

Table of Contents

Preface v

Contributors xv

PART I. DISTANCE METHODS

Ch. 1. Robust Inference in Multivariate Linear Regression
Using Difference of Two Convex Functions
as the Discrepancy Measure 1
Z. D. Bai, C. R. Rao, and Y. H. Wu

1. Introduction 1
2. Assumptions 3
3. Main theorems 4
4. Preliminary lemmas 7
5. Proofs of main theorems 10
6. Comments on difference of two convex functions 13
7. Appendix, extensions of Rockafellar's theorems 14
 Acknowledgement 17
 References 18

Ch. 2. Minimum Distance Estimation: The Approach Using
Density-Based Distances 21
A. Basu, I. R. Harris, and S. Basu

1. Introduction 21
2. Minimum Hellinger distance estimation 22
3. Minimum disparity estimation 32
4. The negative exponential disparity 39
5. The weighted likelihood equation 41
6. A generalized divergence 45
7. Concluding remarks 46
 References 46

PART II. METHODS BASED ON INFLUENCE FUNCTIONS

Ch. 3. Robust Inference: The Approach Based on Influence Functions 49
M. Markatou and E. Ronchetti

1. Introduction 49
 2. Approaches to robustness 50
 3. Robust tests for general parametric models 57
 4. Applications 59
 5. Other techniques 67
 6. Conclusions 71
- Acknowledgement 72
References 72

Ch. 4. Practical Applications of Bounded-Influence Tests 77
S. Heritier and M-P. Victoria-Feser

1. Introduction 77
 2. Robustness concepts and results in testing 78
 3. Robust testing in logistic regression 81
 4. Robust model choice tests 90
 5. Conclusion 95
- Appendix 96
References 98

PART III. OUTLIERS AND HIGH BREAKDOWN METHODS

Ch. 5. Introduction to Positive-Breakdown Methods 101
P. J. Rousseeuw

1. Motivation 101
 2. The breakdown value 103
 3. Positive-breakdown regression 104
 4. Detecting leverage points with the MVE 107
 5. Diagnostic display 110
 6. Substantive applications 112
 7. Other robust methods 113
 8. The maxbias curve 115
 9. Algorithms 115
 10. Perspective and outlook 116
- References 117

Ch. 6. Outlier Identification and Robust Methods 123
U. Gather and C. Becker

1. Introduction 123
2. Outlier models 125
3. Outlier identification rules 129
4. Performance criteria for outlier identification rules 133
5. A comparison of some specific outlier identification rules 134
- References 141

PART IV. METHODS BASED ON RANKS

Ch. 7. Rank-Based Analysis of Linear Models 145
T. P. Hettmansperger, J. W. McKean, and S. J. Sheather

1. Introduction 145
2. Rank-based analysis 146
3. Analyses based on GR-estimates 156
4. Rank-based coefficients of determination 160
5. Diagnostic procedures 163
6. Conclusion 171
7. Acknowledgement 171
- References 171

Ch. 8. Rank Tests for Linear Models 175
R. Koenker

1. Introduction 175
2. Regression quantiles and rank scores 182
3. Rank tests for heteroscedasticity 186
4. Rank tests for time series models 190
5. Conclusions 197
- References 197

**Ch. 9. Some Extensions in the Robust Estimation of Parameters
of Exponential and Double Exponential Distributions
in the Presence of Multiple Outliers 201**
A. Childs and N. Balakrishnan

1. Introduction 201
2. Relations for single moments 204
3. Relations for product moments 208
4. Efficient estimation of θ under the multiple-outlier exponential model 218
5. Sensitivity of robust linear estimators of θ under multiple-outlier exponential model 218

- 6. Examples 224
- 7. Recommendations for the exponential model 225
- 8. Results for two related sets of I.N.I.D. variables 225
- 9. Robustness of location estimation of double exponential distribution 227
- 10. Robustness of scale estimators of double exponential distribution 231
- 11. Illustrative example 232
 - Acknowledgements 234
 - References 234

PART V. TIME SERIES PROBLEMS

- Ch. 10. Outliers, Unit Roots and Robust Estimation of Nonstationary Time Series 237

G. S. Maddala and Y. Yin

- 1. Introduction 237
- 2. Outlier detection in time series models 238
- 3. Effects of outliers on unit root tests 243
- 4. Robust unit root tests 252
- 5. Robust estimation methods for non-stationary data 258
- 6. Outliers and nonlinearities in time series 260
- 7. Conclusions 262
- References 262

- Ch. 11. Autocorrelation-Robust Inference 267

P. M. Robinson and C. Velasco

- 1. Introduction 267
- 2. Inference based on the sample mean 268
- 3. Inference on linear regression 274
- 4. Inference based on robust estimates 278
- 5. Inference in econometric models 280
- 6. Bandwidth selection 284
- 7. High-order asymptotics and the bootstrap 286
- 8. Inference under long range dependence 288
- 9. Inference on nonparametric probability density and regression functions 291
- References 294

- Ch. 12. A Practitioner's Guide to Robust Covariance Matrix Estimation 299

W. J. den Haan and A. Levin

- 1. Introduction 299
- 2. HAC covariance matrix estimators step by step 301
- 3. Asymptotic properties 309
- 4. Choices for kernel-based estimators 319

- 5. Choices for parametric estimators 332
- 6. Concluding comments 339
- References 340

PART VI. PANEL DATA, CENSORED DATA, AND CONTAMINATED DATA

- Ch. 13. Approaches to the Robust Estimation of Mixed Models 343

A. H. Welsh and A. M. Richardson

- 1. Mixed linear models 343
- 2. Robustness in mixed linear models 347
- 3. Estimation by maximising the Gaussian likelihood 350
- 4. Estimation by maximising the student t likelihood 353
- 5. Estimation by maximising a robustified likelihood 358
- 6. Estimation by solving estimating equations 361
- 7. B-optimal estimation 365
- 8. Estimation by maximising the restricted Gaussian likelihood (REML) 366
- 9. Robust versions of the restricted likelihood approach 369
- 10. Estimators defined by algorithms 374
- 11. Approximate inference 378
- 12. Empirical experience 382
- References 383

- Ch. 14. Nonparametric Maximum Likelihood Methods 385

S. R. Cosslett

- 1. Introduction 385
- 2. NPML estimation in semiparametric models 385
- 3. NPMLE for censored and truncated data 387
- 4. Discrete choice models 389
- 5. Censored regression models 392
- 6. Models for duration data 394
- 7. Estimation from endogenously stratified samples 398
- 8. Empirical likelihood ratio 401
- References 403

- Ch. 15. A Guide to Censored Quantile Regressions 405

B. Fitzenberger

- 1. Censored quantile regressions: An overview 405
- 2. Asymptotic results on censored quantile regressions 413
- 3. Interpolation property and algorithms 423
- 4. Application: Earnings function 430
- Acknowledgement 435
- References 435

**Ch. 16. What Can Be Learned About Population Parameters
When the Data Are Contaminated 439***J. L. Horowitz and C.F. Manski*

1. Introduction 439
2. Identification analysis 442
3. Estimation, confidence intervals and hypothesis tests 448
4. Empirical examples 455
5. Regression analysis with contaminated and corrupted data 456
6. Conclusions 458
- Appendix 458
- References 464

PART VII. GENERAL ISSUES**Ch. 17. Asymptotic Representations and Interrelations
of Robust Estimators and Their Applications 467***J. Jurečková and P. K. Sen*

1. Introduction 467
2. *M*-estimators 469
3. *L*-estimators 480
4. *R*-estimation of location and regression 490
5. Minimum distance *P*- and *B*- estimators 500
6. Interrelations of robust estimators 501
7. Concluding remarks 506
- References 510

Ch. 18. Small Sample Asymptotics: Applications in Robustness 513*C. A. Field and M. A. Tingley*

1. Introduction 513
2. General approach 515
3. Approximations for *M*-estimates 516
4. General saddlepoint approximations 520
5. Marginal densities: *M*-estimates 523
6. Marginal densities: General 524
7. Estimation of tail areas 526
8. Confidence intervals 528
9. Comparison of empirical techniques 533
10. Conclusions 534
- References 535

Ch. 19. On the Fundamentals of Data Robustness 537

G. Maguluri and K. Singh

1. Introduction 537
2. Comments on breakdown points 539
3. Comments on influence function (IF) 543
4. Empirical robustness 547
- References 549

Ch. 20. Statistical Analysis With Incomplete Data: A Selective Review 551

M. G. Akritas and M. P. LaValley

1. Introduction 551
2. One-sample problems 554
3. K -sample problems 568
4. Tests of independence 577
5. Factorial designs 579
6. Regression models 584
- Truncation Programs 606
- References 617

Ch. 21. Contamination Level and Sensitivity of Robust Tests 633

J. Á. Višek

1. Introduction 633
2. Formal reflection of diversity of estimates 635
3. Estimating contamination level 636
4. Robust testing 639
- References 642

Ch. 22. Finite Sample Robustness of Tests: An Overview 645

T. Kariya and P. Kim

1. Introduction 645
2. Group invariance 649
3. The general linear hypothesis (MANOVA problem) 651
4. Robustness of tests on Σ 654
5. Tests for serial correlation 656
6. One-sided testing problem 657
- References 660

Ch. 23. Future Directions 661*G. S. Maddala and C. R. Rao*

1. Introduction 661
2. Some comments on diagnostics and robust methods 661
3. Relationship between robust methods and semi-parametric and non-parametric methods 663
4. Generalized distributions 663
5. Robust inference in logistic and censored regression models 664
6. Errors in variables (EIV) and grouped data 665
7. Panel data 665
8. Multivariate methods and simultaneous equations models 666
9. Bootstrap methods for small-sample inference 667
10. Robust Bayesian analysis 668
- References 670

Subject Index 677**Contents of Previous Volumes 683**