PART I: TOOLS

1 Introduction
   1.1 Forty years of evolution
   1.2 What is financial engineering?
   1.3 The nature of risk
   1.4 Financial engineering and risk
   1.5 Layout of this book

2 The cash markets
   2.1 Overview of financial markets
   2.2 The foreign exchange market
   2.3 The money markets
   2.4 The bond markets
   2.5 The equities markets
   2.6 The commodities markets
   2.7 Cash instruments versus derivatives
   2.8 Capital adequacy requirements

3 Forward rates
   3.1 Forward exchange rates
   3.2 Forward interest rates
   3.3 Do forward rates predict future spot rates?
   3.4 Spot and forward rates in practice

4 FRAs
   4.1 What is an FRA?
   4.2 Definitions
   4.3 Terminology
   4.4 The settlement process
   4.5 Hedging with FRAs
   4.6 Pricing FRAs
   4.7 Behaviour of FRA rates
## 5 Financial futures

- 5.1 A brief history of futures markets 58
- 5.2 What is a financial future? 61
- 5.3 Futures trading – from pits to screens 62
- 5.4 Buying and selling 64
- 5.5 The clearing mechanism 64
- 5.6 Futures margins 66
- 5.7 Physical delivery versus cash settlement 70
- 5.8 Futures and cash markets compared 72
- 5.9 The advantages of futures 72

## 6 Short-term interest rate futures

- 6.1 Definitions 76
- 6.2 STIR contracts pricing 79
- 6.3 Basis 83
- 6.4 Convergence 85
- 6.5 Behaviour of futures prices 87
- 6.6 Basic hedging example 91
- 6.7 Short-term futures contracts compared 93
- 6.8 Comparisons of futures and FRAs 96
- 6.9 Spread positions 97

## 7 Bond and stock index futures

- 7.1 Definition of bond futures contracts 104
- 7.2 The cheapest-to-deliver bond 108
- 7.3 Cash-and-carry pricing for bond futures 113
- 7.4 The implied repo rate 119
- 7.5 The delivery mechanism 121
- 7.6 Basic hedging with bond futures 125
- 7.7 Stock indices and stock index futures 128
- 7.8 Definition of stock index futures contracts 128
- 7.9 Advantages of using stock index futures 130
- 7.10 Cash-and-carry pricing for stock index futures 131
- 7.11 Stock index futures prices in practice 134
- 7.12 Turning cash into share portfolios and share portfolios into cash 136

## 8 Swaps

- 8.1 Definition of interest rate and cross-currency swaps 144
- 8.2 Development of the swap market 145
- 8.3 Interest rate swaps 147
- 8.4 Non-standard interest rate swaps 150
- 8.5 Overnight indexed swaps 154
- 8.6 Cross-currency swaps 157
- 8.7 Basic applications for swaps 159
- 8.8 Asset swaps 162
- 8.9 CMS and CMT swaps 164
### VIII CONTENTS

- **8.10 Inflation swaps** | 165
- **8.11 Equity and dividend swaps** | 167
- **8.12 Commodity swaps** | 170
- **8.13 Volatility and variance swaps** | 171
- **8.14 Exotic swaps** | 173
- **8.15 ISDA documentation** | 174
- **8.16 Changes in market infrastructure after the credit crisis** | 176

#### 9 Pricing and valuing swaps
- **9.1 Principles of swap valuation and pricing** | 182
- **9.2 Discount factors and the discount function** | 183
- **9.3 Calculating discount factors from swap and forward rates** | 187
- **9.4 Generating the discount function** | 191
- **9.5 Relationship between zero, swap and forward rates** | 196
- **9.6 Valuation and pricing of interest rate swaps** | 199
- **9.7 Valuation and pricing of currency swaps** | 208
- **9.8 Cancelling a swap** | 212
- **9.9 Hedging swaps with futures** | 213
- **9.10 The convexity correction** | 216
- **9.11 Credit risk of swaps** | 217
- **9.12 Collateralised vs. non-collateralised swaps** | 221
- **9.13 LIBOR-OIS discounting** | 223

#### 10 Options – basics and pricing
- **10.1 Why options are different** | 237
- **10.2 Definitions** | 240
- **10.3 Options terminology** | 243
- **10.4 Value and profit profiles at maturity** | 247
- **10.5 Pricing options** | 251
- **10.6 The behaviour of financial prices** | 255
- **10.7 The Black-Scholes model** | 262
- **10.8 The binomial approach** | 271
- **10.9 The Monte Carlo approach** | 281
- **10.10 Finite difference methods** | 283

#### 11 Options – volatility and the Greeks
- **11.1 Volatility** | 292
- **11.2 Volatility smiles and skews** | 296
- **11.3 The VIX** | 305
- **11.4 Value profiles prior to maturity** | 306
- **11.5 How options behave – the Greeks** | 314
- **11.6 Delta hedging** | 326

#### 12 Options – from building blocks to portfolios
- **12.1 The building block approach** | 338
- **12.2 Option spreads – vertical, horizontal and diagonal** | 342
| 12.3 Volatility structures | 350 |
| 12.4 Range structures | 357 |
| 12.5 Arbitrage structures | 363 |

| 13 Options – interest rate and exotic options | 367 |
| 13.1 Why interest rate options are different | 368 |
| 13.2 Caps, floors and collars | 369 |
| 13.3 Swaptions | 373 |
| 13.4 Cancellable and extendible swaps | 376 |
| 13.5 Pricing interest rate options | 378 |
| 13.6 Compound options | 385 |
| 13.7 Exotic options | 387 |
| 13.8 Path-dependent options | 387 |
| 13.9 Digital options | 397 |
| 13.10 Multivariate options | 398 |
| 13.11 Other exotic options | 400 |
| 13.12 Pricing exotic options | 401 |
| 13.13 Price comparisons between exotic options | 406 |
| 13.14 Embedded options | 411 |

| 14 Introducing credit derivatives | 415 |
| 14.1 Development of the credit derivatives market | 416 |
| 14.2 Motivations for using credit derivatives | 419 |
| 14.3 Introducing credit default swaps (CDS) | 420 |
| 14.4 Market conventions | 423 |
| 14.5 Credit events and determination committees | 426 |
| 14.6 Capital structure, recovery rates, reference and deliverable obligations | 429 |
| 14.7 Settlement methods and auctions | 432 |
| 14.8 Other aspects of CDS | 439 |

| 15 CDS pricing and credit indices | 447 |
| 15.1 A simple CDS pricing model | 448 |
| 15.2 Obtaining default probabilities | 450 |
| 15.3 Developing a multi-period framework | 451 |
| 15.4 The ISDA CDS Standard Model | 452 |
| 15.5 Bootstrapping default probabilities | 455 |
| 15.6 Calculating up-front payments | 459 |
| 15.7 Mark-to-market and CDS valuation | 463 |
| 15.8 PV01 and SDV01 | 465 |
| 15.9 How credit indices developed | 467 |
| 15.10 The CDX and iTraxx credit indices | 468 |
| 15.11 Market quotations and statistics | 473 |
| 15.12 Other credit indices | 475 |
| 15.13 Index tranches | 477 |
PART II: TECHNIQUES

16 Applications for financial engineering

16.1 Applications of financial engineering
16.2 Sources of financial risk
16.3 Accounting and economic risk
16.4 Defining hedging objectives
16.5 Measuring hedge efficiency
16.6 The finance division as a profit centre

17 Managing currency risk

17.1 Forwards and futures solutions
17.2 Options are chameleons
17.3 How FX options are different
17.4 The scenario
17.5 Comparing hedging strategies
17.6 Basic option hedges
17.7 Selling options within a hedging programme
17.8 Collars, range-forwards, forward-bands and cylinders
17.9 Spread hedges
17.10 Participating forwards
17.11 Ratio forwards
17.12 Break-forwards, FOXs and forward-reversing options
17.13 Flexi-forwards
17.14 Using exotic options
17.15 Selling options outside a hedging programme
17.16 Dynamic hedging
17.17 Which strategy is best?

18 Managing interest rate risk using FRAs, futures and swaps

18.1 Using FRAs
18.2 Using short-term interest rate futures
18.3 Calculating the hedge ratio
18.4 Stack vs. strip hedges
18.5 Different kinds of basis risk
18.6 Managing the convergence basis
18.7 Interpolated hedges
18.8 Combining the techniques
18.9 FRAs vs. futures
18.10 Using swaps
18.11 Hedging bond and swap portfolios
18.12 Hedging bond portfolios with bond futures

19 Managing interest rate risk – using options and option-based instruments

19.1 Interest rate guarantees
19.2 Using caps and floors
# CONTENTS

19.3 Collars, participating caps, spread hedges and other variations 600  
19.4 Using captions and swaptions 605  
19.5 Comparison of interest risk management tools 610

## 20 Managing equity risk

20.1 Bull and bear strategies 622  
20.2 Return enhancement 626  
20.3 Value protection strategies 630  
20.4 Vertical, horizontal and diagonal spreads 632  
20.5 Other option strategies 635  
20.6 Using stock index futures and options 637  
20.7 Portfolio insurance 641  
20.8 Guaranteed equity funds 644  
20.9 Warrants and convertibles 646  
20.10 Exotic equity derivatives 648

## 21 Managing commodity risk

21.1 Commodity risk 658  
21.2 Creating commodity derivatives 659  
21.3 Using commodity derivatives 664  
21.4 Hybrid commodity derivatives 669

## 22 Managing credit risk

22.1 Hedging default risk 672  
22.2 Hedging credit risk 679  
22.3 Generating income 684  
22.4 Trading strategies using CDS 687  
22.5 Implementing directional views 687  
22.6 Monetising relative credit views 691  
22.7 Basis trades 695  
22.8 Curve trades 699  
22.9 Index trades 704

## 23 Structured products

23.1 Understanding structured products 710  
23.2 How structured products are built 712  
23.3 Features of structured products 714  
23.4 Principal-protected notes 717  
23.5 Buffered and capped notes 720  
23.6 Leveraged structures 724  
23.7 Path-dependent structures 727  
23.8 Digital and range-accrual structures 732  
23.9 Correlation structures 737  
23.10 Redeeming structured products prior to maturity 739  
23.11 Finalé 741

Index 742