

Contents

PREFACE	v
NOTATION	xv
1. INTRODUCTION	1
1.1 Regression Analysis	1
1.2 Nonparametric Regression	6
1.3 Scope	11
2. WHAT IS A GOOD ESTIMATOR?	15
2.1 Performance Criteria	15
2.2 Estimating $P(\lambda)$ and $R(\lambda)$	23
2.3 Other Properties of CV and GCV	35
2.4 Other Criteria	38
Exercises	41
3. FUNCTION SPACES AND SERIES ESTIMATORS	49
3.1 Introduction	49
3.2 Some Function Space Theory	51
3.3 Generalized Fourier Series Estimators	58
3.4 Classical Fourier Series Estimators	64
3.4.1 Form of the Estimator	65
3.4.2 Some Asymptotic Theory	69
3.4.3 Selection of λ	76
3.4.4 Asymptotic Distribution Theory	76
3.4.5 An Example	82
3.5 Polynomial Regression	89
3.5.1 Form of the Estimator	92
3.5.2 Some Asymptotic Theory	94
3.5.3 An Example	100
Exercises	101
4. KERNEL ESTIMATORS	109
4.1 Introduction	109
4.2 Kernel Estimators	110
4.3 Asymptotic Theory	124
4.4 Selecting a Kernel	136
4.5 Selection of λ	139

4.6	Asymptotic Distribution Theory	144
4.7	Higher Order Kernels, Variable Bandwidths and Optimal Design	149
4.8	Estimation of Derivatives	155
4.9	Applications	159
4.10	Random t's	167
4.11	Robust Smoothers	173
	Exercises	176
5.	SMOOTHING SPLINES	189
5.1	Introduction	189
5.2	Smoothing Splines and Polynomial Regression	191
5.3	Derivation and Computation of the Estimator	195
5.3.1	Splines and Natural Splines	196
5.3.2	Form of the Estimator	200
5.3.3	Selecting a Basis	207
5.4	Selecting λ and m	220
5.5	Bayesian Interpretations and Inference	233
5.5.1	Bayesian Polynomial Regression	233
5.5.2	Selection of λ in the Bayes Model	242
5.5.3	Estimation of σ^2 and σ_s^2	248
5.5.4	Interval Estimation	250
5.5.5	Diagnostic Analysis	258
	Exercises	268
6.	SMOOTHING SPLINES: EXTENSIONS AND ASYMPTOTIC THEORY	275
6.1	Introduction	275
6.2	Extensions	276
6.2.1	The Method of Regularization	276
6.2.2	Constraints	283
6.2.3	Multivariate Smoothing Splines	286
6.2.4	Partial Splines	292
6.2.5	Robust Smoothing Splines	294
6.2.6	The Penalty Function Method	295
6.3	Asymptotic Theory	298
6.3.1	Periodic Smoothing Splines	299
6.3.2	The General Case	314
6.3.3	Asymptotics for Smoothing Spline Variants	328
6.4	Applications	331
6.4.1	Estimation of Posterior Probabilities	331
6.4.2	Estimation of Tumor Size Distributions	334
6.4.3	The Stack Loss Data Revisited	338
6.4.4	Other Applications	348
	Exercises	348
7.	LEAST-SQUARES SPLINES AND OTHER ESTIMATORS	353
7.1	Introduction	353
7.2	Least-Squares Splines	354
7.2.1	Selecting λ	357

7.2.2	Computational Considerations	363
7.2.3	Extensions	367
7.2.4	Asymptotic Analysis	373
7.2.5	Other Inference Problems	376
7.3	Speckman's Minimax Estimator	378
7.4	Nearest Neighbor Estimators	384
7.5	Additive Nonparametric Regression	387
	Exercises	395
APPENDIX: LINEAR AND NONLINEAR REGRESSION		399
A.1	Linear Models	399
A.1.1	Parameter Estimation	400
A.1.2	Hypothesis Tests/Interval Estimates	403
A.1.3	Diagnostic Analysis	404
A.2	Nonlinear Models	407
A.2.1	Parameter Estimation	407
A.2.2	Hypothesis Tests/Interval Estimates	411
A.2.3	Diagnostic Analysis	412
REFERENCES		415
INDEX		435