Contents

Preface *page* xiii

1 Modeling Social Dynamics 1
1.1 Time Series Analysis 8
1.1.1 Contending Approaches and the Quasi-Experimental Tradition 9
1.1.2 The Architecture of the Book 10
1.2 Challenges in Time Series Modeling 11
1.2.1 Time Series Measurement 11
1.2.2 Fit: On the Use of Time Trends and Counters 18
1.2.3 Discerning Structural Change 19
1.3 The First Step 20
1.4 For Further Reading 21
2 Univariate Time Series Models 22
2.1 Understanding Univariate Processes 22
2.1.1 Why Stochastic Models of Time Series? 23
2.1.2 White Noise 26
2.1.3 A Note on Notation 27
2.2 Univariate Processes 29
2.2.1 The Autoregressive (AR) Process 29
2.2.2 The Moving Average (MA) Process 32
2.2.3 The Equivalence of AR and MA Processes 33
2.3 Diagnosing Stationary Univariate Processes 34
2.3.1 The Autocorrelation Function (ACF) 35
2.3.2 The Partial Autocorrelation Function (PACF) 38
2.3.3 Seasonality 43

2.4 Model Estimation, Interpretation, and Diagnosis 44
2.4.1 Residual Analysis 46
2.4.2 Metadiagnosis 46
2.5 Application: U.S. Homicide Rates 48
2.6 Application: U.S. Relations with the Middle East 52
2.7 Intervention Models 58
2.7.1 Impact Assessment: Continuing the Middle East Example 64
2.7.2 Structural Breaks 65
2.8 Conclusion 66
2.9 For Further Reading 67

3 Dynamic Regression Models 68
3.1 Variations of the General Dynamic Regression Model 72
3.1.1 Building Blocks 73
3.1.2 Autoregressive Models/Lagged Endogenous Variables 74
3.1.3 The Workhorse Model 75
3.1.4 Serial Correlation: Tests and Solutions 76
3.2 Obtaining Consistent Estimates 78
3.2.1 Approach Number One: Pseudo-GLS Estimation 78
3.2.2 Approach Number Two: Hatanaka's Method 80
3.3 Illustration: Explaining Voting Intentions in the United Kingdom 81
3.3.1 Voting Intentions and Exchange Rates: Results 83
3.4 Dynamic Regression Models with Multiple Causal Variable Lags 87
3.4.1 Distributed Lag Models 87
3.4.2 Autoregressive Distributed Lag Models 88
3.5 Conclusion 90
3.6 For Further Reading 91

4 Modeling the Dynamics of Social Systems 92
4.1 Two Approaches to Multivariate Time Series Analysis 95
4.2 The Structural Equation Approach 97
4.2.1 The Workhorse Model of Time Series Regression Revisited 100
4.2.2 The Structural Equation Approach in Practice 101
4.2.3 Application: The Political Economy of Monetary Policy in the United Kingdom 102
4.3 Vector Autoregression 106
4.3.1 Terminology and Stationarity 107
4.3.2 Specification and Estimation 110
4.3.3 Tools for Inference in VAR Modeling 112
4.3.4 VAR Modeling in Practice 118
4.4 The Political Economy of Monetary Policy in the United Kingdom Revisited 119

4.5 Conclusion: SEQ and VAR Modeling Compared 122
4.6 For Further Reading 124

5 Univariate, Nonstationary Processes: Tests and Modeling 125
5.1 Stationary Data 125
5.2 Stationarity and Unit Root Tests 130
5.2.1 Dickey-Fuller and Augmented Dickey-Fuller Tests 132
5.2.2 Variance Ratio Test 135
5.2.3 Modified Rescaled Range Test 136
5.2.4 KPSS Test 137
5.2.5 Double Unit Roots 138
5.3 Application: Macropartisanship 138
5.3.1 Macropartisanship: Diagnostic Plots 139
5.3.2 Macropartisanship: Formal Statistical Tests 142
5.3.3 Macropartisanship: An ARIMA Model 147
5.4 Conclusion 148
5.5 For Further Reading 149

6 Cointegration and Error Correction Models 150
6.1 Introduction 150
6.2 The Intuition behind Cointegration 152
6.3 Estimating an ECM 160
6.3.1 Engle-Granger Regression-Based Approach 161
6.3.2 Johansen's VAR Approach 164
6.3.3 Application: The Engle-Granger Methodology and the Indo-Pakistani Arms Race 166
6.4 ECMs for Non-Integrated Data? 169
6.5 Conclusion 171
6.6 For Further Reading 171

7 Selections on Time Series Analysis 173
7.1 Fractional Integration 175
7.1.1 Fractional Cointegration 178
7.1.2 Near and Fractional Integration 179
7.2 Incorporating Heterogeneity 181
7.3 Forecasting 187
7.3.1 Purpose and Definitions 188
7.3.2 Approaches to Forecasting 193
7.3.3 Criteria for Determining Optimum Forecast 199
7.3.4 Illustration: Forecasts of the U.S. Uniform Crime Reports Homicide Data, 1975–1993 200
7.3.5 Forecasting Discussion 202
7.4 Estimating and Modeling with Unknown Structural Breaks 205
7.4.1 Identifying a Single Unknown Structural Break 206
7.4.2 Identifying Multiple Unknown Structural Breaks 207

7.4.3 Hypothesis Tests for Multiple Structural Breaks 209
7.5 Conclusion 211
7.6 For Further Reading 212
8 Concluding Thoughts for the Time Series Analyst 214
8.1 A Review 215
8.2 Looking Ahead 217
Appendix: Time Series Models as Difference Equations 219
A.1 Introduction 219
A.2 The Nature of Difference Equation Models 226
A.2.1 Expressing Difference Equations 226
A.2.2 The Solutions of Difference Equations 229
A.3 Finding the Solutions of Difference Equation Models 240
A.3.1 Solving the Most Simple First-Order Difference Equations 240
A.3.2 Solving More Complicated Difference Equations 246
A.3.3 Solving Systems of Difference Equations 259
A.4 Bring on the Data 261
Bibliography 263
Index 277