

Hideo Tanaka · Peijun Guo

Possibilistic Data Analysis for Operations Research

With 58 Figures
and 33 Tables

Physica-Verlag
A Springer-Verlag Company

Contents

Foreword	v
<i>D. Dubois and H. Prade</i>	
Preface	vii
<i>H. Tanaka and P. Guo</i>	
Chapter 1. Introduction: Possibility Theory in Operations Research	1
1.1. Possibility Distribution: A Knowledge Representation	3
1.2. The Role of Possibility Theory in Regression Analysis	5
1.3. The Role of Possibility Theory in Portfolio Selection Problems	6
1.4. The Role of Possibility Theory in Discriminant Analysis	7
1.5. The Roles of Possibility Theory in Other Topics	8
1.6. Chapter Description	10
References	12
Chapter 2. Possibility Models	15
2.1. Possibility Distributions	15
2.2. Operations on Possibility Distributions	24
2.2.1. Interval Arithmetic	25
2.2.2. Fuzzy Number Arithmetic	26
2.2.3. Fuzzy Vector Arithmetic	32
2.3. Possibility and Necessity Measures	35
2.4. Probability Measures of Fuzzy Events	42
2.5. Possibilistic Linear Systems	45
2.6. Brief Bibliographical Remarks	48
References	48
Chapter 3. Theory of Possibilistic Systems Based on Exponential Possibility Distributions	51
3.1. Combination Rule of Exponential Possibility Distributions	51
3.2. Marginal and Conditional Possibility Distributions	56
3.3. Continuous Fuzzy Relation Systems	61
3.4. Brief Bibliographical Remarks	66
References	67

Chapter 4. Identification of Possibility Distributions	69
4.1. Principle of Maximum Likelihood	69
4.2. Identification of Upper and Lower Possibility Distributions	71
4.3. Numerical Examples	81
4.4. Brief Bibliographical Remarks	83
References	85
Chapter 5. Possibilistic Regression Analysis	87
5.1. Statistical Regression Analysis	88
5.2. Interval Regression	90
5.3. Fuzzy Regression	102
5.4. Exponential Possibilistic Regression	111
5.5. Interval Nonlinear Regression	118
5.6. Brief Bibliographical Remarks	123
References	124
Chapter 6. Possibilistic Portfolio Selection Problems	125
6.1. Portfolio Selection Models Based on Probability Theory	125
6.1.1. Markowitz's Portfolio Selection Model	126
6.1.2. Models Based on Probability Measures	127
6.1.3 Model Based on Mean-Absolute Deviation	130
6.2. Portfolio Selection Models Based on Possibility Theory	131
6.2.1. Portfolio Selection Model Based on Aspiration Levels of Decision-Makers	131
6.2.2. Portfolio Selection Models Based on Possibility and Necessity Measures	133
6.3. Portfolio Selection Models Based on Fuzzy Probabilities	135
6.3.1. Definition of Fuzzy Probabilities	136
6.3.2. Fuzzy Probability Portfolio Selection Model	136
6.4. Portfolio Selection Models Based on Exponential Possibility Distributions	137
6.4.1. Identification of Possibility Distributions from Given Security Data	137

6.4.2. Portfolio Selection Model Based on Upper and Lower Possibility Distributions	138
6.4.3. Model Based on Necessity Measure	141
6.5. Numerical Examples	143
6.5.1. Portfolio Selection Based on Fuzzy Probabilities	144
6.5.2. Portfolio Selection Based on Upper and Lower Possibility Distributions	145
6.6. Brief Bibliographical Remarks	147
References	147
Chapter 7. Discriminant Analysis Based on Possibility Distributions	149
7.1. Discriminant Analysis by Bayes' Formula	149
7.2. Linear Discriminant Functions	153
7.3. Possibilistic Discriminant Rules	154
7.4. Feature Vector for Classification by Possibility Measures	156
7.5. Possibilistic Classification for the Group of Data	158
7.6. Numerical Example	160
7.7. Brief Bibliographical Remarks	163
References	163
Chapter 8. Rough Set Analysis	165
8.1. Basic Notions of Rough Sets	165
8.2. Reduction of Information Systems by Elementary Sets	170
8.3. Reduction of Information Systems by Accuracy Measures	171
8.4. Reduction for Divisions of Attributes	174
8.5. Fuzzy Inference Models	176
8.6. Fuzzy Expert System for Medical Diagnosis	177
8.7. Similarities between Rough Sets and Possibility Models	179
8.8. Brief Bibliographical Remarks	182
References	182