

TABLE OF CONTENTS

| | |
|--|-----------|
| PREFACE | v |
| 1 INTRODUCTION | 1 |
| 1.1 Objectives of This Study | 2 |
| 1.2 (Fuzzy) Multiple Objective Decision Making | 2 |
| 1.3 Classification of (Fuzzy) Multiple Objective Decision Making | 6 |
| 1.4 Applications of (Fuzzy) Multiple Objective Decision Making | 15 |
| 1.5 Literature Survey | 17 |
| 1.6 Fuzzy Sets | 21 |
| 2 MULTIPLE OBJECTIVE DECISION MAKING | 27 |
| 2.1 Introduction | 28 |
| 2.2 Goal Programming | 32 |
| 2.2a A Portfolio Selection Problem | 33 |
| 2.2b An Audit Sampling Problem | 37 |
| 2.3 Fuzzy Programming | 40 |
| 2.3.1 Max-Min Approach | 40 |
| 2.3.1a A Trade Balance Problem | 46 |
| 2.3.1b A Media Selection Problem | 49 |
| 2.3.2 Augmented Max-Min Approach | 53 |
| Example | 55 |
| 2.3.2a A Trade Balance Problem | 56 |
| 2.3.2b A Logistics Planning Model | 57 |
| 2.3.3 Parametric Approach | 61 |
| Example | 63 |
| 2.4 Global Criterion Approach | 65 |
| 2.4.1 Global Criterion Approach | 67 |
| 2.4.1a A Nutrition Problem | 69 |

| | | |
|----------|--|------------|
| 2.4.2 | TOPSIS for MODM | 71 |
| 2.4.2a | A Water Quality Management Problem | 75 |
| 2.5 | Interactive Multiple Objective Decision Making | 82 |
| 2.5.1 | Optimal System Design | 83 |
| 2.5.1a | A Production Planning Problem | 83 |
| 2.5.2 | KSU-STEM | 88 |
| 2.5.2a | A Nutrition Problem | 92 |
| 2.5.2b | A Project Scheduling Problem | 93 |
| 2.5.3 | ISGP-II | 100 |
| 2.5.3a | A Nutrition Problem | 106 |
| 2.5.3b | A Bank Balance Sheet Management Problem | 110 |
| 2.5.4 | Augmented Min-Max Approach | 115 |
| 2.5.4a | A Water Pollution Control Problem | 119 |
| 2.6 | Multiple Objective Linear Fractional Programming | 124 |
| 2.6.1 | Luhandjula's Approach | 125 |
| | Example | 129 |
| 2.6.2 | Lee and Tcha's Approach | 129 |
| 2.6.2a | A Financial Structure Optimization Problem | 132 |
| 2.7 | Multiple Objective Geometric Programming | 134 |
| | Example | 136 |
| 2.7a | A Postal Regulation Problem | 137 |
| 3 | FUZZY MULTIPLE OBJECTIVE DECISION MAKING | 139 |
| 3.1 | Fuzzy Goal Programming | 139 |
| 3.1.1 | Fuzzy Goal Programming | 140 |
| 3.1.1a | A Production-Marketing Problem | 143 |
| 3.1.1b | An Optimal Control Problem | 145 |
| 3.1.1c | A Facility Location Problem | 147 |
| 3.1.2 | Preemptive Fuzzy Goal Programming | 152 |
| | Example: The Production-Marketing Problem | 154 |
| 3.1.3 | Interpolated Membership Function | 155 |

| | | |
|---------|--|-----|
| 3.1.3.1 | Hannan's Method | 156 |
| | Example: The Production-Marketing Problem | 156 |
| 3.1.3.2 | Inuiguchi, Ichihashi and Kume's Method | 159 |
| | Example: The Trade Balance Problem | 161 |
| 3.1.3.3 | Yang, Ignizio and Kim's Method | 165 |
| | Example | 167 |
| 3.1.4 | Weighted Additive Model | 168 |
| 3.1.4.1 | Crisp Weights | 169 |
| | 3.1.4.1a Maximin Approach | 170 |
| | Example: The Production-Marketing Problem | 170 |
| | 3.1.4.1b Augmented Maximin Approach | 172 |
| | 3.1.4.1c Supertransitive Approximation | 172 |
| | Example: The Production-Marketing Problem | 174 |
| 3.1.4.2 | Fuzzy Weights | 176 |
| | Example: The Production-Marketing Problem | 176 |
| 3.1.5 | A Preference Structure on Aspiration Levels | 179 |
| | Example: The Production-Marketing Problem | 183 |
| 3.1.6 | Nested Priority | 185 |
| | 3.1.6a A Personnel Selection Problem | 189 |
| 3.2 | Fuzzy Global Criterion | 193 |
| | Example | 197 |
| 3.3 | Interactive Fuzzy Multiple Objective Decision Making | 201 |
| 3.3.1 | Werners's Method | 202 |
| | Example: The Trade Balance Problem | 208 |
| | 3.3.1a An Aggregate Production Planning Problem | 211 |
| 3.3.2 | Lai and Hwang's Method | 219 |
| 3.3.3 | Leung's Method | 232 |
| | Example | 234 |
| 3.3.4 | Fabian, Ciobanu and Stoica's Method | 237 |
| | Example | 240 |

| | | |
|----------|--|------------|
| 3.3.5 | Sasaki, Nakahara, Gen and Ida's Method | 244 |
| | Example | 246 |
| 3.3.6 | Baptistella and Ollero's Method | 248 |
| | 3.3.6a An Optimal Scheduling Problem | 256 |
| 4 | POSSIBILISTIC MULTIPLE OBJECTIVE DECISION MAKING | 263 |
| 4.1 | Introduction | 264 |
| | 4.1.1 Resolution of Imprecise Objective Functions | 265 |
| | 4.1.2 Resolution of Imprecise Constraints | 268 |
| 4.2 | Possibilistic Multiple Objective Decision Making | 268 |
| | 4.2.1 Tanaka and His Collegergues' Methods | 269 |
| | Example | 273 |
| | 4.2.1.1 Possibilistic Regression | 275 |
| | Example 1 | 281 |
| | Example 2 | 282 |
| | 4.2.1.2 Possibilistic Group Method of Data Handling | 284 |
| | Example | 286 |
| | 4.2.2 Lai and Hwang's Method | 290 |
| | 4.2.3 Negi's Method | 292 |
| | Example | 295 |
| | 4.2.4 Luhandjula's Method | 297 |
| | Example | 299 |
| | 4.2.5 Li and Lee's Method | 302 |
| | Example | 306 |
| | 4.2.6 Wierzchon's Method | 309 |
| 4.3 | Interactive Methods for PMODM | 316 |
| | 4.3.1 Sakawa and Yano's Method | 316 |
| | Example | 322 |
| | 4.3.2 Slowinski's Method | 324 |
| | 4.3.2a A Long-Term Development Planning Problem of a Water Supply System | 333 |

| | | |
|---|--|------------|
| 4.3.2b | A Land-Use Planning Problem | 338 |
| 4.3.2c | A Farm Structure Optimization Problem | 342 |
| 4.3.3 | Rommelfanger's Method | 346 |
| | Example | 350 |
| 4.4 | Hybrid Problems | 351 |
| 4.4.1 | Tanaka, Ichihashi and Asai's Method | 352 |
| | Example | 354 |
| 4.4.2 | Inuiguchi and Ichihashi's Method | 360 |
| | Example | 364 |
| 4.5 | Possibilistic Multiple Objective Linear Fractional Programming | 368 |
| 4.6 | Interactive Possibilistic Regression | 373 |
| 4.6.1 | Crisp Output and Crisp Input | 375 |
| | Example | 378 |
| 4.6.2 | Imprecise Output and Crisp Input | 379 |
| | Example | 384 |
| 4.6.3 | Imprecise Output and Imprecise Input | 386 |
| | Example | 392 |
| 5 | CONCLUDING REMARKS | 394 |
| 5.1 | Future Research | 395 |
| 5.2 | Fuzzy Mathematical Programming | 396 |
| 5.3 | Multiple Attribute Decision Making | 399 |
| 5.4 | Fuzzy Multiple Attribute Decision Making | 403 |
| 5.5 | Group Decision Making under Multiple Criteria | 404 |
| BIBLIOGRAPHY | | 410 |
| | Books, Monographs and Conference Proceedings | 410 |
| | Journal Articles, Technical Reports and Theses | 416 |
| APPENDIX: STOCHASTIC PROGRAMMING | | 449 |
| A.1 | Stochastic Programming with a Single Objective Function | 450 |

| | | |
|-------|--|-----|
| A.1.1 | Distribution Problems | 451 |
| A.1.2 | Two-Stage Programming | 455 |
| A.1.3 | Chance-Constrained Programming | 458 |
| A.2 | Stochastic Programming with Multiple Objective Functions | 460 |
| A.2.1 | Distribution Problem | 460 |
| A.2.2 | Goal Programming Problem | 463 |
| A.2.3 | Utility Function Problem | 467 |
| A.2.4 | Interactive Problem | 469 |
| | References | 475 |