

Contents

Preface	ix
1. BASIC NOTATION	1
2. BASIC PROBLEMS OF MULTIVALUED ANALYSIS	5
1 Basic Concepts of Convex Analysis	5
1.1 Convex Sets	5
1.2 Convex Functions	9
1.3 Topological and Differential Properties of Convex Functions	12
2 Elements of Nonsmooth Analysis	14
2.1 Tangent Cones	14
2.2 Directional Derivatives	15
2.3 Clarke Subdifferentials	16
3 Quasidifferentiable Functions and Problems	18
3.1 Elements of Quasidifferential Calculus	18
3.2 Necessary Optimality Conditions	22
3. PROPERTIES OF MULTIVALUED MAPPINGS	27
1 Topological Properties of Multivalued Mappings and Marginal Functions	27
1.1 Multivalued Mappings	27
1.2 Marginal Functions	32
1.3 Pseudolipschitz and Pseudohölder Continuity of Multivalued Mappings	37
1.4 Properties of Convex Mappings	39
1.5 Closed convex processes	41
2 Directional Differentiability of Multivalued Mappings	43

2.1	Tangent Cones and Derivatives of Multivalued Mappings	43
2.2	Description of Derivatives of Multivalued Mappings in Terms of the Distance Function	46
2.3	First-order Approximations of Mappings	50
2.4	Properties of Derivatives of Multivalued Mappings	51
3	Lemma About the Removal of Constraints	54
4.	SUBDIFFERENTIALS OF MARGINAL FUNCTIONS	59
1	Clarke Subdifferentials of Marginal Functions	59
1.1	Estimates for Subdifferentials	59
1.2	Pseudolipschitz Continuity and Metrical Regularity	68
2	Locally Convex Mappings	71
2.1	Weakly Pseudoconvexity and Directional Derivatives of Marginal Functions	71
2.2	Subdifferentials of Marginal Functions for Locally Convex Multivalued Mappings	73
5.	DERIVATIVES OF MARGINAL FUNCTIONS	77
1	Weakly Uniformly Differentiable Functions	77
2	Weakly Uniformly Differentiable Multivalued Mappings	84
3	Strongly Differentiable Mappings and Directional Differentiability of Marginal Functions	90
3.1	Strong differentiability of multivalued mappings	90
3.2	Directional differentiability of marginal functions	93
6.	SENSITIVITY ANALYSIS	97
1	Stability Properties of Optimal Solutions in Mathematical Programming Problems	98
2	Regular Multivalued Mappings	102
2.1	Regularity Conditions	103
2.2	(R)-regular Mappings	106
2.3	Linear Tangent Cone and Derivatives of Regular Multivalued Mappings	114
2.4	Subdifferentials of Marginal Functions	117
2.5	Second-order Derivatives of Mappings	119
2.6	Directional Regularity	120
3	Directional Derivatives of Optimal Value Functions and Sensitivity Analysis of Suboptimal Solutions	128
3.1	General Case	129

<i>Contents</i>	vii
3.2 Directional Derivatives of Optimal Value Functions in Nonlinear Programming Problems	137
3.3 Hölder Behaviour of Optimal Solutions in (R)- regular Problems	148
3.4 Problems with Vertical Perturbations	165
3.5 Quasidifferentiable Programming Problems	169
4 Second-Order Analysis of the Optimal Value Function and Differentiability of Optimal Solutions	175
Bibliographical Comments	187
References	191
Index	203