

Contents

Preface	vii
Acknowledgements	viii
Book Overview	1
I METHODOLOGY AND ANALYSIS OF FACILITY LOCATION	7
1 Estimating Distances	9
<i>Jack Brimberg and Robert F. Love</i>	
1.1 Introduction	9
1.2 Norms as Distance Estimating Functions	10
1.3 The ℓ_p Norm	15
1.4 Conclusions	31
2 Replacing Discrete Demand with Continuous Demand	33
<i>Zvi Drezner</i>	
2.1 Introduction	33
2.2 Formulation and Analysis	34
2.3 Evaluating a Double Integral	35
2.4 Analysis of the Example Problem	37
2.5 The Distance Correction Approach	41
2.6 Conclusions	42
3 Global Optimization in Location	43
<i>Pierre Hansen, Brigitte Jaumard, and Hoang Tuy</i>	
3.1 Introduction	43
3.2 Branch-and-bound Methods	45
3.3 Lipschitz Optimization	50
3.4 Outer Approximation	52
3.5 Polyhedral Annexation	57
3.6 Decomposition Methods	62
3.7 Linearization Methods	63
3.8 Specialized Methods	65
3.9 Conclusions	67

4	Inferred Ideal Weights for Multiple Facilities	69
	<i>Morton E. O'Kelly</i>	
4.1	Introduction	69
4.2	Information Minimizing Model	70
4.3	Extensions to Multiple Facilities	77
4.4	Conclusions	88
5	Conjugate Duality in Facility Location	89
	<i>Carlton H. Scott, Thomas R. Jefferson, and Soheila Jorjani</i>	
5.1	Introduction	89
5.2	Conjugate Duality Theory	90
5.3	The Minisum Model	93
5.4	The Minimax Model	99
6	Using Voronoi Diagrams	103
	<i>Atsuo Suzuki and Atsuyuki Okabe</i>	
6.1	Introduction	103
6.2	The Voronoi Diagram	104
6.3	The Continuous p -median Problem	105
6.4	Continuous p -center Problems	108
6.5	The Time-Space p -Median Problem	111
6.6	Mobile Facility Location Problem (Constrained p -median)	114
6.7	Other Continuous Location Problems	116
6.8	Conclusions	118
II	VARIOUS OBJECTIVES IN FACILITY LOCATION	119
7	Location with Market Externalities	121
	<i>Margaret L. Brandeau, Samuel S. Chiu, Shiv Kumar, and Thomas A. Grossman, Jr.</i>	
7.1	Introduction	121
7.2	Notation and Assumptions	124
7.3	Analysis of User-Choice Equilibrium	126
7.4	Facility Location with Market Externalities	130
7.5	Resource Allocation with Market Externalities	144
7.6	Future Research and Conclusions	150
8	Objectives in Location Problems	151
	<i>H.A. Eiselt and Gilbert Laporte</i>	
8.1	Introduction	151
8.2	Elements of Location Models	152
8.3	Pull Objectives	156
8.4	Push Objectives	165

8.5	Balancing Objectives	169
8.6	Conclusions	179
8.7	Glossary	179
9	Distribution System Design	181
	<i>Arthur M. Geoffrion, James G. Morris, and Scott T. Webster</i>	
9.1	Introduction	181
9.2	A Case Study	182
9.3	Diagnostic Tools	190
9.4	Algebraic Language Tools	192
9.5	Conclusions	195
9.6	Annotated Bibliography	196
10	Siting Emergency Services	199
	<i>Vladimir Marianov and Charles ReVelle</i>	
10.1	Introduction - What are the Important Issues?	199
10.2	Methods Based on Deterministic Optimization Models	204
10.3	Deterministic Models Addressing Congestion	210
10.4	Methods Based on Probabilistic Optimization Models	213
10.5	Descriptive Models and Heuristic Solution Procedures	218
10.6	Conclusions	222
11	Continuous Location Problems	225
	<i>Frank Plastria</i>	
11.1	Continuous Location	225
11.2	Distance	229
11.3	Dominance, Efficiency and Voting	235
11.4	Single Facility Location Problems	239
11.5	Single Facility Location-Allocation Problems	251
11.6	Multifacility Location Problems	253
11.7	Multifacility Location-Allocation Problems	257
11.8	Other Related Problems	260
12	Global Manufacturing Strategy	263
	<i>Vedat Verter and M. Cemal Dincer</i>	
12.1	Introduction	263
12.2	Global Manufacturing Strategy Planning Process	266
12.3	The Production-Distribution System Design Problem	270
12.4	Designing International Production-Distribution Systems	276
12.5	Concluding Comments	281

III COMPETITIVE FACILITY LOCATION 283

13 Competitive Facility Location in the Plane 285

Tammy Drezner

13.1 Introduction 285
 13.2 The Deterministic Utility Model 289
 13.3 The Random Utility Model 290
 13.4 Gravity Models 292
 13.5 Computational Results 295
 13.6 Conclusions 298

14 Multifacility Retail Networks 301

Avijit Ghosh, Sara McLafferty, and C. Samuel Craig

14.1 Introduction 301
 14.2 Location-Allocation Models 302
 14.3 The Components of Retail Location-Allocation Models . . . 304
 14.4 Five Types of Location-Allocation Models 306
 14.5 Applying Covering Models for Service Center Location . . . 316
 14.6 Extension to Basic Models 325
 14.7 Conclusions 329

15 Economic Models of Firm Location 331

Dominique Peeters and Jacques-François Thisse

15.1 Introduction 331
 15.2 Spatial Pricing Policies 334
 15.3 Finding the Optimal Price(s) 340
 15.4 The Price-Continuous Facility Location Problem 350
 15.5 The Price-Discrete Facility Location Problem 357
 15.6 Conclusions 366

16 Competitive Location in Discrete Space 367

Daniel Serra and Charles ReVelle

16.1 Introduction 367
 16.2 Discrete Competitive Location Models: An Overview 368
 16.3 A Review of The Maximum Capture Problem 372
 16.4 Extensions of the Maximum Capture Problem 375
 16.5 Extensions of the Pre-emptive Capture Problem 380
 16.6 Conclusions 384

IV ROUTING AND LOCATION 387

17 Flow-Interception Problems 389

Oded Berman, M. John Hodgson, and Dmitry Krass

17.1 Introduction 389
 17.2 Deterministic Flow Interception Problems 390

17.3 Probabilistic Flow Interception Problems	406
17.4 Future Research	425
18 Location-Routing Problems with Uncertainty	427
<i>Oded Berman, Patrick Jaillet, and David Simchi-Levi</i>	
18.1 Introduction	427
18.2 The Traveling Salesman Location Problem	432
18.3 The Probabilistic Traveling Salesman Location Problem . .	441
18.4 Applications to Systems Design and Strategic Planning . .	451
18.5 A Different Class of Stochastic Facility Location Problems .	452
19 Location, Routing and the Environment	453
<i>Brian Boffey and John Karkazis</i>	
19.1 Introduction	453
19.2 The Mechanism of Airborne Pollution Spread	454
19.3 Relevant Features of Bicriterion Problems	458
19.4 Location of Obnoxious Facilities	461
19.5 Routing of Obnoxious Vehicles	463
19.6 Future Directions	465
20 Hazardous Materials Logistics	467
<i>Erhan Erkut and Vedat Verter</i>	
20.1 Introduction	467
20.2 Risk Assessment	470
20.3 Equity	478
20.4 Cost Aspects	482
20.5 Planning Potentially Hazardous Facilities	483
20.6 Hazardous Materials Transport Planning	490
20.7 Integrated Models	497
20.8 Conclusions and Suggestions	500
References	507