CONTENTS

1 Introduction to the Logistic Regression Model 1

1.1 Introduction, 1
1.2 Fitting the Logistic Regression Model, 7
1.3 Testing for the Significance of the Coefficients, 11
1.4 Confidence Interval Estimation, 17
1.5 Other Methods of Estimation, 21
1.6 Data Sets, 23
1.6.1 The ICU Study, 23
1.6.2 The Low Birth Weight Study, 25
1.6.3 The Prostate Cancer Study, 26
1.6.4 The UMARU IMPACT Study, 27
Exercises, 28

2 Multiple Logistic Regression 31

2.1 Introduction, 31
2.2 The Multiple Logistic Regression Model, 31
2.3 Fitting the Multiple Logistic Regression Model, 33
2.4 Testing for the Significance of the Model, 36
2.5 Confidence Interval Estimation, 40
2.6 Other Methods of Estimation, 43
Exercises, 44

3 Interpretation of the Fitted Logistic Regression Model 47

3.1 Introduction, 47
3.2 Dichotomous Independent Variable, 48
3.3 Polychotomous Independent Variable, 56
3.4 Continuous Independent Variable, 63
3.5 The Multivariable Model, 64
3.6 Interaction and Confounding, 70
3.7 Estimation of Odds Ratios in the Presence of Interaction, 74
3.8 A Comparison of Logistic Regression and Stratified Analysis for 2 × 2 Tables, 79
3.9 Interpretation of the Fitted Values, 85
Exercises, 88

4 Model-Building Strategies and Methods for

Logistic Regression **91**
4.1 Introduction, 91
4.2 Variable Selection, 92
4.3 Stepwise Logistic Regression, 116
4.4 Best Subsets Logistic Regression, 128
4.5 Numerical Problems, 135
Exercises, 142

5 Assessing the Fit of the Model **143**
5.1 Introduction, 143
5.2 Summary Measures of Goodness-of-Fit, 144
5.2.1 Pearson Chi-Square Statistic and Deviance, 145
5.2.2 The Hosmer-Lemeshow Tests, 147
5.2.3 Classification Tables, 156
5.2.4 Area Under the ROC Curve, 160
5.2.5 Other Summary Measures, 164
5.3 Logistic Regression Diagnostics, 167
5.4 Assessment of Fit via External Validation, 186
5.5 Interpretation and Presentation of Results from a Fitted Logistic Regression Model, 188
Exercises, 200

6 Application of Logistic Regression with Different Sampling Models **203**
6.1 Introduction, 203
6.2 Cohort Studies, 203
6.3 Case-Control Studies, 205
6.4 Fitting Logistic Regression Models to Data from Complex Sample Surveys, 211
Exercises, 222

7 Logistic Regression for Matched Case-Control Studies **223**
7.1 Introduction, 223
7.2 Logistic Regression Analysis for the 1–1 Matched Study, 226
7.3 An Example of the Use of the Logistic Regression Model in a 1–1 Matched Study, 230
7.4 Assessment of Fit in a Matched Study, 236
7.5 An Example of the Use of the Logistic Regression Model in a 1–M Matched Study, 243
7.6 Methods for Assessment of Fit in a 1–M

Matched Study, 248
7.7 An Example of Assessment of Fit in a 1–*M* Matched Study, 252
Exercises, 259

8 Special Topics **260**
8.1 The Multinomial Logistic Regression Model, 260
8.1.1 Introduction to the Model and Estimation of the Parameters, 260
8.1.2 Interpreting and Assessing the Significance of the Estimated Coefficients, 264
8.1.3 Model-Building Strategies for Multinomial Logistic Regression, 273
8.1.4 Assessment of Fit and Diagnostics for the Multinomial Logistic Regression Model, 280
8.2 Ordinal Logistic Regression Models, 288
8.2.1 Introduction to the Models, Methods for Fitting and Interpretation of Model Parameters, 288
8.2.2 Model Building Strategies for Ordinal Logistic Regression Models, 305
8.3 Logistic Regression Models for the Analysis of Correlated Data, 308
8.4 Exact Methods for Logistic Regression Models, 330
8.5 Sample Size Issues When Fitting Logistic Regression Models, 339
Exercises, 347

Addendum **352**

References **354**

Index **369**