

Contents

Preface to the 2nd Edition	v
Preface to the 1st Edition	vii
Contributors	xxi
Frequently Used Notation	xxv
I Value at Risk	1
1 Modeling Dependencies with Copulae	3
<i>Wolfgang Härdle, Ostap Okhrin and Yarema Okhrin</i>	
1.1 Introduction	3
1.2 Bivariate Copulae	4
1.2.1 Copula Families	6
1.2.2 Dependence Measures	9
1.3 Multivariate Copulae	11
1.3.1 Copula Families	13
1.3.2 Dependence Measures	15
1.4 Estimation Methods	17
1.5 Goodness-of-Fit Tests for Copulae	19
1.6 Simulation Methods	21
1.6.1 Conditional Inverse Method	22
1.6.2 Marshal-Olkin Method	22
1.7 Applications to Finance	23
1.7.1 Asset Allocation	24
1.7.2 Value-at-Risk	25
1.7.3 Time Series Modeling	26
1.8 Simulation Study and Empirical Results	28
1.8.1 Simulation Study	28
1.8.2 Empirical Example	30
1.9 Summary	33

2 Quantification of Spread Risk by Means of Historical Simulation 37

Christoph Frisch and Germar Knöchlein

2.1	<i>Introduction</i>	37
2.2	<i>Risk Categories – a Definition of Terms</i>	37
2.3	<i>Yield Spread Time Series</i>	39
2.3.1	<i>Data Analysis</i>	40
2.3.2	<i>Discussion of Results</i>	44
2.4	<i>Historical Simulation and Value at Risk</i>	49
2.4.1	<i>Risk Factor: Full Yield</i>	49
2.4.2	<i>Risk Factor: Benchmark</i>	52
2.4.3	<i>Risk Factor: Spread over Benchmark Yield</i>	53
2.4.4	<i>Conservative Approach</i>	54
2.4.5	<i>Simultaneous Simulation</i>	54
2.5	<i>Mark-to-Model Backtesting</i>	54
2.6	<i>VaR Estimation and Backtesting</i>	55
2.7	<i>P-P Plots</i>	59
2.8	<i>Q-Q Plots</i>	60
2.9	<i>Discussion of Simulation Results</i>	60
2.9.1	<i>Risk Factor: Full Yield</i>	60
2.9.2	<i>Risk Factor: Benchmark</i>	61
2.9.3	<i>Risk Factor: Spread over Benchmark Yield</i>	61
2.9.4	<i>Conservative Approach</i>	62
2.9.5	<i>Simultaneous Simulation</i>	62
2.10	<i>Internal Risk Models</i>	63

3 A Copula-Based Model of the Term Structure of CDO Tranches 69

Umberto Cherubini, Sabrina Mulinacci and Silvia Romagnoli

3.1	<i>Introduction</i>	69
3.2	<i>A Copula-Based Model of Basket Credit Losses Dynamics</i>	71
3.3	<i>Stochastic Processes with Dependent Increments</i>	72
3.4	<i>An Algorithm for the Propagation of Losses</i>	75
3.5	<i>Empirical Analysis</i>	76
3.6	<i>Concluding Remarks</i>	80

4 VaR in High Dimensional Systems – a Conditional Correlation Approach 83

Helmut Herwartz and Bruno Pedrinha

4.1	<i>Introduction</i>	83
4.2	<i>Half-Vec Multivariate GARCH Models</i>	85
4.3	<i>Correlation Models</i>	86
4.3.1	<i>Motivation</i>	86

4.3.2	<i>Log-Likelihood Decomposition</i>	87
4.3.3	<i>Constant Conditional Correlation Model</i>	88
4.3.4	<i>Dynamic Conditional Correlation Model</i>	89
4.3.5	<i>Inference in the Correlation Models</i>	90
4.3.6	<i>Generalizations of the DCC Model</i>	92
4.4	<i>Value-at-Risk</i>	92
4.5	<i>An Empirical Illustration</i>	93
4.5.1	<i>Equal and Value Weighted Portfolios</i>	93
4.5.2	<i>Estimation Results</i>	96
II	Credit Risk	103
5	Rating Migrations	105
	<i>Steffi Höse, Stefan Huschens and Robert Wania</i>	
5.1	<i>Rating Transition Probabilities</i>	106
5.1.1	<i>From Credit Events to Migration Counts</i>	106
5.1.2	<i>Estimating Rating Transition Probabilities</i>	107
5.1.3	<i>Dependent Migrations</i>	108
5.1.4	<i>Computational Aspects</i>	111
5.2	<i>Analyzing the Time-Stability of Transition Probabilities</i>	111
5.2.1	<i>Aggregation over Periods</i>	111
5.2.2	<i>Testing the Time-Stability of Transition Probabilities</i>	112
5.2.3	<i>Example</i>	114
5.2.4	<i>Computational Aspects</i>	115
5.3	<i>Multi-Period Transitions</i>	115
5.3.1	<i>Homogeneous Markov Chain</i>	116
5.3.2	<i>Bootstrapping Markov Chains</i>	117
5.3.3	<i>Rating Transitions of German Bank Borrowers</i>	118
5.3.4	<i>Portfolio Migration</i>	119
5.3.5	<i>Computational Aspects</i>	121
6	Cross- and Autocorrelation in Multi-Period Credit Portfolio Models	125
	<i>Christoph K.J. Wagner</i>	
6.1	<i>Introduction</i>	125
6.2	<i>The Models</i>	127
6.2.1	<i>A Markov-Chain Credit Migration Model</i>	127
6.2.2	<i>The Correlated-Default-Time Model</i>	130
6.2.3	<i>A Discrete Barrier Model</i>	132
6.2.4	<i>The Time-Changed Barrier Model</i>	133

6.3	<i>Inter-Temporal Dependency and Autocorrelation</i>	135
6.4	<i>Conclusion</i>	137
7	Risk Measurement with Spectral Capital Allocation	139
	<i>Ludger Overbeck and Maria Sokolova</i>	
7.1	<i>Introduction</i>	139
7.2	<i>Review of Coherent Risk Measures and Allocation</i>	140
7.2.1	<i>Coherent Risk Measures</i>	140
7.2.2	<i>Spectral Risk Measures</i>	143
7.2.3	<i>Coherent Allocation Measures</i>	144
7.2.4	<i>Spectral Allocation Measures</i>	145
7.3	<i>Weight Function and Mixing Measure</i>	146
7.4	<i>Risk Aversion</i>	146
7.5	<i>Implementation</i>	147
7.5.1	<i>Mixing Representation</i>	148
7.5.2	<i>Density Representation</i>	149
7.6	<i>Credit Portfolio Model</i>	149
7.7	<i>Examples</i>	150
7.7.1	<i>Weighting Scheme</i>	150
7.7.2	<i>Concrete Example</i>	151
7.8	<i>Summary</i>	158
8	Valuation and VaR Computation for CDOs Using Stein's Method	161
	<i>Nicole El Karoui, Ying Jiao, David Kurtz</i>	
8.1	<i>Introduction</i>	161
8.1.1	<i>A Primer on CDO</i>	161
8.1.2	<i>Factor Models</i>	163
8.1.3	<i>Numerical Algorithms</i>	164
8.2	<i>First Order Gauss-Poisson Approximations</i>	165
8.2.1	<i>Stein's Method - the Normal Case</i>	165
8.2.2	<i>First-Order Gaussian Approximation</i>	167
8.2.3	<i>Stein's Method - the Poisson Case</i>	171
8.2.4	<i>First-Order Poisson Approximation</i>	172
8.3	<i>Numerical Tests</i>	175
8.3.1	<i>Validity Domain of the Approximations</i>	175
8.3.2	<i>Stochastic Recovery Rate - Gaussian Case</i>	177
8.3.3	<i>Sensitivity Analysis</i>	179
8.4	<i>Real Life Applications</i>	180
8.4.1	<i>Gaussian Approximation</i>	180
8.4.2	<i>Poisson Approximation</i>	181

8.4.3	<i>CDO Valuation</i>	182
8.4.4	<i>Robustness of VaR Computation</i>	184

III Implied Volatility **191**

9 Least Squares Kernel Smoothing of the Implied Volatility Smile **193**

Matthias R. Fengler and Qihua Wang

9.1	<i>Introduction</i>	193
9.2	<i>Least Squares Kernel Smoothing of the Smile</i>	194
9.3	<i>Application</i>	197
9.3.1	<i>Weighting Functions, Kernels, and Minimization Scheme</i>	197
9.3.2	<i>Data Description and Empirical Demonstration</i>	198
9.4	<i>Proofs</i>	203

10 Numerics of Implied Binomial Trees **209**

Wolfgang Härdle and Alena Myšičková

10.1	<i>Construction of the IBT</i>	210
10.1.1	<i>The Derman and Kani Algorithm</i>	212
10.1.2	<i>Compensation</i>	218
10.1.3	<i>Barle and Cakici Algorithm</i>	219
10.2	<i>A Simulation and a Comparison of the SPDs</i>	220
10.2.1	<i>Simulation Using the DK Algorithm</i>	221
10.2.2	<i>Simulation Using the BC Algorithm</i>	223
10.2.3	<i>Comparison with the Monte-Carlo Simulation</i>	224
10.3	<i>Example – Analysis of EUREX Data</i>	227

11 Application of Extended Kalman Filter to SPD Estimation **233**

Zdeněk Hlávka and Marek Svojik

11.1	<i>Linear Model</i>	234
11.1.1	<i>Linear Model for Call Option Prices</i>	235
11.1.2	<i>Estimation of State Price Density</i>	236
11.1.3	<i>State-Space Model for Call Option Prices</i>	237
11.2	<i>Extended Kalman Filter and Call Options</i>	238
11.3	<i>Empirical Results</i>	239
11.3.1	<i>Extended Kalman Filtering in Practice</i>	240
11.3.2	<i>SPD Estimation in 1995</i>	241
11.3.3	<i>SPD Estimation in 2003</i>	243
11.4	<i>Conclusions</i>	245

12 Stochastic Volatility Estimation Using Markov Chain Simulation 249*Nikolaus Hautsch and Yangguoyi Ou*

12.1	<i>The Standard Stochastic Volatility Model</i>	250
12.2	<i>Extended SV Models</i>	252
12.2.1	<i>Fat Tails and Jumps</i>	252
12.2.2	<i>The Relationship Between Volatility and Returns</i>	254
12.2.3	<i>The Long Memory SV Model</i>	256
12.3	<i>MCMC-Based Bayesian Inference</i>	257
12.3.1	<i>Bayes' Theorem and the MCMC Algorithm</i>	257
12.3.2	<i>MCMC-Based Estimation of the Standard SV Model</i>	261
12.4	<i>Empirical Illustrations</i>	264
12.4.1	<i>The Data</i>	264
12.4.2	<i>Estimation of SV Models</i>	265
12.5	<i>Appendix</i>	270
12.5.1	<i>Derivation of the Conditional Posterior Distributions</i>	270

13 Measuring and Modeling Risk Using High-Frequency Data 275*Wolfgang Härdle, Nikolaus Hautsch and Uta Pigorsch*

13.1	<i>Introduction</i>	275
13.2	<i>Market Microstructure Effects</i>	277
13.3	<i>Stylized Facts of Realized Volatility</i>	280
13.4	<i>Realized Volatility Models</i>	284
13.5	<i>Time-Varying Betas</i>	285
13.5.1	<i>The Conditional CAPM</i>	286
13.5.2	<i>Realized Betas</i>	287
13.6	<i>Summary</i>	289

14 Valuation of Multidimensional Bermudan Options 295*Shih-Feng Huang and Meihui Guo*

14.1	<i>Introduction</i>	295
14.2	<i>Model Assumptions</i>	296
14.3	<i>Methodology</i>	298
14.4	<i>Examples</i>	302
14.5	<i>Conclusion</i>	308

IV Econometrics	311
15 Multivariate Volatility Models	313
<i>Matthias R. Fengler and Helmut Herwartz</i>	
15.1 Introduction	313
15.1.1 Model Specifications	314
15.1.2 Estimation of the BEKK-Model	316
15.2 An Empirical Illustration	317
15.2.1 Data Description	317
15.2.2 Estimating Bivariate GARCH	318
15.2.3 Estimating the (Co)Variance Processes	320
15.3 Forecasting Exchange Rate Densities	323
16 The Accuracy of Long-term Real Estate Valuations	327
<i>Rainer Schulz, Markus Staiber, Martin Wersing and Axel Werwatz</i>	
16.1 Introduction	327
16.2 Implementation	328
16.2.1 Computation of the Valuations	329
16.2.2 Data	331
16.3 Empirical Results	333
16.3.1 Characterization of the Test Market	333
16.3.2 Horse Race	337
16.4 Conclusion	343
17 Locally Time Homogeneous Time Series Modelling	345
<i>Mstislav Elagin and Vladimir Spokoiny</i>	
17.1 Introduction	345
17.2 Model and Setup	346
17.2.1 Conditional Heteroskedastic Model	346
17.2.2 Parametric and Local Parametric Estimation and Inference	347
17.2.3 Nearly Parametric Case	348
17.3 Methods for the Estimation of Parameters	349
17.3.1 Sequence of Intervals	349
17.3.2 Local Change Point Selection	349
17.3.3 Local Model Selection	350
17.3.4 Stagewise Aggregation	351
17.4 Critical Values and Other Parameters	352
17.5 Applications	354
17.5.1 Forecasting Performance for One and Multiple Steps	355

17.5.2	Value-at-Risk	357
17.5.3	A Multiple Time Series Example	359
18	Simulation Based Option Pricing	363
	<i>Denis Belomestny and Grigori N. Milstein</i>	
18.1	Introduction	363
18.2	The Consumption Based Processes	365
18.2.1	The Snell Envelope	365
18.2.2	The Continuation Value, the Continuation and Exercise Regions	366
18.2.3	Equivalence of American Options to European Ones with Consumption Processes	367
18.2.4	Upper and Lower Bounds Using Consumption Processes	367
18.2.5	Bermudan Options	368
18.3	The Main Procedure	369
18.3.1	Local Lower Bounds	369
18.3.2	The Main Procedure for Constructing Upper Bounds for the Initial Position (Global Upper Bounds)	370
18.3.3	The Main Procedure for Constructing Lower Bounds for the Initial Position (Global Lower Bounds)	372
18.3.4	Kernel Interpolation	373
18.4	Simulations	374
18.4.1	Bermudan Max Calls on d Assets	374
18.4.2	Bermudan Basket-Put	375
18.5	Conclusions	377
19	High-Frequency Volatility and Liquidity	379
	<i>Nikolaus Hautsch and Vahidin Jeleskovic</i>	
19.1	Introduction	379
19.2	The Univariate MEM	380
19.3	The Vector MEM	383
19.4	Statistical Inference	385
19.5	High-Frequency Volatility and Liquidity Dynamics	387
20	Statistical Process Control in Asset Management	399
	<i>Vasyl Golosnoy and Wolfgang Schmid</i>	
20.1	Introduction	399
20.2	Review of Statistical Process Control Concepts	400
20.3	Applications of SPC in Asset Management	403

20.3.1	<i>Monitoring Active Portfolio Managers</i>	404
20.3.2	<i>Surveillance of the Optimal Portfolio Proportions</i>	408
20.4	<i>Summary</i>	414
21	Canonical Dynamics Mechanism of Monetary Policy and Interest Rate	417
	<i>Jenher Jeng, Wei-Fang Niu, Nan-Jye Wang, and Shih-Shan Lin</i>	
21.1	<i>Introduction</i>	417
21.2	<i>Statistical Technology</i>	419
21.3	<i>Principles of the Fed Funds Rate Decision-Making</i>	424
21.3.1	<i>Fairness of Inflation Gauge</i>	424
21.3.2	<i>Neutral Interest Rate Based on Fair Gauge of Inflation</i>	425
21.3.3	<i>Monetary Policy-Making as Tight-Accommodative Cycles Along Neutral Level as Dynamic Principal</i>	427
21.4	<i>Response Curve Structure and FOMC Behavioral Analysis</i>	428
21.4.1	<i>Data Analysis and Regressive Results</i>	428
21.4.2	<i>The Structure of the FOMC's Response Curve – Model Characteristics, Interpretations</i>	429
21.4.3	<i>The Dynamics of the FFR – Model Implications</i>	432
21.4.4	<i>General Dynamic Mechanism for Long-Run Dependence of Interest Rate and Inflation</i>	437
21.5	<i>Discussions and Conclusions</i>	439
	Index	443