

Contents

PREFACE	iii
1/ INTRODUCTION TO REGRESSION MODELS	1
1.1 Linear Regression Models	1
1.2 Nonlinear Regression Models	5
1.3 Geometrical Representation of Nonlinear Regression Models	7
1.4 The Concept of Nonlinear Estimation Behavior of Nonlinear Regression Models	10
Exercises	11
2/ ASSESSING NONLINEARITY IN NONLINEAR REGRESSION MODELS	13
2.1 Introduction	13
2.2 Obtaining the LS Estimates of the Parameters	15
2.3 Goodness of Fit of a Model	17
2.4 The Curvature Measures of Nonlinearity of Bates and Watts	18
2.5 The Bias Calculation of M. J. Box	20
2.6 Simulation Studies	23
2.7 Confidence Regions for the Parameters	30
2.8 t-Values for the Parameter Estimates	33
2.9 Asymmetry Measure of Bias	34
2.10 Some Remarks on Reparameterizations	37
Appendix 2.A: The Gauss-Newton Method	39
Appendix 2.B: The Curvature Measures of Nonlinearity	42
Exercises	46
3/ YIELD-DENSITY MODELS	49
3.1 Introduction	49
3.2 Examination of Nonlinearity in the Yield-Density Models	51
3.3 Choice of Yield-Density Model	56
Appendix 3.A: Data Sets	58
Appendix 3.B: LS Estimates of Parameters in Yield-Density Models	59
Exercises	59

4/	SIGMOIDAL GROWTH MODELS	61
4.1	Introduction	61
4.2	Stability of Parameter Estimates to Varying Assumptions About the Error Term	63
4.3	Examination of Nonlinearity in the Sigmoidal Growth Models	66
4.4	Searching for Better Parameterizations of the Growth Models	69
4.4.1	Gompertz model	69
4.4.2	Logistic model	71
4.4.3	Richards model	73
4.4.4	Morgan-Mercer-Flodin (MMF) model	75
4.4.5	Weibull-type model	79
4.5	Choice of Growth Model or Model Function	83
4.6	Interpretation of the Parameters in the Sigmoidal Growth Models	87
	Appendix 4.A: Data Sets	88
	Exercises	89
5/	ASYMPTOTIC REGRESSION MODEL	93
5.1	Introduction	93
5.2	Examination of Nonlinearity in the Asymptotic Regression Model	95
5.3	Positioning the Design Values X	97
5.4	Choice of Model Function for the Asymptotic Regression Model	100
	Appendix 5.A: Data Sets	101
	Exercises	103
6/	SOME MISCELLANEOUS MODELS	105
6.1	Introduction	105
6.2	Model Relating the Age of Wild Rabbits to the Weight of Their Eye Lenses	105
6.3	Model Describing Catalytic Chemical Reaction	110
6.4	Model and Data Set from a Paper of Meyer and Roth (1972)	116
6.5	Model Relating the Resistance of a Thermistor to Temperature	119
6.6	Bent-Hyperbola Regression Models	122
	Exercises	133
7/	COMPARING PARAMETER ESTIMATES FROM MORE THAN ONE DATA SET	135
7.1	Introduction	135
7.2	Comparing Parameter Estimates in Linear Models	135
7.3	Comparing Parameter Estimates in Nonlinear Models	143
7.4	Discussion of Comparison of Parameters Procedures	149
	Exercises	151

8/	OBTAINING GOOD INITIAL PARAMETER ESTIMATES	155
8.1	Introduction	155
8.2	Initial Parameter Estimates for Yield-Density Models	156
8.2.1	Holliday model	156
8.2.2	Farazdaghi-Harris model	160
8.2.3	Bleasdale-Nelder model	162
8.3	Initial Parameter Estimates for Sigmoidal Growth Models	163
8.3.1	Gompertz model	164
8.3.2	Logistic model	167
8.3.3	Richards model	169
8.3.4	Morgan-Mercer-Flodin (MMF) model	172
8.3.5	Weibull-type model	175
8.4	Initial Parameter Estimates for the Asymptotic Regression Model	178
8.5	Summary	180
	Exercises	181
9/	SUMMARY: TOWARD A UNIFIED APPROACH TO NONLINEAR REGRESSION MODELING	183
9.1	Introduction	183
9.2	Consequences of Intrinsic Nonlinearity	184
9.3	Consequences of Parameter-Effects Nonlinearity	189
9.4	Some Fallacies in Nonlinear Regression Modeling	191
9.4.1	Parameter correlation and nonlinear behavior	191
9.4.2	Linear-appearing and nonlinear-appearing parameters	196
9.5	Recommendations to the Modeler on the Procedure for Examining Nonlinear Behavior	198
	Exercises	202
	REFERENCES	205
	APPENDIX	209
	SOLUTIONS TO EXERCISES	255
	AUTHOR INDEX	271
	SUBJECT INDEX	273