# Contents

Preface to the 2nd edition xi
Preface to the 1st edition xiii
Some Hints for Troubleshooting xv

## 1 Estimating Credit Scores with Logit
- Linking scores, default probabilities and observed default behavior 1
- Estimating logit coefficients in Excel 4
- Computing statistics after model estimation 8
- Interpreting regression statistics 10
- Prediction and scenario analysis 12
- Treating outliers in input variables 16
- Choosing the functional relationship between the score and explanatory variables 20
- Concluding remarks 25
- Appendix 25
  - Logit and probit 25
  - Marginal effects 25
- Notes and literature 26

## 2 The Structural Approach to Default Prediction and Valuation
- Default and valuation in a structural model 27
- Implementing the Merton model with a one-year horizon 30
  - The iterative approach 30
  - A solution using equity values and equity volatilities 35
- Implementing the Merton model with a T-year horizon 39
- Credit spreads 43
- CreditGrades 44
- Appendix 50
- Notes and literature 52
  - Assumptions 52
  - Literature 53
## Contents

### 3 Transition Matrices
- Cohort approach 55
- Multi-period transitions 56
- Hazard rate approach 61
- Obtaining a generator matrix from a given transition matrix 69
- Confidence intervals with the binomial distribution 71
- Bootstrapped confidence intervals for the hazard approach 74
- Notes and literature 78
- Appendix 78
  - Matrix functions 78

### 4 Prediction of Default and Transition Rates
- Candidate variables for prediction 83
- Predicting investment-grade default rates with linear regression 85
- Predicting investment-grade default rates with Poisson regression 88
- Backtesting the prediction models 94
- Predicting transition matrices 99
- Adjusting transition matrices 100
- Representing transition matrices with a single parameter 101
- Shifting the transition matrix 103
- Backtesting the transition forecasts 108
- Scope of application 108
- Notes and literature 110
- Appendix 110

### 5 Prediction of Loss Given Default
- Candidate variables for prediction 115
  - Instrument-related variables 116
  - Firm-specific variables 117
  - Macroeconomic variables 118
  - Industry variables 118
- Creating a data set 119
- Regression analysis of LGD 120
- Backtesting predictions 123
- Notes and literature 126
- Appendix 126

### 6 Modeling and Estimating Default Correlations with the Asset Value Approach
- Default correlation, joint default probabilities and the asset value approach 131
- Calibrating the asset value approach to default experience: the method of moments 133
- Estimating asset correlation with maximum likelihood 136
- Exploring the reliability of estimators with a Monte Carlo study 144
- Concluding remarks 147
- Notes and literature 147
7 Measuring Credit Portfolio Risk with the Asset Value Approach 149
   A default-mode model implemented in the spreadsheet 149
   VBA implementation of a default-mode model 152
   Importance sampling 156
   Quasi Monte Carlo 160
   Assessing Simulation Error 162
   Exploiting portfolio structure in the VBA program 165
   Dealing with parameter uncertainty 168
   Extensions 170
      First extension: Multi-factor model 170
      Second extension: *t*-distributed asset values 171
      Third extension: Random LGDs 173
      Fourth extension: Other risk measures 175
      Fifth extension: Multi-state modeling 177
   Notes and literature 179

8 Validation of Rating Systems 181
   Cumulative accuracy profile and accuracy ratios 182
   Receiver operating characteristic (ROC) 185
   Bootstrapping confidence intervals for the accuracy ratio 187
   Interpreting caps and ROCs 190
   Brier score 191
   Testing the calibration of rating-specific default probabilities 192
   Validation strategies 195
   Testing for missing information 198
   Notes and literature 201

9 Validation of Credit Portfolio Models 203
   Testing distributions with the Berkowitz test 203
      Example implementation of the Berkowitz test 206
   Representing the loss distribution 207
   Simulating the critical chi-square value 209
   Testing modeling details: Berkowitz on subportfolios 211
   Assessing power 214
   Scope and limits of the test 216
   Notes and literature 217

10 Credit Default Swaps and Risk-Neutral Default Probabilities 219
   Describing the term structure of default: PDs cumulative, marginal and seen from today 220
   From bond prices to risk-neutral default probabilities 221
      Concepts and formulae 221
      Implementation 225
   Pricing a CDS 232
   Refining the PD estimation 234
Contents

Market values for a CDS 237
Example 239
Estimating upfront CDS and the ‘Big Bang’ protocol 240
Pricing of a pro-rata basket 241
Forward CDS spreads 242
Example 243
Pricing of swaptions 243
Notes and literature 247
Appendix 247
Deriving the hazard rate for a CDS 247

11 Risk Analysis and Pricing of Structured Credit: CDOs and First-to-Default Swaps 249
Estimating CDO risk with Monte Carlo simulation 249
The large homogeneous portfolio (LHP) approximation 253
Systemic risk of CDO tranches 256
Default times for first-to-default swaps 259
CDO pricing in the LHP framework 263
Simulation-based CDO pricing 272
Notes and literature 281
Appendix 282
Closed-form solution for the LHP model 282
Cholesky decomposition 283
Estimating PD structure from a CDS 284

12 Basel II and Internal Ratings 285
Calculating capital requirements in the Internal Ratings-Based (IRB) approach 285
Assessing a given grading structure 288
Towards an optimal grading structure 294
Notes and literature 297

Appendix A1 Visual Basics for Applications (VBA) 299
Appendix A2 Solver 307
Appendix A3 Maximum Likelihood Estimation and Newton’s Method 313
Appendix A4 Testing and Goodness of Fit 319
Appendix A5 User-defined Functions 325
Index 333