CONTENTS

PREFACE *ix*

CHAPTER 1 *Toward Better Decisions: Operations Research and Management Science* *1*

1-1 *A Way of Thinking* *1*
1-2 *What Is in a Name . . . ?* *2*
1-3 *Multidisciplinary Approach* *3*
1-4 *Scientific Approach* *9*
1-5 *Foreword and Forward* *15*

CHAPTER 2 *Problem Investigation: Cause-&-Effect Diagrams* *19*

2-1 *Getting Started* *19*
2-2 *Problem Portrait* *20*
2-3 *C & E Analysis Procedures* *21*
2-4 *Variations of C & E Diagrams* *26*
2-5 *History and Theory* *30*
2-6 *C & E Benefits and Applications* *32*

CHAPTER 3 *Data Analysis: Pareto Pattern* *38*

3-1 *Data Deluge* *38*
3-2 *Vilfredo Pareto* *39*
3-3 *Pareto Diagram* *40*
3-4 *Pareto Patterns* *42*

CHAPTER 4 *Problem Formulation: Resource Planning and Management System* *60*

4-1 *Value of Resources* *60*
4-2 *Model Construction* *61*
4-3 *General Systems Theory* *64*

4-4 *RPMS Postulates* 71
4-5 *RPM Network Construction Procedure* 75

CHAPTER 5 *Model Experimentation: Graphic Introduction to Linear Programming* 84

5-1 *OR/MS Experimentation* 84
5-2 *Construction of E^2 FSS and Its Role in Optimization* 86
5-3 *Adaptivity Analysis* 95
5-4 *Minimization* 99
5-5 *RPM Network Interpretation* 104

CHAPTER 6 *Normative Model Formulation: Programming LP Problems* 112

6-1 *Origin of Programming* 112
6-2 *Standard Forms of LP Problems* 114
6-3 *Diet Problem* 117
6-4 *Using Dominance to Simplify an LP Model* 125
6-5 *Using Basic Nodes to Simplify LP Models* 129
6-6 *Values of Leftovers* 136
6-7 *When Nature is Hostile* 140

CHAPTER 7 *Applied Normative Models: Linear Programming Paradigms* 151

7-1 *Golden Rules of RPMS Linear Programming* 151
7-2 *Basic RPM Network Patterns* 153
7-3 *Technological Constraints* 158
7-4 *Blending Problems* 161
7-5 *Cyclic Scheduling* 165
7-6 *Potpourri: Traditional LP Paradigms* 175
7-7 *Double Trouble: Common Problems and Cures* 181

CHAPTER 8 *Network Programming: Transportation and Transshipment* 199

8-1 *Hitchcock-Koopmans Transportation Problem* 199
8-2 *Relating Supplies to Transfer Costs to Demands* 200
8-3 *Feasibility Analysis* 208
8-4 *Optimality Analysis* 215
8-5 *Extensions of Transportation Models* 226
8-6 *Branch-and-Bound Method* 231

CHAPTER 9 *Simplex Tableau: A Table for Resource Exchange* 243

9-1 *Climbing a Convex Hull* 243
9-2 *Economic Interpretation of the Dual Flows in RPM Networks* 246
9-3 *Simplex Tableau Format* 248
9-4 *Dimensional Scaling* 253

9-5 *Standard Simplex Procedure* 255
9-6 *Nonfeasible Initial Solution* 266
9-7 *Complications in Simplex* 269
9-8 *Incorporating a Tableau within an RPM Network* 280

CHAPTER 10 *Sequential Decision Process: Dynamic Programming* 288

10-1 *One Thing at a Time* 288
10-2 *Characteristics of DP Models* 296
10-3 *Longest- and Shortest-Path Problems* 299
10-4 *Resource Allocation* 304
10-5 *Planning Horizon* 316
10-6 *Combining Linear and Dynamic Programming* 328

CHAPTER 11 *Implementing the Implementation: Project Planning and Management* 336

11-1 *Value of OR/MS* 336
11-2 *History of Project Management* 337
11-3 *Planning Phase* 341
11-4 *Scheduling Phase* 349
11-5 *Resource Management* 364
11-6 *LP Interpretation of Scheduling Problems* 370
11-7 *Time-Cost Tradeoff* 371
11-8 *PERT Probability Analysis* 380

CHAPTER 12 *Systems Evaluation: Queuing Models and Simulation* 394

12-1 *Diagnostic Tools for Systems* 394
12-2 *Basic Queuing Theory* 395
12-3 *Finite-queue Single-server Models* 398
12-4 *Infinite-queue Single-server Models* 405
12-5 *RPMS Representation of Queuing Models* 409
12-6 *Multiserver Systems* 416
12-7 *Monte Carlo Simulation* 419

CHAPTER 13 *RPMS: A Tool for General Systems Analysis* 425

13-1 *Think Ahead—Think Behind* 425
13-2 *Think Big—Think Small* 430
13-3 *Think Again* 443

APPENDIX A *Conversational Computer Programs for Linear Programming* 452

A-1 *Time-Sharing Terminals* 453
A-2 *LINPRO**** 453
A-3 *Customized Conversational Linear Programs* 462

APPENDIX B *Mathematical Programming System: The Product-Form Approach* 473

B-1 *Revised Simplex Production Form* 473
B-2 *MPS* 475
B-3 **REX* 482

ANNOTATED BIBLIOGRAPHY 485

INDEX 492