Contents

Preface xi
Yannis DIMOTIKALIS, Alex KARAGRIGORIOU, Christina PARPOULA and Christos H. SKIADAS

Part 1. Financial and Demographic Modeling Techniques 1

Chapter 1. Data Mining Application Issues in the Taxpayer Selection Process 3
Mauro BARONE, Stefano PISANI and Andrea SPINGOLA

1.1. Introduction 3
1.2. Materials and methods 5
1.2.1. Data 5
1.2.2. Interesting taxpayers 6
1.2.3. Enforced tax recovery proceedings 9
1.2.4. The models 11
1.3. Results 13
1.4. Discussion 23
1.5. Conclusion 23
1.6. References 24

Chapter 2. Asymptotics of Implied Volatility in the Gatheral Double Stochastic Volatility Model 27
Mohammed ALBUHAYRI, Anatoliy MALYARENKO, Sergei SILVESTROV, Ying NI, Christopher ENGSTRÖM, Finnan TEWOLDE and Jiahui ZHANG

2.1. Introduction 27
2.2. The results 30
2.3. Proofs 30
2.4. References 38

Chapter 3. New Dividend Strategies 39
Ekaterina BULINSKAYA

3.1. Introduction 39
3.2. Model 1 41
3.3. Model 2 48
3.4. Conclusion and further results 51
3.5. Acknowledgments 51
3.6. References 52

Chapter 4. Introduction of Reserves in Self-adjusting Steering of Parameters of a Pay-As-You-Go Pension Plan 53
Keivan DIAKITE, Abderrahim OULIDI and Pierre DEVOLDER

4.1. Introduction 53
4.2. The pension system 54
4.3. Theoretical framework of the Musgrave rule 57
4.4. Transformation of the retirement fund 60
4.5. Conclusion 63
4.6. References 64

Chapter 5. Forecasting Stochastic Volatility for Exchange Rates using EWMA 65
Jean-Paul MURARA, Anatoliy MALYARENKO, Milica RANCIC and Sergei SILVESTROV

5.1. Introduction 65
5.2. Data 66
5.3. Empirical model 67
5.4. Exchange rate volatility forecasting 69
5.5. Conclusion 73
5.6. Acknowledgments 73
5.7. References 74

Chapter 6. An Arbitrage-free Large Market Model for Forward Spread Curves 75
Hossein NOHROUZIAN, Ying NI and Anatoliy MALYARENKO

6.1. Introduction and background 75
6.1.1. Term-structure (interest rate) models 76
6.1.2. Forward-rate models versus spot-rate models 77
6.1.3. The Heath–Jarrow–Morton framework 77
6.1.4. Construction of our model 78
6.2. Construction of a market with infinitely many assets 79
6.2.1. The Cuchiero–Klein–Teichmann approach 79

6.2.2. Adapting Cuchiero–Klein–Teichmann's results to our objective . . 82
6.3. Existence, uniqueness and non-negativity 82
6.3.1. Existence and uniqueness: mild solutions 83
6.3.2. Non-negativity of solutions 85
6.4. Conclusion and future works 87
6.5. References 88

Chapter 7. Estimating the Healthy Life Expectancy (HLE) in the Far Past: The Case of Sweden (1751–2016) with Forecasts to 2060 91
Christos H. SKIADAS and Charilaos SKIADAS

7.1. Life expectancy and healthy life expectancy estimates 92
7.2. The logistic model 94
7.3. The HALE estimates and our direct calculations 95
7.4. Conclusion 96
7.5. References 96

Chapter 8. Vaccination Coverage Against Seasonal Influenza of Workers in the Primary Health Care Units in the Prefecture of Chania 97
Aggeliki MARAGKAKI and George MATALLIOTAKIS

8.1. Introduction 98
8.2. Material and method 98
8.3. Results 101
8.4. Discussion 105
8.5. References 107

Chapter 9. Some Remarks on the Coronavirus Pandemic in Europe 109
Konstantinos ZAFEIRIS and Marianna KOUKLI

9.1. Introduction 109
9.2. Background 110
9.2.1. CoV pathogens 110
9.2.2. Clinical characteristics of COVID-19 111
9.2.3. Diagnosis 113
9.2.4. Epidemiology and transmission of COVID-19 113
9.2.5. Country response measures 115
9.2.6. The role of statistical research in the case of COVID-19 and its challenges 119
9.3. Materials and analyses 119
9.4. The first phase of the pandemic 121

9.5. Concluding remarks 126
9.6. References 127

Part 2. Applied Stochastic and Statistical Models and Methods . . . 135

Chapter 10. The Double Flexible Dirichlet: A Structured Mixture Model for Compositional Data 137
Roberto ASCARI, Sonia MIGLIORATI and Andrea ONGARO

10.1. Introduction 138
10.1.1. The flexible Dirichlet distribution 139
10.2. The double flexible Dirichlet distribution 140
10.2.1. Mixture components and cluster means 141
10.3. Computational and estimation issues 144
10.3.1. Parameter estimation: the EM algorithm 145
10.3.2. Simulation study 148
10.4. References 151

Chapter 11. Quantization of Transformed Lévy Measures 153
Mark Anthony CARUANA

11.1. Introduction 153
11.2. Estimation strategy 156
11.3. Estimation of masses and the atoms 159
11.4. Simulation results 165
11.5. Conclusion 166
11.6. References 167

Chapter 12. A Flexible Mixture Regression Model for Bounded Multivariate Responses 169
Agnese M. DI BRISCO and Sonia MIGLIORATI

12.1. Introduction 169
12.2. Flexible Dirichlet regression model 170
12.3. Inferential issues 172
12.4. Simulation studies 173
12.4.1. Simulation study 1: presence of outliers 174
12.4.2. Simulation study 2: generic mixture of two Dirichlet distributions 179
12.4.3. Simulation study 3: FD distribution 180
12.5. Discussion 182
12.6. References 183

Chapter 13. On Asymptotic Structure of the Critical Galton–Watson Branching Processes with Infinite Variance and Allowing Immigration 185
Azam A. IMOMOV and Erkin E. TUKHTAEV

13.1. Introduction 185
13.2. Invariant measures of GW process 187
13.3. Invariant measures of GWPI 190
13.4. Conclusion 193
13.5. References 194

Chapter 14. Properties of the Extreme Points of the Joint Eigenvalue Probability Density Function of the Wishart Matrix . . . 195
Asaph Keikara MUHUMUZA, Karl LUNDENGÅRD, Sergei SILVESTROV, John Magero MANGO and Godwin KAKUBA

14.1. Introduction 195
14.2. Background 196
14.3. Polynomial factorization of the Vandermonde and Wishart matrices 197
14.4. Matrix norm of the Vandermonde and Wishart matrices 200
14.5. Condition number of the Vandermonde and Wishart matrices 203
14.6. Conclusion 206
14.7. Acknowledgments 206
14.8. References 207

Chapter 15. Forecast Uncertainty of the Weighted TAR Predictor 211
Francesco GIORDANO and Marcella NIGLIO

15.1. Introduction 211
15.2. SETAR predictors and bootstrap prediction intervals 214
15.3. Monte Carlo simulation 218
15.4. References 222

Chapter 16. Revisiting Transitions Between Superstatistics 223
Petr JIZBA and Martin PROKŠ

16.1. Introduction 223
16.2. From superstatistic to transition between superstatistics 224
16.3. Transition confirmation 225
16.4. Beck's transition model 227
16.5. Conclusion 230
16.6. Acknowledgments 231
16.7. References 231

Chapter 17. Research on Retrial Queue with Two-Way Communication in a Diffusion Environment 233
Viacheslav VAVILOV

17.1. Introduction 233
17.2. Mathematical model 234
17.3. Asymptotic average characteristics 236
17.4. Deviation of the number of applications in the system 241
17.5. Probability distribution density of device states 247
17.6. Conclusion 248
17.7. References 248

List of Authors 251

Index 255