

Chun-houh Chen  
Wolfgang Härdle  
Antony Unwin

*Editors*

# Handbook of Data Visualization

With 569 Figures and 50 Tables

 Springer

*Editors*

*Dr. Chun-houh Chen*

Institute of Statistical Science  
Academia Sinica  
128 Academia Road, Section 2  
Taipei 115  
Taiwan  
cchen@stat.sinica.edu.tw

*Professor Wolfgang Härdle*

CASE – Center for Applied Statistics  
and Economics  
School of Business and Economics  
Humboldt-Universität zu Berlin  
Spandauer Straße 1  
10178 Berlin  
Germany  
haerdle@wiwi.hu-berlin.de

*Professor Antony Unwin*

Mathematics Institute  
University of Augsburg  
86135 Augsburg  
Germany  
unwin@math.uni-augsburg.de

ISBN 978-3-540-33036-3

e-ISBN 978-3-540-33037-0

DOI 10.1007/978-3-540-33037-0

Library of Congress Control Number: 2007931825

© 2008 Springer-Verlag Berlin Heidelberg

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilm or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable for prosecution under the German Copyright Law.

The use of general descriptive names, registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

*Typesetting and Production:* LE- $\TeX$  Jelonek, Schmidt & Vöckler GbR, Leipzig, Germany  
*Cover:* deblik, Berlin, Germany

Printed on acid-free paper

9 8 7 6 5 4 3 2 1

springer.com

# Table of Contents

## I. Data Visualization

### I.1 Introduction

*Antony Unwin, Chun-houh Chen, Wolfgang K. Härdle* . . . . . 3

## II. Principles

### II.1 A Brief History of Data Visualization

*Michael Friendly* . . . . . 15

### II.2 Good Graphics?

*Antony Unwin* . . . . . 57

### II.3 Static Graphics

*Paul Murrell* . . . . . 79

### II.4 Data Visualization Through Their Graph Representations

*George Michailidis* . . . . . 103

### II.5 Graph-theoretic Graphics

*Leland Wilkinson* . . . . . 121

### II.6 High-dimensional Data Visualization

*Martin Theus* . . . . . 151

### II.7 Multivariate Data Glyphs: Principles and Practice

*Matthew O. Ward* . . . . . 179

### II.8 Linked Views for Visual Exploration

*Adalbert Wilhelm* . . . . . 199

### II.9 Linked Data Views

*Graham Wills* . . . . . 217

### II.10 Visualizing Trees and Forests

*Simon Urbanek* . . . . . 243

### III. Methodologies

<b>III.1 Interactive Linked Micromap Plots for the Display of Geographically Referenced Statistical Data</b>	
<i>Jürgen Symanzik, Daniel B. Carr</i> . . . . .	267
<b>III.2 Grand Tours, Projection Pursuit Guided Tours, and Manual Controls</b>	
<i>Dianne Cook, Andreas Buja, Eun-Kyung Lee, Hadley Wickham</i> . . . . .	295
<b>III.3 Multidimensional Scaling</b>	
<i>Michael A.A. Cox, Trevor F. Cox</i> . . . . .	315
<b>III.4 Huge Multidimensional Data Visualization: Back to the Virtue of Principal Coordinates and Dendrograms in the New Computer Age</b>	
<i>Francesco Palumbo, Domenico Vistocco, Alain Morineau</i> . . . . .	349
<b>III.5 Multivariate Visualization by Density Estimation</b>	
<i>Michael C. Minnotte, Stephan R. Sain, David W. Scott</i> . . . . .	389
<b>III.6 Structured Sets of Graphs</b>	
<i>Richard M. Heiberger, Burt Holland</i> . . . . .	415
<b>III.7 Regression by Parts: Fitting Visually Interpretable Models with GUIDE</b>	
<i>Wei-Yin Loh</i> . . . . .	447
<b>III.8 Structural Adaptive Smoothing by Propagation–Separation Methods</b>	
<i>Jörg Polzehl, Vladimir Spokoiny</i> . . . . .	471
<b>III.9 Smoothing Techniques for Visualisation</b>	
<i>Adrian W. Bowman</i> . . . . .	493
<b>III.10 Data Visualization via Kernel Machines</b>	
<i>Yuan-chin Ivan Chang, Yuh-Jye Lee, Hsing-Kuo Pao, Mei-Hsien Lee, Su-Yun Huang</i> . . . . .	539
<b>III.11 Visualizing Cluster Analysis and Finite Mixture Models</b>	
<i>Friedrich Leisch</i> . . . . .	561
<b>III.12 Visualizing Contingency Tables</b>	
<i>David Meyer, Achim Zeileis, Kurt Hornik</i> . . . . .	589
<b>III.13 Mosaic Plots and Their Variants</b>	
<i>Heike Hofmann</i> . . . . .	617
<b>III.14 Parallel Coordinates: Visualization, Exploration and Classification of High-Dimensional Data</b>	
<i>Alfred Inselberg</i> . . . . .	643
<b>III.15 Matrix Visualization</b>	
<i>Han-Ming Wu, ShengLi Tzeng, Chun-Houh Chen</i> . . . . .	681
<b>III.16 Visualization in Bayesian Data Analysis</b>	
<i>Jouni Kerman, Andrew Gelman, Tian Zheng, Yuejing Ding</i> . . . . .	709
<b>III.17 Programming Statistical Data Visualization in the Java Language</b>	
<i>Junji Nakano, Yoshikazu Yamamoto, Keisuke Honda</i> . . . . .	725
<b>III.18 Web-Based Statistical Graphics using XML Technologies</b>	
<i>Yoshiro Yamamoto, Masaya Iizuka, Tomokazu Fujino</i> . . . . .	757

---

## IV. Selected Applications

### IV.1 Visualization for Genetic Network Reconstruction

*Grace S. Shieh, Chin-Yuan Guo* ..... 793

### IV.2 Reconstruction, Visualization and Analysis of Medical Images

*Henry Horng-Shing Lu* ..... 813

### IV.3 Exploratory Graphics of a Financial Dataset

*Antony Unwin, Martin Theus, Wolfgang K. Härdle* ..... 831

### IV.4 Graphical Data Representation in Bankruptcy Analysis

*Wolfgang K. Härdle, Rouslan A. Moro, Dorothea Schäfer* ..... 853

### IV.5 Visualizing Functional Data with an Application

#### to eBay's Online Auctions

*Wolfgang Jank, Galit Shmueli, Catherine Plaisant, Ben Shneiderman* ..... 873

### IV.6 Visualization Tools for Insurance Risk Processes

*Krzysztof Burnecki, Rafał Weron* ..... 899