

Contents

Foreword	xi
Introduction	xiii
1 Foundations	1
Risk management: principles and practice	1
Definitions	3
Systematic and unsystematic risk	4
Insurable risks	4
Exposure	7
Management	7
Risk management	7
Risk management objectives	8
Organizational objectives	8
Other significant objectives	10
Risk management decision process	11
Step 1–Diagnosis of exposures	11
Step 2–Risk treatment	16
Step 3–Audit and corrective actions	19
State of the art and the trends in risk management	20
Risk profile, risk map or risk matrix	20
Frequency × Severity	20
Risk financing and strategic financing	23
From risk management to strategic risk management	23
From managing physical assets to managing reputation	25
From risk manager to chief risk officer	26
Why is risk quantification needed?	27
Risk quantification – a knowledge-based approach	28
Introduction	28
Causal structure of risk	28
Building a quantitative causal model of risk	31
Exposure, frequency, and probability	33
Exposure, occurrence, and impact drivers	34

vi	Contents	
	Controlling exposure, occurrence, and impact	35
	Controllable, predictable, observable, and hidden drivers	35
	Cost of decisions	36
	Risk financing	37
	Risk management programme as an influence diagram	38
	Modelling an individual risk or the risk management programme	39
	Summary	41
2	Tool Box	43
	Probability basics	43
	Introduction to probability theory	43
	Conditional probabilities	45
	Independence	49
	Bayes' theorem	50
	Random variables	54
	Moments of a random variable	57
	Continuous random variables	58
	Main probability distributions	62
	Introduction—the binomial distribution	62
	Overview of usual distributions	64
	Fundamental theorems of probability theory	67
	Empirical estimation	68
	Estimating probabilities from data	68
	Fitting a distribution from data	69
	Expert estimation	71
	From data to knowledge	71
	Estimating probabilities from expert knowledge	73
	Estimating a distribution from expert knowledge	74
	Identifying the causal structure of a domain	74
	Conclusion	75
	Bayesian networks and influence diagrams	76
	Introduction to the case	77
	Introduction to Bayesian networks	78
	Nodes and variables	79
	Probabilities	79
	Dependencies	81
	Inference	83
	Learning	85
	Extension to influence diagrams	87
	Introduction to Monte Carlo simulation	90
	Introduction	90
	Introductory example: structured funds	90
	Risk management example 1 – hedging weather risk	96
	Description	96
	Collecting information	98
	Model	99

	Contents	vii
Manual scenario		101
Monte Carlo simulation		101
Summary		104
Risk management example 2– potential earthquake in cement industry		104
Analysis		104
Model		106
Monte Carlo simulation		107
Conclusion		109
A bit of theory		109
Introduction		109
Definition		110
Estimation according to Monte Carlo simulation		111
Random variable generation		112
Variance reduction		113
Software tools		117
3 Quantitative Risk Assessment: A Knowledge Modelling Process		119
Introduction		119
Increasing awareness of exposures and stakes		119
Objectives of risk assessment		120
Issues in risk quantification		121
Risk quantification: a knowledge management process		122
The basel II framework for operational risk		122
Introduction		123
The three pillars		123
Operational risk		124
The basic indicator approach		124
The sound practices paper		125
The standardized approach		125
The alternative standardized approach		127
The advanced measurement approaches (AMA)		127
Risk mitigation		130
Partial use		130
Conclusion		131
Identification and mapping of loss exposures		131
Quantification of loss exposures		134
The candidate scenarios for quantitative risk assessment		134
The exposure, occurrence, impact (XOI) model		135
Modelling and conditioning exposure at peril		135
Summary		136
Modelling and conditioning occurrence		137
Consistency of exposure and occurrence		137
Evaluating the probability of occurrence		140
Conditioning the probability of occurrence		143
Summary		144
Modelling and conditioning impact		145

viii Contents

Defining the impact equation	145
Defining the distributions of variables involved	146
Identifying drivers	147
Summary	148
Quantifying a single scenario	148
An example – “fat fingers” scenario	150
Modelling the exposure	150
Modelling the occurrence	151
Modelling the impact	152
Quantitative simulation	154
Merging scenarios	157
Modelling the global distribution of losses	158
Conclusion	159
4 Identifying Risk Control Drivers	161
Introduction	161
Loss control – a qualitative view	163
Loss prevention (action on the causes)	164
Eliminating the exposure	164
Reducing the probability of occurrence	166
Loss reduction (action on the consequences)	166
Pre-event or passive reduction	166
Post-event or active reduction	167
An introduction to cindynics	169
Basic concepts	170
Dysfunctions	172
General principles and axioms	174
Perspectives	174
Quantitative example 1 – pandemic influenza	176
Introduction	176
The influenza pandemic risk model	177
Exposure	177
Occurrence	177
Impact	178
The Bayesian network	180
Risk control	181
Pre-exposition treatment (vaccination)	182
Post-exposition treatment (antiviral drug)	182
Implementation within a Bayesian network	183
Strategy comparison	185
Cumulated point of view	185
Discussion	188
Quantitative example 2 – basel II operational risk	189
The individual loss model	189
Analysing the potential severe losses	189
Identifying the loss control actions	189
Analysing the cumulated impact of loss control actions	191

	Contents	ix
Discussion		192
Quantitative example 3 – enterprise-wide risk management		194
Context and objectives		195
Risk analysis and complex systems		195
An alternative definition of risk		196
Representation using Bayesian networks		196
Selection of a time horizon		197
Identification of objectives		197
Identification of risks (events) and risk factors (context)		198
Structuring the network		199
Identification of relationships (causal links or influences)		200
Quantification of the network		200
Example of global enterprise risk representation		200
Usage of the model for loss control		201
Risk mapping		201
Importance factors		202
Scenario analysis		202
Application to the risk management of an industrial plant		203
Description of the system		203
Assessment of the external risks		204
Integration of external risks in the global risk assessment		207
Usage of the model for risk management		210
Summary – using quantitative models for risk control		210
5 Risk Financing: The Right Cost of Risks		211
Introduction		211
Risk financing instruments		212
Retention techniques		214
Current treatment		214
Reserves		215
Captives (insurance or reinsurance)		215
Transfer techniques		219
Contractual transfer (for risk financing – to a noninsurer)		219
Purchase of insurance cover		219
Hybrid techniques		220
Pools and closed mutual		220
Claims history-based premiums		222
Choice of retention levels		222
Financial reinsurance and finite risks		223
Prospective aggregate cover		225
Capital markets products for risk financing		225
Securitization		226
Insurance derivatives		227
Contingent capital arrangements		228
Risk financing and risk quantifying		230
Using quantitative models		231

x	Contents	
	Example 1: Satellite launcher	231
	Example 2: Defining a property insurance programme	243
	A tentative general representation of financing methods	252
	Introduction	252
	Risk financing building blocks	254
	Usual financing tools revisited	257
	Combining a risk model and a financing model	261
	Conclusion	263
	Index	267