__ Contents ____

Fo	rewor	d	XV	
Pr	Preface			
A	Acknowledgements About the Authors			
Αl				
Αl	brevia	ntions	XXV	
PA	ART I	THE ASSESSMENT OF RISK AND ITS STRATEGIC IMPORTANCE	1	
1	Intro	duction	3	
	1.1	Executive Cverview: Responsiveness, Competitive Advantage, and		
		Survival	3	
	1.2	Understanding the Increasingly Complex and Competitive Banking		
		Environment	7	
	1.3	Risk Management and Strategy – Identifying Winners and Losers	11	
	1.4	Capital – Understanding and Assessing its Importance and Limitations	20	
2	The I	mportance of Corporate Governance	31	
	2.1	Defining Corporate Governance	31	
	2.2	Understanding the Importance of Corporate Governance and Ethics	31	
	2.3	International Organizations and their Activities	32	
	2.4	The Basel Paper on Corporate Governance for Banks	33	
	2.5	Countries: Their Different Requirements and Experiences	34	
	2.6	Board Structures	37	
	2.7	Shareholder Activism and Extra-Financial Issues	37	
	2.8	Assessing Governance, Bribery, and Corruption	38	
	2.9	Key Considerations	40	
	2.10	Conclusions	42	
		Appendix 2A	42	

Avoiding Ossification

Managing Risk within Communities of Practice

viii Contents 45 3 Fundamental Assessment 3.1 45 Introduction 3.2 The Fundamental Relationship Between Credit Risk, Market Risk, and 45 Operational Risk 3.3 **External Assessment Frameworks** 46 Credit Rating Agencies' Approach: The 7 Pillars 49 3.4 3.5 Moody's Operational Risk Assessments - Towards a More Forensic Approach 51 3.6 The Regulatory Approach – Development of the Arrow Framework 53 3.7 **Enhanced Analytics** 56 3.8 Measuring Customer Satisfaction and Loyalty 57 Appendix 3A 58 Appendix 3B 60 An Introduction to Risk and Default Analysis 65 **Predicting Soundness** 4.1 65 Argenti's A-score: Causes of Business Failure 4.2 66 4.3 Statistical Failure Prediction Models 66 4.4 Credit Risk Models 70 4.5 Merton's 1974 Model 71 4.6 The KMV Model 72 72 4.7 CreditRisk+ Portfolio Credit Risk Model 73 4.8 73 4.9 Internal Operational Risk Models 4.10 Commercially Available Operational Risk Systems and Models 75 Control Risk Self Assessment (CRSA) – A Behavioural Approach 79 to Risk Management 79 5.1 Introduction 5.2 Advocates 80 5.3 Defining Control Risk Self Assessment 80 5.4 Benefits and Limitations of a CRSA Approach 80 5.5 Residual Risks 81 5.6 Methodology 81 5.7 Types of Meeting 82 5.8 Questionnaires and Weightings 83 5.9 Resource Allocation 83 5.10 Loss Data 83 5.11 Determination of Capital Requirement 84 85 5.12 Developing and Refining the System 5.13 Achieving and Maintaining Credibility and Appropriateness 85 5.14 Validation 86 5.15 Auditing 86 5.16 The Relationship between Risk Management and Knowledge Management 87 87 5.17 Aetiology of Knowledge Management

88

89

		Contents	ix	
	5.20	Flexibility and Responsiveness	90	
	5.21	The Limitations of Enforced Best Practice	91	
	5.22	Benchmarking and Stress Testing Human Factors	93	
	5.23	Reasons for Failure	94	
6	Data and Data Collection			
	6.1	The Importance of Data	99	
	6.2	The Regulatory Perspective	100	
	6.3	Sources and Limitations of Data	101	
	6.4	Not All Data will be Recorded	101	
	6.5	Differences in Approach Lead to Variations in Capital Requirement	102	
	6.6	Gross or Net Losses	102	
	6.7	Date of Loss	102	
	6.8	Damage to Physical Assets	103	
	6.9 6.10	Allocation of Central Losses Across Business Units Boundary Issues between Operational Risk, Credit Risk, Market Risk,	103	
		and Other Risks	103	
	6.11 6.12	Extreme Events do not Lend Themselves to Detection by Data Analysis The Small Sample Problem (Overrepresentation and	104	
		Underrepresentation)	104	
	6.13	The Past is Not Necessarily a Good Predictor of the Future	105	
	6.14	Inflation and Currency Variations Limit the Use of Historical Data	105	
	6.15	Error and Accuracy	105	
	6.16	External Data is Not Readily Transferable from One Organization		
		to Another	105	
	6.17	Data is Not Readily Scaleable	106	
	6.18	Emergent Properties	106	
	6.19	Risk Types and Causes	107	
	6.20	Actions by Feople	107	
	6.21	Systems and Process-based Loss Events	108	
		External Events	109	
	6.23	Random Events	112	
		Accumulation of Errors and Weaknesses	112	
	6.25	Granularity	114	
	6.26	Validation and Adjustments	115	
7	Data	Analysis, Quantification, and Modeling	119	
	7.1	Analyzing Data	119	
	7.2	Empirical Distributions	120	
	7.3	Theoretical Probability Distributions – Why is it Necessary to		
		Combine Separate Curves for Frequency and Severity?	120	
	7.4	Choosing Appropriate Curves	121	
	7.5	Testing the "Goodness of Fit"	122	
	7.6	Characteristics (Moments) Defining a Distribution Curve	122	
	7.7	Combining the Severity and Frequency Curves Using Monte Carlo		
	_	Analysis	122	
	7.8	Extreme Value Theory (EVT)	124	

11.2 ERM Frameworks

Contents 7.9 Interpreting the Results - the Adequacy of Regulatory Capital is Difficult to Determine 126 The Causes of Risk Measurement Error 126 7.11 Model Validation, Back Testing, and Stress Testing 127 7.12 Loss Data is Comprised of Many Different Risk Types, Hence the Need for Granularity 128 7.13 Risk Assessment Requires Both Quantitative and Qualitative Methods 128 129 The Risk Analysis and Modeling Continuum 7.14 7.15 Stochastic Modeling and Stochastic Differential Equations (SDE) 131 7.16 Regression Equations 131 7.17 **Quantifying Expert Testimony** 132 7.18 Causal Analysis 132 7.19 Conclusions and Recommendations 133 **Causal Analysis** 135 8.1 Introduction 135 8.2 History of Causality 136 8.3 Mapping Causality 138 8.4 The Bayesian Approach 141 8.5 Summary 149 Scenario Analysis and Contingency Planning 153 Introduction 9.1 153 9.2 Historical Development 153 9.3 Morphological Analysis 155 9.4 Model Development 155 9.5 Management and Facilitation 156 9.6 Relationship between Scenario Analysis and Quantitative Techniques 157 9.7 Validity and Repeatability 157 9.8 Application of Scenario Analysis to Risk Management within Banks 157 9.9 External Business Environment Assessment 160 9.10 Shell Global Scenarios to 2025 162 9.11 Conclusions 164 10 Dynamic Financial Analysis 167 10.1 Introduction 167 10.2 Background 168 10.3 The Generalized DFA Framework 170 10.4 DFA Methodology 170 10.5 Data Considerations 171 10.6 Aggregation, Correlation, and Diversification 171 10.7 Limitations of DFA Models 171 10.8 Outputs and Analysis 172 10.9 The Future 172 11 Enterprise Risk Management 177 11.1 Introduction 177

178

		Contents	xi
	11.3	ERM Modeling	184
	11.4	Risk Correlation and Integration	184
12	Insurance and Other Risk Transfer Methods		187
	12.1	Introduction	187
	12.2	Background	187
	12.3	Findings	198
	12.4	Conclusions and Recommendations	205
13	Obser	rved Best Practices and Future Considerations	213
	13.1	Introduction	213
	13.2	Governance and Management	219
	13.3	Quantification and Assessment	227
	13.4	Contingency and Business Continuity	231
	13.5	Information Technology	233
	13.6	Insurance and Other Risk Transfer Options	236
	13.7	Transparency	239
		Information Technology Insurance and Other Risk Transfer Options Transparency Appendix 13.1 try Views The effective evenes of companies (iv the large pencien funds and	243
14	Indus	try Views	245
	14.1	The effective owners of companies (i.e. the large pension funds and	
		insurance companies) do not appear to be taking sufficient action to	
		prevent excessive risk taking What needs to be done?	245
	14.2	How important do you think "extra-financial enhanced analytics"	
		factors are?	246
	14.3	The pressure to perform, from analysts, is often said to be a	
		contributory factor to fraudulent events such as Enron. What can be	
		done to improve the quality of reporting and the accuracy of forecasting?	247
	14.4	The credit rating agencies are often criticized for their inability to spot	
		problems early. (a) To what extent is this criticism justified? (b) What	
		have the credit rating agencies done to improve their ability to predict	
		possible loss events earlier?	248
	14.5	There appear to be differences between what a credit rating agency	
		provides and what securities analysts and investors want. Why is this?	248
	14.6	Is a more forensic approach towards risk assessment and rating	
		necessary or do you think that complexity and chaos limit the extent to	
		which risk can be deconstructed and accurately assessed?	249
	14.7	How important is enterprise risk management (ERM) to the rating process?	249
	14.8	Do you use models to quantify operational risk and capital adequacy?	250
	14.9	Models that use market data are claimed by some to be better	
		predictors than traditional credit rating agency methods	250
	14.10	What level of loss or risk would trigger a downgrade?	251
	14.11	What analysis is done into the reasons for default, and what does this	
		analysis show?	251
	14.12	Should credit rating agency analysts be given smaller portfolios in	
		order for them to devote more time to the analysis of each company, or	
		would the costs be prohibitive?	251

xii		Contents	
	14.13	Should specialists be employed to carry out more forensic analysis	
		and, if so, what specialists are required?	252
	14.14	The rating agencies are in a privileged position in that they receive	
		confidential information about a firm, which has the effect of adding	
		credibility to their ratings and statements	252
	14.15	Is it possible for the rating agencies to highlight concerns about a	
		particular firm, to the market, without precipitating a crisis?	253
	14.16	Should the rating agencies be given the opportunity, or indeed be	
		required, to discuss in confidence any concerns they may have about a	
		particular firm with the regulators?	253
	14.17	Is litigation likely to become an increasing problem, with the	
		possibility of investors suing where information later proves to be	
		inaccurate and misleading?	254
	14.18	Do you think that greater transparency, as proposed by the third pillar	
		of Basel II, will bring the benefits envisaged by the regulators, or is	
		transparency somewhat of an illusory concept?	254
	14.19	A fundamental requirement of externally audited accounts is to	
		provide shareholders with a "true and fair view." However, banks have	
		been deliberately concealing important information affecting the levels	
		of risk faced. This has brought into question the value of their audited	
		accounts, the integrity of externa auditors (who are in fact paid by the	
		bank being audited), the appropriateness of practices such as the use of	
		off-balance-sheet activities, and the relevance of mark-to-market ("fair	
		value") valuations in a time of high market uncertainty	255
	14.20	What further changes do you think are necessary to improve the	
		stability and credibility of the financial system?	257
	14.21	What are the major challenges currently facing the sector? What	
		changes do you think are necessary and what is preventing them?	257
15	Sumr	nary, Conclusions, and Recommendations	261
	15.1	Introduction	261
	15.2	Institutional Shareholder-Investors	262
	15.3	Regulators, Legislators, and Central Banks	263
	15.4	Accountants, Auditors, and Financial Reporting Bodies	264
	15.5	Rating Agencies	268
	15.6	Insurance Companies	270
	15.7	Banks	271
PA	RT II	QUANTIFICATION	277
16	Intro	duction to Quantification	279
	16.1	Objectives	280
	16.2	Measuring the Unmeasurable	280
	16.3	Loss Data Analysis: Regulatory Requirements under Basel II	281
	16.4		283
17	Loss		285
	17.1	Data Classification	285

			Contents	xiii
	17.2	Database Creation		285
		Use of Questionnaires		286
	17.4	Illustrative Examples of Data Sets		286
	17.5	Summarizing Data Sets with a Proportion Plot or Histogram Plot	f	289
	17.6	Summarizing Data Sets with Sample Moment Statistics	ı	291
	17.7	Summarizing Data Sets with Sample Quantile Statistics		296
	17.7	Checking Data Quality		302
	17.8	Difficulties Arising in OR Modeling		305
	17.9	Difficulties Arising in Ok Moderning		303
18	Introd	luctory Statistical Theory		307
	18.1	Discrete Probability Models		307
		Continuous Probability Models		307
		The state of the s		315
		Regression Analysis		321
		Validation: Testing Model Fit		326
	18.6	Subjective Probability and Bayesian Statistics		330
19	Frequ	Regression Analysis Validation: Testing Model Fit Subjective Probability and Bayesian Statistics Hency Models Bernoulli Distribution, Bernoulli (0)		337
	19.1	Bernoulli Distribution, $Bernoulli(\theta)$		337
	19.2	Binomial Distribution, Binomial (R, θ)		337
	19.3	Geometric Distribution, $Geometric(\theta)$		341
	19.4	Hypergeometric Distribution, <i>Hypergeometric</i> (N, M, n)		343
	19.5	Negative Binomial Distribution, Negative Binomial (v, θ)		343
	19.6	Poisson Distribution, $Poisson(\theta)$		347
	19.7	(Discrete) Uniform Distribution, (Discrete) Uniform (k)		352
	19.8	Mixture Models		353
	17.0	Whater Words		333
20	Conti	nuona Deskability Distributions		255
20		nuous Probability Distributions		355
		Beta Distribution, $Beta(\alpha, \beta)$		355
		Burr Distribution, $Burr(\alpha, \beta)$		357
		Cauchy Distribution		357
		Exponential Distribution, Exponential (λ)		357
		Fréchet Distribution, $Fréchet(\xi, \mu, \sigma)$		360
		Gamma Distribution, $Gamma(v, \lambda)$		361
	20.7	Generalized Extreme Value Distribution, $GEV(\xi, \mu, \sigma)$		362
	20.8	Generalized Pareto Distribution, GPD		364
	20.9	Gumbel Distribution, $Gumbel(\mu, \sigma)$		366
		Logistic Distribution		368
		Normal Distribution, $N(\mu, \sigma^2)$		370
		Lognormal Distribution, Lognormal (μ, σ^2)		371
		Pareto Distribution, $Pareto(\xi, \mu, \sigma)$		372
		Power Function Distribution, $Power(\xi)$		373
		Tukey's g-and-h Distributions		374
		Tukey's Lambda Distributions		374
	20.17	Uniform Distribution, $Uniform(\alpha, \beta)$		375
	20.18	Weibull Distribution, Weibull (ξ, λ)		376

Index

19:43

xiv Contents 21 What is Risk and How Do We Measure It? 379 21.1 Return Values 379 21.2 Quantile Functions 380 21.3 Simulation Data from Continuous Distributions 383 21.4 Quantile Regression 384 21.5 Quantile Functions for Extreme Value Models 384 22 Frequency Modeling from Small Data Sets 387 22.1 Introduction 387 Assessing the Quality of Fit: Model Selection Uncertainty 387 Simulating Frequency Distributions 388 23 Severity Modeling 391 23.1 Which Severity Model Should We Use? 391 23.2 Extreme Value Theory 391 23.3 Modeling Excesses 394 23.4 Estimating the Tail Shape Parameter from the Largest Order Statistics 394 23.5 Goodness-of-Fit Tests 396 23.6 Fitting a GPD Tail to a GEV 397 399 24 Case Studies 24.1 Case Study: Fitting a Loss Data Set 399 24.2 Case Study: Fitting Sequencial Loss Data 403 25 Combining Frequency and Severity Data 407 25.1 Aggregating Losses 407 25.2 Simulating Aggregated Losses 408 25.3 Aggregation with Thresholds 408 25.4 Aggregation Incorporating External Data 409 26 Brief Notes 411 26.1 What is VaR? 411 26.2 Coherent Risk Measures 411 26.3 Dynamic Financial Analysis 412 26.4 Bayes Belief Networks (BBN) 412 26.5 Credibility Theory 413 26.6 Resampling Methods 414 26.7 Data Mining 415 26.8 Linear Discriminant Analysis 415 26.9 Copulas 416 26.10 Quality Control and Risk Management 416 **Bibliography** 419

423