Contents

I	Intro	duction
Pa	ırt I	Financial Formulas
2	Simp	le Interest and Discount
	2.1	Simple Interest
	2.2	Calendar Conventions
	2.3	Simple Interest with Principals Credited mthly
	2.4	Simple Discount
	Furth	er Reading
3	Comp	oound Interest and Discount
	3.1	Compound Interest
	3.2	Compound Discount
	3.3	Compound Interest and Discount Convertible <i>m</i> thly 13
	3.4	Combination of Simple and Compound Interest
	Furth	er Reading
4	Conti	nuous Interest and Discount 1
	Furth	er Reading
5	Class	ical Analysis of Interest Rates
	5.1	Risk-Free Interest Rate and Real Interest Rate 2
	5.2	Term Structure of Interest Rates
	Furth	er Reading
6	Syste	ms of Cash Flows
	6.1	Present and Future Value
	6.2	Internal Rate of Return
	6.3	Payback Period
	6.4	Duration
	6.5	Convexity
	Furthe	er Reading 34

digitalisiert durch

riii	Contents
------	----------

7	Annuities	35
	7.1 Annuity Calculus	36
	7.2 Dynamic Annuities	40
	7.3 Annuities Payable <i>m</i> thly	44
	7.4 Continuously Payable Annuities	45
	7.5 Amortization of Debt	46
	Further Reading	48
8	Depreciation	51
	Further Reading	53
9	Financial Instruments	55
	9.1 Discount Securities	55
	9.2 Bonds	57
	9.3 Stocks	65
	9.4 Currencies	71
	Further Reading	71
10	Derivative Securities	73
	10.1 General Classification	73
	10.2 Forwards	74
	10.3 Futures	78
	10.4 Swaps	80
	10.5 Options	81
	Further Reading	89
11		91
11	Utility Theory	93
	Further Reading	93
12	Rate of Return and Financial Risk	95
	12.1 Rate of Return	95
	12.2 Financial Risk	98
	12.3 Value at Risk VaR	102
	12.4 Credit at Risk CaR	105
	Further Reading	107
13	Portfolio Analysis and CAPM Model	109
	13.1 Construction of Portfolio	109
	13.2 Portfolio with a Risk-Free Asset	114
	13.3 CAPM Model	116
	Further Reading	118
14	Arbitrage Theory	119
	Further Reading	122
15	Financial Stochastic Analysis	123
	15.1 Wiener Process in Finance	123
	15.2 Poisson Process in Finance	125
	15.3 Ito Stochastic Integral	126

Contents ix

	15.4	Stochastic Differential Equations SDE
	15.5	Ito's Lemma
	15.6	Girsanov Theorem on Equivalent Martingale Probability 130
	15.7	Theorem on Martingale Representation
	15.8	Derivatives Pricing by Means of Equivalent Martingale
	10.0	Probabilities
	15.9	Derivatives Pricing by Means of Partial Differential
	13.7	Equations PDE
	15.10	Term Structure Modeling
		<u> </u>
	ruittiei	Reading
Part	t II I	nsurance Formulas
16	Insura	nce Classification
		Reading
4-		
17		ial Demography
	17.1	Selected Population Indicators
	17.2	Life Tables
	17.3	Mortality and Survival Modeling
	17.4	Multiple Decrement Models
	17.5	Multiple Life Functions
	17.6	Commutation Functions
	Further	Reading
18	Classic	al Life Insurance
	18.1	Basic Concepts of Life Insurance
	18.2	Symbols and Calculation Principles of Life Insurance 167
	18.3	Technical Provisions in Life Insurance
	18.4	Pure Endowments
	18.5	Whole Life and Term Insurance
	18.6	Further Products of Capital Life Insurance
	18.7	Life Annuities
	18.8	Multiple Life Insurance
	18.9	Premium Reserve and Its Implications
	18.10	Medical Underwriting
		Reading
19		n Approaches to Life Insurance
	19.1	Critical Illness Insurance
	19.2	Flexible Products of Life Insurance
	19.3	Unit Linked
	19.4	Profit Testing
	19.5	Embedded Value
	19.6	Fair Value
	Further	Reading

x Contents

20	Pension	n Insurance	209
	20.1	Basic Concepts of Pension Insurance	209
	20.2	Defined Contribution Plan	211
	20.3	Defined Benefit Plan	213
		Reading	217
21	Classic	al Non-Life Insurance	219
	21.1	Basic Concepts of Non-Life Insurance	219
	21.2	Premium Calculations in Non-Life Insurance	222
	21.3	Forms of Non-Life Insurance and Deductibles	225
	21.4	Technical Provisions in Non-Life Insurance	228
	21.5	Bonus-Malus Systems	233
		Reading	234
		-	
22		heory in Insurance	235
	22.1	Collective Risk Model	235
	22.2	Aggregate Claim Distribution	238
	22.3	Copula	242
	22.4	Credibility Premium	243
	22.5	Ruin Probability	246
	22.6	Deductible	248
	22.7	Calculations for Bonus-Malus Systems	251
		Reading	252
23		Insurance	255
	Further	Reading	257
24	Reinsu	rance	259
	24.1	Basic Concepts of Reinsurance	259
	24.2	Types of Reinsurance	261
	24.2		267
		Solvency	
	24.4	Alternative Risk Transfer ART	269
	Further	r Reading	271
_			
Pai	rt III F	Formulas of Related Disciplines	
25	Mathe	matical Compendium	275
	25.1	Powers with Integral Exponents $(a, b \in \mathbb{R}; a, b \neq 0; p,$	
		$q \in \mathbb{Z}$)	275
	25.2	Roots of Real Numbers $(a, b \in \mathbb{R}; a, b > 0; m, n \in \mathbb{N};$	
	20.2	$p \in \mathbb{Z}$)	275
	25.3	Powers with Rational Exponents $(a \in \mathbb{R}; a > 0; m, n \in \mathbb{N})$	
			275
	25.4	Powers with Real Exponents $(a, b \in \mathbb{R}; a, b > 0; x, y \in \mathbb{R})$	276
	25.5	Formulas $a^n \pm b^n$ $(a, b \in \mathbb{R}; n, k \in \mathbb{N})$	276
	25.6	Logarithms $(x, y \in R; x, y > 0; a, b, c \in R; a, b > 0; a,$	
		$b \neq 1$)	276
	25.7	Factorial and Binomial Coefficients $(k, m, n \in \mathbb{N}_0;$	
		$k \leq m, k \leq n$	277

Contents xi

	25.8	Binomial Theorem $(a, b \in \mathbb{R}; n \in \mathbb{N})$	278
	25.9	Sums of Powers of Natural Numbers $(n \in \mathbb{N})$	278
	25.10	Numerical Series $(a_1, d, q, v \in \mathbb{R}; n \in \mathbb{N})$	278
	25.11	Means $(x_1,, x_n \in \mathbb{R}; k, n, n_1,, n_k \in \mathbb{N}; n = \sum_{i=1}^k n_i)$	280
	25.12	Beta and Gamma Function $(x, p, q \in \mathbb{R}; p > 0, q > 0; n \in \mathbb{N})$.	280
	Further	r Reading	281
26	Probal	bility Theory	283
	26.1	Random Events and Probability	283
	26.2	Conditional Probability and Independent Events	284
	26.3	Random Variables and Their Basic Characteristics	285
	26.4	Important Discrete Distributions	288
	26.5	Important Continuous Distributions	289
	26.6	Random Vectors and Their Basic Characteristics	291
	26.7	Transformation of Random Variables	294
	26.8	Conditional Mean Value	295
	26.9	Martingales	296
	26.10	Generating Function	298
	26.11	Convolutions and Sums of Random Variables	300
	26.12	Random Sums of Random Variables	301
	26.13	Some Inequalities	301
	26.13	Limit Theorems of Probability Theory	302
		r Reading	305
27		ptive and Mathematical Statistics	307
	27.1	Sampling Theory: Simple Random Sample	307
	27.2	Sampling Theory: Stratified Random Sample	308
	27.3	Elementary Statistical Treatment	309
	27.4	Sample Quantiles	310
	27.5	Measures of Sample Level	310
	27.6	Measures of Sample Variability	312
	27.7	Measures of Sample Concentration	313
	27.8	Measures of Sample Dependence	314
	27.9	Point and Interval Estimators	315
	27.10	Hypothesis Testing	318
	27.11	Regression Analysis	320
	27.12	Analysis of Variance (ANOVA)	327
	27.13	Multivariate Statistical Analysis	328
	Further	r Reading	329
28	Econometrics		
	28.1	Multicollinearity	331
	28.2	A Priori Restrictions	333
	28.3	Qualitative Regressors	333
	28.4	Probit and Logit Models	334

xii Contents

	28.5 28.6 Further	Random Regressors and Instrumental Variable Estimation Simultaneous Equation Models and 2SLS-Estimator	335 336 338
29	Index N	Numbers	339
	29.1	Indices as Instruments of Comparison	339
	29.2	Indices in Practice	340
	29.3	Stock Exchange Indicators	342
	Further	Reading	343
30	Stochastic Processes		
	30.1	Classification and Basic Characteristics	
		of Stochastic Processes	345
	30.2	Markov Chains	347
	30.3	Markov Processes	351
	30.4	Important Stochastic Processes	353
	30.5	Spectral Properties of Stochastic Processes	357
	Further	Reading	360
31	Statistical Analysis of Time Series		
	31.1	Predictions in Time Series	361
	31.2	Decomposition of (Economic) Time Series	362
	31.3	Estimation of Correlation and Spectral Characteristics	369
	31.4	Linear Time Series	371
	31.5	Nonlinear and Financial Time Series	376
	31.6	Multivariate Time Series	381
	31.7	Kalman Filter	382
	Further	Reading	385
Ind	ex		387