Tetsuzo Tanino Tamaki Tanaka Masahiro Inuiguchi

## Multi-Objective Programming and Goal Programming

Theory and Applications

With 77 Figures and 48 Tables

> TECHNISCHE INFORMATIONSBIBLIOTHEK

UNIVERSITÄTSBIBLIOTHEK HANNOVER



## Contents

A DESCRIPTION OF THE OWNER OWN

P/	ART I: Invited Papers	1
	ultiple Objective Combinatorial Optimization – A Tutorial . Atthias Ehrgott, Xavier Gandibleux	3
1	Importance in Practice	3
2	Definitions	4
3	Characteristics of MOCO Problems	4
4	Exact Solution Methods	5
5	Heuristic Solution Methods	8
6	Directions of Research and Resources	12
Re	ferences	13
	nalysis of Trends in Distance Metric Optimisation Modelling	
	r Operational Research and Soft Computing	19
	F. Jones, M. Tamiz	
1	Introduction	19
2	Distance Metric Optimisation and Meta Heuristic Methods	20
3	Distance Metric Optimisation and the Analytical Hierarchy Process	21
4	Distance Metric Optimisation and Data Mining	22
5	Some Further Observations on Goal Programming Modelling Practice	22
6 D-	Conclusions	23 23
Re	ferences	23
	OP/GP Approaches to Data Mining	27
	rotaka Nakayama	<u> </u>
1	Introduction	27
2	Multisurface Method (MSM)	28
3	Goal Programming Approaches to Pattern Classification	29
4	Revision of MSM by MOP/GP	30
5	Support Vector Machine	31
6 D	Concluding Remarks	34
ĸe	ferences	34
	omputational Investigations Evidencing Multiple Objectives	
	Portfolio Optimization	35
Ra	llph E. Steuer, Yue Qi	
1	Introduction	35
2	Different Perspectives	38
3	Computational Investigations	40
4	Concluding Remarks	42
Re	eferences	43

Behavioral Aspects of Decision Analysis with Application to			
Public Sectors			
Hiroyuki Tamura			
	45		
<ol> <li>Behavioral Models to Resolve Expected Utility Paradoxes</li> <li>Behavioral Models to Resolve Restrictions of Additive/Utility In-</li> </ol>	45		
	49		
4 Concluding Remarks	54		
References	54		
Optimization Models for Planning Future Energy Systems in			
	57		
Kiichiro Tsuji			
	57		
F	58		
	59		
	61		
	62		
	63		
References	64		
Multiple Objective Decision Making in Past, Present, and Fu-			
	65		
Gwo-Hshiung Tzeng			
	65		
	67		
• • •	67		
	68		
5 Two Phase Approach for Solving FMOLP Problem	69		
6 Goal Programming with Achievement Functions	70		
7 Multiple Objective Programming with DEA	71		
8 De Novo Programming Method in MODM	73		
9 Summary	74		
References	75		
Dynamic Multiple Goals Optimization in Behavior Mechanism	77		
P. L. Yu, C. Y. ChiangLin			
1 Introduction	78		
2 Goal Setting and State Evaluation	79		
3 Charge Structures and Attention Allocation	81		
	82		
5 Information Input	82		
6 Conclusion	83		
References	83		
PART II: General Papers – Theory	85		

An Example-Based Learning Approach to Multi-Objective Pro-			
gramming			
Masami Amano, Hiroyuki Okano			
1 Introduction	87		
2 Our Learning Approach	88		
3 Numerical Experiments	90		
4 Concluding Remarks	92		
References	92		
Support Vector Machines using Multi Objective Programming Takeshi Asada, Hirotaka Nakayama	93		
1 Principle of SVM	93		
2 Multi Objective Programming formulation	94		
3 Application to Stock Investment problem	97		
4 Conclusion	97		
References	98		
On the Decomposition of DEA Inefficiency Yao Chen, Hiroshi Morita, Joe Zhu	99		
1 Introduction	99		
2 Scale and Congestion Components 1	100		
3 Conclusion 1	104		
References	104		
An Approach for Determining DEA Efficiency Bounds Yao Chen, Hiroshi Morita, Joe Zhu	105		
1 Introduction 1	105		
2 Determination of the Lower Bounds 1	106		
References	110		
An Extended Approach of Multicriteria Optimization for MODM	T		
Problems			
Hua-Kai Chiou, Gwo-Hshiung Tzeng			
1 Introduction	111		
2 The Multicriteria Metric for Compromise Ranking Methods	112		
3 The Extended Compromise Ranking Approach 1			
4 Illustrative Example			
5 Conclusion			
References	116		
The Method of Elastic Constraints for Multiobjective Com- binatorial Optimization and its Application in Airline Crew			
Scheduling Matthias Ehrgott, David M. Ryan			
1 Multiobjective Combinatorial Optimization			
2 The Method of Elastic Constraints	110		

3 4 5 Be	Bicriteria Airline Crew Scheduling: Cost and Robustness       119         Numerical Results       121         Conclusion       121         ferences       122
	me Evaluations Based on DEA with Interval Data
	moe Entani, Hideo Tanaka
1	Introduction
<b>2</b>	Relative Efficiency Value 124
3	Approximations of Relative Efficiency Value with Interval Data 125
4	Numerical Example 127
5	Conclusion
Re	ferences
Po	ssibility and Necessity Measures in Dominance-based Rough
	t Approach
Sa	lvatore Greco, Masahiro Inuiguchi, Roman Słowiński
1	Introduction
<b>2</b>	Possibility and Necessity Measures 130
3	Approximations by Means of Fuzzy Dominance Relations 132
4	Conclusion
Re	ferences
Si	mplex Coding Genetic Algorithm for the Global Optimiza-
tic	on of Nonlinear Functions
Ab	del-Rahman Hedar, Masao Fukushima
1	Introduction
<b>2</b>	Description of SCGA 136
3	Experimental Results 138
4	Conclusion
Re	ferences
	n Minimax and Maximin Values in Multicriteria Games 141
	asakazu Higuchi, Tamaki Tanaka
1	Introduction
2	Multicriteria Two-person Zero-sum Game
3	Coincidence Condition
Re	ferences $\dots \dots \dots$
Ba	acktrack Beam Search for Multiobjective Scheduling Prob-
	m
1	aya Honda Introduction
$\frac{1}{2}$	Problem Formulation
2 3	Search Method
3 4	Numerical Experiments
4	numerical paperiments

5 Re	Conclusion         152           eferences         152
	ones to Aid Decision Making in Multicriteria Programming . 153
	rian J. Hunt, Margaret M. Wiecek
1	Introduction 153
2	Problem Formulation 154
3	Pointed and Non-Pointed Cones in Multicriteria Programming 154
4	Decision Making with Polyhedral Cones
5	Example 157
6	Conclusion
Re	eferences
E	ficiency in Solution Generation Based on Extreme Ray Gen-
	ation Method for Multiple Objective Linear Programming. 159
М	asaaki Ida
1	Introduction
2	Cone Representation and Efficiency Test 160
3	Efficient Solution Generation Algorithm
4	Numerical Example
5	Conclusion
Re	eferences
	obust Efficient Basis of Interval Multiple Criteria and Mul-
	ple Constraint Level Linear Programming 165
	asaaki Ida
1	Introduction
2	Multiple Criteria and Multiple Constraint Level Linear Programming 166 Interval Coefficient Problem
3 4	Main Results
4 5	Conclusion
	eferences
10	100
	n Interactive Satisficing Method through the Variance Mini-
	ization Model for Fuzzy Random Multiobjective Linear Pro-
	ramming Problems
н: 1	ideki Katagiri, Masatoshi Sakawa, Shuuji Ohsaki
12	Introduction
2 3	Interactive Decision Making Using the Variance Minimization Model
J	Based on a Possibility Measure
4	Conclusion
-	eferences

	n Saddle Points of Multiobjective Functions	
	enji Kimura, El Mostafa Kalmoun, Tamaki Tanaka	
1	Introduction	
2	Preliminary and Terminology	
3	Existense Results of Cone Saddle Points	
Re	ferences	
	n Application of Fuzzy Multiobjective Programming to Fuzzy	
A	HP	
Hi	iroaki Kuwano	
1	Introduction	
2	Preliminaries	
3	Subjective Evaluation	
4	A Numerical Example	
5	Conclusions	
Re	ferences	
O	n Affine Vector Variational Inequality	
$G_1$	ue Myung Lee, Kwang Baik Lee	
1	Introduction and Preliminaries	
2	Main Result	
Re	ferences	
G	raphical Illustration of Pareto Optimal Solutions	
K	aisa Miettinen	
1	Introduction	
2	Graphical Illustration	
3	Discussion	
4	Conclusions	
Re	eferences	
A	n Efficiency Evaluation Model for Company System Orga-	
	zation	
	ukashi Namatame, Hiroaki Tanimoto, Toshikazu Yamaguchi	
1	Introduction	
2	Characteristics of the Company System Organization	
3	Evaluation Model	
4	Example	
5	Conclusion	
-	eferences	
g.	ackelberg Solutions to Two-Level Linear Programming Prob-	
	ms with Random Variable Coefficients	
	hiro Nishizaki, Masatoshi Sakawa, Kosuke Kato, Hideki Katagiri	
1	Introduction	

2	Two-level Linear Programming Problems with Random Variable Coefficients	200
9		
3	A Numerical Example	
Re	ferences	214
	n Inherited Properties for Vector-Valued Multifunctions	215
	ogo Nishizawa, Tamaki Tanaka, Pando Gr. Georgiev	
1	Introduction	
2	Inherited Properties of Convexity	
3	Inherited Properties of Semicontinuity	
4	Conclusions	
Re	ferences	220
м	ulticriteria Expansion of a Competence Set Using Genetic	
A	gorithm	221
Se	rafim Opricovic, Gwo-Hshiung Tzeng	
1	Introduction	221
2	Multicriteria Expansion of a Competence Set	
3	Multicriteria Genetic Algorithm	
4	Illustrative Example	
5	Conclusion	
•	eferences	
		220
C	omparing DEA and MCDM Method	227
Se	rafim Opricovic, Gwo-Hshiung Tzeng	
1	Introduction	
2	Comparison of DEA and VIKOR	228
3	Numerical Experiment	
4	Conclusions	232
Re	eferences	
Li	near Coordination Method for Multi-Objective Problems	233
	usaba Phruksaphanrat, Ario Ohsato	
1	Introduction	233
2	Lexicographic Models	
3	Efficient Linear Coordination Method Based on Convex Cone Con-	204
J	cept	19E
	•	
4	Numerical Example	
5 D	Conclusions	
Re	eferences	238
	xperimental Analysis for Rational Decision Making by As-	
	ration Level AHP	239
K	ouichi Taji, Junsuke Suzuki, Satoru Takahashi, Hiroyuki Tamura	
1	Introduction	
2	Irrational Ranking	240

3	Cause and Several Revisions	241
4	Experimental Analysis	<b>242</b>
5	Conclusion	244
Re	ferences	244
	hoquet Integral Type DEA	945
	ichiro Takahagi	240
1	Introduction	945
2	Fuzzy Measure Choquet Integral Model	
2 3	CCR Model (Notations)	
4	Choquet Integral Type DEA (Maximum Model)	
5	Choquet Integral Type DEA(Average Model)	
6	Numerical Examples	
7	Conclusions	
	eferences	
ne	serences	200
	teractive Procedures in Hierarchical Dynamic Goal Pro-	
	amming	251
T.	Trzaskalik	
1	Discrete Multi-Objective Dynamic Programming Problem	
2	Goal Programming Approach	252
3	Hierarchical Goal Programming Approach	253
4	Numerical Example	
Re	eferences	256
So	olution Concepts for Coalitional Games in Constructing Net-	
	orks	257
М	asayo Tsurumi, Tetsuzo Tanino, Masahiro Inuiguchi	
1	Introduction	257
2	Games in Constructing Networks	258
3	Conventional Solution Concepts	259
4	A New Concept of Demand Operations	261
<b>5</b>	Conclusion	262
Re	eferences	262
м	Iulti-Objective Facility Location Problems in Competitive	
	nvironments	263
	akeshi Uno, Hiroaki Ishii, Seiji Saito, Shiqehiro Osumi	200
1	Introduction	263
2	Medianoid Problem with Single Objective	260
23	Medianoid Problem with Multi-Objective	
3 4	Algorithm for Competitive Facility Location Problems	
4 5	Numerical Experiments	
6	Conclusions	
-	eferences	
10		

Solving Portfolio Problems Based on Meta-Controled E			
mann Machine			
Junzo Watada, Teruyuki Watanabe			
1 Introduction			
2 Portfolio Selection Problem			
3 Energy Functions for Meta-controlled Boltzmann Machine	270		
4 Numerical Example	272		
5 Concluding Remarks	273		
References	273		
Tradeoff Directions and Dominance Sets			
Petra Weidner			
1 Introduction	275		
2 Tradeoff Concepts			
3 A Scalarization Using Widened Dominance Sets	278		
4 Calculation of Tradeoffs	279		
References			
A Soft Margin Algorithm Controlling Tolerance Directly Min Yoon, Hirotaka Nakayama, Yeboon Yun	y 281		
1 Introduction			
2 Error Bound for Soft Margin Algorithms			
3 The Proposed Method			
4 Conclusion			
References			
An Analysis of Expected Utility Based on Fuzzy Interva	d Data 289		
Shin-ichi Yoshikawa, Tetsuji Okuda			
1 Introduction			
2 Fuzzy Interval Data and Membership Functions			
3 Expected Utility Using Fuzzy Interval Data			
4 The Value of Fuzzy Information			
5 The Amount of Fuzzy Information $\mu_j$			
6 Numerical Example	293		
7 Conclusions			
On Analyzing the Stability of Discrete Descriptor System			
Generalized Lyapunov Equations			
Qingling Zhang, James Lam, Liqian Zhang	~~~		
1 Introduction.			
2 Preliminaries			
3 Asymptotic Stability			
References	<b>30</b> 0		

	Diving DEA via Excel	301
	e Zhu	901
1	Introduction	
2	DEA Spreadsheets	
3	Conclusions	
Re	eferences	306
<b>P</b> .	ART III: General Papers – Applications	307
	anning and Scheduling Staff Duties by Goal Programming Joney CK Chu, Christina SY Yuen	309
1	Introduction	309
<b>2</b>	Goal Programming Models	311
3	A Concluding Remark	314
Re	eferences	315
	n Interactive Approach to Fuzzy-based Robust Design ideo Fujimoto, Yu Tao, Satoko Yamakawa	317
1	Introduction	317
2	Proposed Approach	
3	Pressure Vessel Design Problem	321
4	Conclusions	323
Re	eferences	324
	Hybrid Genetic Algorithm for solving a capacity Constrained	
	ruckload Transportation with crashed customer	325
	ngheon Han, Yoshio Tabata	
1	Introduction	
2	The Vehicle Routing Problem; The Case of Crashed Customers	
3	A hybrid methodology for Vehicle Routing Problem	
4	Numerical Example and Discussions	
5 D	Conclusions and Recommendations	
	eferences	
	Multi-Objective Programming Approach for Evaluating Agri- nvironmental Policy	
	iyotada Hayashi	000
1	Introduction	222
1 2	Mathematical Programming Approach to Agri-Environmental Prob-	000
4	lems	334
3	Possibility of Integrated Evaluation	
4	Concluding Remarks	
_	eferences	

	prove the Shipping Performance of Build-to-ORder (BTO) oduct in Semiconductor Wafer Manufacturing
	ao-Chung Hsu, Chen-Yuan Peng, Chia-Hung Wu
1	Introduction
2	The Yield Forecast Model
3	Computational Simulation
4	An Empirical Case and the Application
5	Conclusion and Future Work
-	ferences
	ompetence Set Expansion for Obtaining Scheduling Plans in
	telligent Transportation Security Systems
	-Chung Hu, Yu-Jing Chiu, Chin-Mi Chen, Gwo-Hshiung Tzeng
1	Introduction         347           Competence Set Expansion         348
2	
3	A Relationship-Based Method
4	Generate Learning Sequences
5	Empirical Results
6 D	Conclusions
Ке	ferences
	EA for Evaluating the Current-period and Cross-period Ef-
	iency of Taiwan's Upgraded Technical Institutes
	-Chen Liu, Chuan Lee, Gwo-Hshiung Tzeng
1	Introduction
2	The Selection of School Objects and Variables for Performance Eval-
0	uation
3	Building the Performance Model
4	Emperical Study: Taiwan's 38 Upgraded Technical Institutes 357
5	Conclusions
Re	ferences
	sing DEA of REM and EAM for Efficiency Assessment of
	echnology Institutes Upgraded from Junior Colleges: The
	ase in Taiwan
Li	-Chen Liu, Chuan Lee, Gwo-Hshiung Tzeng
1	Introduction
2	Selection of Variables and Samples for Efficiency Assessment 362
3	Measure of Assessment Model 362
4	Analysis and Conclusion for the Results of Case Study 365
5	Conclusions
Re	eferences

## XVIII

Jerzy Michnik       367         1 Introduction       367         2 Model Formulation       368         3 The Exemplary Model and Computational Tests       371         4 Conclusions       372         References       372         The Effectiveness of the Balanced Scorecard Framework for       373         E-Commerce       373         Jamshed J. Mistry, B. K. Pathak       373         1 Introduction       373         3 Background and Significance       374         3 Methodology       375         4 Results       376         References       379         A Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       381         1 Introduction       381         2 Proposed Market Mechanism       382         3 Scenario and Simulation Analysis       384         4 Discussion and Conclusion       386         References       380         Santha Chenayah Ramu, Eiji Takeda       390         1 Introduction       389         2 Ternary Comparison Method (TCM)       390         3 Pseudo-Criterion Approaches to Mangrove Forests Management       399         4 Concluding Remarks <th>The Comprehensive Financial Risk Management in a Bank Stochastic Goal Programming Optimization</th> <th></th>	The Comprehensive Financial Risk Management in a Bank Stochastic Goal Programming Optimization	
1       Introduction       367         2       Model Formulation       368         3       The Exemplary Model and Computational Tests       371         4       Conclusions       372         References       372         The Effectiveness of the Balanced Scorecard Framework for       572         E-Commerce       373         Jamshed J. Mistry, B. K. Pathak       373         1       Introduction       373         2       Background and Significance       374         3       Methodology       375         4       Results       376         References       377         A Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       381         1       Introduction       381         2       Proposed Market Mechanism       382         3       Scenario and Simulation Analysis       384         4       Discussion and Conclusion       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       1       1       1         1       Introduction       389		507
2       Model Formulation       368         3       The Exemplary Model and Computational Tests       371         4       Conclusions       372         References       372         References       372         The Effectiveness of the Balanced Scorecard Framework for       572         Fe-Commerce       373         Jamshed J. Mistry, B. K. Pathak       373         1       Introduction       373         2       Background and Significance       374         3       Methodology       375         4       Results       376         References       379         A Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       381         1       Introduction       381         2       Proposed Market Mechanism       382         3       Scenario and Simulation Analysis       386         References       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       Mangrove Forests Management         390       Pseudo-Criterion Approaches to Mangrove Forests Management       390         2       Ternary Comparison Method (TCM)       390         394		367
3       The Exemplary Model and Computational Tests       371         4       Conclusions       372         References       372         The Effectiveness of the Balanced Scorecard Framework for       E-Commerce         E-Commerce       373         Jamshed J. Mistry, B. K. Pathak       373         1       Introduction       373         Jakspering       374         3       Methodology       375         4       Results       376         74       Results       376         75       Results       376         76       References       379         7       A Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       381         Jin-Tang Peng, Chen-Fu Chien       382         1       Introduction       381         2       Proposed Market Mechanism       382         3       Scenario and Simulation Analysis       384         4       Discussion and Conclusion       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       1       1 <t< td=""><td></td><td></td></t<>		
4       Conclusions       372         References       372         The Effectiveness of the Balanced Scorecard Framework for       372         The Effectiveness of the Balanced Scorecard Framework for       373         Jamshed J. Mistry, B. K. Pathak       373         1       Introduction       373         Jamshed J. Mistry, B. K. Pathak       374         1       Introduction       373         2       Background and Significance       374         3       Methodology       375         4       Results       376         References       379         A Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       381         1       Introduction       381         2       Proposed Market Mechanism       382         3       Scenario and Simulation Analysis       384         4       Discussion and Conclusion       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       394       1       1         1       Introduction       399       394         2       Ternary		
References       372         The Effectiveness of the Balanced Scorecard Framework for       373         F-Commerce       373         Jamshed J. Mistry, B. K. Pathak       373         1       Introduction       373         2       Background and Significance       374         3       Methodology       375         4       Results       376         References       379         A Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       381         1       Introduction       381         2       Proposed Market Mechanism       382         3       Scenario and Simulation Analysis       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       Mangrove Forests Management         3       Subth Chenayah Ramu, Eiji Takeda       390         1       Introduction       389         Statha Chenayah Ramu, Eiji Takeda       394         1       Introduction       390         2       Ternary Comparison Method (TCM)       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         4       Concluding Remarks       394	• • •	
E-Commerce       373         Jamshed J. Mistry, B. K. Pathak       373         Introduction       373         Background and Significance       374         Methodology       375         Results       376         References       379         A Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       1         Introduction       381         J Proposed Market Mechanism       382         Scenario and Simulation Analysis       384         Discussion and Conclusion       386         References       380         Pseudo-Criterion Approaches to Evaluating Alternatives in Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       389         Introduction       389         Prenary Comparison Method (TCM)       390         Pseudo-Criterion Approaches to Mangrove Forests Management       390         Introduc		
E-Commerce       373         Jamshed J. Mistry, B. K. Pathak       373         Introduction       373         Background and Significance       374         Methodology       375         Results       376         References       379         A Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       1         Introduction       381         J Proposed Market Mechanism       382         Scenario and Simulation Analysis       384         Discussion and Conclusion       386         References       380         Pseudo-Criterion Approaches to Evaluating Alternatives in Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       389         Introduction       389         Prenary Comparison Method (TCM)       390         Pseudo-Criterion Approaches to Mangrove Forests Management       390         Introduc	The Effectiveness of the Balanced Scorecard Framework fo	۱r
Jamshed J. Mistry, B. K. Pathak         1       Introduction       373         2       Background and Significance       374         3       Methodology       375         4       Results       376         7       Results       376         References       379         A Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       381         1       Introduction       381         2       Proposed Market Mechanism       382         3       Scenario and Simulation Analysis       384         4       Discussion and Conclusion       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       389       390         1       Introduction       389         2       Ternary Comparison Method (TCM)       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       394         4       Chenayah Ramu, Eiji Takeda       394         1       Introduction       394         2       Ternary Comparison Method (TCM)       390         3       Pseud		
1       Introduction       373         2       Background and Significance       374         3       Methodology       375         4       Results       376         References       377         A Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       381         1       Introduction       381         2       Proposed Market Mechanism       382         3       Scenario and Simulation Analysis       384         4       Discussion and Conclusion       386         References       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       Mangrove Forests Management         Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       389         1       Introduction       389         2       Ternary Comparison Method (TCM)       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       394         Concluding Remarks       394         References       394         References       394         References       395         Hideharu Sugihara, Kiichiro Tsuji       1		
2       Background and Significance       374         3       Methodology       375         4       Results       376         7       Results       376         References       379         A Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       381         1       Introduction       381         2       Proposed Market Mechanism       382         3       Scenario and Simulation Analysis       384         4       Discussion and Conclusion       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       1       Introduction       389         2       Ternary Comparison Method (TCM)       390       394         2       Ternary Comparison Method (TCM)       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         4       Concluding Remarks       394         5       Ternary Comparison Method (TCM)       390         4       Concluding Remarks       395         4       Introduction       395         4       Goncludin		373
3       Methodology       375         4       Results       376         74       Results       376         References       377         A       Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       1       1         1       Introduction       381         2       Proposed Market Mechanism       382         3       Scenario and Simulation Analysis       384         4       Discussion and Conclusion       386         References       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       389         Santha Chenayah Ramu, Eiji Takeda       389         1       Introduction       389         2       Ternary Comparison Method (TCM)       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         4       Concluding Remarks       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       1       1         1       Introduction       395         5       Definitions of Energy System Alternatives       395		
4       Results       376         References       379         A Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       381         1       Introduction       381         2       Proposed Market Mechanism       382         3       Scenario and Simulation Analysis       384         4       Discussion and Conclusion       386         References       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       Mangrove Forests Management         Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       389         1       Introduction       390         2       Ternary Comparison Method (TCM)       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         4       Concluding Remarks       394         References       394       Serences         Stems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       1       Introduction         1       Introduction       395         3       Formulation of Multi-objective Optimization Model       397         4       Conclusion	<b>e e</b>	
References       379         A Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       381         1 Introduction       381         2 Proposed Market Mechanism       382         3 Scenario and Simulation Analysis       384         4 Discussion and Conclusion       386         References       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       389         Santha Chenayah Ramu, Eiji Takeda       389         2 Ternary Comparison Method (TCM)       390         3 Pseudo-Criterion Approaches to Mangrove Forests Management       390         2 Ternary Comparison Method (TCM)       390         3 Pseudo-Criterion Approaches to Mangrove Forests Management       390         4 Concluding Remarks       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       1         1 Introduction       395         395       Formulation of Multi-objective Optimization Model       397         4 Tradeoff Analyses       399         5 Conclusion       400		
A Study of Variance of Locational Price in a Deregulated Generation Market       381         Jin-Tang Peng, Chen-Fu Chien       381         1 Introduction       381         2 Proposed Market Mechanism       382         3 Scenario and Simulation Analysis       384         4 Discussion and Conclusion       386         References       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       389         Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       380         1 Introduction       390         2 Ternary Comparison Method (TCM)       390         3 Pseudo-Criterion Approaches to Mangrove Forests Management       390         3 Pseudo-Criterion Approaches to Mangrove Forests Management       390         2 Ternary Comparison Method (TCM)       390         3 Pseudo-Criterion Approaches to Mangrove Forests Management       390         3 Concluding Remarks       394         References       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         97       Introduction       395         3 Definitions of Energy System Alternatives       395         3 Formulation of Multi-objective Optimization Model       397         4 Tr		
eration Market       381         Jin-Tang Peng, Chen-Fu Chien       381         1 Introduction       381         2 Proposed Market Mechanism       382         3 Scenario and Simulation Analysis       384         4 Discussion and Conclusion       386         References       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       389         Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       389         1 Introduction       389         2 Ternary Comparison Method (TCM)       390         3 Pseudo-Criterion Approaches to Mangrove Forests Management       394         Concluding Remarks       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       1         1 Introduction       395         2 Definitions of Energy System Alternatives       395         3 Formulation of Multi-objective Optimization Model       397         4 Tradeoff Analyses       399         5 Conclusion       400	References	3/9
Jin-Tang Peng, Chen-Fu Chien       381         1       Introduction       381         2       Proposed Market Mechanism       382         3       Scenario and Simulation Analysis       384         4       Discussion and Conclusion       386         References       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       389         Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       389         1       Introduction       389         2       Ternary Comparison Method (TCM)       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       394         Concluding Remarks       394         References       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       1         1       Introduction       395         2       Definitions of Energy System Alternatives       395         3       Formulation of Multi-objective Optimization Model       397         4       Tradeoff Analyses       399         5       Conclusion       400 <td></td> <td></td>		
1       Introduction       381         2       Proposed Market Mechanism       382         3       Scenario and Simulation Analysis       384         4       Discussion and Conclusion       386         References       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       389         Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       389         1       Introduction       390         2       Ternary Comparison Method (TCM)       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         4       Concluding Remarks       394         References       394       Settems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       1       1       1         1       Introduction       395       395         2       Definitions of Energy System Alternatives       395         3       Formulation of Multi-objective Optimization Model       397         4       Tradeoff Analyses       399 <td></td> <td> 381</td>		381
2       Proposed Market Mechanism       382         3       Scenario and Simulation Analysis       384         4       Discussion and Conclusion       386         References       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       389         Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       389         1       Introduction       389         2       Ternary Comparison Method (TCM)       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         4       Concluding Remarks       394         References       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       395         1       Introduction       395         2       Definitions of Energy System Alternatives       395         3       Formulation of Multi-objective Optimization Model       397         4       Tradeoff Analyses       399         5       Conclusion       400		
3       Scenario and Simulation Analysis       384         4       Discussion and Conclusion       386         References       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       389         Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       389         1       Introduction       389         2       Ternary Comparison Method (TCM)       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         4       Concluding Remarks       394         References       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         1       Introduction       395         2       Definitions of Energy System Alternatives       395         3       Formulation of Multi-objective Optimization Model       397         4       Tradeoff Analyses       399         5       Conclusion       400	1 Introduction	381
4       Discussion and Conclusion       386         References       386         Pseudo-Criterion Approaches to Evaluating Alternatives in       389         Santha Chenayah Ramu, Eiji Takeda       389         1       Introduction       389         2       Ternary Comparison Method (TCM)       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         4       Concluding Remarks       394         References       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       395         1       Introduction       395         2       Definitions of Energy System Alternatives       395         3       Formulation of Multi-objective Optimization Model       397         4       Tradeoff Analyses       399         5       Conclusion       400	2 Proposed Market Mechanism	382
References386Pseudo-Criterion Approaches to Evaluating Alternatives in Mangrove Forests Management389Santha Chenayah Ramu, Eiji Takeda3891 Introduction3892 Ternary Comparison Method (TCM)3903 Pseudo-Criterion Approaches to Mangrove Forests Management3904 Concluding Remarks394References394Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area395Hideharu Sugihara, Kiichiro Tsuji3951 Introduction3953 Formulation of Multi-objective Optimization Model3974 Tradeoff Analyses3995 Conclusion400	3 Scenario and Simulation Analysis	384
Pseudo-Criterion Approaches to Evaluating Alternatives in         Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       389         1 Introduction       389         2 Ternary Comparison Method (TCM)       390         3 Pseudo-Criterion Approaches to Mangrove Forests Management       390         4 Concluding Remarks       394         References       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       395         1 Introduction       395         3 Formulation of Multi-objective Optimization Model       397         4 Tradeoff Analyses       399         5 Conclusion       400	4 Discussion and Conclusion	386
Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       389         1 Introduction       389         2 Ternary Comparison Method (TCM)       390         3 Pseudo-Criterion Approaches to Mangrove Forests Management       390         4 Concluding Remarks       394         References       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       395         1 Introduction       395         3 Formulation of Multi-objective Optimization Model       397         4 Tradeoff Analyses       399         5 Conclusion       400	References	386
Mangrove Forests Management       389         Santha Chenayah Ramu, Eiji Takeda       389         1 Introduction       389         2 Ternary Comparison Method (TCM)       390         3 Pseudo-Criterion Approaches to Mangrove Forests Management       390         4 Concluding Remarks       394         References       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       395         1 Introduction       395         3 Formulation of Multi-objective Optimization Model       397         4 Tradeoff Analyses       399         5 Conclusion       400	Pseudo-Criterion Approaches to Evaluating Alternatives i	in
Santha Chenayah Ramu, Eiji Takeda         1       Introduction       389         2       Ternary Comparison Method (TCM)       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         4       Concluding Remarks       394         References       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       395         1       Introduction       395         2       Definitions of Energy System Alternatives       395         3       Formulation of Multi-objective Optimization Model       397         4       Tradeoff Analyses       399         5       Conclusion       400		
2       Ternary Comparison Method (TCM)       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         4       Concluding Remarks       394         References       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       395         1       Introduction       395         2       Definitions of Energy System Alternatives       395         3       Formulation of Multi-objective Optimization Model       397         4       Tradeoff Analyses       399         5       Conclusion       400		
2       Ternary Comparison Method (TCM)       390         3       Pseudo-Criterion Approaches to Mangrove Forests Management       390         4       Concluding Remarks       394         References       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       395         1       Introduction       395         2       Definitions of Energy System Alternatives       395         3       Formulation of Multi-objective Optimization Model       397         4       Tradeoff Analyses       399         5       Conclusion       400	1 Introduction	389
3       Pseudo-Criterion Approaches to Mangrove Forests Management	2 Ternary Comparison Method (TCM)	390
4       Concluding Remarks       394         References       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       395         1       Introduction       395         2       Definitions of Energy System Alternatives       395         3       Formulation of Multi-objective Optimization Model       397         4       Tradeoff Analyses       399         5       Conclusion       400		
References       394         Energy-Environment-Cost Tradeoffs in Planning Energy Systems for an Urban Area       395         Hideharu Sugihara, Kiichiro Tsuji       395         1 Introduction       395         2 Definitions of Energy System Alternatives       395         3 Formulation of Multi-objective Optimization Model       397         4 Tradeoff Analyses       399         5 Conclusion       400		
tems for an Urban Area395Hideharu Sugihara, Kiichiro Tsuji11Introduction2Definitions of Energy System Alternatives39533Formulation of Multi-objective Optimization Model4Tradeoff Analyses5Conclusion400	9	
tems for an Urban Area395Hideharu Sugihara, Kiichiro Tsuji11Introduction2Definitions of Energy System Alternatives39533Formulation of Multi-objective Optimization Model4Tradeoff Analyses5Conclusion400	Energy-Environment-Cost Tradeoffs in Planning Energy Sy	s-
Hideharu Sugihara, Kiichiro Tsuji1Introduction		
1Introduction3952Definitions of Energy System Alternatives3953Formulation of Multi-objective Optimization Model3974Tradeoff Analyses3995Conclusion400		
2Definitions of Energy System Alternatives3953Formulation of Multi-objective Optimization Model3974Tradeoff Analyses3995Conclusion400		395
3Formulation of Multi-objective Optimization Model3974Tradeoff Analyses3995Conclusion400		
4 Tradeoff Analyses		
5 Conclusion	• •	
	5	
Keterence A00	Reference	

DEA Approach to the Allocation of Various TV Commercials
to Dayparts
Katsuaki Tanaka, Eiji Takeda
1 Introduction
2 DEA Approach to the Allocation of Various TV Commercials to Dayparts
3 Concluding Remarks
References
Analyzing Alternative Strategies of Semiconductor Final Test-
ing
1 Introduction
2 Research Framework 409
3 An Empirical Study 411
4 Conclusion
References
A Discrete-Time European Options Model under Uncertainty
in Financial Engineering 415
Yuji Yoshida
1 Introduction
2 Fuzzy Stochastic Processes 416
3 European Options in Uncertain Environment
4 The Expected Price of European Options
References
References
References       420         Multipurpose Decision-Making in House Plan by Using AHP.       421         Bingjiang Zhang, Hui Liang, Tamaki Tanaka       421         1 Introduction       421
References       420         Multipurpose Decision-Making in House Plan by Using AHP . 421         Bingjiang Zhang, Hui Liang, Tamaki Tanaka         1 Introduction       421         2 Housing Planing Model by AHP       421
References       420         Multipurpose Decision-Making in House Plan by Using AHP . 421         Bingjiang Zhang, Hui Liang, Tamaki Tanaka         1 Introduction       421         2 Housing Planing Model by AHP       421         3 Comprehensive Evaluation for the House of Room Arrangements       423
References       420         Multipurpose Decision-Making in House Plan by Using AHP . 421         Bingjiang Zhang, Hui Liang, Tamaki Tanaka         1 Introduction       421         2 Housing Planing Model by AHP       421         3 Comprehensive Evaluation for the House of Room Arrangements       423         4 Algorithm       425
References       420         Multipurpose Decision-Making in House Plan by Using AHP . 421         Bingjiang Zhang, Hui Liang, Tamaki Tanaka         1 Introduction       421         2 Housing Planing Model by AHP       421         3 Comprehensive Evaluation for the House of Room Arrangements       423

the start of the start of the