

Contents

Preface	ix
Authors	xi
Introduction	1
1 Mathematical tools of robustness	5
1.1 Statistical model	5
1.2 Illustration on statistical estimation	8
1.3 Statistical functional	9
1.4 Fisher consistency	11
1.5 Some distances of probability measures	12
1.6 Relations between distances	13
1.7 Differentiable statistical functionals	14
1.8 Gâteaux derivative	15
1.9 Fréchet derivative	17
1.10 Hadamard (compact) derivative	18
1.11 Large sample distribution of empirical functional	18
1.12 Computation and software notes	19
1.13 Problems and complements	23
2 Basic characteristics of robustness	27
2.1 Influence function	27
2.2 Discretized form of influence function	28
2.3 Qualitative robustness	30

2.4	Quantitative characteristics of robustness based on influence function	32
2.5	Maximum bias	33
2.6	Breakdown point	35
2.7	Tail-behavior measure of a statistical estimator	36
2.8	Variance of asymptotic normal distribution	41
2.9	Problems and complements	41
3	Robust estimators of real parameter	43
3.1	Introduction	43
3.2	M -estimators	43
3.3	M -estimator of location parameter	45
3.4	Finite sample minimax property of M -estimator	54
3.5	Moment convergence of M -estimators	58
3.6	Studentized M -estimators	61
3.7	L -estimators	63
3.8	Moment convergence of L -estimators	70
3.9	Sequential M - and L -estimators	72
3.10	R -estimators	74
3.11	Numerical illustration	77
3.12	Computation and software notes	80
3.13	Problems and complements	83
4	Robust estimators in linear model	85
4.1	Introduction	85
4.2	Least squares method	87
4.3	M -estimators	94
4.4	GM -estimators	98
4.5	S -estimators and MM -estimators	100
4.6	L -estimators, regression quantiles	101
4.7	Regression rank scores	104
4.8	Robust scale statistics	106

CONTENTS	vii
4.9 Estimators with high breakdown points	109
4.10 One-step versions of estimators	110
4.11 Numerical illustrations	112
4.12 Computation and software notes	115
4.13 Problems and complements	126
5 Multivariate location model	129
5.1 Introduction	129
5.2 Multivariate M -estimators of location and scatter	129
5.3 High breakdown estimators of multivariate location and scatter	132
5.4 Admissibility and shrinkage	133
5.5 Numerical illustrations and software notes	134
5.6 Problems and complements	139
6 Some large sample properties of robust procedures	141
6.1 Introduction	141
6.2 M -estimators	142
6.3 L -estimators	144
6.4 R -estimators	146
6.5 Interrelationships of M -, L - and R -estimators	146
6.6 Minimaximally robust estimators	150
6.7 Problems and complements	153
7 Some goodness-of-fit tests	155
7.1 Introduction	155
7.2 Tests of normality of the Shapiro-Wilk type with nuisance regression and scale parameters	155
7.3 Goodness-of-fit tests for general distribution with nuisance regression and scale	158
7.4 Numerical illustration	160
7.5 Computation and software notes	166

Appendix A: R system	173
A.1 Brief R overview	174
References	181
Subject index	191
Author index	195