

# Table of Contents

|                                                                       |           |
|-----------------------------------------------------------------------|-----------|
| <b>1 Introduction</b>                                                 | <b>1</b>  |
| <b>2 Basic Probability Theory and Markov Chains</b>                   | <b>5</b>  |
| 2.1 Random Variables                                                  | 5         |
| 2.2 Function of Random Variable                                       | 7         |
| 2.3 Normal Random Variable                                            | 8         |
| 2.4 Lognormal Random Variable                                         | 9         |
| 2.5 Markov Chains                                                     | 10        |
| 2.6 Passage Time                                                      | 14        |
| 2.7 Examples and Exercises                                            | 16        |
| References                                                            | 17        |
| <b>3 Estimation Techniques</b>                                        | <b>19</b> |
| 3.1 Models, Parameters and Likelihood - An Overview                   | 19        |
| 3.2 Maximum Likelihood Estimation and Covariance Matrix of Parameters | 20        |
| 3.3 MLE Example — Classical Linear Regression                         | 22        |
| 3.4 Dependent Observations                                            | 23        |
| 3.5 Prediction Error Decomposition                                    | 24        |
| 3.6 Serially Correlated Errors - Overview                             | 25        |
| 3.7 Constrained Optimization and the Covariance Matrix                | 27        |
| 3.8 Examples and Exercises                                            | 28        |
| References                                                            | 29        |
| <b>4 Non-Parametric Method of Estimation</b>                          | <b>31</b> |
| 4.1 Background                                                        | 31        |
| 4.2 Non-Parametric Approach                                           | 32        |
| 4.3 Kernel Regression                                                 | 33        |
| 4.4 Illustration 1 (EViews)                                           | 35        |
| 4.5 Optimal Bandwidth Selection                                       | 36        |
| 4.6 Illustration 2 (EViews)                                           | 36        |
| 4.7 Examples and Exercises                                            | 38        |
| References                                                            | 39        |

|                                                              |                |
|--------------------------------------------------------------|----------------|
| <b>5 Unit Root, Cointegration and Related Issues</b>         | <b>41</b>      |
| 5.1 Stationary Process                                       | 41             |
| 5.2 Unit Root                                                | 44             |
| 5.3 Dickey-Fuller Test                                       | 46             |
| 5.4 Cointegration                                            | 49             |
| 5.5 Residual-based Cointegration Test                        | 50             |
| 5.6 Unit Root in a Regression Model                          | 51             |
| 5.7 Application to Stock Markets                             | 52             |
| References                                                   | 54             |
| <br><b>6 VAR Modeling</b>                                    | <br><b>55</b>  |
| 6.1 Stationary Process                                       | 55             |
| 6.2 Granger Causality                                        | 57             |
| 6.3 Cointegration and Error Correction                       | 59             |
| 6.4 Johansen Test                                            | 61             |
| 6.5 LA-VAR                                                   | 62             |
| 6.6 Application to Stock Prices                              | 64             |
| References                                                   | 65             |
| <br><b>7 Time Varying Volatility Models</b>                  | <br><b>67</b>  |
| 7.1 Background                                               | 67             |
| 7.2 ARCH and GARCH Models                                    | 68             |
| 7.3 TGARCH and EGARCH Models                                 | 71             |
| 7.4 Causality-in-Variance Approach                           | 74             |
| 7.5 Information Flow between Price Change and Trading Volume | 77             |
| References                                                   | <b>81</b>      |
| <br><b>8 State-Space Models (I)</b>                          | <br><b>83</b>  |
| 8.1 Background                                               | 83             |
| 8.2 Classical Regression                                     | 83             |
| 8.3 Important Time Series Processes                          | 86             |
| 8.4 Recursive Least Squares                                  | 89             |
| 8.5 State-Space Representation                               | 91             |
| 8.6 Examples and Exercises                                   | 94             |
| References                                                   | 103            |
| <br><b>9 State-Space Models (II)</b>                         | <br><b>105</b> |
| 9.1 Likelihood Function Maximization                         | 105            |
| 9.2 EM Algorithm                                             | 108            |

|                                                                        |            |
|------------------------------------------------------------------------|------------|
| 9.3 Time Varying Parameters and Changing Conditional Variance (EViews) | 111        |
| 9.4 GARCH and Stochastic Variance Model for Exchange Rate (EViews)     | 113        |
| 9.5 Examples and Exercises                                             | 116        |
| References                                                             | 126        |
| <b>10 Discrete Time Real Asset Valuation Model</b>                     | <b>127</b> |
| 10.1 Asset Price Basics                                                | 127        |
| 10.2 Mining Project Background                                         | 129        |
| 10.3 Example 1                                                         | 130        |
| 10.4 Example 2                                                         | 131        |
| 10.5 Example 3                                                         | 133        |
| 10.6 Example 4                                                         | 135        |
| Appendix                                                               | 138        |
| References                                                             | 140        |
| <b>11 Discrete Time Model of Interest Rate</b>                         | <b>141</b> |
| 11.1 Preliminaries of Short Rate Lattice                               | 141        |
| 11.2 Forward Recursion for Lattice and Elementary Price                | 145        |
| 11.3 Matching the Current Term Structure                               | 148        |
| 11.4 Immunization: Application of Short Rate Lattice                   | 149        |
| 11.5 Valuing Callable Bond                                             | 152        |
| 11.6 Exercises                                                         | 153        |
| References                                                             | 154        |
| <b>12 Global Bubbles in Stock Markets and Linkages</b>                 | <b>155</b> |
| 12.1 Introduction                                                      | 155        |
| 12.2 Speculative Bubbles                                               | 156        |
| 12.3 Review of Key Empirical Papers                                    | 158        |
| 12.4 New Contribution                                                  | 164        |
| 12.5 Global Stock Market Integration                                   | 165        |
| 12.6 Dynamic Linear Models for Bubble Solutions                        | 167        |
| 12.7 Dynamic Linear Models for No-Bubble Solutions                     | 172        |
| 12.8 Subset VAR for Linkages between Markets                           | 174        |
| 12.9 Results and Discussions                                           | 175        |
| 12.10 Summary                                                          | 186        |
| References                                                             | 187        |
| <b>13 Forward FX Market and the Risk Premium</b>                       | <b>193</b> |
| 13.1 Introduction                                                      | 193        |

|                                                     |            |
|-----------------------------------------------------|------------|
| 13.2 Alternative Approach to Model Risk Premia      | 195        |
| 13.3 The Proposed Model                             | 196        |
| 13.4 State-Space Framework                          | 201        |
| 13.5 Brief Description of WolftfCheung Model        | 204        |
| 13.6 Application of the Model and Data Description  | 205        |
| 13.7 Summary and Conclusions                        | 209        |
| Appendix                                            | 210        |
| References                                          | 211        |
| <b>14 Equity Risk Premia from Derivative Prices</b> | <b>215</b> |
| 14.1 Introduction                                   | 215        |
| 14.2 The Theory behind the Modeling Framework       | 217        |
| 14.3 The Continuous Time State-Space Framework      | 220        |
| 14.4 Setting Up The Filtering Framework             | 223        |
| 14.5 The Data Set                                   | 228        |
| 14.6 Estimation Results                             | 228        |
| 14.7 Summary and Conclusions                        | 235        |
| References                                          | 236        |
| <b>Index</b>                                        | <b>239</b> |
| <b>About the Authors</b>                            | <b>243</b> |