
CONTENTS

CHAPTER 1: INTRODUCTION, 1

- 1.1 Examples of Time Series, 1
- 1.2 Model-Building Strategy, 2
- 1.3 Time Series Plots, 6
- 1.4 Overview of the Book, 8

CHAPTER 2: FUNDAMENTAL CONCEPTS, 9

- 2.1 Time Series and Stochastic Processes, 9
- 2.2 Means and Covariances, 10
- 2.3 Stationarity, 14
- Appendix A: Expectation, Variance, and Covariance, 22

CHAPTER 3: TRENDS, 25

- 3.1 Deterministic versus Stochastic Trends, 25
- 3.2 Estimation of a Constant Mean, 26
- 3.3 Regression Methods, 28
- 3.4 Reliability and Efficiency of Regression Estimates, 35
- 3.5 Interpreting the Regression Output, 39
- 3.6 Residual Analysis, 40

CHAPTER 4: MODELS FOR STATIONARY TIME SERIES, 52

- 4.1 General Linear Processes, 52
- 4.2 Moving Average Processes, 54
- 4.3 Autoregressive Processes, 59
- 4.4 The Mixed Autoregressive–Moving Average Model, 71
- 4.5 Invertibility, 73

- Appendix B:** Simulation of ARMA Models with Minitab, 76
Appendix C: Stationarity Checking via Schur's Theorem, 80
Appendix D: The Autocorrelation Function for ARMA(p, q), 82

CHAPTER 5: MODELS FOR NONSTATIONARY SERIES, 83

- 5.1** Stationarity through Differencing, 84
5.2 ARIMA Models, 88
5.3 Constant Terms in ARIMA Models, 93
5.4 Other Transformations, 94
Appendix E: The Backshift Operator, 101

CHAPTER 6: MODEL SPECIFICATION, 103

- 6.1** Properties of the Sample Autocorrelation Function, 103
6.2 The Partial Autocorrelation Function, 106
6.3 Simulated Series, 109
6.4 Nonstationarity, 117
6.5 Specification of Some Actual Time Series, 119
6.6 Other Specification Methods, 122

CHAPTER 7: PARAMETER ESTIMATION, 125

- 7.1** The Method of Moments, 125
7.2 Least Squares Estimation, 129
7.3 Maximum Likelihood and Unconditional Least Squares, 134
7.4 Properties of the Estimates, 137
7.5 The Minitab ARIMA Command, 139

CHAPTER 8: MODEL DIAGNOSTICS, 144

- 8.1** Residual Analysis, 144
8.2 Overfitting and Parameter Redundancy, 154

CHAPTER 9: FORECASTING, 161

- 9.1** Minimum Mean Square Error Forecasts, 161
9.2 Deterministic Trends, 161

- 9.3 ARIMA Forecasting, 163
- 9.4 Prediction Limits, 172
- 9.5 Forecasting and Prediction Limits with Minitab, 175
- 9.6 Updating ARIMA Forecasts, 179
- 9.7 Forecast Weights and Exponentially Weighted Moving Averages, 180
- 9.8 Forecasting Transformed Series, 182
- 9.9 Summary of Forecasting with Certain ARIMA Models, 184
- Appendix F: Conditional Expectation, 187
- Appendix G: Minimum Mean Square Error Prediction, 188
- Appendix H: The Truncated Linear Process, 191
- Appendix I: Backcasting, 194

CHAPTER 10: SEASONAL MODELS, 196

- 10.1 Seasonal ARMA Models, 196
- 10.2 Multiplicative Seasonal ARMA Models, 198
- 10.3 Nonstationary Seasonal ARIMA Models, 200
- 10.4 Model Specification, Fitting and Checking, 201
- 10.5 Forecasting Seasonal Models, 216

CHAPTER 11 SPECIAL TOPICS, 231

- 11.1 Combined Deterministic Trend/ARIMA Models, 231
- 11.2 State Space Models, 234
- 11.3 Missing Data, 240
- 11.4 Calendar Problems—Holiday and Trading Day Variations, 244
- 11.5 Outliers, 245
- 11.6 Nonnormal Models, 250
- Appendix J: Minitab Primer, 256
- Appendix K: Data Sets, 268

References and Bibliography, 271

Answers to Selected Exercises, 279

Index, 281