

Nikolaus Hautsch

Modelling Irregularly Spaced Financial Data

Theory and Practice
of Dynamic Duration Models



Springer

C

Contents

Introduction	1
Point Processes	9
2.1 Basic Concepts of Point Processes.	9
2.1.1 Fundamental Definitions.	9
2.1.2 The Homogeneous Poisson Process.	11
2.1.3 The Intensity Function and its Properties.	12
2.1.4 Intensity-Based Inference.	15
2.2 Types of Point Processes.	16
2.2.1 Poisson Processes.	16
2.2.2 Renewal Processes.	17
2.2.3 Dynamic Point Processes.	17
2.3 Non-Dynamic Point Process Models.	18
2.3.1 Intensity-Based Models.	18
2.3.2 Duration Models.	23
2.3.3 Count Data Models.	24
2.4 Censoring and Time-Varying Covariates.	24
2.4.1 Censoring	24
2.4.2 Time-Varying Covariates.	26
2.5 Outlook on Dynamic Extensions.	28
Economic Implications of Financial Durations	31
3.1 Types of Financial Durations.	31
3.1.1 Selection by Single Marks.	32
3.1.2 Selection by Sequences of Marks.	33
3.2 The Role of Trade Durations in Market Microstructure Theory	34
3.2.1 Traditional Market Microstructure Approaches.	34
3.2.2 Determinants of Trade Durations.	36
3.3 Risk Estimation based on Price Durations.	38
3.3.1 Duration-Based Volatility Measurement	38
3.3.2 Economic Implications of Directional Change Durations	42

3.4	Liquidity Measurement	42
3.4.1	The Liquidity Concept	42
3.4.2	Volume Durations and Liquidity	43
3.4.3	The VNET Measure	43
3.4.4	Measuring (II)liquidity Risks using Excess Volume Durations	44
4	Statistical Properties of Financial Durations	47
4.1	Data Preparation Issues	47
4.1.1	Matching Trades and Quotes	47
4.1.2	Treatment of Split-Transactions	48
4.1.3	Identification of Buyer- and Seller-Initiated Trades	48
4.2	Transaction Databases and Data Preparation	49
4.2.1	NYSE Trading	49
4.2.2	XETRA Trading	50
4.2.3	Frankfurt Floor Trading	51
4.2.4	Bund Future Trading at EUREX and.LIFFE	51
4.2.5	ASX Trading	52
4.3	Statistical Properties of Trade, Limit Order and Quote Durations	53
4.4	Statistical Properties of Price Durations	61
4.5	Statistical Properties of (Excess) Volume Durations	69
4.6	Summarizing the Statistical Findings	75
5	Autoregressive Conditional Duration Models	77
5.1	ARMA Models for (Log-)Durations	77
5.2	The ACD Model	79
5.2.1	The Basic ACD Framework	80
5.2.2	QML Estimation of the ACD Model	82
5.2.3	Distributional Issues and ML Estimation of the ACD Model	85
5.2.4	Seasonalities and Explanatory Variables	88
5.3	Extensions of the ACD Framework	90
5.3.1	Augmented ACD Models	90
5.3.2	Theoretical Properties of Augmented ACD Models	95
5.3.3	Regime-Switching ACD Models	97
5.3.4	Long Memory ACD Models	102
5.3.5	Further Extensions	103
5.4	Testing the ACD Model	105
5.4.1	Simple Residual Checks	105
5.4.2	Density Forecast Evaluations	106
5.4.3	Lagrange Multiplier Tests	107
5.4.4	Conditional Moment Tests	108
5.4.5	Integrated Conditional Moment Tests	110
5.4.6	- Monte Carlo Evidence	115

- 5.5. Applications of ACD Models : 123
 - 5.5.1 Evaluating ACD Models based on Trade and Price Durations. 123
 - 5.5.2 Modelling Trade Durations. 143
 - 5.5.3 Quantifying (Il)liquidity Risks. 147
- 6 Semiparametric Dynamic Proportional Intensity Models. . . 159**
 - 6.1 Dynamic Integrated Intensity Processes. 160
 - 6.2 The Semiparametric ACPI Model. 162
 - 6.3 Properties of the Semiparametric ACPI Model. 165
 - 6.3.1 Autocorrelation Structure. 165
 - 6.3.2 Evaluating the Estimation Quality. 167
 - 6.4 Extensions of the ACPI Model. 171
 - 6.4.1 Regime-Switching Dynamics. 171
 - 6.4.2 Regime-Switching Baseline Intensities. 172
 - 6.4.3 Censoring. 173
 - 6.4.4 Unobserved Heterogeneity. 173
 - 6.5 Testing the ACPI Model. 175
 - 6.6 Estimating Volatility Using the ACPI Model. 177
 - 6.6.1 The Data and the Generation of Price Events. 177
 - 6.6.2 Empirical Findings. 180
- 7 Univariate and Multivariate Dynamic Intensity Models 193**
 - 7.1 Univariate Dynamic Intensity Models. 194
 - 7.1.1 The ACI Model. 194
 - 7.1.2 The Hawkes Model. 198
 - 7.2 Multivariate Dynamic Intensity Models. 202
 - 7.2.1 Definitions. 202
 - 7.2.2 The Multivariate ACI Model. 203
 - 7.2.3 The Multivariate Hawkes Model. 208
 - 7.3 Dynamic Latent Factor Models for Intensity Processes. 210
 - 7.3.1 The LFI Model. 212
 - 7.3.2 The Univariate LFI Model. 214
 - 7.3.3 The Multivariate LFI Model. 215
 - 7.3.4 Dynamic Properties of the LFI Model. 216
 - 7.3.5 SML Estimation of the LFI Model. 228
 - 7.3.6 Testing the LFI Model. 231
 - 7.4 Applications of Dynamic Intensity Models. 232
 - 7.4.1 Estimating Multivariate Price Intensities. 232
 - 7.4.2 Estimating Simultaneous Buy/Sell Intensities. 236
 - 7.4.3 Estimating Trading Intensities Using LFI Models. 246
- 8 Summary and Conclusions 255**
- A Important Distributions for Duration Data 259**

B List of Symbols (in Alphabetical Order)	265
References	273
Index	285