

# Contents

<b>1</b>	<b>Interest, Coupons and Yields</b>	<b>1</b>
1.1	Time Value of Money	1
1.2	Interest on Debt, Day-Count Conventions	2
1.3	Accrued Interest	5
1.4	Floating Rates, Libor and Euribor	6
1.5	Bond Yields and the Term Structure of Interest Rates	8
1.6	Duration and Convexity	10
1.7	Key Takeaways, References and Exercises	13
<b>2</b>	<b>Financial Products</b>	<b>15</b>
2.1	Bonds, Stocks and Commodities	15
2.2	Derivatives	19
2.3	Forwards and Futures	20
2.4	Swaps	22
2.5	Options	23
2.6	Key Takeaways, References and Exercises	25
<b>3</b>	<b>The No-Arbitrage Principle</b>	<b>27</b>
3.1	Introduction	27
3.2	Pricing Forward Contracts and Managing Counterparty Risk	29
3.3	Bootstrapping	31
3.4	Forward Rate Agreements (FRAs)	33
3.5	Key Takeaways, References and Exercises	34
<b>4</b>	<b>European and American Options</b>	<b>37</b>
4.1	Put-Call Parity, Bounds for Option Prices	38
4.2	Some Option Trading Strategies	40
4.3	American Options	41
4.4	Key Takeaways, References and Exercises	43
<b>5</b>	<b>The Binomial Option Pricing Model</b>	<b>47</b>
5.1	A One-Period Option Pricing Model	47
5.2	The Principle of Risk-Neutral Valuation	49
5.3	The Cox-Ross-Rubinstein Model	50
5.4	Key Takeaways, References and Exercises	53

<b>6</b>	<b>The Black-Scholes Model</b> .....	55
6.1	Brownian Motion and Itô's Lemma .....	56
6.2	The Black-Scholes Model .....	59
6.3	Key Takeaways, References and Exercises .....	61
<b>7</b>	<b>The Black-Scholes Formula</b> .....	63
7.1	The Black-Scholes formula from a PDE .....	63
7.2	The Black-Scholes Formula as Limit in the CRR-Model .....	65
7.3	Discussion of the Formula, Hedging .....	68
7.4	Delta-Hedging and the 'Greeks' .....	70
7.5	Does Hedging Work? .....	71
7.6	Key Takeaways, References and Exercises .....	73
<b>8</b>	<b>Stock-Price Models</b> .....	77
8.1	Shortcomings of the Black-Scholes Model: Skewness, Kurtosis and Volatility Smiles .....	77
8.2	The Dupire Model .....	79
8.3	The Heston Model .....	80
8.4	Price Jumps and the Merton Model .....	85
8.5	Key Takeaways, References and Exercises .....	88
<b>9</b>	<b>Interest Rate Models</b> .....	91
9.1	Caps, Floors and Swaptions .....	91
9.2	Short-Rate Models .....	93
9.3	The Hull-White Model: a Short-Rate Model .....	94
9.4	Market Models .....	98
9.5	Key Takeaways, References and Exercises .....	100
<b>10</b>	<b>Numerical Methods</b> .....	103
10.1	Binomial Trees .....	103
10.2	Trinomial Trees .....	106
10.3	Finite Differences and Finite Elements .....	107
10.4	Pricing with the Characteristic Function .....	111
10.5	Numerical Algorithms in UnRisk .....	113
10.6	Key Takeaways, References and Exercises .....	113
<b>11</b>	<b>Simulation Methods</b> .....	117
11.1	The Monte Carlo Method .....	117
11.2	Quasi-Monte Carlo (QMC) Methods .....	124
11.3	Simulation of Stochastic Differential Equations .....	127
11.4	Key Takeaways, References and Exercises .....	128
<b>12</b>	<b>Calibrating Models – Inverse Problems</b> .....	133
12.1	Fitting Yield Curves in the Hull-White Model .....	134
12.2	Calibrating the Black-Karasinski Model .....	137
12.3	Local Volatility and the Dupire Model .....	137
12.4	Calibrating the Heston Model or the LIBOR-Market Model .....	140
12.5	Key Takeaways, References and Exercises .....	140

---

<b>13</b>	<b>Case Studies: Exotic Derivatives</b>	143
13.1	Barrier Options and (Reverse) Convertibles	143
13.2	Bermudan Bonds – To Call or Not To Call?	146
13.3	Bermudan Callable Snowball Floaters	147
13.4	More Examples of Exotic Interest Rate Derivatives	148
13.5	Model Risk in Interest Rate Models	149
13.6	Equity Basket Instruments	150
13.7	Key Takeaways, References and Exercises	151
<b>14</b>	<b>Portfolio Optimization</b>	155
14.1	Mean-Variance Optimization	155
14.2	Risk Measures and Utility Theory	164
14.3	Portfolio Optimization in Continuous Time	166
14.4	Key Takeaways, References and Exercises	167
<b>15</b>	<b>Introduction to Credit Risk Models</b>	171
15.1	Introduction	171
15.2	Credit Ratings	172
15.3	Structural Models	174
15.4	Reduced-Form Models	178
15.5	Credit Derivatives and Dependent Defaults	180
15.6	Key Takeaways, References and Exercises	183
	<b>References</b>	185
	<b>Index</b>	189