

Wolfgang Härdle · Yuichi Mori
Philippe Vieu

Statistical Methods for Biostatistics and Related Fields

With 91 Figures and 57 Tables



Contents

| | |
|---|----------|
| I Biostatistics | 1 |
| 1 Discriminant Analysis Based on Continuous and Discrete Variables | 3 |
| <i>Avner Bar-Hen and Jean-Jacques Daudin</i> | |
| 1.1 Introduction | 3 |
| 1.2 Generalisation of the Mahalanobis Distance | 4 |
| 1.2.1 Introduction | 4 |
| 1.2.2 Kullback–Leibler Divergence | 5 |
| 1.2.3 Asymptotic Distribution of Matusita Distance | 10 |
| 1.2.4 Simulations | 12 |
| 1.3 Methods and Stopping Rules for Selecting Variables | 13 |
| 1.4 Reject Option | 15 |
| 1.4.1 Distributional Result | 15 |
| 1.4.2 Derivation of the Preliminary Test | 18 |
| 1.5 Example | 22 |
| 1.5.1 Location Model | 22 |
| 1.5.2 Comparison with the Linear Discriminant Analysis | 24 |
| 1.5.3 Conclusion | 24 |
| Bibliography | 25 |

| | |
|--|-----------|
| 2 Longitudinal Data Analysis with Linear Regression | 29 |
| <i>Jörg Breitung, Rémy Slama and Axel Werwatz</i> | |
| 2.1 Introduction | 29 |
| 2.2 Theoretical Aspects | 32 |
| 2.2.1 The Fixed-effect Model | 32 |
| 2.2.2 The Random Effects Model | 36 |
| 2.3 Computing Fixed and Random-effect Models | 37 |
| 2.3.1 Data Preparation | 37 |
| 2.3.2 Fixed and Random-effect Linear Regression | 38 |
| 2.3.3 Options for <code>panfix</code> | 38 |
| 2.3.4 Options for <code>panrand</code> | 39 |
| 2.4 Application | 40 |
| 2.4.1 Results | 41 |
| Bibliography | 43 |
| 3 A Kernel Method Used for the Analysis of Replicated Micro-array Experiments | 45 |
| <i>Ali Gannoun, Beno Liquetît, Jérôme Saracco and Wolfgang Urfer</i> | |
| 3.1 Introduction | 45 |
| 3.2 Statistical Model and Some Existing Methods | 46 |
| 3.2.1 The Basic Model | 47 |
| 3.2.2 The T-test | 47 |
| 3.2.3 The Mixture Model Approach | 48 |
| 3.3 A Fully Nonparametric Approach | 49 |
| 3.3.1 Kernel Estimation of f_0 and f | 50 |
| 3.3.2 The Reflection Approach in Kernel Estimation | 50 |
| 3.3.3 Implementation of the Nonparametric Method | 51 |
| 3.4 Data Analysis | 52 |
| 3.4.1 Results Obtained with the Normal Mixture Model | 53 |

| | |
|--|-----------|
| 3.4.2 Results Obtained with the Nonparametric Approach | 53 |
| 3.4.3 A Simulation Study | 56 |
| 3.5 Discussion and Concluding Remarks | 58 |
| Bibliography | 59 |
| 4 Kernel Estimates of Hazard Functions for Biomedical Data Sets | 63 |
| <i>Ivana Horová and Jiří Zelinka</i> | |
| 4.1 Introduction | 63 |
| 4.2 Kernel Estimate of the Hazard Function and Its Derivatives | 64 |
| 4.3 Choosing the Shape of the Kernel | 68 |
| 4.4 Choosing the Bandwidth | 69 |
| 4.5 Description of the Procedure | 74 |
| 4.6 Application | 75 |
| Bibliography | 83 |
| 5 Partially Linear Models | 87 |
| <i>Wolfgang Härdle and Hua Liang</i> | |
| 5.1 Introduction | 87 |
| 5.2 Estimation and Nonparametric Fits | 89 |
| 5.2.1 Kernel Regression | 89 |
| 5.2.2 Local Polynomial | 90 |
| 5.2.3 Piecewise Polynomial | 93 |
| 5.2.4 Least Square Spline | 96 |
| 5.3 Heteroscedastic Cases | 97 |
| 5.3.1 Variance Is a Function of Exogenous Variables | 98 |
| 5.3.2 Variance Is an Unknown Function of T | 99 |
| 5.3.3 Variance Is a Function of the Mean | 99 |
| 5.4 Real Data Examples | 100 |
| Bibliography | 102 |

| | |
|--|------------|
| 6 Analysis of Contingency Tables | 105 |
| <i>Masahiro Kuroda</i> | |
| 6.1 Introduction | 105 |
| 6.2 Log-linear Models | 105 |
| 6.2.1 Log-linear Models for Two-way Contingency Tables . | 106 |
| 6.2.2 Log-linear Models for Three-way Contingency Tables . | 107 |
| 6.2.3 Generalized Linear Models | 109 |
| 6.2.4 Fitting to Log-linear Models | 111 |
| 6.3 Inference for Log-linear Models Using XploRe | 113 |
| 6.3.1 Estimation of the Parameter Vector λ | 113 |
| 6.3.2 Computing Statistics for the Log-linear Models | 113 |
| 6.3.3 Model Comparison and Selection | 114 |
| 6.4 Numerical Analysis of Contingency Tables | 115 |
| 6.4.1 Testing Independence | 115 |
| 6.4.2 Model Comparison | 119 |
| Bibliography | 124 |
| 7 Identifying Coexpressed Genes | 125 |
| <i>Qihua Wang</i> | |
| 7.1 Introduction | 125 |
| 7.2 Methodology and Implementation | 127 |
| 7.2.1 Weighting Adjustment | 128 |
| 7.2.2 Clustering | 132 |
| 7.3 Concluding Remarks | 142 |
| Bibliography | 144 |

| | |
|--|------------|
| 8 Bootstrap Methods for Testing Interactions in GAMs | 147 |
| <i>Javier Roca-Pardiñas, Carmen Cadarso-Suárez and Wenceslao González-Manteiga</i> | |
| 8.1 Introduction | 147 |
| 8.2 Logistic GAM with Interactions | 149 |
| 8.2.1 Estimation: the Local Scoring Algorithm | 150 |
| 8.3 Bootstrap-based Testing for Interactions | 152 |
| 8.3.1 Likelihood Ratio-based Test | 153 |
| 8.3.2 Direct Test | 153 |
| 8.3.3 Bootstrap Approximation | 153 |
| 8.4 Simulation Study | 154 |
| 8.5 Application to Real Data Sets | 156 |
| 8.5.1 Neural Basis of Decision Making | 156 |
| 8.5.2 Risk of Post-operative Infection | 159 |
| 8.6 Discussion | 162 |
| 8.7 Appendix | 163 |
| Bibliography | 165 |
| 9 Survival Trees | 167 |
| <i>Carmela Cappelli and Heping Zhang</i> | |
| 9.1 Introduction | 167 |
| 9.2 Methodology | 170 |
| 9.2.1 Splitting Criteria | 170 |
| 9.2.2 Pruning | 173 |
| 9.3 The Quantlet stree | 174 |
| 9.3.1 Syntax | 174 |
| 9.3.2 Example | 175 |
| Bibliography | 179 |