Statistical Data Analysis
Based on the $L_1$-Norm
and Related Methods

Yadolah Dodge
Editor

Giuseppe Melfi
Technical Assistant

Birkhäuser
Basel • Boston • Berlin
## Contents

Preface xi

### Part One – All About Quantiles 1

Quantile Functions and Spread for Multivariate Distributions  
*Jean Averous* ......................................................... 3

A New Definition of Multivariate M-quantiles  
*Philip Kokic, Jens Breckling, and Oliver Lübke* .................. 15

A Depth Function and a Scale Curve Based on Spatial Quantiles  
*Robert Serfling* ..................................................... 25

Sample Quantiles for Locally Dependent Processes  
*Frits Ruymgaart* .................................................. 39

What are the Limiting Distributions of Quantile Estimators?  
*Keith Knight* ........................................................ 47

New Selection Indices for University Admissions: A Quantile Approach  
*Mo-Yin S. Tam, Gilbert W. Bassett Jr., and Uday Sukhatme* ...... 67

Exploring Transition Data Through Quantile Regression Methods: An Application to U.S. Unemployment Duration  
*José A. F. Machado and Pedro Portugal* .................................. 77

### Part Two – Financial Statistics and Time Series 95

How to be Pessimistic: Choquet Risk and Portfolio Optimization  
*Gilbert W. Bassett, Jr., Roger Koenker, and Gregory Kordas* ........ 97

Expected Shortfall and Beyond  
*Dirk Tasche* ......................................................... 109

Credit Scoring Using Binary Quantile Regression  
*Gregory Kordas* ...................................................... 125

Prediction of 0-1-Events for Short- and Long-memory Time Series  
*Jan Beran* ............................................................. 139

Nonparametric Quantile Regression with Applications to Financial Time Series  
*Klaus Abberger and Siegfried Heiler* ................................ 149

An Algorithm for Optimal Bandwidth Selection for Smooth Nonparametric Quantile Estimation  
*Sucharita Ghosh and Dana Florea-Draghicescu* .................. 161
Contents

Part Three - Estimation, Testing and Characterization 169
Orthogonal $L_1$-norm Estimation
Hans Nyquist ................................................................. 171

$L_1$-Derivatives, Score Functions and Tests
Jana Jurečková ................................................................. 183

Optimal Bias Robust M-estimates of Regression
Marcela Svarc, Victor J. Yohai, and Ruben H. Zamar .................. 191

Robust Bootstrap for S-estimators of Multivariate Regression
Stefan Van Aelst and Gert Willems .................................... 201

M-tests for Detection of Structural Changes in Regression
Marie Hušková and Jan Picek ........................................... 213

Change Point Detection Based on Empirical Quantiles
Lajos Horváth, Agnieszka Jach, and Piotr Kokoszka .................. 229

A Class of Probability Metrics and its Statistical Applications
Lev B. Klebanov ............................................................. 241

Whose Hare and Whose Tortoise
Richard William Farebrother ............................................ 253

Sign and Rank Covariance Matrices: Statistical Properties and
Application to Principal Components Analysis
Christophe Croux, Esa Ollila, and Hannu Oja .......................... 257

Multivariate Signed Ranks: Randles' Interdirections or Tyler's Angles?
Marc Hallin and Davy Paindaveine .................................... 271

Part Four – Deep in the Data 283

$L_1$-Depth, Depth Relative to a Model, and Robust Regression
Xin Tian, Yehuda Vardi, and Cun-Hui Zhang ......................... 285

Perturbation Properties of Depth Regions
Mario Romanazzi ............................................................... 301

Multivariate Trimmed Means Based on Data Depth
Yijun Zuo ........................................................................... 313

Part Five – Classification 323

Graphs, $L_1$-Metrics and Clustering
Jean-Pierre Barthélemy and François Brucker .......................... 325

Classification Based on the Support Vector Machine
and on Regression Depth
Andreas Christmann ........................................................... 341

A Robust Clustering Method and Visualization Tool Based On Data Depth
Rebecka Jörnsten, Yehuda Vardi, and Cun-Hui Zhang ............... 353
Contents

The Median Extension of Data Analysis Metric Structures
Mohammed Benayade and Bernard Fichet .................................................. 367

Text Classification for Mining Massive Aviation Inspection Reports
Regina Y. Liu, David Madigan, and Susana Eyheramendy .......................... 379

Part Six – Density Estimation and Image Processing 393

A Comparison Between L1 Markov Random Field-Based and
Wavelet-Based Estimators
Sylvain Sardy, Cédric Bilat, Paul Tseng, and Valérie Chavez-Demoulin ...... 395
Elastic and Plastic Splines: Some Experimental Comparisons
Roger Koenker and Ivan Mizera ............................................................... 405
On the Bitplane Compression of Microarray Images
Robecka Jornsten, Yehuda Vardi, and Cun-Hui Zhang ......................... 415

Part Seven – Regression Models in Environmental Studies 427

Overdispersed Regression Models for Air Pollution and Human Health
Silvia L.P. Ferrari, Jacqueline S.E. David, Paulo A. André, and Luiz A.A. Pereira .......................................................... 429
Atmospheric Pollution and Mortality in São Paulo
Julio M. Singer, Carmen D.S. André, Lilian P. Lima, and Gleice M.S. Conceição .................................................. 439

Contributors 451