

Contents

Preface	xii
1 Representation and Geometry of Multivariate Data	1
1.1 Introduction, 1	
1.2 Historical Perspective, 4	
1.3 Graphical Display of Multivariate Data Points, 5	
1.4 Graphical Display of Multivariate Functionals, 16	
1.5 Geometry of Higher Dimensions, 27	
Problems, 31	
2 Nonparametric Estimation Criteria	33
2.1 Estimation of the Cumulative Distribution Function, 34	
2.2 Direct Nonparametric Estimation of the Density, 35	
2.3 Error Criteria for Density Estimates, 37	
2.4 Nonparametric Families of Distributions, 43	
Problems, 45	
3 Histograms: Theory and Practice	47
3.1 Sturges' Rule for Histogram Bin Width Selection, 47	
3.2 The L_2 Theory of Univariate Histograms, 49	
3.3 Practical Data-Based Bin Width Rules, 72	
3.4 L_2 Theory for Multivariate Histograms, 80	
3.5 Modes and Bumps in a Histogram, 86	
3.6 Other Error Criteria: L_1, L_4, L_6, L_8 , and L_∞ , 90	
Problems, 91	

4 Frequency Polygons	95
4.1 Univariate Frequency Polygons,	95
4.2 Multivariate Frequency Polygons,	106
4.3 Bin Edge Problems,	109
Problems,	111
5 Averaged Shifted Histograms	113
5.1 Construction,	113
5.2 Asymptotic Properties,	116
5.3 The Limiting ASH as a Kernel Estimator,	121
Problems,	124
6 Kernel Density Estimators	125
6.1 Motivation for Kernel Estimators,	125
6.2 Theoretical Properties: Univariate Case,	130
6.3 Theoretical Properties: Multivariate Case,	149
6.4 Generality of the Kernel Method,	155
6.5 Cross-Validation,	160
6.6 Adaptive Smoothing,	181
Problems,	190
7 The Curse of Dimensionality and Dimension Reduction	195
7.1 Introduction,	195
7.2 Curse of Dimensionality,	198
7.3 Dimension Reduction,	206
Problems,	216
8 Nonparametric Regression and Additive Models	219
8.1 Nonparametric Kernel Regression,	219
8.2 General Linear Nonparametric Estimation,	226
8.3 Robustness,	232
8.4 Regression in Several Dimensions,	236
8.5 Summary,	244
Problems,	244

9 Other Applications	247
9.1 Classification, Discrimination, and Likelihood Ratios, 247	
9.2 Modes and Bump Hunting, 253	
9.3 Specialized Topics, 257	
Problems, 265	
Appendix A Computer Graphics in \Re^3	267
A.1 Bivariate and Trivariate Contouring Display, 267	
A.2 Drawing 3-D Objects on the Computer, 271	
Appendix B Data Sets	273
B.1 United States Economic Variables Data, 273	
B.2 University Data, 274	
B.3 Blood Fat Concentration Data, 275	
B.4 Penny Thickness Data, 276	
B.5 Gas Meter Accuracy Data, 276	
B.6 Old Faithful Data, 278	
B.7 Silica Data, 279	
B.8 LRL Data, 279	
B.9 Buffalo Snowfall Data, 279	
Appendix C Notation	281
References	285
Author Index	301
Subject Index	305