Contents

Preface vii

Acknowledgments xi

Chapter 1 **Introduction to Survival Analysis 1**

Introduction 2
Abbreviated Outline 2
Objectives 3
Presentation 4
Detailed Outline 44
Practice Exercises 50
Test 52
Answers to Practice Exercises 54

Chapter 2 **Kaplan-Meier Survival Curves and the Log-Rank Test 55**

Introduction 56
Abbreviated Outline 56
Objectives 57
Presentation 58
Detailed Outline 83
Practice Exercises 87
Test 91
Answers to Practice Exercises 93

Chapter 3 **The Cox Proportional Hazards Model and Its Characteristics 97**

Introduction 98
Abbreviated Outline 98
Objectives 99
Presentation 100
Detailed Outline 145
Practice Exercises 149
Test 153
Answers to Practice Exercises 157

Chapter 4 **Evaluating the Proportional Hazards Assumption 161**

Introduction 162
Abbreviated Outline 162
Objectives 163
Presentation 164
Detailed Outline 188
Practice Exercises 191
Test 194
Answers to Practice Exercises 197

Chapter 5 **The Stratified Cox Procedure 201**

Introduction 202
Abbreviated Outline 202
Objectives 203
Presentation 204
Detailed Outline 228
Practice Exercises 231
Test 234
Answers to Practice Exercises 237

Chapter 6 **Extension of the Cox Proportional Hazards Model for Time-Dependent Variables 241**

Introduction 242
Abbreviated Outline 242
Objectives 243
Presentation 244
Detailed Outline 278
Practice Exercises 281
Test 285
Answers to Practice Exercises 287

Chapter 7 **Parametric Survival Models 289**

Introduction 290
Abbreviated Outline 290
Objectives 291
Presentation 292
Detailed Outline 345
Practice Exercises 351
Test 356
Answers to Practice Exercises 359

Chapter 8 **Recurrent Event Survival Analysis 363**

Introduction 364
Abbreviated Outline 364
Objectives 365
Presentation 366
Detailed Outline 402
Practice Exercises 408
Test 412
Answers to Practice Exercises 422

Chapter 9 **Competing Risks Survival Analysis 425**

Introduction 426
Abbreviated Outline 428
Objectives 429
Presentation 430
Detailed Outline 474
Practice Exercises 481
Test 486
Answers to Practice Exercises 492

Chapter 10 **Design Issues for Randomized Trials 497**

Introduction 498
Abbreviated Outline 498
Objectives 499
Presentation 500
Detailed Outline 518
Practice Exercises 521
Test 523
Answers to Practice Exercises 523

Computer Appendix: Survival Analysis on the Computer 525

A. Stata 527
B. SAS 570
C. SPSS 607
D. R Software 620

Test Answers 665

References 690

Index 695