

Contents

List of Symbols and Abbreviations	xvii
Preface	xix
PART I FOUNDATIONS	1
1 Basic Instruments	3
1.1 Introduction	3
1.2 Interest Rates	3
1.2.1 LIBOR vs Treasury Rates	4
1.2.2 Yield Curves	4
1.2.3 Time Value of Money	5
1.2.4 Bonds	6
1.2.5 Zero Coupon Bonds	7
1.3 Equities and Currencies	8
1.3.1 Stocks	8
1.3.2 Foreign Exchange	10
1.3.3 Indices	10
1.3.4 Exchange-traded Funds	11
1.3.5 Forward Contracts	11
1.3.6 Futures	12
1.4 Swaps	13
1.4.1 Interest Rate Swaps	13
1.4.2 Cross-currency Swaps	14
1.4.3 Total Return Swaps	16
1.4.4 Asset Swaps	16
1.4.5 Dividend Swaps	16
2 The World of Structured Products	19
2.1 The Products	19
2.1.1 The Birth of Structured Products	19
2.1.2 Structured Product Wrappers	20
2.1.3 The Structured Note	20

2.2	The Sell Side	21
2.2.1	Sales and Marketing	21
2.2.2	Traders and Structurers	22
2.3	The Buy Side	23
2.3.1	Retail Investors	23
2.3.2	Institutional Investors	24
2.3.3	Bullish vs Bearish, the Economic Cycle	24
2.3.4	Credit Risk and Collateralized Lines	25
2.4	The Market	26
2.4.1	Issuing a Structured Product	26
2.4.2	Liquidity and a Two-way Market	27
2.5	Example of an Equity Linked Note	28
3	Vanilla Options	31
3.1	General Features of Options	31
3.2	Call and Put Option Payoffs	32
3.3	Put–call Parity and Synthetic Options	34
3.4	Black–Scholes Model Assumptions	35
3.4.1	Risk-neutral Pricing	36
3.5	Pricing a European Call Option	37
3.6	Pricing a European Put Option	38
3.7	The Cost of Hedging	40
3.8	American Options	42
3.9	Asian Options	43
3.10	An Example of the Structuring Process	44
3.10.1	Capital Protection and Equity Participation	44
3.10.2	Capital at Risk and Higher Participation	46
4	Volatility, Skew and Term Structure	49
4.1	Volatility	49
4.1.1	Realized Volatility	49
4.1.2	Implied Volatility	51
4.2	The Volatility Surface	52
4.2.1	The Implied Volatility Skew	52
4.2.2	Term Structure of Volatilities	56
4.3	Volatility Models	57
4.3.1	Model Choice and Model Risk	57
4.3.2	Black–Scholes or Flat Volatility	58
4.3.3	Local Volatility	60
4.3.4	Stochastic Volatility	62
5	Option Sensitivities: Greeks	65
5.1	Delta	66
5.2	Gamma	72
5.3	Vega	74
5.4	Theta	76

5.5	Rho	77
5.6	Relationships between the Greeks	78
5.7	Volga and Vanna	80
5.7.1	Vega–Gamma (Volga)	80
5.7.2	Vanna	81
5.8	Multi-asset Sensitivities	81
5.9	Approximations to Black–Scholes and Greeks	82
6	Strategies Involving Options	87
6.1	Traditional Hedging Strategies	87
6.1.1	Protective Puts	87
6.1.2	Covered Calls	89
6.2	Vertical Spreads	90
6.2.1	Bull Spreads	90
6.2.2	Bear Spreads	93
6.3	Other Spreads	96
6.3.1	Butterfly Spreads	96
6.3.2	Condor Spreads	98
6.3.3	Ratio Spreads	99
6.3.4	Calendar Spreads	99
6.4	Option Combinations	100
6.4.1	Straddles	100
6.4.2	Strangles	101
6.5	Arbitrage Freedom of the Implied Volatility Surface	102
7	Correlation	105
7.1	Multi-asset Options	105
7.2	Correlation: Measurements and Interpretation	106
7.2.1	Realized Correlation	106
7.2.2	Correlation Matrices	109
7.2.3	Portfolio Variance	110
7.2.4	Implied Correlation	111
7.2.5	Correlation Skew	113
7.3	Basket Options	114
7.4	Quantity Adjusting Options: “Quantos”	116
7.4.1	Quanto Payoffs	116
7.4.2	Quanto Correlation and Quanto Option Pricing	116
7.4.3	Hedging Quanto Risk	117
7.5	Trading Correlation	118
7.5.1	Straddles: Index versus Constituents	118
7.5.2	Correlation Swaps	118
PART II	EXOTIC DERIVATIVES AND STRUCTURED PRODUCTS	121
8	Dispersion	123
8.1	Measures of Dispersion and Interpretations	123
8.2	Worst-of Options	125

8.2.1	Worst-of Call	125
8.2.2	Worst-of Put	127
8.2.3	Market Trends in Worst-of Options	128
8.3	Best-of options	129
8.3.1	Best-of Call	129
8.3.2	Best-of Put	131
8.3.3	Market Trends in Best-of Options	132
9	Dispersion Options	135
9.1	Rainbow Options	135
9.1.1	Payoff Mechanism	135
9.1.2	Risk Analysis	136
9.2	Individually Capped Basket Call (ICBC)	137
9.2.1	Payoff Mechanism	137
9.2.2	Risk Analysis	138
9.3	Outperformance Options	141
9.3.1	Payoff Mechanism	141
9.3.2	Risk Analysis	142
9.4	Volatility Models	143
10	Barrier Options	145
10.1	Barrier Option Payoffs	145
10.1.1	Knock-out Options	145
10.1.2	Knock-in Options	148
10.1.3	Summary	150
10.2	Black-Scholes Valuation	151
10.2.1	Parity Relationships	151
10.2.2	Closed Formulas for Continuously Monitored Barriers	151
10.2.3	Adjusting for Discrete Barriers	154
10.3	Hedging Down-and-in Puts	155
10.3.1	Monitoring the Barrier	155
10.3.2	Volatility and Down-and-in Puts	157
10.3.3	Dispersion Effect on Worst-of Down-and-in Puts	158
10.4	Barriers in Structured Products	160
10.4.1	Multi-asset Shark	160
10.4.2	Single Asset Reverse Convertible	163
10.4.3	Worst-of Reverse Convertible	164
11	Digitals	167
11.1	European Digitals	167
11.1.1	Digital Payoffs and Pricing	167
11.1.2	Replicating a European Digital	169
11.1.3	Hedging a Digital	169
11.2	American Digitals	172
11.3	Risk Analysis	174
11.3.1	Single Asset Digitals	174

11.3.2	Digital Options with Dispersion	176
11.3.3	Volatility Models for Digitals	177
11.4	Structured Products Involving European Digitals	178
11.4.1	Strip of Digitals Note	178
11.4.2	Growth and Income	179
11.4.3	Bonus Steps Certificate	181
11.5	Structured Products Involving American Digitals	183
11.5.1	Wedding Cake	183
11.5.2	Range Accrual	184
11.6	Outperformance Digital	185
11.6.1	Payoff Mechanism	185
11.6.2	Correlation Skew and Other Risks	186
12	Autocallable Structures	187
12.1	Single Asset Autocallables	187
12.1.1	General Features	187
12.1.2	Interest Rate/Equity Correlation	190
12.2	Autocallable Participating Note	192
12.3	Autocallables with Down-and-in Puts	194
12.3.1	Adding the Put Feature	194
12.3.2	Twin-Wins	194
12.3.3	Autocallables with Bonus Coupons	196
12.4	Multi-asset Autocallables	198
12.4.1	Worst-of Autocallables	198
12.4.2	Snowball Effect and Worst-of put Feature	200
12.4.3	Outperformance Autocallables	202
PART III	MORE ON EXOTIC STRUCTURES	205
13	The Cliquet Family	207
13.1	Forward Starting Options	207
13.2	Cliquets with Local Floors and Caps	208
13.2.1	Payoff Mechanism	209
13.2.2	Forward Skew and Other Risks	210
13.3	Cliquets with Global Floors and Caps	210
13.3.1	Vega Convexity	213
13.3.2	Levels of These Risks	215
13.4	Reverse Cliquets	217
14	More Cliquets and Related Structures	219
14.1	Other Cliquets	219
14.1.1	Digital Cliquets	219
14.1.2	Bearish Cliquets	220
14.1.3	Variable Cap Cliquets	221
14.1.4	Accumulators/Lock-in Cliquets	222
14.1.5	Replacement Cliquets	222
14.2	Multi-asset Cliquets	224

14.2.1	Multi-asset Cliquet Payoffs	224
14.2.2	Multi-asset Cliquet Risks	225
14.3	Napoleons	226
14.3.1	The Napoleon Structure	226
14.3.2	The Bearish Napoleon	227
14.4	Lookback Options	227
14.4.1	The Various Lookback Payoffs	227
14.4.2	Hedging Lookbacks	228
14.4.3	Sticky Strike and Sticky Delta	229
14.4.4	Skew Risk in Lookbacks	229
15	Mountain Range Options	231
15.1	Altiplano	231
15.2	Himalaya	233
15.3	Everest	235
15.4	Kilimanjaro Select	236
15.5	Atlas	238
15.6	Pricing Mountain Range Products	239
16	Volatility Derivatives	243
16.1	The Need for Volatility Derivatives	243
16.2	Traditional Methods for Trading Volatility	243
16.3	Variance Swaps	244
16.3.1	Payoff Description	245
16.3.2	Variance vs Volatility Swaps	246
16.3.3	Replication and Pricing of Variance Swaps	246
16.3.4	Capped Variance Swaps	248
16.3.5	Forward Starting Variance Swaps	249
16.3.6	Variance Swap Greeks	249
16.4	Variations on Variance Swaps	250
16.4.1	Corridor Variance Swaps	250
16.4.2	Conditional Variance Swaps	251
16.4.3	Gamma Swaps	253
16.5	Options on Realized Variance	254
16.6	The VIX: Volatility Indices	254
16.6.1	Options on the VIX	255
16.6.2	Combining Equity and Volatility Indices	256
16.7	Variance Dispersion	256
PART IV	HYBRID DERIVATIVES AND DYNAMIC STRATEGIES	259
17	Asset Classes (I)	261
17.1	Interest Rates	262
17.1.1	Forward Rate Agreements	262
17.1.2	Constant Maturity Swaps	263
17.1.3	Bonds	264
17.1.4	Yield Curves	265

17.1.5	Zero Coupon, LIBOR and Swap Rates	267
17.1.6	Interest Rate Swaptions	268
17.1.7	Interest Rate Caps and Floors	269
17.1.8	The SABR Model	270
17.1.9	Exotic Interest Rate Structures	271
17.2	Commodities	272
17.2.1	Forward and Futures Curves, Contango and Backwardation	273
17.2.2	Commodity Vanillas and Skew	276
18	Asset Classes (II)	279
18.1	Foreign Exchange	279
18.1.1	Forward and Futures Curves	279
18.1.2	FX Vanillas and Volatility Smiles	281
18.1.3	FX Implied Correlations	287
18.1.4	FX Exotics	287
18.2	Inflation	288
18.2.1	Inflation and the Need for Inflation Products	289
18.2.2	Inflation Swaps	289
18.2.3	Inflation Bonds	290
18.2.4	Inflation Derivatives	290
18.3	Credit	291
18.3.1	Bonds and Default Risk	292
18.3.2	Credit Default Swaps	293
19	Structuring Hybrid Derivatives	295
19.1	Diversification	295
19.1.1	Multi-asset Class Basket Options	296
19.1.2	Multi-asset Class Himalaya	297
19.2	Yield Enhancement	297
19.2.1	Rainbows	298
19.2.2	In- and Out-barriers	299
19.2.3	Multi-asset Class Digitals	299
19.2.4	Multi-asset Range Accruals	300
19.3	Multi-asset Class Views	301
19.4	Multi-asset Class Risk Hedging	303
20	Pricing Hybrid Derivatives	305
20.1	Additional Asset Class Models	305
20.1.1	Interest Rate Modelling	305
20.1.2	Commodity Modelling	309
20.1.3	FX Modelling	310
20.2	Copulas	312
20.2.1	Some Copula Theory	313
20.2.2	Modelling Dependencies in Copulas	314
20.2.3	Gaussian Copula	315
20.2.4	Pricing with Copulas	318

21 Dynamic Strategies and Thematic Indices	321
21.1 Portfolio Management Concepts	321
21.1.1 Mean–variance Analysis	321
21.1.2 Minimum-variance Frontier and Efficient Portfolios	322
21.1.3 Capital Asset Pricing Model	326
21.1.4 Sharpe Ratio	327
21.1.5 Portfolio Rebalancing	328
21.2 Dynamic Strategies	329
21.2.1 Why Dynamic Strategies?	329
21.2.2 Choosing the Assets	330
21.2.3 Building the Dynamic Strategy	330
21.3 Thematic Products	332
21.3.1 Demand for Thematic Products	333
21.3.2 Structuring a Thematic Index	334
21.3.3 Structured Products on Thematic Indices	335
21.3.4 Pricing Options on Thematic Indices	335
 APPENDICES	 339
 A Models	 341
A.1 Black–Scholes	341
A.1.1 Black–Scholes SDE	341
A.1.2 Black–Scholes PDE	341
A.2 Local Volatility Models	342
A.3 Stochastic Volatility	343
A.3.1 Heston’s Model	343
A.3.2 The SABR Model	345
A.4 Jump Models	346
A.5 Hull–White Interest Rate Model and Extensions	346
 B Approximations	 349
B.1 Approximations for Vanilla Prices and Greeks	349
B.2 Basket Price Approximation	351
B.3 ICBC/CBC Inequality	351
B.4 Digitals: Vega and the Position of the Forward	352
 Postscript	 355
 Bibliography	 357
 Index	 361