
Contents

Part I Introduction to Credit Risk Modeling

1	Risk Measurement	3
1.1	Variables of Risk	4
1.2	The General Model Setting	5
1.3	Exchangeable Models	7
2	Modeling Credit Risk	9
2.1	The Regulatory Framework	10
2.2	Expected and Unexpected Loss	12
2.3	Value-at-Risk	13
2.4	Expected Shortfall	15
2.5	Economic Capital	17
3	The Merton Model	19
3.1	The General Framework	20
3.2	The Multi-Factor Merton Model	23
3.3	Industry Models Based on the Merton Approach	29
3.3.1	The KMV Model	29
3.3.2	The CreditMetrics Model	30
4	The Asymptotic Single Risk Factor Model	31
4.1	The ASRF Model	32
4.2	The IRB Risk Weight Functions	35
4.3	The Loss Distribution of an Infinitely Granular Portfolio	38
5	Mixture Models	43
5.1	Bernoulli and Poisson Mixture Models	43
5.2	The Influence of the Mixing Distribution on the Loss Distribution	48
5.3	Relation Between Latent Variable Models and Mixture Models	50

6	The CreditRisk⁺ Model	53
6.1	Basic Model Setting	54
6.2	The Poisson Approximation	56
6.3	Model with Random Default Probabilities	57

Part II Concentration Risk in Credit Portfolios

7	Introduction	63
8	Ad-Hoc Measures of Concentration	67
8.1	Concentration Indices	68
8.2	Conclusion	72
9	Name Concentration	75
9.1	A Granularity Adjustment for the ASRF Model	76
9.1.1	Example as Motivation for GA Methodology	77
9.1.2	The General Framework	78
9.1.3	The Granularity Adjustment in a Single Factor CreditRisk ⁺ Setting	81
9.1.4	Data on German Bank Portfolios	84
9.1.5	Numerical Results	86
9.1.6	Summary	88
9.2	The Semi-Asymptotic Approach	90
9.2.1	The General Framework	90
9.2.2	Numerical Results	93
9.3	Methods Based on the Saddle-Point Approximation	93
9.3.1	The General Framework	94
9.3.2	Application to Name Concentration Risk	96
9.4	Discussion and Comparison Study of the Granularity Adjustment Methods	99
9.4.1	Empirical Relevance of the Granularity Adjustment	100
9.4.2	Why a Granularity Adjustment Instead of the HHI?	100
9.4.3	Accuracy of the Granularity Adjustment and Robustness to Regulatory Parameters	102
9.4.4	Comparison of Granularity Adjustment with Other Model-Based Approaches	103
9.4.5	Agreement of Granularity Adjustment and Saddle- Point Approximation Method in the CreditRisk ⁺ Model	104
10	Sector Concentration	107
10.1	Analytical Approximation Models	108
10.1.1	Analytical Approximation for Value-at-Risk	109
10.1.2	Analytical Approximation for Expected Shortfall	117
10.1.3	Performance Testing	118

10.1.4	Summary and Discussion	119
10.2	Diversification Factor Models	120
10.2.1	The Multi-Sector Framework	121
10.2.2	The Capital Diversification Factor	123
10.2.3	Marginal Capital Contributions	124
10.2.4	Parameterization	126
10.2.5	Application to a Bank Internal Multi-Factor Model	127
10.2.6	Discussion	129
11	Empirical Studies on Concentration Risk	131
11.1	Sector Concentration and Economic Capital	132
11.1.1	The Model Framework	133
11.1.2	Data Description and Portfolio Composition	133
11.1.3	Impact of Sector Concentration on Economic Capital	135
11.1.4	Robustness of EC Approximations	136
11.1.5	Discussion	139
11.2	The Influence of Systematic and Idiosyncratic Risk on Large Portfolio Losses	140
11.2.1	Descriptive Analysis of SNC Data	140
11.2.2	Simple Indices of Name and Sector Concentration	141
11.2.3	Modeling Dependencies in Losses	142
11.2.4	Monte Carlo Simulation of the Portfolio Loss Distribution	143
11.2.5	Empirical Results	145
11.2.6	Summary and Discussion	147
<hr/>		
Part III Default Contagion		
<hr/>		
12	Introduction	151
13	Empirical Studies on Default Contagion	155
13.1	The Doubly Stochastic Property and its Testable Implications	156
13.2	Data for Default Intensity Estimates	159
13.3	Goodness-of-Fit Tests	159
13.4	Discussion	162
14	Models Based on Copulas	165
14.1	Equivalence of Latent Variable Models	166
14.2	Sensitivity of Losses on the Dependence Structure	168
14.3	Discussion	170

15 A Voter Model for Credit Contagion	173
15.1 The Model Framework	174
15.2 Invariant and Ergodic Measures for the Voter Model	177
15.3 The Non-Dense Business Partner Network	179
15.4 The Dense Business Partner Network	180
15.5 Aggregate Losses on Large Portfolios	182
15.6 Discussion and Comparison with Alternative Approaches	186
15.6.1 The Mean-Field Model with Interacting Default Intensities	187
15.6.2 A Dynamic Contagion Model	189
15.7 Contagion Through Macro- and Microstructural Channels	190
15.7.1 A Model with Macro- and Micro-Structural Dependence	191
15.7.2 The Rating Migrations Process	193
15.7.3 Results and Discussion	194
16 Equilibrium Models	197
16.1 A Mean-Field Model of Credit Ratings	198
16.2 The Mean-Field Model with Local Interactions	202
16.3 Large Portfolio Losses	205
16.4 Discussion	208
A Copulas	211
References	217
Index	223