

Contents

	<i>page</i>
<i>Preface to the Second Edition</i>	x
<i>Preface to the First Edition</i>	xi
<i>Notation and Convention</i>	xiii
<i>Computation Notes</i>	xiv
Part I Loss Models	1
1 Claim-Frequency Distribution	3
1.1 Claim Frequency, Claim Severity and Aggregate Claim	4
1.2 Review of Statistics	4
1.3 Some Discrete Distributions for Claim Frequency	6
1.4 The $(a, b, 0)$ Class of Distributions	14
1.5 Some Methods for Creating New Distributions	19
1.6 R Laboratory	31
1.7 Summary and Conclusions	32
2 Claim-Severity Distribution	37
2.1 Review of Statistics	38
2.2 Some Continuous Distributions for Claim Severity	44
2.3 Some Methods for Creating New Distributions	47
2.4 Tail Properties of Claim Severity	54
2.5 Effects of Coverage Modifications	59
2.6 R Laboratory	71
2.7 Summary and Conclusions	71
3 Aggregate-Loss Models	77
3.1 Individual Risk and Collective Risk Models	78
3.2 Individual Risk Model	79
3.3 Collective Risk Model	86
3.4 Coverage Modifications and Stop-Loss Reinsurance	93

3.5 R Laboratory	97
3.6 Summary and Conclusions	98
Part II Risk and Ruin	103
4 Risk Measures	105
4.1 Uses of Risk Measures	106
4.2 Some Premium-Based Risk Measures	107
4.3 Axioms of Coherent Risk Measures	108
4.4 Some Capital-Based Risk Measures	110
4.5 More Premium-Based Risk Measures	118
4.6 Distortion-Function Approach	122
4.7 Wang Transform	125
4.8 Summary and Conclusions	127
5 Ruin Theory	131
5.1 Discrete-Time Surplus and Events of Ruin	132
5.2 Discrete-Time Ruin Theory	133
5.3 Summary and Conclusions	144
Part III Credibility	147
6 Classical Credibility	149
6.1 Framework and Notations	149
6.2 Full Credibility	151
6.3 Partial Credibility	162
6.4 Summary and Discussions	165
7 Bühlmann Credibility	169
7.1 Framework and Notations	170
7.2 Variance Components	171
7.3 Bühlmann Credibility	179
7.4 Bühlmann–Straub Credibility	185
7.5 Summary and Discussions	192
8 Bayesian Approach	199
8.1 Bayesian Inference and Estimation	200
8.2 Conjugate Distributions	209
8.3 Bayesian versus Bühlmann Credibility	211
8.4 Linear Exponential Family and Exact Credibility	216
8.5 R Laboratory	222
8.6 Summary and Discussions	223
9 Empirical Implementation of Credibility	228
9.1 Empirical Bayes Method	229

	<i>Contents</i>	vii
9.2 Nonparametric Estimation	230	
9.3 Semiparametric Estimation	243	
9.4 Parametric Estimation	244	
9.5 Summary and Discussions	246	
Part IV Model Construction and Evaluation	253	
10 Model Estimation and Types of Data	255	
10.1 Estimation	256	
10.2 Types of Data	260	
10.3 Summary and Discussions	270	
11 Nonparametric Model Estimation	274	
11.1 Estimation with Complete Individual Data	275	
11.2 Estimation with Incomplete Individual Data	282	
11.3 Estimation with Grouped Data	294	
11.4 R Laboratory	296	
11.5 Summary and Discussions	299	
12 Parametric Model Estimation	307	
12.1 Methods of Moments and Percentile Matching	308	
12.2 Bayesian Estimation Method	314	
12.3 Maximum Likelihood Estimation Method	316	
12.4 Models with Covariates	328	
12.5 Modeling Joint Distribution Using Copula	336	
12.6 R Laboratory	340	
12.7 Summary and Discussions	341	
13 Model Evaluation and Selection	350	
13.1 Graphical Methods	351	
13.2 Misspecification Tests and Diagnostic Checks	355	
13.3 Information Criteria for Model Selection	362	
13.4 R Laboratory	363	
13.5 Summary and Discussions	364	
14 Basic Monte Carlo Methods	370	
14.1 Monte Carlo Simulation	371	
14.2 Uniform Random Number Generators	372	
14.3 General Random Number Generators	374	
14.4 Specific Random Number Generators	383	
14.5 Accuracy and Monte Carlo Sample Size	387	
14.6 Variance Reduction Techniques	390	
14.7 R Laboratory	395	
14.8 Summary and Discussions	395	

15 Applications of Monte Carlo Methods	402
15.1 Monte Carlo Simulation for Hypothesis Test	402
15.2 Bootstrap Estimation of <i>p</i> -Value	406
15.3 Bootstrap Estimation of Bias and Mean Squared Error	408
15.4 A General Framework of Bootstrap	412
15.5 R Laboratory	413
15.6 Summary and Discussions	415
Part V Loss Reserving and Ratemaking	419
16 Loss Reserving	421
16.1 Periods, Premiums and Reserves	421
16.2 Three Methods of Estimating Reserves	425
16.3 Developing Frequency and Severity Separately	432
16.4 Discounting Loss Reserves	438
16.5 R Laboratory	439
16.6 Summary and Discussions	440
17 Ratemaking	448
17.1 Exposure, Expenses, Expected Losses and Premiums	448
17.2 Premium Changes and Earned Premium	452
17.3 Loss Trending	456
17.4 Group Differentials and Their Updates	457
17.5 Policies with Cross Categorization	459
17.6 R Laboratory	469
17.7 Summary and Discussions	470
Appendix: Review of Statistics	476
A.1 Distribution Function, Probability Density Function, Probability Function and Survival Function	476
A.2 Random Variables of the Mixed Type and Stieltjes Integral	477
A.3 Expected Value	478
A.4 Mean, Variance and Other Moments	479
A.5 Conditional Probability and Bayes' Theorem	480
A.6 Bivariate Random Variable	481
A.7 Mean and variance of sum of random variables	483
A.8 Moment Generating Function and Probability Generating Function	483
A.9 Some Discrete Distributions	485
A.10 Some Continuous Distributions	487
A.11 Conditional Expectation, Conditional Mean and Conditional Variance	492
A.12 Compound Distribution	495

<i>Contents</i>	ix
A.13 Convolution	495
A.14 Mixture Distribution	496
A.15 Bayesian Approach of Statistical Inference	497
A.16 Conjugate Distribution	498
A.17 Least Squares Estimation	503
A.18 Fisher Information and Cramér–Rao Inequality	505
A.19 Maximum Likelihood Estimation	508
<i>Answers to Exercises</i>	510
<i>References</i>	530
<i>Index</i>	532