

# Contents

<b>Introduction: Wall Street Lessons from Bubbles</b>	<b>xxiii</b>
Key Fallacies in Risk Management	xxiii
Selected Events in the Credit Crisis	xxviii
<b>PART ONE</b>	
<b>Risk Management: Definitions and Objectives</b>	
<b>CHAPTER 1</b>	
<b>A Risk Management Synthesis: Market Risk, Credit Risk, Liquidity Risk, and Asset and Liability Management</b>	<b>3</b>
Risk Management: Definitions and Objectives	6
Advances in Integrated Risk Management and Institutional Barriers to Progress	8
Measuring the Trade-Offs between Risk and Return	11
When Bad Things Happen to Good People	11
U.S. Savings and Loan Crisis	12
Long-Term Capital Management	13
The 2006–2011 Credit Crisis	13
A Thousand Cuts	13
<b>CHAPTER 2</b>	
<b>Risk, Return, Performance Measurement, and Capital Regulation</b>	<b>15</b>
Practical Quantification of Risk	15
Perils and Pitfalls in the Measurement of Risk: The Impact of Selection Bias	16
Biases in Return vs. a Relative Benchmark	17
Historical Value at Risk: Selection Bias Again	18
Monte Carlo–Based Value at Risk	19
Expected Losses on Tranches of Collateralized Debt Obligations	19
Measuring Return: Market vs. Accounting Returns	20
Introduction to Transfer Pricing: Extracting Interest Rate Risk in a Financial Accounting Context	20
Bank of America, 1973–1979	21
First Interstate, 1982–1987	24
Performance Measurement and Capital Regulation	26
Perspectives on Measuring Risk: One Source of Risk or Many Sources of Risk?	26
Interest Rate Risk Management Evolution	27
Equity Risk Management Evolution	28

Option Risk Management Evolution	28
Credit Risk Management Evolution	28
Managing Risk and Strategy, Business by Business	29
Risk and Strategy Management in a Complex Financial Institution	29
What Causes Financial Institutions to Fail?	31
The Role of Capital in Risk Management and Business Strategy	32
Capital-Based Risk Management in Banking Today: Pros and Cons	35
History of Capital-Based Regulations in Commercial Banking	37

## **PART TWO**

### **Risk Management Techniques for Interest Rate Analytics**

#### **CHAPTER 3**

<b>Interest Rate Risk Introduction and Overview</b>	<b>45</b>
Background Information on Movements in the U.S. Treasury Yield Curve	46
A Step-by-Step Approach to Analyzing Interest Rate Risk	55
The Interest Rate Risk Safety Zone	58

#### **CHAPTER 4**

<b>Fixed Income Mathematics: The Basic Tools</b>	<b>58</b>
Modern Implications of Present Value	59
Price, Accrued Interest, and Value	60
Calculation of Accrued Interest	60
Present Value	61
The Basic Present Value Calculation	61
Example	62
Calculating the Value of a Fixed Coupon Bond with Principal Paid at Maturity	62
Calculating the Coupon of a Fixed Coupon Bond with Principal Paid at Maturity When the Value Is Known	62
Example	63
The Value of an Amortizing Loan	63
Calculating the Payment Amount of an Amortizing Bond When the Value Is Known	63
Risk Management Implications	64
Calculating the Value of a Floating-Rate Bond or Loan with Principal Paid at Maturity	64
Example	65
Risk Management Implications	65
Compound Interest Conventions and Formulas	66
Future Value of an Invested Amount Earning at a Simple Interest Rate of $y$ Compounded $m$ Times per Year for $n$ Periods	66
Future Value of an Invested Amount Earning at a Simple Interest Rate of $y$ Compounded Continuously for $n$ Years	66
Example	67
Present Value of a Future Amount If Funds Are Invested at a Simple Interest Rate of $y$ Compounded $m$ Times per Year for $n$ Periods	67

Present Value of a Future Amount If Funds Are Invested at a Simple Interest Rate of $y$ Compounded Continuously for $n$ Years	67
Compounding Formulas and Present Value Factors $P(t)$	67
Yields and Yield-to-Maturity Calculations	68
The Formula for Yield to Maturity	68
Yield to Maturity for Long or Short First Coupon Payment Periods	69
Calculating Forward Interest Rates and Bond Prices	69
Implied Forward Interest Rates on Zero-Coupon Bonds	69
Example	70
Implied Forward Zero-Coupon Bond Prices	70
Present Value of Forward Fixed Coupon Bond	70
Implied Forward Price on a Fixed Coupon Bond	71
Implied Forward Coupon on a Fixed Coupon Bond	71
Other Forward Calculations	71
Summary	71
<b>CHAPTER 5</b>	
<b>Yield Curve Smoothing</b>	<b>73</b>
Example A: Stepwise Constant Yields and Forwards vs. Nelson-Siegel	77
Deriving the Form of the Yield Curve Implied by Example A	79
Fitting the Nelson-Siegel Approach to Sample Data	81
Example D: Quadratic Yield Splines and Related Forward Rates	85
Deriving the Form of the Yield Curve Implied by Example D	86
Example F: Cubic Yield Splines and Related Forwards	94
Deriving the Form of the Yield Curve Implied by	
Example F Assumptions	95
Example H: Maximum Smoothness Forward	
Rates and Related Yields	101
Deriving the Parameters of the Quartic Forward Rate Curves	
Implied by Example H Assumptions	104
Comparing Yield Curve and Forward Rate Smoothing Techniques	111
Ranking 23 Smoothing Techniques by Smoothness of the	
Forward Rate Curve	112
Ranking 23 Smoothing Techniques by Length of the	
Forward Curve	112
Trading Off Smoothness vs. the Length of the Forward Rate Curve	112
The Shimko Test for Measuring Accuracy of Smoothing Techniques	116
Smoothing Yield Curves Using Coupon-Bearing Bond Prices as Inputs	116
Appendix: Proof of the Maximum Smoothness Forward Rate Theorem	117
<b>CHAPTER 6</b>	
<b>Introduction to Heath, Jarrow, and Morton Interest Rate Modeling</b>	<b>123</b>
Objectives of the Example and Key Input Data	124
Key Implications and Notation of the HJM Approach	129
Pseudo-Probabilities	131
The Formula for Zero-Coupon Bond Price Shifts	132
Building the Bushy Tree for Zero-Coupon Bonds	
Maturing at Time $T = 2$	132

Building the Bushy Tree for Zero-Coupon Bonds	
Maturing at Time $T = 4$	134
Valuation in the HJM Framework	137
Valuation of a Zero-Coupon Bond Maturing at Time $T = 4$	139
Valuation of a Coupon-Bearing Bond Paying Annual Interest	140
Valuation of a Digital Option on the One-Year U.S. Treasury Rate	140
Conclusion	140
<b>CHAPTER 7</b>	
<b>HJM Interest Rate Modeling with Rate and Maturity-Dependent Volatility</b>	<b>142</b>
Objectives of the Example and Key Input Data	142
Key Implications and Notation of the HJM Approach	146
Pseudo-Probabilities	147
The Formula for Zero-Coupon Bond Price Shifts	147
Building the Bushy Tree for Zero-Coupon Bonds	
Maturing at Time $T = 2$	149
Building the Bushy Tree for Zero-Coupon Bonds	
Maturing at Time $T = 4$	150
Valuation in the HJM Framework	153
Valuation of a Zero-Coupon Bond Maturing at Time $T = 4$	155
Valuation of a Coupon-Bearing Bond Paying Annual Interest	156
Valuation of a Digital Option on the One-Year U.S. Treasury Rate	158
Conclusion	158
<b>CHAPTER 8</b>	
<b>HJM Interest Rate Modeling with Two Risk Factors</b>	<b>161</b>
Probability of Yield Curve Twists in the U.S. Treasury Market	161
Objectives of the Example and Key Input Data	162
Introducing a Second Risk Factor Driving Interest Rates	163
Key Implications and Notation of the HJM Approach	167
Pseudo-Probabilities	171
The Formula for Zero-Coupon Bond Price Shifts with	
Two Risk Factors	171
Building the Bushy Tree for Zero-Coupon Bonds	
Maturing at Time $T = 2$	173
Building the Bushy Tree for Zero-Coupon Bonds	
Maturing at Time $T = 3$	174
Building the Bushy Tree for Zero-Coupon Bonds	
Maturing at Time $T = 4$	175
Valuation in the HJM Framework	178
Valuation of a Zero-Coupon Bond Maturing at Time $T = 4$	183
Valuation of a Coupon-Bearing Bond Paying Annual Interest	184
Valuation of a Digital Option on the One-Year	
U.S. Treasury Rate	185
Replication of HJM Example 3 in Common Spreadsheet Software	186
Conclusion	189

<b>CHAPTER 9</b>	
<b>HJM Interest Rate Modeling with Three Risk Factors</b>	<b>190</b>
Probability of Yield Curve Twists in the U.S. Treasury Market	190
Objectives of the Example and Key Input Data	191
Risk Factor 1: Annual Changes in the One-Year U.S. Treasury Spot Rate	192
Alternative Specifications of the Interest Rate Volatility Surface	200
Key Implications and Notation of the HJM Approach	201
Pseudo-Probabilities	205
The Formula for Zero-Coupon Bond Price Shifts with Three Risk Factors	205
Building the Bushy Tree for Zero-Coupon Bonds Maturing at Time $T = 2$	206
Building the Bushy Tree for Zero-Coupon Bonds Maturing at Time $T = 3$	208
Building the Bushy Tree for Zero-Coupon Bonds Maturing at Time $T = 4$	208
Valuation in the HJM Framework	217
Valuation of a Zero-Coupon Bond Maturing at Time $T = 4$	219
Valuation of a Coupon-Bearing Bond Paying Annual Interest	225
Valuation of a Digital Option on the One-Year U.S. Treasury Rate	227
Conclusion	229
<b>CHAPTER 10</b>	
<b>Valuation, Liquidity, and Net Income</b>	<b>230</b>
How Many Risk Factors Are Necessary to Accurately Model Movements in the Risk-Free Yield Curve?	230
Revisiting the Phrase “No Arbitrage”	231
Valuation, Liquidity Risk, and Net Income	234
Risk-Neutral and Empirical Probabilities of Interest Rate Movements	235
Monte Carlo Simulation Using HJM Modeling	236
Common Pitfalls in Interest Rate Risk Management	238
Pitfalls in the Use of One-Factor Term Structure Models	238
Common Pitfalls in Asset and Liability Management	243
Summarizing the Problems with Interpolated Monte Carlo Simulation for Risk Analysis	246
<b>CHAPTER 11</b>	
<b>Interest Rate Mismatching and Hedging</b>	<b>250</b>
Political Factions in Interest Rate Risk Management	251
Pension Fund Considerations	251
Life Insurance Companies and Property and Casualty Insurance Companies	252
Commercial Banks	253

Making a Decision on Interest Rate Risk and Return: The Safety Zone	254
Obvious Interest Rate Risk Decisions	255
Assessing the Risk and Return Trade-Offs from a Change in Interest Rate Risk	255
<b>CHAPTER 12</b>	
<b>Legacy Approaches to Interest Rate Risk Management</b>	<b>257</b>
Gap Analysis and Simulation Models	257
Measuring Interest Rate Risk: A Review	258
Legacy Rate Risk Tools: Interest Rate Sensitivity Gap Analysis	258
The Safety Zone	259
What's Wrong with Gap Analysis?	263
Legacy Rate Risk Tools: Multiperiod Simulation	264
Key Assumptions in Simulation	264
Data Aggregation in Simulation Modeling	266
Constraining the Model	266
Modeling the Maturity Structure of a Class of Assets	267
Periodicity of the Analysis	267
Exceptions to the Exact Day Count Trend	267
Legacy Rate Risk Tools: Duration and Convexity	267
Macaulay's Duration: The Original Formula	268
Using Duration for Hedging	270
Comparing a Duration Hedge with Hedging in the HJM Framework	271
Duration: The Traditional Market Convention	273
The Formula for Yield to Maturity	273
Yield to Maturity for Long or Short First Coupon Payment Periods	274
Applying the Yield-to-Maturity Formula to Duration	275
Modified Duration	276
The Perfect Duration Hedge: The Difference between the Original Macaulay and Conventional Durations	278
Convexity and Its Uses	278
Convexity: A General Definition	279
Convexity for the Present Value Formula	280
Hedging Implications of the Convexity Concept	280
Conclusion	281
<b>CHAPTER 13</b>	
<b>Special Cases of Heath, Jarrow, and Morton Interest Rate Modeling</b>	<b>283</b>
What Is an Academic Term Structure Model and Why Was It Developed?	284
The Vocabulary of Term Structure Models	284
Ito's Lemma	286
Ito's Lemma for More Than One Random Variable	287
Using Ito's Lemma to Build a Term Structure Model	287
Duration as a Term Structure Model	288
Conclusions about the Use of Duration's Parallel Shift Assumptions	290
The Vasicek and Extended Vasicek Models	292

The Merton Term Structure Model: Parallel Yield Curve Shifts	293
The Extended Merton Model	298
The Vasicek Model	300
The Extended Vasicek–Hull and White Model	303
Alternative Term Structure Models	303
Alternative One-Factor Interest Rate Models	304
Two-Factor Interest Rate Models	306
Chen’s Three-Factor Term Structure Model	307
Reprising the HJM Approach	308
Appendix A: Deriving Zero-Coupon Bond Prices in the Extended Merton/Ho and Lee Model	308
Appendix B: Deriving Zero-Coupon Bond Prices in the Vasicek Model	310
Appendix C: Valuing Zero-Coupon Bonds in the Extended Vasicek Model	313
<b>CHAPTER 14</b>	
<b>Estimating the Parameters of Interest Rate Models</b>	<b>318</b>
Revisiting the Meaning of No Arbitrage	316
A Framework for Fitting Term Structure Models	316
Fitting Zero-Coupon Bond Prices and Volatility Parameters Jointly	317
Steps in Fitting the Interest Rate Volatility Assumptions	318
Example 1: Fitting Interest Rate Volatility When Six Callable Bonds Are Observable	318
Example 2: The Consequences of Fewer Inputs	329
Example 3: The Case of One Input	329
Interest Rate Parameter Fitting in Practical Application	330
<b>PART THREE</b>	
<b>Risk Management Techniques for Credit Risk Analytics</b>	
<b>CHAPTER 15</b>	
<b>An Introduction to Credit Risk: Using Market Signals in Loan     Pricing and Performance Measurement</b>	<b>335</b>
Market Prices for Credit Risk	335
Critical Sources of Market Data on Credit Risk	336
Bond Prices	336
Credit Default Swap Prices	337
First to Default Swaps	337
Collateralized Debt Obligations	338
Interest Rate Swap Prices	338
Equity Prices	338
Increased Accuracy in Pricing	339
Increased Clarity in Corporate Strategy	339
Increased Sophistication in Risk Management	340
Increased Precision in Measuring the Safety and Soundness of Financial Institutions	340
Credit Default Swaps: The Dangers of Market Manipulation	341

Daily Nondealer Trading Volume for 1,090 Reference Names	347
Credit Default Swap Trading Volume in Municipals and Sub-Sovereigns	352
Credit Default Swap Trading Volume in Sovereign Credits	353
Implications of CDS Trading Volume Data	357

**CHAPTER 16**

<b>Reduced Form Credit Models and Credit Model Testing</b>	<b>359</b>
The Jarrow-Turnbull Model	359
The Jarrow-Turnbull Framework	360
The Jarrow Model	361
Zero-Coupon Bond Prices in the Jarrow Model	363
The Jarrow Model and the Issue of Liquidity in the Bond Market	364
The Jarrow-Merton Put Option as a Risk Index and a Practical Hedge	364
Fitting the Jarrow Model to Bond Prices, Credit Derivatives Prices, and Historical Default Databases	365
Fitting the Jarrow Model to Debt Prices	365
Fitting to Current Price Data and Historical Price Data	366
Fitting the Jarrow Model to Credit Derivatives Prices	366
Fitting the Jarrow Model to a Historical Database of Defaults	366
Fitting the Jarrow Model to Retail, Small Business, and Governmental Counterparties	370
Correlations in Default Probabilities	372
The Jarrow and Jarrow-Turnbull Models: A Summary	373
Tests of Credit Models Using Historical Data	374
An Introduction to Credit Model Testing	375
Misunderstandings about Credit Model Testing	376
The Two Components of Credit Model Performance	378
Measuring Ordinal Ranking of Companies by Credit Risk	379
The Predictive ROC Accuracy Ratio: Techniques and Results	380
The Predictive Capability of the Jarrow-Chava Reduced Form Model Default Probabilities	380
Measuring the Predictive ROC Accuracy Ratio	381
Reduced Form Model vs. Merton Model Performance	381
Consistency of Estimated and Actual Defaults	383
Recent Results from North America	383
The Falkenstein and Boral Test	383
Performance of Credit Models vs. Naïve Models of Risk	386
ROC Accuracy Ratios for Merton Model Theoretical Version vs. Selected Naïve Models	387
Tests of Credit Models Using Market Data	388
Testing Credit Models: The Analogy with Interest Rates	388
Market Data Test 1: Accuracy in Fitting Observable Yield Curves and Credit Spreads	388
Market Data Test 2: Tests of Hedging Performance	389
Market Data Test 3: Consistency of Model Implications with Model Performance	390



Market Data Test 4: Comparing Performance with Credit Spreads and Credit Default Swap Prices	391
Appendix: Converting Default Intensities to Discrete Default Probabilities	391
Converting Monthly Default Probabilities to Annual Default Probabilities	392
Converting Annual Default Probabilities to Monthly Default Probabilities	392
Converting Continuous Instantaneous Probabilities of Default to an Annual Default Probability or Monthly Default Probability	392
Converting Continuous Default Probability to an Annual Default Probability	393
Converting Continuous Default Probability to a Monthly Default Probability	393
Converting an Annual Default Probability to a Continuous Default Intensity	393
Converting a Monthly Default Probability to a Continuous Default Intensity	394
<b>CHAPTER 17</b>	
<b>Credit Spread Fitting and Modeling</b>	<b>396</b>
Introduction to Credit Spread Smoothing	396
The Market Convention for Credit Spreads	397
A Better Convention for Credit Model–Independent Credit Spreads	398
Deriving the Full Credit Spread of a Risky Issuer	399
Credit Spread Smoothing Using Yield Curve–Smoothing Techniques	404
Setting the Scene: Smoothing Results for the Risk-Free Curve	404
A Naïve Approach: Smoothing ABC Yields by Ignoring the Risk-Free Curve	406
Fitting Credit Spreads with Cubic Splines	409
Maximum Smoothness Forward Credit Spreads	410
Comparing Results	411
Data Problems with Risky Issuers	413
The Case of LIBOR	413
Determinants of Credit Spread Levels	415
The Credit Risk Premium: The Supply and Demand for Credit	416
Conclusion	420
<b>CHAPTER 18</b>	
<b>Legacy Approaches to Credit Risk</b>	<b>421</b>
The Rise and Fall of Legacy Ratings	421
Ratings: What They Do and Don't Do	422
Through the Cycle vs. Point in Time, a Distinction without a Difference	423
Stress Testing, Legacy Ratings, and Transition Matrices	425
Transition Matrices: Analyzing the Random Changes in Ratings from One Level to Another	426

Moral Hazard in “Self-Assessment” of Ratings Accuracy by Legacy Rating Agencies	426
Comparing the Accuracy of Ratings and Reduced Form Default Probabilities	429
Problems with Legacy Ratings in the 2006 to 2011 Credit Crisis	431
The Jarrow-Merton Put Option and Legacy Ratings	437
The Merton Model of Risky Debt	438
The Intuition of the Merton Model	439
The Basic Merton Model	441
Valuing Multipayment Bonds with the Merton Model of Risky Debt	444
Estimating the Probability of Default in the Merton Model	445
Implying the Value of Company Assets and Their Return Volatility $\sigma$	446
Mapping the Theoretical Merton Default Probabilities to Actual Defaults	447
The Merton Model When Interest Rates Are Random	447
The Merton Model with Early Default	447
Loss Given Default in the Merton Model	448
Copulas and Correlation between the Events of Default of Two Companies	448
Back to the Merton Case	448
Problems with the Merton Model: Summing Up	449
Appendix	450
Assumptions	450
Using Ito’s Lemma to Expand Changes in the Value of Company Equity	450
<b>CHAPTER 19</b>	
<b>Valuing Credit Risky Bonds</b>	<b>453</b>
The Present Value Formula	453
Valuing Bonds with No Credit Risk	454
Simulating the Future Values of Bonds with No Credit Risk	454
Current and Future Values of Fixed Income Instruments: HJM Background and a Straight Bond Example	455
Valuation of a Straight Bond with a Bullet Principal Payment at Maturity	461
Valuing an Amortizing Loan	461
Valuing Risk-Free, Floating-Rate Loans	465
Valuing Bonds with Credit Risk	465
Simulating the Future Values of Bonds with Credit Risk	471
Valuing the Jarrow-Merton Put Option	472
<b>CHAPTER 20</b>	
<b>Credit Derivatives and Collateralized Debt Obligations</b>	<b>473</b>
Credit Default Swaps: Theory	474
Credit Default Swaps: Practice	477
Collateralized Debt Obligations: Theory	480
Collateralized Debt Obligations: A Worked Example of Reduced Form Simulation	483

Collateralized Debt Obligations: Practice	486
The Copula Method of CDO Valuation: A Postmortem	487
Valuing the Jarrow–Merton Put Option	490
<b>PART FOUR</b>	
<b>Risk Management Applications: Instrument by Instrument</b>	
<b>CHAPTER 21</b>	
<b>European Options on Bonds</b>	<b>495</b>
Example: European Call Option on Coupon-Bearing Bond	501
Example: Coupon-Bearing Bond with Embedded European Call Option	503
European Options on Defaultable Bonds	509
HJM Special Case: European Options in the One-Factor Vasicek Model	509
Options on Coupon-Bearing Bonds	511
The Jarrow-Merton Put Option	512
<b>CHAPTER 22</b>	
<b>Forward and Futures Contracts</b>	<b>513</b>
Forward Contracts on Zero-Coupon Bonds	514
Forward Rate Agreements	520
Eurodollar Futures-Type Forward Contracts	524
Futures on Zero-Coupon Bonds: The Sydney Futures Exchange Bank Bill Contract	527
Futures on Coupon-Bearing Bonds: Dealing with the Cheapest to Deliver Option	528
Eurodollar and Euroyen Futures Contracts	529
Defaultable Forward and Futures Contracts	530
<b>CHAPTER 23</b>	
<b>European Options on Forward and Futures Contracts</b>	<b>531</b>
Valuing Options on Forwards and Futures: Notations and Useful Formulas	531
European Options on Forward Contracts on Zero-Coupon Bonds	532
European Options on Forward Rate Agreements	538
European Options on a Eurodollar Futures-Type Forward Contract European Options on Futures on Coupon-Bearing Bonds	546
European Options on Money Market Futures Contracts	546
Defaultable Options on Forward and Futures Contracts	546
<b>CHAPTER 24</b>	
<b>Caps and Floors</b>	<b>548</b>
Caps as European Options on Forward Rate Agreements	550
Forming Other Cap-Related Securities Valuing a Cap	550
Valuing a Floor	554
Valuing a Floating Rate Loan with a Cap	557

Value of a Loan with a Cap and a Floor	563
Variations on Caps and Floors	565
Measuring the Credit Risk of Counterparties on Caps and Floors	565
<b>CHAPTER 25</b>	
<b>Interest Rate Swaps and Swaptions</b>	<b>567</b>
Interest Rate Swap Basics	567
Valuing the Interest Rate Swaps	568
The Observable Fixed Rate in the Swap Market	574
An Introduction to Swaptions	574
Valuation of European Swaptions	578
Valuation of American Swaptions	579
Defaultable Interest Rate Swaps and Swaptions	579
<b>CHAPTER 26</b>	
<b>Exotic Swap and Options Structures</b>	<b>580</b>
Arrears Swaps	580
Digital Option	586
Digital Range Notes	588
Range Floater	588
Other Derivative Securities	593
Credit Risk and Exotic Derivatives Structures	594
<b>CHAPTER 27</b>	
<b>American Fixed Income Options</b>	<b>596</b>
An Overview of Numerical Techniques for Fixed Income Option Valuation	597
An Example of Valuation of a Callable Bond with a Three-Factor HJM Bushy Tree	598
What Is the Par Coupon on a Callable Bond?	613
An Example of Valuation of a Rationally Prepaid Amortizing Loan	613
Monte Carlo Simulation	615
Conclusions	618
Finite Difference Methods	618
Binomial Lattices	619
Trinomial Lattices	619
HJM Valuation of American Fixed Income Options When Default Risk Is Present	620
<b>CHAPTER 28</b>	
<b>Irrational Exercise of Fixed Income Options</b>	<b>622</b>
Analysis of Irrationality: Criteria for a Powerful Explanation	623
The Transactions Cost Approach	624
Irrational Exercise of European Options	625
The Irrational Exercise of American Options	626

A Worked Example Using an Amortizing Loan with Rational and Irrational Prepayment Behavior	626
Implied Irrationality and Hedging	636
Credit Risk and Irrational Prepayment Behavior	637
<b>CHAPTER 29</b>	
<b>Mortgage-Backed Securities and Asset-Backed Securities</b>	<b>639</b>
Transactions Costs, Prepayments, Default, and Multinomial Logit	640
Legacy Prepayment Analysis of Mortgage-Backed Securities	643
Legacy Approaches: Prepayment Speeds and the Valuation of Mortgages	643
Constant Prepayment Speeds Are Simply a Principal Amortization Assumption	644
Legacy Approaches: Option-Adjusted Spread	645
Implications for OAV Spread, CMOs, and ARMs	647
Logistic Regression, Credit Risk, and Prepayment	648
Mortgage-Servicing Rights: The Ultimate Structured Product	648
An Introduction to the Valuation of Mortgage-Servicing Rights	649
Comparing Best Practice and Common Practice in Valuing and Hedging Mortgage-Servicing Rights	650
Valuation Yield Curve for Cash Flows	650
Simulation of Random Movements in Yields	651
The Role of Home Prices in Defaults and Prepayments	652
Other Sources of Cash Flow Related to Mortgage-Servicing Rights	653
Incorrect Hedging of Mortgage-Servicing Rights	653
Conclusion	654
<b>CHAPTER 30</b>	
<b>Nonmaturity Deposits</b>	<b>658</b>
The Value of the Deposit Franchise	657
Total Cash Flow of Nonmaturity Deposits	658
Specifying the Rate and Balance Movement Formulas	659
The Impact of Bank Credit Risk on Deposit Rates and Balances	669
Case Study: German Three-Month Notice Savings Deposits	672
The Regulators' View	673
Conclusion	674
<b>CHAPTER 31</b>	
<b>Foreign Exchange Markets</b>	<b>675</b>
Setting the Stage: Assumptions for the Domestic and Foreign Economies	675
Foreign Exchange Forwards	676
Numerical Methods for Valuation of Foreign Currency Derivatives	677
Legacy Approaches to Foreign Exchange Options Valuation	678
Implications of a Term Structure Model-Based FX Options Formula	680
The Impact of Credit Risk on Foreign Exchange Risk Formulas	681

**CHAPTER 32****Impact of Collateral on Valuation Models: The Example of Home Prices in the Credit Crisis 682**

The Impact of Changing Home Prices on Collateral Values in the Credit Crisis	682
Modeling Variations in Collateral Values	683
The Impact of Collateral Values on a Rationally Prepaid Mortgage	684
Conclusions about the Impact of Collateral Values	693

**CHAPTER 33****Pricing and Valuing Revolving Credit and Other Facilities 694**

Analyzing Revolving Credit and Other Facilities	695
Fluctuating Credit Risk and Revolving Credit Drawdowns	696
Incorporating Links between Credit Quality and Line Usage	697
Is a Line of Credit a Put Option on the Debt of the Issuer?	697

**CHAPTER 34****Modeling Common Stock and Convertible Bonds on a Default-Adjusted Basis 700**

Modeling Equities: The Traditional Fund Management Approach	701
Modeling Equities: The Derivatives Approach	702
Modeling Equities: A Credit Risk–Adjusted Approach	703
Options on the Common Stock of a Company That Can Go Bankrupt	704
Convertible Bonds of a Company That Can Go Bankrupt	706

**CHAPTER 35****Valuing Insurance Policies and Pension Obligations 708**

Life Insurance: Mortality Rates vs. Default Probabilities	708
Cyclicality in Default Probabilities and Mortality Rates	711
Valuing Life Insurance Policies	711
Pension Obligations	712
Property and Casualty Insurance	713
The Jarrow-Merton Put Option	714

**PART FIVE****Portfolio Strategy and Risk Management****CHAPTER 36****Value-at-Risk and Risk Management Objectives Revisited at the Portfolio and Company Level 719**

The Jarrow-Merton Put Option as a Measure of Total Risk: An Example	719
A Four-Question Pass–Fail Test for Financial Institutions’ CEOs and Boards of Directors	723
Why Do These Four Questions Matter?	724
An Alphabet of 26 Extra-Credit Questions	724
Is Your Value-at-Risk from Value-at-Risk?	726

VaR vs. the Put Option for Capital Allocation	728
Why Are the VaR and Put Approaches So Different:	
Self-Insurance vs. Third-Party Insurance	729
Calculating the Jarrow-Merton Put Option Value and	
Answering the Key 4 + 26 Questions	731
Valuing and Simulating the Jarrow-Merton Put Option	732
What's the Hedge?	733
Liquidity, Performance, Capital Allocation, and	
Own Default Risk	734
<b>CHAPTER 37</b>	
<b>Liquidity Analysis and Management: Examples from the Credit Crisis</b>	<b>735</b>
Liquidity Risk Case Studies from the Credit Crisis	735
Case Studies in Liquidity Risk	736
Largest Funding Shortfalls	736
American International Group (AIG)	737
Consolidated JPMorgan Chase, Bear Stearns, and	
Washington Mutual	744
State Street	746
Morgan Stanley	749
Dexia Credit Local New York Branch	751
Implications of the Credit Crisis History for Liquidity	
Risk Management and Analysis	758
Types of Liquidity Events	758
Liquidity Risk and Credit Risk Linkages	759
Measuring Liquidity Risk as a Line of Credit in the	
Jarrow-Merton Put Option Sense	760
Integrating Managerial Behavior and Market Funds Supply	
in Liquidity Risk Measurement	761
Determining the Optimal Liquidity Strategy	763
Summing Up	763
<b>CHAPTER 38</b>	
<b>Performance Measurement: Plus Alpha vs. Transfer Pricing</b>	<b>765</b>
Transaction-Level Performance Measurement vs. Portfolio-	
Level Performance Measurement	766
Plus Alpha Benchmark Performance vs. Transfer Pricing	767
Why Default Risk Is Critical in Performance Measurement	
of Equity Portfolios	768
"Plus Alpha" Performance Measurement in Insurance and Banking	769
Decomposing the Reasons for Plus or Minus Alpha in a Fixed	
Income Portfolio	770
A Worked Example of Modern Fixed Income Performance Attribution	772
The Jarrow-Merton Put Option and Capital	780
Using the Jarrow-Merton Put Option for Capital Allocation	780
Introduction	780
Using the Jarrow-Merton Put Option Concept for Capital Allocation	780

Extending the Jarrow-Merton Capital Allocation to a Multiperiod Framework	782
Summing Up	782
<b>CHAPTER 39</b>	
<b>Managing Institutional Default Risk and Safety and Soundness</b>	<b>783</b>
Step 1: Admitting the Possibility of Failure	783
Managing the Probability of Failure	785
Are Ratings a Useful Guide?	785
Are CDS Spreads a Useful Guide?	786
Using Quantitative Default Probabilities	787
Controlling the Probability of Failure through the Credit Cycle	789
Hedging Total Risk to Maximize Shareholder Value	790
Implications for Basel II, Basel III, and Solvency II	791
Simulating Your Own Probability of Default	792
<b>CHAPTER 40</b>	
<b>Information Technology Considerations</b>	<b>793</b>
Common Practice in Risk Management Systems: Dealing with Legacy Systems	793
Upgrading the Risk Infrastructure: The Request for Proposal Process	795
Paid Pilots as Final Proof of Concept	796
Keys to Success in Software Installation	797
Vendor Size: Larger Vendor or Small Vendor?	798
Being a Best Practice User	799
<b>CHAPTER 41</b>	
<b>Shareholder Value Creation and Destruction</b>	<b>800</b>
Do No Harm	800
Measure the Need to Change	801
Rating Your Primary Risk System	803
Master the Politics and Exposition of Risk Management:	
Shareholder Value Creation	803
Daily Management Reporting of Total Risk	805
Moving from Common Practice to Best Practice	806
The Senior Management Perspective	807
The Middle Management Perspective	807
The Working-Level Perspective	807
Getting Help to Create Shareholder Value	808
Postscript	808
<b>Bibliography</b>	<b>809</b>
<b>Index</b>	<b>819</b>