## Contents

Preface ix  

1 Introduction 1  
1.1 Panel Data: Some Examples 1  
1.2 Why Should We Use Panel Data? Their Benefits and Limitations 5  
Note 9  

2 The One-way Error Component Regression Model 11  
2.1 Introduction 11  
2.2 The Fixed Effects Model 12  
2.3 The Random Effects Model 15  
2.4 Maximum Likelihood Estimation 20  
2.5 Prediction 22  
2.6 Examples 23  
2.7 Selected Applications 26  
2.8 Computational Note 27  
Notes 27  
Problems 27  

3 The Two-way Error Component Regression Model 31  
3.1 Introduction 31  
3.2 The Fixed Effects Model 31  
3.3 The Random Effects Model 33  
3.4 Maximum Likelihood Estimation 39
## 8 Dynamic Panel Data Models

- **8.1 Introduction**
- **8.2 The Arellano and Bond Study**
- **8.3 The Arellano and Bover Study**
- **8.4 The Ahn and Schmidt Study**
- **8.5 The Blundell and Bond Study**
- **8.6 The Keane and Runkle Study**
- **8.7 Recent Developments**
- **8.8 Empirical Illustration**
- **8.9 Further Reading**

### Notes

### Problems

## 9 Unbalanced Panel Data Models

- **9.1 Introduction**
- **9.2 The Unbalanced One-way Error Component Model**
- **9.3 The Unbalanced Two-way Error Component Model**
- **9.4 Testing for Individual and Time Effects Using Unbalanced Panel Data**
- **9.5 The Unbalanced Nested Error Component Model**

### Notes

### Problems

## 10 Special Topics

- **10.1 Measurement Error and Panel Data**
- **10.2 Rotating Panels**
- **10.3 Pseudo-panels**
- **10.4 Alternative Methods of Pooling Time Series of Cross-section Data**
- **10.5 Spatial Panels**
- **10.6 Short-run vs Long-run Estimates in Pooled Models**
- **10.7 Heterogeneous Panels**

### Notes

### Problems
11 Limited Dependent Variables and Panel Data 205
  11.1 Fixed and Random Logit and Probit Models 206
  11.2 Fixed and Random Tobit Models 212
  11.3 Simulation Estimation of Limited Dependent Variable Models 
      with Panel Data 214
  11.4 State Dependence and Heterogeneity 215
  11.5 Selection Bias in Panel Data 219
  11.6 Empirical Applications 225
  11.7 Further Reading 226
  Notes 228
  Problems 229

12 Nonstationary Panels 233
  12.1 Introduction 233
  12.2 Panel Unit Root Tests 235
  12.3 Spurious Regression in Panel Data 243
  12.4 Panel Cointegration Tests 247
  12.5 Estimation and Inference in Panel Cointegration Models 252
  12.6 Further Reading 254
  Notes 254
  Problems 255

References 257

Index 285