Contents

Preface xix
Introduction xxi

PART ONE
Quantitative Analysis

CHAPTER 1
Bond Fundamentals 3

1.1 Discounting, Present, and Future Value 3
1.2 Price-Yield Relationship 6
1.2.1 Valuation 6
1.2.2 Taylor Expansion 8
1.3 Bond Price Derivatives 9
1.3.1 Interpreting Duration and Convexity 16
1.3.2 Portfolio Duration and Convexity 23
1.4 Important Formulas 25
1.5 Answers to Chapter Examples 26
Appendix: Applications of Infinite Series 29

CHAPTER 2
Fundamentals of Probability 31

2.1 Characterizing Random Variables 31
2.1.1 Univariate Distribution Functions 32
2.1.2 Moments 33
2.2 Multivariate Distribution Functions 37
2.2.1 Joint Distributions 37
2.2.2 Copulas 38
2.2.3 Covariances and Correlations 38
2.3 Functions of Random Variables 40
2.3.1 Linear Transformation of Random Variables 41
2.3.2 Sum of Random Variables 41
2.3.3 Portfolios of Random Variables 42
2.3.4 Product of Random Variables 43
2.3.5 Distributions of Transformations of RVs 44
2.4 Important Distribution Functions 46
2.4.1 Uniform Distribution 46
2.4.2 Normal Distribution 47
2.4.3 Lognormal Distribution 51
2.4.4 Student's *t* Distribution 54
2.4.5 Binomial Distribution 55
2.4.6 Poisson Distribution 57

COPYRIGHTED MATERIAL

JWPR017-FM Design-Sample May 2, 2007 21:42 Char Count= 0

2.5 Limit Distributions 58
2.5.1 Distribution of Averages 58
2.5.2 Distribution of Tails 59
2.6 Important Formulas 60
2.7 Answers to Chapter Examples 61
Appendix: Review of Matrix Multiplication 63

CHAPTER 3
Fundamentals of Statistics **65**

3.1 Real Data 65
3.1.1 Measuring Returns 66
3.1.2 Time Aggregation 67
3.1.3 Portfolio Aggregation 70
3.2 Parameter Estimation 71
3.3 Regression Analysis 74
3.3.1 Bivariate Regression 74
3.3.2 Autoregression 76
3.3.3 Multivariate Regression 77
3.3.4 Example 77
3.3.5 Pitfalls with Regressions 80
3.4 Important Formulas 82
3.5 Answers to Chapter Examples 83

CHAPTER 4
Monte Carlo Methods **85**

4.1 Simulations with One Random Variable 85
4.1.1 Simulating Markov Processes 85
4.1.2 The Geometric Brownian Motion 86
4.1.3 Simulating Yields 90
4.1.4 Binomial Trees 92
4.2 Implementing Simulations 95
4.2.1 Simulation for VAR 95
4.2.2 Simulation for Derivatives 95
4.2.3 Accuracy 96
4.3 Multiple Sources of Risk 98
4.3.1 The Cholesky Factorization 99
4.3.2 The Curse of Dimensionality 100
4.4 Important Formulas 101
4.5 Answers to Chapter Examples 102

PART TWO
Capital Markets

CHAPTER 5
Introduction to Derivatives **107**

5.1 Overview of Derivatives Markets 107
5.2 Forward Contracts 109
5.2.1 Definition 109
5.2.2 Valuing Forward Contracts 111

JWPR017-FM Design-Sample May 2, 2007 21:42 Char Count= 0

5.2.3 Valuing an Off-Market Forward Contract 113
5.2.4 Valuing Forward Contracts with Income Payments 113
5.3 Futures Contracts 117
5.3.1 Definitions of Futures 117
5.3.2 Valuing Futures Contracts 119
5.4 Swap Contracts 120
5.5 Important Formulas 121
5.6 Answers to Chapter Examples 121

CHAPTER 6
Options 123

6.1 Option Payoffs 123
6.1.1 Basic Options 123
6.1.2 Put-Call Parity 126
6.1.3 Combination of Options 128
6.2 Option Premiums 132
6.2.1 General Relationships 132
6.2.2 Early Exercise of Options 134
6.3 Valuing Options 136
6.3.1 Pricing by Replication 136
6.3.2 Black-Scholes Valuation 137
6.3.3 Extensions 140
6.3.4 Market versus Model Prices 141
6.4 Other Option Contracts 143
6.5 Valuing Options by Numerical Methods 146
6.6 Important Formulas 148
6.7 Answers to Chapter Examples 149

CHAPTER 7
Fixed-Income Securities 152

7.1 Overview of Debt Markets 152
7.2 Fixed-Income Securities 155
7.2.1 Instrument Types 155
7.2.2 Methods of Quotation 157
7.3 Analysis of Fixed-Income Securities 158
7.3.1 The NPV Approach 158
7.3.2 Pricing 159
7.3.3 Duration 161
7.4 Spot and Forward Rates 162
7.5 Prepayment 167
7.5.1 Describing Prepayment Speed 167
7.5.2 Prepayment Risk 169
7.6 Securitization 174
7.6.1 Principles of Securitization 174
7.6.2 Tranching 176
7.6.3 Tranching: Inverse Floaters 178
7.6.4 Tranching: CMOs 180
7.7 Important Formulas 182
7.8 Answers to Chapter Examples 182

CHAPTER 8
Fixed-Income Derivatives **186**

8.1 Forward Contracts 186
8.2 Futures 189
8.2.1 Eurodollar Futures 189
8.2.2 T-bond Futures 190
8.3 Swaps 193
8.3.1 Instruments 193
8.3.2 Pricing 194
8.4 Options 199
8.4.1 Caps and Floors 199
8.4.2 Swaptions 202
8.4.3 Exchange-Traded Options 204
8.5 Important Formulas 205
8.6 Answers to Chapter Examples 206

CHAPTER 9
Equity, Currency, and Commodity Markets **209**

9.1 Equities 209
9.1.1 Overview 209
9.1.2 Valuation 211
9.2 Convertible Bonds and Warrants 212
9.2.1 Definitions 212
9.2.2 Valuation 214
9.3 Equity Derivatives 216
9.3.1 Stock Index Futures 216
9.3.2 Single Stock Futures 219
9.3.3 Equity Options 219
9.3.4 Equity Swaps 220
9.3.5 Variance Swaps 220
9.4 Currency Markets 221
9.5 Currency Swaps 223
9.5.1 Instruments 223
9.5.2 Pricing 224
9.6 Commodities 228
9.6.1 Products 228
9.6.2 Pricing of Futures 229
9.6.3 Futures and Expected Spot Prices 231
9.7 Important Formulas 234
9.8 Answers to Chapter Examples 235

PART THREE
Market Risk Management

CHAPTER 10
Introduction to Market Risk Measurement **241**

10.1 Introduction to Financial Market Risks 241
10.1.1 Types of Financial Risks 241
10.1.2 Risk Management Tools 242
10.2 VAR as a Downside Risk Measure 244
10.2.1 VAR: Definition 244

JWPR017-FM Design-Sample May 2, 2007 21:42 Char Count= 0

10.2.2 VAR: Caveats 246
10.2.3 Alternative Measures of Risk 247
10.2.4 Cash Flow at Risk 249
10.3 VAR Parameters 250
10.3.1 Confidence Level 251
10.3.2 Horizon 251
10.3.3 Application: The Basel Rules 253
10.4 Elements of VAR Systems 254
10.4.1 Portfolio Positions 254
10.4.2 Risk Factors 255
10.4.3 VAR Methods 255
10.5 Stress-Testing 256
10.6 Liquidity Risk 259
10.7 Important Formulas 262
10.8 Answers to Chapter Examples 262
Appendix: Desirable Properties for Risk Measures 264

CHAPTER 11
Sources of Market Risk **267**

11.1 Sources of Loss: A Decomposition 267
11.2 Currency Risk 268
11.2.1 Currency Volatility 269
11.2.2 Correlations 270
11.2.3 Cross-Rate Volatility 271
11.3 Fixed-Income Risk 271
11.3.1 Factors Affecting Yields 272
11.3.2 Bond Price and Yield Volatility 274
11.3.3 Correlations 276
11.3.4 Global Interest Rate Risk 278
11.3.5 Real Yield Risk 279
11.3.6 Credit Spread Risk 280
11.3.7 Prepayment Risk 280
11.4 Equity Risk 281
11.4.1 Stock Market Volatility 281
11.5 Commodity Risk 282
11.5.1 Commodity Volatility 282
11.5.2 Futures Risk 282
11.6 Risk Simplification 285
11.6.1 Diagonal Model 285
11.6.2 Fixed-Income Portfolio Risk 286
11.7 Important Formulas 288
11.8 Answers to Chapter Examples 288
Appendix: Simplification of the Covariance Matrix 290

CHAPTER 12
Hedging Linear Risk **292**

12.1 Introduction to Futures Hedging 293
12.1.1 Unitary Hedging 293
12.1.2 Basis Risk 294

JWPR017-FM Design-Sample May 2, 2007 21:42 Char Count= 0

12.2 Optimal Hedging 296
12.2.1 The Optimal Hedge Ratio 296
12.2.2 Example 299
12.2.3 Liquidity Issues 301
12.3 Applications of Optimal Hedging 301
12.3.1 Duration Hedging 301
12.3.2 Beta Hedging 305
12.4 Important Formulas 307
12.5 Answers to Chapter Examples 307

CHAPTER 13
Nonlinear Risk: Options **309**

13.1 Evaluating Options 309
13.1.1 Definitions 309
13.1.2 Taylor Expansion 310
13.1.3 Option Pricing 311
13.2 Option "Greeks" 313
13.2.1 Option Sensitivities: Delta and Gamma 313
13.2.2 Option Sensitivities: Vega 316
13.2.3 Option Sensitivities: Rho 318
13.2.4 Option Sensitivities: Theta 319
13.2.5 Option Pricing and the "Greeks" 319
13.2.6 Option Sensitivities: Summary 321
13.3 Dynamic Hedging 325
13.3.1 Delta and Dynamic Hedging 325
13.3.2 Implications 325
13.3.3 Distribution of Option Payoffs 326
13.4 Important Formulas 330
13.5 Answers to Chapter Examples 330

CHAPTER 14
Modeling Risk Factors **333**

14.1 Normal and Lognormal Distributions 333
14.1.1 Why the Normal? 333
14.1.2 Computing Returns 334
14.1.3 Time Aggregation 335
14.2 Fat Tails 337
14.3 Time-Variation in Risk 339
14.3.1 GARCH 339
14.3.2 EWMA 342
14.3.3 Option Data 344
14.3.4 Implied Distributions 345
14.4 Important Formulas 347
14.5 Answers to Chapter Examples 347

CHAPTER 15
VAR Methods **349**

15.1 VAR: Local versus Full Valuation 349
15.1.1 Local Valuation 350
15.1.2 Full Valuation 350
15.1.3 Delta-Gamma Method 351
15.2 VAR Methods: Overview 353
15.2.1 Mapping 353

JWPR017-FM Design-Sample May 2, 2007 21:42 Char Count= 0

15.2.2 Delta-Normal Method 353
15.2.3 Historical Simulation Method 354
15.2.4 Monte Carlo Simulation Method 355
15.2.5 Comparison of Methods 356
15.3 Example 358
15.3.1 Mark-to-Market 358
15.3.2 Risk Factors 360
15.3.3 VAR: Historical Simulation 361
15.3.4 VAR: Delta-Normal Method 362
15.4 Important Formulas 364
15.5 Answers to Chapter Examples 365

PART FOUR
Investment Risk Management

CHAPTER 16
Portfolio Management 369

16.1 Institutional Investors 369
16.2 Portfolio Management 370
16.2.1 Risk Measurement 370
16.2.2 Performance Measurement 373
16.2.3 Performance Attribution 374
16.2.4 Performance Evaluation and Survivorship 376
16.3 Risk Budgeting 378
16.4 Important Formulas 380
16.5 Answers to Chapter Examples 381

CHAPTER 17
Hedge Fund Risk Management 383

17.1 The Hedge Fund Industry 383
17.2 Leverage, Long, and Short Positions 384
17.2.1 Long Position 384
17.2.2 Short Position 385
17.2.3 Long and Short Positions 386
17.3 Hedge Fund Risk Management 389
17.3.1 Types of Market Risks 389
17.3.2 Hedge Fund Styles 389
17.3.3 Liquidity and Model Risk 396
17.4 Hedge Fund Transparency 399
17.5 Important Formulas 402
17.6 Answers to Chapter Examples 403

PART FIVE
CREDIT RISK MANAGEMENT

CHAPTER 18
Introduction to Credit Risk 409

18.1 Settlement Risk 409
18.1.1 Presettlement Versus Settlement Risk 409
18.1.2 Handling Settlement Risk 410

JWPR017-FM Design-Sample May 2, 2007 21:42 Char Count= 0

18.2 Overview of Credit Risk 412
18.2.1 Drivers of Credit Risk 412
18.2.2 Measurement of Credit Risk 412
18.2.3 Credit Risk versus Market Risk 413
18.3 Measuring Credit Risk 414
18.3.1 Credit Losses 414
18.3.2 Joint Events 414
18.3.3 An Example 416
18.4 Credit Risk Diversification 420
18.5 Important Formulas 424
18.6 Answers to Chapter Examples 424

CHAPTER 19
Measuring Actuarial Default Risk **427**

19.1 Credit Event 428
19.2 Default Rates 429
19.2.1 Credit Ratings 429
19.2.2 Historical Default Rates 432
19.2.3 Cumulative and Marginal Default Rates 435
19.2.4 Transition Probabilities 440
19.2.5 Time Variation in Default Probabilities 442
19.3 Recovery Rates 443
19.3.1 The Bankruptcy Process 443
19.3.2 Estimates of Recovery Rates 444
19.4 Assessing Corporate and Sovereign Rating 447
19.4.1 Corporate Ratings 447
19.4.2 Sovereign Ratings 448
19.5 Important Formulas 451
19.6 Answers to Chapter Examples 451

CHAPTER 20
Measuring Default Risk from Market Prices **454**

20.1 Corporate Bond Prices 454
20.1.1 Spreads and Default Risk 455
20.1.2 Risk Premium 456
20.1.3 The Cross-Section of Yield Spreads 458
20.1.4 Time Variation in Credit Spreads 459
20.2 Equity Prices 461
20.2.1 The Merton Model 461
20.2.2 Pricing Equity and Debt 463
20.2.3 Applying the Merton Model 465
20.2.4 Example 467
20.3 Important Formulas 469
20.4 Answers to Chapter Examples 469

CHAPTER 21
Credit Exposure **471**

21.1 Credit Exposure by Instrument 471
21.1.1 Loans or Bonds 472
21.1.2 Guarantees 472
21.1.3 Commitments 472
21.1.4 Swaps or Forwards 472

21.1.5 Long Options 473
21.1.6 Short Options 473
21.2 Distribution of Credit Exposure 474
21.2.1 Expected and Worst Exposure 474
21.2.2 Time Profile 475
21.2.3 Exposure Profile for Interest Rate Swaps 476
21.2.4 Exposure Profile for Currency Swaps 484
21.2.5 Exposure Profile for Different Coupons 486
21.3 Exposure Modifiers 487
21.3.1 Marking to Market 488
21.3.2 Exposure Limits 489
21.3.3 Recouponing 490
21.3.4 Netting Arrangements 490
21.4 Credit Risk Modifiers 496
21.4.1 Credit Triggers 496
21.4.2 Time Puts 496
21.5 Important Formulas 496
21.6 Answers to Chapter Examples 497

CHAPTER 22
Credit Derivatives and Structured Products **500**

22.1 Introduction 500
22.2 Types of Credit Derivatives 501
22.2.1 Credit Default Swaps 501
22.2.2 Total Return Swaps 506
22.2.3 Credit Spread Forward and Options 507
22.3 Pricing and Hedging Credit Derivatives 509
22.3.1 Methods 510
22.3.2 Example: Credit Default Swap 510
22.4 Structured Products 514
22.4.1 Creating Structured Products 514
22.4.2 Credit-Linked Notes 514
22.4.3 Collateralized Debt Obligations 515
22.5 CDO Market 517
22.5.1 Balance Sheet and Arbitrage CDOs 517
22.5.2 Cash Flow and Synthetic CDOs 518
22.5.3 Cash Flow and Market Value CDOs 518
22.5.4 Static and Managed CDOs 519
22.5.5 Other Products 519
22.6 Conclusions 522
22.7 Important Formulas 524
22.8 Answers to Chapter Examples 524

CHAPTER 23
Managing Credit Risk **527**

23.1 Measuring the Distribution of Credit Losses 528
23.2 Measuring Expected Credit Loss 530
23.2.1 Expected Loss over a Target Horizon 530
23.2.2 The Time Profile of Expected Loss 531
23.3 Measuring Credit VAR 533
23.4 Portfolio Credit Risk Models 535
23.4.1 Approaches to Portfolio Credit Risk Models 535

JWPR017-FM Design-Sample May 2, 2007 21:42 Char Count= 0

23.4.2 CreditMetrics 536
23.4.3 CreditRisk+ 539
23.4.4 Moody's KMV 539
23.4.5 Credit Portfolio View 540
23.4.6 Comparison 540
23.5 Important Formulas 544
23.6 Answers to Chapter Examples 545

PART SIX
Operational and Integrated Risk Management

CHAPTER 24
Operational Risk **551**

24.1 The Importance of Operational Risk 551
24.1.1 Case Histories 552
24.1.2 Business Lines 552
24.2 Identifying Operational Risk 553
24.3 Assessing Operational Risk 556
24.3.1 Comparison of Approaches 556
24.3.2 Actuarial Models 557
24.4 Managing Operational Risk 561
24.4.1 Capital Allocation and Insurance 561
24.4.2 Mitigating Operational Risk 563
24.4.3 Conceptual Issues 564
24.5 Answers to Chapter Examples 565
Appendix: Causal Networks 567

CHAPTER 25
Risk Capital and RAROC **569**

25.1 RAROC 569
25.1.1 Risk Capital 570
25.1.2 RAROC Methodology 571
25.1.3 Application to Compensation 572
25.2 Performance Evaluation and Pricing 573
25.3 Important Formulas 575
25.4 Answers to Chapter Examples 575

CHAPTER 26
Firm-Wide Risk Management **577**

26.1 Integrated Risk Management 577
26.1.1 Types of Risk 577
26.1.2 Risk Interactions 578
26.2 Best Practices Reports 580
26.2.1 The G-30 Report 580
26.2.2 The Bank of England Report on Barings 582
26.2.3 The CRMPG Report on LTCM 582
26.3 Organizational Structure 584
26.4 Controlling Traders 588
26.4.1 Trader Compensation 588
26.4.2 Trader Limits 589
26.5 Answers to Chapter Examples 592

PART SEVEN
Legal, Accounting, and Tax Risk Management

CHAPTER 27
Legal Issues **597**

27.1 Legal Risks with Derivatives 597
27.2 Netting 600
27.2.1 Netting under the Basel Accord 601
27.2.2 Walk-Away Clauses 602
27.2.3 Netting and Exchange Margins 602
27.3 ISDA Master Netting Agreement 603
27.4 The 2002 Sarbanes-Oxley Act 606
27.5 Glossary 608
27.5.1 General Legal Terms 608
27.5.2 Bankruptcy Terms 608
27.5.3 Contract Terms 609
27.6 Answers to Chapter Examples 610

CHAPTER 28
Accounting and Tax Issues **611**

28.1 Internal Reporting 612
28.1.1 Purpose of Internal Reporting 612
28.1.2 Comparison of Methods 612
28.2 Major Issues in Reporting 613
28.2.1 Valuation Issues 613
28.2.2 Reporting Method for Derivatives 615
28.3 External Reporting: FASB 616
28.3.1 FAS 133 617
28.3.2 Definition of Derivative 617
28.3.3 Embedded Derivatives 618
28.3.4 Disclosure Rules 619
28.3.5 Hedge Effectiveness 620
28.3.6 General Evaluation of FAS 133 621
28.3.7 Accounting Treatment of SPEs 622
28.4 External Reporting: IASB 625
28.4.1 IAS 39 625
28.5 Tax Considerations 627
28.6 Answers to Chapter Examples 628

PART EIGHT
Regulation and Compliance

CHAPTER 29
Regulation of Financial Institutions **633**

29.1 Definition of Financial Institutions 633
29.2 Systemic Risk 634
29.3 Regulation of Commercial Banks 635
29.4 Regulation of Securities Houses 638
29.5 Tools and Objectives of Regulation 639
29.6 Answers to Chapter Examples 642

JWPR017-FM Design-Sample May 2, 2007 21:42 Char Count= 0

CHAPTER 30
The Basel Accord **643**

30.1 Steps in the Basel Accord 643
30.1.1 The Basel I Accord 643
30.1.2 The 1996 Amendment 644
30.1.3 The Basel II Accord 644
30.2 The 1988 Basel Accord 646
30.2.1 Risk Capital 646
30.2.2 On–Balance Sheet Risk Charges 649
30.2.3 Off–Balance Sheet Risk Charges 649
30.2.4 Total Risk Charge 654
30.3 Illustration 655
30.4 The New Basel Accord 658
30.4.1 Issues with the 1988 Basel Accord 658
30.4.2 Definition of Capital 658
30.4.3 The Credit Risk Charge 659
30.4.4 The Operational Risk Charge 663
30.4.5 Evaluation 666
30.5 Conclusions 667
30.6 Important Formulas 668
30.7 Answers to Chapter Examples 668

CHAPTER 31
The Basel Market Risk Charge **671**

31.1 The Standardized Method 671
31.2 The Internal Models Approach 672
31.2.1 Qualitative Requirements 673
31.2.2 The Market Risk Charge 673
31.2.3 Combination of Approaches 675
31.3 Stress Testing 677
31.4 Backtesting 679
31.4.1 Measuring Exceptions 679
31.4.2 Statistical Decision Rules 679
31.4.3 The Penalty Zones 680
31.5 Important Formulas 683
31.6 Answers to Chapter Examples 683

About the CD-ROM **685**

Index **687**