinationals Operating in Emerging Markets* 452

11-5 Pricing in Practice 453
CASE STUDY 11-6 *Transfer Pricing in India* 453
Cost-Plus Pricing 454
Evaluation of Cost-Plus Pricing 454
Incremental Analysis in Pricing 456
CASE STUDY 11-7 *Incremental Pricing at Indian Railways* 457
Peak-Load Pricing, Two-Part Tariff, Tying, and Bundling 458
Other Pricing Practices 459
CASE STUDY 11-8 *Bundling Offers in India* 460
CASE STUDY 11-9 *No-Haggling Value Pricing in Car Buying* 461
CASE STUDY 11-10 *Name Your Price at Priceline* 462

Summary 463
Discussion Questions 464
Problems 465

Appendix to Chapter 11: Third-Degree Price Discrimination with Calculus 467

Appendix Problems 470
Supplementary Readings 470
Internet Site Addresses 471

INTEGRATING CASE STUDY 4: *eBay and Competition on the Internet* 472
INTEGRATING CASE STUDY 5: *The Art of Devising Airfares* 474

PART FIVE **Regulation, Risk Analysis, and Capital Budgeting** 477

■ **CHAPTER 12** Regulation and Antitrust: The Role of Government in the Economy 479

12-1 Government Regulation to Support Business and to Protect Consumers, Workers, and the Environment 480
Government Regulations that Restrict Competition 481
Government Regulations to Protect Consumers, Workers, and the Environment 482
CASE STUDY 12-1 *Food Regulation Acts in India* 485
CASE STUDY 12-2 *Regulation Greatly Reduced Air Pollution in India* 486

12-2 Externalities and Regulation 487
The Meaning and Importance of Externalities 487
Policies to Deal with Externalities 489
CASE STUDY 12-3 *The Market for Dumping Rights* 491

12-3 Public Utility Regulation 492
Public Utilities as Natural Monopolies 492
Difficulties in Public Utility Regulation 494

12-4 Antitrust: Government Regulation of Market Structure and Conduct 495

12-5 Enforcement of Antitrust Laws and the Deregulation Movement 495
Enforcement of Antitrust Laws: Some General Observations 495
Enforcement of Antitrust Laws: Structure 496
CASE STUDY 12-4 *The IBM and AT&T Cases* 497
Enforcement of Antitrust Laws: Conduct 498
CASE STUDY 12-5 *Antitrust and the New Merger Boom* 499
The Deregulation Movement 500
CASE STUDY 12-6 *The Microsoft Antitrust Case* 501
CASE STUDY 12-7 *Deregulation of the Airline Industry: An Assessment* 503

12-6 Regulation of International Competition 504
CASE STUDY 12-8 *Voluntary Export Restraints on Japanese Automobiles to the United States* 505
The Competition Act in India 506

12-7 The Effect of Taxation on Business Decisions 507
CASE STUDY 12-9 *Corporate Tax Rates around the World* 507
CASE STUDY 12-10 *U.S. Border Taxes and Export Subsidies* 508

Summary 509
Discussion Questions 510

Problems 511
Supplimentary Readings 513
Internet Site Addresses 515

■ **CHAPTER 13** Risk Analysis 516

13-1 Risk and Uncertainty in Managerial Decision Making 518
CASE STUDY 13-1 *The Risk Faced by Coca-Cola in Changing Its Secret Formula* 519

13-2 Measuring Risk with Probability Distributions 519
CASE STUDY 13-2 *Business Failures in India* 520
Probability Distributions 521
An Absolute Measure of Risk: The Standard Deviation 524
Measuring Probabilities with the Normal Distribution 525
A Relative Measure of Risk: The Coefficient of Variation 527
CASE STUDY 13-3 *RiskMetrics: A Method of Measuring Value at Risk* 528

13-3 Utility Theory and Risk Aversion 529
CASE STUDY 13-4 *The Purchase of Insurance and Gambling by the Same Individual—A Seeming Contradiction* 532

13-4 Adjusting the Valuation Model for Risk 533
Risk-Adjusted Discount Rates 533
Certainty-Equivalent Approach 535
CASE STUDY 13-5 *Adjusting the Valuation Model for Risk in the Real World for India* 537

13-5 Other Techniques for Incorporating Risk into Decision Making 538
Decision Trees 538
Simulation 540

13-6 Decision Making under Uncertainty 541
The Maximin Criterion 541
The Minimax Regret Criterion 542
Other Methods of Dealing with Uncertainty 543
CASE STUDY 13-6 *Spreading Risks in the Choice of a Portfolio* 544

13-7 Foreign-Exchange Risks and Hedging 545
CASE STUDY 13-7 *How Foreign Stocks Have Benefited a Domestic Portfolio* 546
CASE STUDY 13-8 *Information, Risk, and the Collapse of Long-Term Capital Management* 548

13-8 Information and Risk 549
Asymmetric Information and the Market for Lemons 549
The Insurance Market and Adverse Selection 550
The Problem of Moral Hazard 550

The Principal–Agent Problem 551
CASE STUDY 13-9 *Voluntary Retirement Schemes in India* 552
Auctions 553
Telecom Auctions 554
Auctions for Basic Wireline Services 554
CASE STUDY 13-10 *Auctioning of the Airwaves in India* 554
Spectrum Auctions for Cellular Services 555
Auctioning for Radio 555

Summary 556
Discussion Questions 557
Problems 558
Supplementary Readings 562
Internet Site Addresses 563

CHAPTER 14 Long-Run Investment Decisions: Capital Budgeting 564

14-1 Capital Budgeting: An Overview 565
Meaning and Importance of Capital Budgeting 565
Overview of the Capital Budgeting Process 567
CASE STUDY 14-1 *Cost–Benefit Analysis of the Delhi Metro* 569

14-2 The Capital Budgeting Process 570
Projecting Cash Flows 570
CASE STUDY 14-2 *The Eurotunnel: Another Bad French–British Investment?* 571
Net Present Value (*NPV*) 573
Internal Rate of Return (*IRR*) 574
Comparison of *NPV* and *IRR* 574

14-3 Capital Rationing and the Profitability Index 575
CASE STUDY 14-3 *Pennzoil's $3 Billion Capital Budgeting Challenge* 576
CASE STUDY 14-4 *Capital Budgeting for Investments in Human Capital* 577

14-4 The Cost of Capital 578
The Cost of Debt 579
The Cost of Equity Capital: The Risk-Free Rate Plus Premium 579
The Cost of Equity Capital: The Dividend Valuation Model 580
The Cost of Equity Capital: The Capital Asset Pricing Model (CAPM) 581
The Weighted Cost of Capital 582

14-5 Reviewing Investment Projects after Implementation 583
CASE STUDY 14-5 *The Choice between Equity and Debt in India* 584
CASE STUDY 14-6 *Capital Budgeting Techniques of Major Firms in India* 585

14-6 The Cost of Capital and International Competitiveness 586

Summary 587
Discussion Questions 588
Problems 589
Supplementary Readings 592
Internet Site Addresses 593

INTEGRATING CASE STUDY 6: *Deregulation, Risk, Capital Budgeting, and the Telecom Crisis* 594

Appendixes 597

APPENDIX A Compounding, Discounting, and Present Value 599

A-1 Future Value and Compounding 599
A-2 Present Value and Discounting 601
A-3 Future Value of an Annuity 601
A-4 Present Value of an Annuity 602
A-5 Compounding and Discounting Periods 603
A-6 Determining the Interest Rate 603
A-7 Perpetuities 604

APPENDIX B Interest Factor Tables 605

TABLE B-1 Compound Value of $1 606
TABLE B-2 Present Value of $1 607
TABLE B-3 Future Value of an Annuity of $1 for *n* Periods 608
TABLE B-4 Present Value of an Annuity of $1 for *n* Periods 609

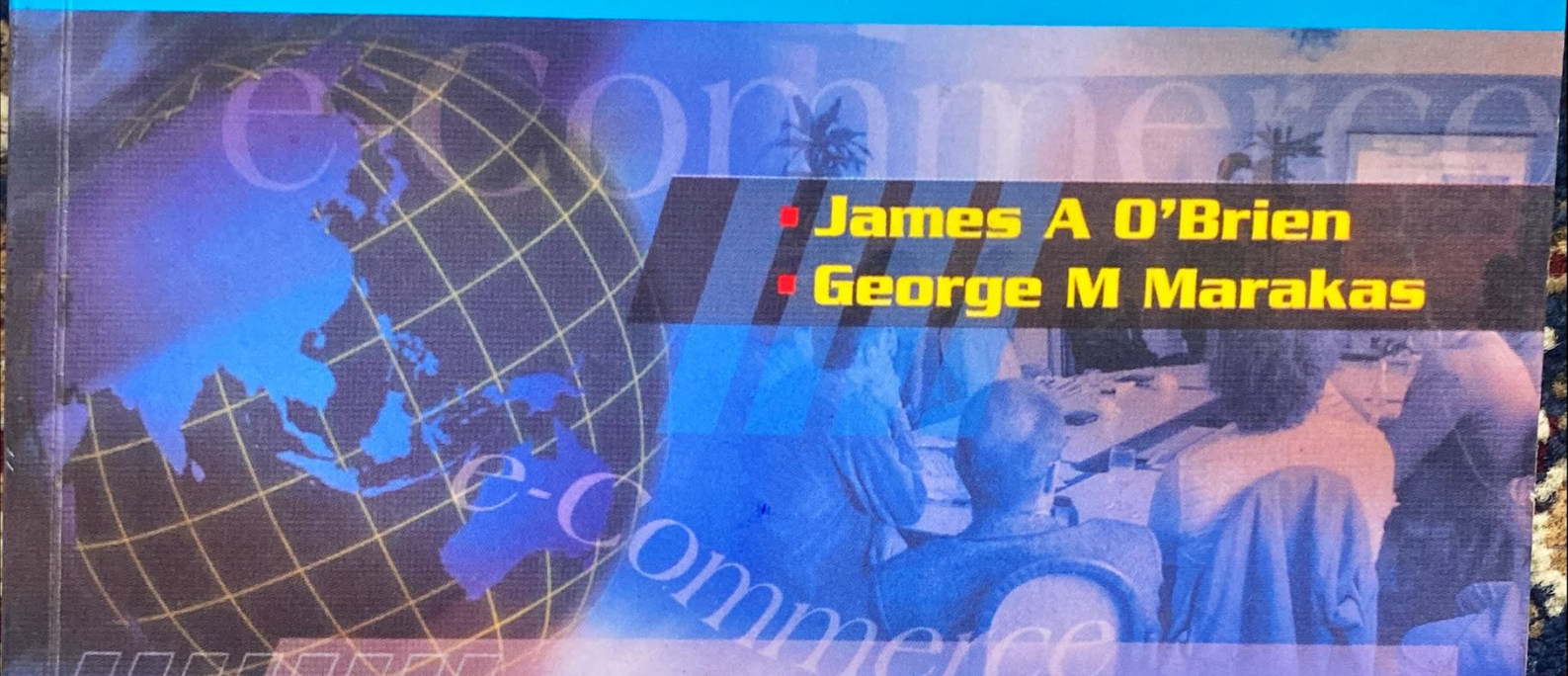
APPENDIX C Statistical Tables 610

TABLE C-1 Areas under the Standard Normal Distribution 611
TABLE C-2 Areas in the Tails of the *t* Distribution 612
TABLE C-3 *F* Distribution for 5 Percent Significance 613
TABLE C-3 *F* Distribution for 1 Percent Significance 614
TABLE C-4 Durbin–Watson Statistic for 5 Percent Significance Points of d_L and d_U 615
TABLE C-4 Durbin–Watson Statistic for 1 Percent Significance Points of d_L and d_U 616

APPENDIX D Answers to Selected (Asterisked) Problems 617

Glossary 642
Index 655

IILM

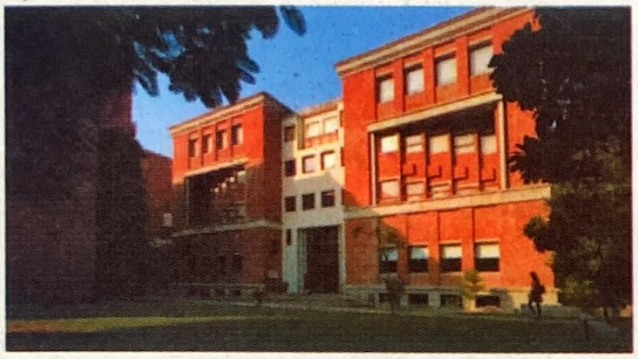
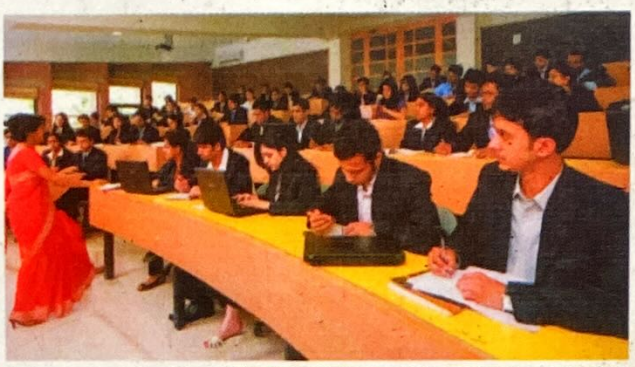
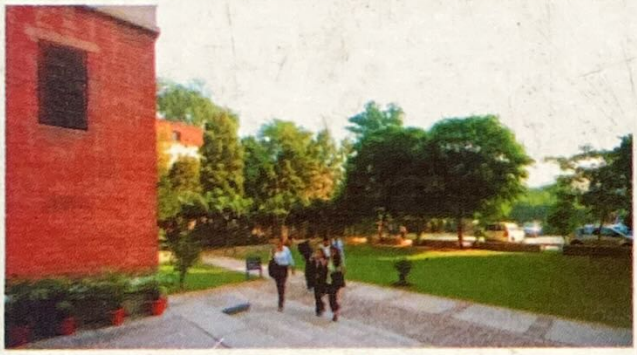


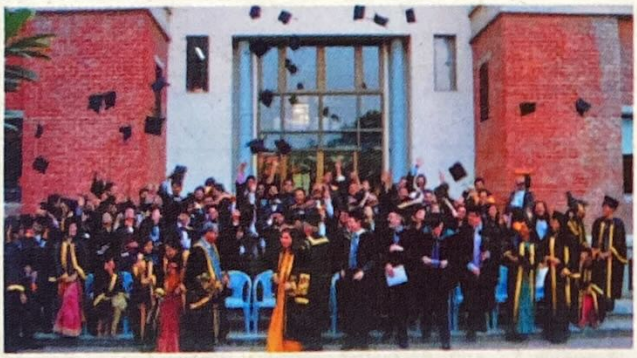
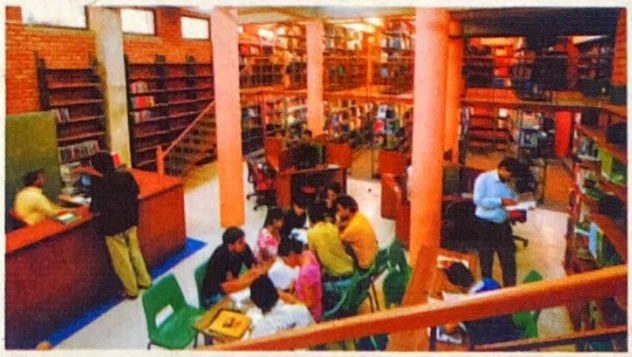
James A O'Brien
George M Marakas

Management Information Systems

For IILM only
Not for sale in the open market

Management Information Systems

IILM

Visit us at: www.tatamcgrawhill.com

ISBN-13: 978-0-07-068219-1
ISBN-10: 0-07-068219-4

9 780070 682191

McGraw Hill Custom Publishing

IILM

SAKIB ASHAI
SEC-C (65)
PGP-0911
LR.

MANAGEMENT INFORMATION SYSTEMS

James A. O'Brien
College of Business Administration
Northern Arizona University

George M. Marakas
KU School of Business
University of Kansas

Contributing Author
Ramesh Behl
International Management Institute
New Delhi

Tata McGraw Hill Education Private Limited
NEW DELHI

McGraw-Hill Offices
New Delhi New York St Louis San Francisco Auckland Bogotá
Caracas Kuala Lumpur Lisbon London Madrid Mexico City Milan Montreal
San Juan Santiago Singapore Sydney Tokyo Toronto

Tata McGraw Hill

Management Information Systems

Indian Adaptation done by arrangement with The McGraw-Hill Companies, Inc., New York

Not for open market sale. Customised for IILM Institute for Higher Education.

Copyright © 2008, by The McGraw-Hill Companies, Inc. All Rights reserved. No part of this publication may be reproduced or distributed in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise or stored in a database or retrieval system without the prior written permission of The McGraw-Hill Companies, 1221 Avenue of the Americas, New York, NY, 10020 including, but not limited to, in any network or other electronic storage or transmission, or broadcast for distance learning.

Tata McGraw Hill Edition 2010

ISBN (13): 978-0-07-068219-1
ISBN (10): 0-07-068219-4

Managing Director: *Ajay Shukla*
Head—Higher Education Publishing: *Vibha Mahajan*
Publishing Manager—B&E/HSSL: *Tapas K Maji*
Deputy Manager—Sponsoring: *Surabhi Khare*
Assistant Manager (Editorial Services): *Anubha Srivastava*
Senior Production Manager: *Manohar Lal*
Production Executive: *Atul Gupta*
General Manager—Marketing (Higher Ed): *Michael J Cruz*
Product Manager: *Vijay S Jagannathan*
General Manager—Production: *Rajender P Ghansela*
Assistant General Manager—Production: *B L Dogra*

Information contained in this work has been obtained by Tata McGraw Hill, from sources believed to be reliable. However, neither Tata McGraw Hill nor its authors guarantee the accuracy or completeness of any information published herein, and neither Tata McGraw Hill nor its authors shall be responsible for any errors, omissions, or damages arising out of use of this information. This work is published with the understanding that Tata McGraw Hill and its authors are supplying information but are not attempting to render engineering or other professional services. If such services are required, the assistance of an appropriate professional should be sought.

Published by the Tata McGraw Hill Education Private Limited, 7 West Patel Nagar, New Delhi 110 008, typeset at Script Maker, 19, A 1-B, DDA Market, Paschim Vihar, New Delhi 110 063 and printed at India Binding House, A-98, Sector – 65, Noida, U.P.

Cover Design: K Anoop

Cover Printer: India Binding House

RZXXZDDZRAYBL

The McGraw·Hill Companies

Contents

Introduction v

Course Outline xi

Chapter 1

Foundations of Information Systems in Business 1

Section I: Foundation Concepts: Information Systems in Business 2

Introduction 2

The Real World of Information Systems 2

Real World Case I: The 2004 Athens Olympics Network: Faster, Stronger—and Redundant 3

What You Need to Know 4

The Fundamental Roles of IS in Business 5

Trends in Information Systems 6

The Role of e-Business in Business 8

Types of Information Systems 9

Managerial Challenges of Information Technology 12

Section II: Foundation Concepts: The Components of Information Systems 18

System Concepts: A Foundation 18

Real World Case 2: Lufthansa: Taking Mobile Computing to the Skies While Keeping the Mobile Workforce Connected 19

Components of an Information System 22

Information System Resources 23

Information System Activities 26

Recognizing Information Systems 28

Real World Case 3: Aviall Inc.: From Failure to Success with Information Technology 34

Real World Case 4: Continental Airlines: This Call Is Being Monitored 35

Chapter 2

Competing with Information Technology 37

Section I: Fundamentals of Strategic Advantage 38

Strategic IT 38

Competitive Strategy Concepts 38

Real World Case 1: GE, Dell, Intel, and Others: The Competitive Advantage of Information Technology 39

Strategic Uses of Information Technology 41

Building a Customer-Focused Business 45

The Value Chain and Strategic IS 47

Section II: Using Information Technology for Strategic Advantage 49

Strategic Uses of IT 49

Reengineering Business Processes 49

Real World Case 2: The U.S. Department of Commerce: Using IT to Tap Experts' Know-How Through Knowledge Management 50

Becoming an Agile Company 51

Creating a Virtual Company 53

Building a Knowledge-Creating Company 55

Real World Case 3: Shareware Grows Up: CIOs Are Saving Money by Pooling Resources and Software 62

Real World Case 4: CDW and Harrah's Entertainment: Developing Strategic Customer-Loyalty Systems 63

Chapter 3

Telecommunications and Networks 65

Section I: The Networked Enterprise 66

Networking the Enterprise 66

Trends in Telecommunications 66

Real World Case 1: Celanese Chemicals and Others: Wireless Business Applications 67

The Business Value of Telecommunications Networks 70

The Internet Revolution 71
Business Use of the Internet 72
The Business Value of the Internet 74
The Role of Intranets 75
The Role of Extranets 76
Section II: Telecommunications Network Alternatives 79
Telecommunications Alternatives 79
A Telecommunications Network Model 79
Types of Telecommunications Networks 81
Telecommunications Media 86
Wireless Technologies 87
Telecommunications Processors 89
Telecommunications Software 92
Network Topologies 93
Network Achitectures and Protocols 94
Bandwidth Alternatives 97
Switching Alternatives 97
Real World Case 2: UPS, Wells' Dairy, Novell, and GM: The Business Value and Challenges of Wi-Fi Networks 104
Real World Case 3: Boeing Company and Others: Converging Voice and Data Using Voice Over IP 105

Chapter 4
Enterprise Business Systems 107
Section I: Customer Relationship Management: The Business Focus 108
Introduction 108
What Is CRM? 108
Real World Case 1: Mitsubishi Motor Sales: Implementing Customer Relationship Management Systems 109
The Three Phases of CRM 111
Benefits and Challenges of CRM 114
Trends in CRM 114
Section II: Enterprise Resource Planning: The Business Backbone 117
Introduction 117
What Is ERP? 117
Benefits and Challenges of ERP 118
Real World Case 2: Agilent Technologies and Russ Berrie: Challenges of Implementing ERP Systems 119
Trends in ERP 122
Section III: Supply Chain Management: The Business Network 124
Introduction 124
What Is SCM? 125
The Role of SCM 129
Benefits and Challenges of SCM 131
Trends in SCM 132
Real World Case 3: HP, Eastman Chemical, and Others: The Benefits and Challenges of SCM Systems 138
Real World Case 4: Wal-Mart and Mattel: Supply Chain Management Best Practices 139

Chapter 5
Electronic Commerce Systems 141
Section I: Electronic Commerce Fundamentals 142
Introduction to e-Commerce 142
Real World Case 1: eBay Inc.: Managing Success in a Dynamic Online Marketplace 143
The Scope of e-Commerce 144
Essential e-Commerce Processes 146
Electronic Payment Processes 151
Section II: e-Commerce Applications and Issues 154
e-Commerce Application Trends 154
Business-to-Consumer e-Commerce 154
Web Store Requirements 158
Business-to-Business e-Commerce 162
e-Commerce Marketplaces 164
Clicks and Bricks in e-Commerce 166
Real World Case 2: E-Trade and Wells Fargo: The Business Case for Clicks and Bricks e-Commerce 175
Real World Case 3: Microsoft and Dell: The WWW Is Anything but Business as Usual 176

Chapter 6

Developing Business/ IT Solutions 177

Section I: Developing Business Systems 178

IS Development 178

The Systems Approach 178

Real World Case 1: Blue Cross, AT&T Wireless, and CitiStreet: Development Challenges of Self-Service Web Systems 179

The Systems Development Cycle 180

Prototyping 180

Starting the Systems Development Process 184

Systems Analysis 185

Systems Design 187

End User Development 189

Section II: Implementing Business Systems 192

Implementation 192

Implementing New Systems 192

Evaluating Hardware, Software, and Services 193

Other Implementation Activities 196

Real World Case 2: Du Pont and Southwire: Implementing Successful Enterprise Information Portals 206

Real World Case 3: Wyndham International and Amazon.com: Cost-Effective IT 207

Chapter 7

Security and Ethical Challenges 209

Section I: Security, Ethical, and Societal Challenges of IT 210

Introduction 210

Real World Case 1: F-Secure, Microsoft, GM, and Verizon: The Business Challenge of Computer Viruses 211

Ethical Responsibility of Business Professionals 212

Computer Crime 215

Privacy Issues 223

Other Challenges 226

Health Issues 228

Societal Solutions 229

Section II: Security Management of Information Technology 231

Introduction 231

Real World Case 2: Geisinger Health Systems and Du Pont: Security Management 232

Tools of Security Management 233

Internetworked Security Defenses 233

Other Security Measures 237

System Controls and Audits 242

Real World Case 3: Online Resources, Lehman Brothers, and Others: Managing Network Security Systems 248

Chapter 8

Enterprise and Global Management of Information Technology 249

Section I: Managing Information Technology 250

Business and IT 250

Managing Information Technology 250

Real World Case 1: Chicago Board of Trade: From Failure to Success in Managing Information Technology 251

Business/IT Planning 253

Managing the IS Function 255

Failures in IT Management 260

Section II: Managing Global IT 263

The International Dimension 263

Global IT Management 263

Cultural, Political, and Geoeconomic Challenges 263

Real World Case 2: Global Exchange Services and Allstate: Challenges and Solutions in Offshore Systems Development 264

Global Business/IT Strategies 266

Global Business/IT Applications 266

Global IT Platforms 268

Global Data Access Issues 272

Global Systems Development 274

Real World Case 3: Avon Products and Guardian Life Insurance: Successful Management of IT Projects 281

Appendix: Real World Case Studies 283

Additional Cases (Indian)

Case Study 1: CRM for Building closer relationship with costumers 312

Case Study 2: Drishtee.Com connecting India village by village 317

Case Study 3: Leveraging Internet for education (egurucool.com) 326

Case Study 4: Indian Distrubutors Ltd. 335

Case Study 5: Busy-An Accounting software 338

Case Study 6: Role of Information Technoloy in the Processed Food Industry 344

Selected References 351

Additional References and Bibliography 360

Glossary for Business Professionals 365

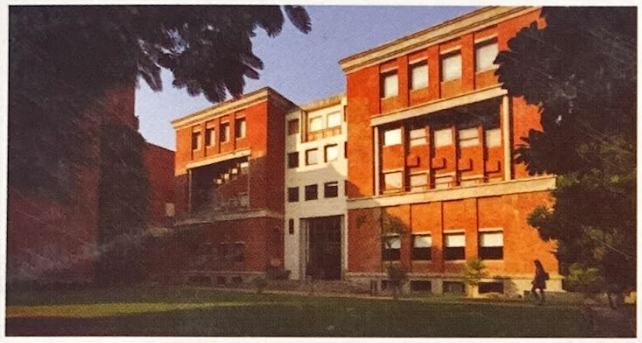
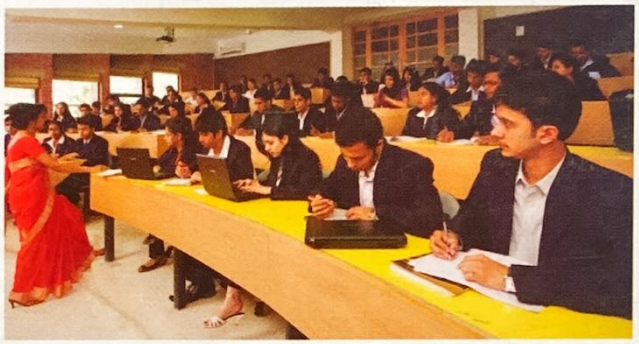
IILM

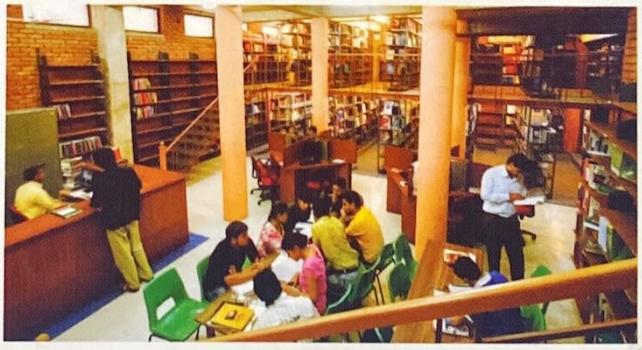
FINANCIAL MANAGEMENT

Prasanna Chandra

For IILM only
Not for sale in the open market

FINANCIAL MANAGEMENT



IILM

The McGraw·Hill Companies

Visit us at : www.tatamcgrawhill.com

ISBN-13: 978-0-07-069975-5
ISBN-10: 0-07-069975-5

9 780070 699755

Mc Graw Hill Custom Publishing

IILM

Financial Management
Theory and Practice

Prasanna Chandra
Director
Centre for Financial Management
Bangalore
www.cfm-india.com

Tata McGraw Hill Education Private Limited
NEW DELHI

McGraw-Hill Offices
New Delhi New York St Louis San Francisco Auckland Bogotá Caracas
Kuala Lumpur Lisbon London Madrid Mexico City Milan Montreal
San Juan Santiago Singapore Sydney Tokyo Toronto

Tata McGraw Hill

Published by Tata McGraw Hill Education Private Limited
7 West Patel Nagar, New Delhi 110 008.

Not for open market sale. Customised for IILM Institute for Higher Education.

Copyright © 2010 by Prasanna Chandra

No part of this publication may be reproduced or distributed in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise or stored in a database or retrieval system without the prior written permission of the publishers. The program listings (if any) may be entered, stored and executed in a computer system, but they may not be reproduced for publication.

This edition can be exported from India only by the publishers,
Tata McGraw Hill Education Private Limited.

ISBN (13 digits): 978-0-07-069975-5

ISBN (10 digits): 0-07-069975-5

Managing Director: *Ajay Shukla*
Head—Professional and Healthcare: *Roystan La'Porte*
Executive Publisher: *R Chandra Sekhar*
Manager—Production: *Sohan Gaur*
Manager—Sales & Marketing: *S. Girish*
General Manager—Production: *Rajender P Ghansela*
Asst. General Manager—Production: *B L Dogra*

Information contained in this work has been obtained by Tata McGraw Hill, from sources believed to be reliable. However, neither Tata McGraw Hill nor its authors guarantee the accuracy or completeness of any information published herein, and neither Tata McGraw Hill nor its authors shall be responsible for any errors, omissions, or damages arising out of use of this information. This work is published with the understanding that Tata McGraw Hill and its authors are supplying information but are not attempting to render engineering or other professional services. If such services are required, the assistance of an appropriate professional should be sought.

Typeset at Script Makers, 19, A1-B, DDA Market, Paschim Vihar, New Delhi 110 063, text printed at Sai Printo Pack, A-102/4, Okhla Industrial Area, Phase – II, New Delhi – 110 020.

Cover Printer: Sai Printo Pack

Cover Designer: K Anoop

RZXRQDDZRZXQC

The McGraw·Hill Companies

Contents

Introduction *v*
Course Outline *xi*

1. The Time Value of Money **1**

1.1 Time Lines and Notation *1*
1.2 Future Value of a Single Amount *2*
1.3 Present Value of a Single Amount *6*
1.4 Future Value of an Annuity *8*
1.5 Present Value of an Annuity *12*
1.6 Present Value of a Perpetuity *19*
1.7 Intra-year Compounding and Discounting *20*
Summary *23*
Questions *24*
Solved Problems *25*
Problems *28*
Mini Case *31*

2. Valuation of Bonds and Stocks **33**

2.1 Distinction among Valuation Concepts *33*
2.2 Bond Valuation *34*
2.3 Bond Yields *38*
2.4 Bond Market *41*
2.5 Valuation of Preference Stock *42*
2.6 Equity Valuation: Dividend Discount Model *42*
2.7 Equity Valuation: The P/E Ratio Approach *51*
2.8 The Relationship between Earnings-price Ratio, Expected Return, and Growth *52*
2.9 Stock Market *54*
Summary *57*
Questions *58*
Solved Problems *59*
Problems *63*
Mini Case *64*

3. Risk and Return **66**

3.1 Risk and Return of a Single Asset *67*
3.2 Risk and Return of a Portfolio *74*
3.3 Measurement of Market Risk *77*
3.4 Determinants of Beta *80*

3.5 Relationship between Risk and Return *83*
Summary *88*
Questions *89*
Solved Problems *89*
Problems *93*

4. Techniques of Capital Budgeting **95**

4.1 Capital Budgeting Process *96*
4.2 Project Classification *98*
4.3 Investment Criteria *99*
4.4 Net Present Value *99*
4.5 Benefit Cost Ratio (or Profitability Index) *102*
4.6 Internal Rate of Return *103*
4.7 Modified Internal Rate of Return (MIRR) *109*
4.8 Payback Period *110*
4.9 Accounting Rate of Return *113*
4.10 Investment Appraisal in Practice *114*
Summary *115*
Questions *115*
Solved Problems *116*
Problems *116*
Mini Case *119*

5. Estimation of Project Cash Flows **120**

5.1 Elements of the Cash Flow Stream *120*
5.2 Basic Principles of Cash Flow Estimation *122*
5.3 Cash Flow Illustrations *128*
5.4 Cash Flows for Replacement Projects *130*
5.5 Biases in Cash Flow Estimation *133*
Summary *136*
Questions *136*
Solved Problems *136*
Problems *138*
Mini Case *140*

6. The Cost of Capital **142**

6.1 Some Preliminaries *142*
6.2 Cost of Debt and Preference *144*
6.3 Cost of Equity *146*
6.4 Determining the Proportions *150*
6.5 Weighted Average Cost of Capital *151*
6.6 Weighted Marginal Cost of Capital *152*
6.7 Determining the Optimal Capital Budget *154*

6.8 Divisional and Project Cost of Capital *154*
6.9 Floatation Cost and the Cost of Capital *158*
6.10 Factors Affecting the Weighted Average Cost of Capital *160*
6.11 Misconceptions Surrounding Cost of Capital *161*
Summary *163*
Questions *164*
Solved Problems *165*
Problems *168*
Mini Case *170*

7. Sources of Long Term Finance **172**

7.1 Equity Capital *173*
7.2 Internal Accruals *176*
7.3 Preference Capital *177*
7.4 Term Loans *178*
7.5 Debentures *180*
7.6 Comparative Picture *182*
7.7 Pattern of Corporate Financing in India *182*
Summary *183*
Questions *183*