Actuarial Modelling Of Claim Counts Risk Classification Credibility And Bonus Malus Systems By Michel Denuit 10 Aug 2007 Hardcover

Presents a comprehensive treatment of the increasingly topical field of reinsurance Reinsurance: Actuarial and Statistical Aspects provides a survey of both the academic literature in the field as well as challenges appearing in reinsurance practice and puts the two in perspective. The book is written for researchers with an interest in reinsurance problems, for graduate students with a basic knowledge of probability and statistics as well as for reinsurance practitioners. The focus of the book is on modelling together with the statistical challenges that go along with it. The discussed statistical approaches are illustrated alongside six case studies of insurance loss data sets, ranging from MTPL over fire to storm and flood loss data. Some of the presented material also contains new results that have not yet been published in the research literature. An extensive bibliography provides readers with links for further study.

Predictive modeling uses data to forecast future events. It exploits relationships between explanatory variables and the predicted variables from past occurrences to predict future outcomes. Forecasting financial events is a core skill that actuaries routinely apply in insurance and other risk-management applications. Predictive Modeling Applications in Actuarial Science emphasizes life-long learning by developing tools in an insurance context, providing the relevant actuarial applications, and introducing advanced statistical techniques that can be used to gain a competitive advantage in situations with complex data. Volume 2 examines applications of predictive modeling. Where Volume 1 developed the foundations of predictive modeling, Volume 2 explores practical uses for techniques, focusing on property and casualty insurance. Readers are exposed to a variety of techniques in concrete, real-life contexts that demonstrate their value and the overall value of predictive modeling, for seasoned practicing analysts as well as those just starting out.

A Hands-On Approach to Understanding and Using Actuarial Models Computational Actuarial Science with R provides an introduction to the computational aspects of actuarial science. Using simple R code, the book helps you understand the algorithms involved in actuarial computations. It also covers more advanced topics, such as parallel computing and C/C++ embedded codes. After an introduction to the R language, the book is divided into four parts. The first one addresses methodology and statistical modeling issues. The second part discusses the computational facets of life insurance, including life contingencies calculations and prospective life tables. Focusing on finance from an actuarial perspective, the next part presents techniques for modeling stock prices, nonlinear time series, yield curves, interest rates, and portfolio optimization. The last part explains how to use R to deal with computational issues of nonlife insurance. Taking a do-it-yourself approach to understanding algorithms, this book demystifies the computational aspects of actuarial science. It shows that even complex computations can usually be done without too much trouble. Datasets used in the text are available in an R package (CASdatasets).

Modern mortality modelling for actuaries and actuarial students, with example R code, to unlock the potential of individual data.

Innovations in Classification, Data Science, and Information Systems

Risk Classification, Credibility and Bonus-Malus Systems

Generalized Linear Models for Insurance Rating

A Multivariate Claim Count Model for Applications in Insurance

Modern Actuarial Risk Theory

This new edition of the Handbook of Insurance reviews the last forty years of research developments in insurance and its related fields. A single reference source for professors, researchers, graduate students, regulators, consultants and practitioners, the book starts with the history and foundations of risk and insurance theory, followed by a review of prevention and precaution, asymmetric information, risk management, insurance pricing, new financial innovations, reinsurance, corporate governance, capital allocation, securitization, systemic risk, insurance regulation, the industrial organization of insurance markets and other insurance market applications. It ends with health insurance, longevity risk, long-term care insurance, life insurance financial products and social insurance. This second version of the Handbook contains 15 new chapters. Each of the 37 chapters has been written by leading authorities in risk and insurance research, all contributions have been peer reviewed, and each chapter can be read independently of the others.

An essential resource for constructing and analyzing advanced actuarial models Loss Models: Further Topics presents extended coverage of modeling through the use of tools related to risk theory, loss distributions, and survival models. The book uses these methods to construct and evaluate actuarial models in the fields of insurance and business. Providing an advanced study of actuarial methods, the book features extended discussions of risk modeling and risk measures, including Tail-Value-at-Risk. Loss Models: Further Topics contains additional material to accompany the Fourth Edition of Loss Models: From Data to Decisions, such as: Extreme value distributions Coxian and related distributions Mixed Erlang distributions Computational and analytical methods for aggregate claim models Counting processes Compound distributions with time-dependent claim amounts Copula models Continuous time ruin models Interpolation and smoothing The book is an essential reference for practicing actuaries and actuarial researchers who want to go beyond the material required for actuarial qualification. Loss Models: Further Topics is also an excellent resource for graduate students in the actuarial field.

There are a wide range of variables for actuaries to consider when calculating a motorist’s insurance premium, such as age, gender and type of vehicle. Further to these factors, motorists’ rates are subject to experience rating systems, including credibility mechanisms and Bonus Malus systems (BMSs). Actuarial Modelling of

Claim Counts presents a comprehensive treatment of the various experience rating systems and their relationships with risk classification. The authors summarize the most recent developments in the field, presenting ratemaking systems, whilst taking into account exogenous information. The text: Offers the first self-contained, practical approach to a priori and a posteriori ratemaking in motor insurance. Discusses the issues of claim frequency and claim severity, multi-event systems, and the combinations of deductibles and BMSs. Introduces recent developments in actuarial science and exploits the generalised linear model and generalised linear mixed model to achieve risk classification. Presents credibility mechanisms as refinements of commercial BMSs. Provides practical applications with real data sets processed with SAS software. Actuarial Modelling of Claim Counts is essential reading for students in actuarial science, as well as practicing and academic actuaries. It is also ideally suited for professionals involved in the insurance industry, applied mathematicians, quantitative economists, financial engineers and statisticians.

This collection of articles addresses the most modern forms of loss reserving methodology: granular models and machine learning models. New methodologies come with questions about their applicability. These questions are discussed in one article, which focuses on the relative merits of granular and machine learning models. Others illustrate applications with real-world data. The examples include neural networks, which, though well known in some disciplines, have previously been limited in the actuarial literature. This volume expands on that literature, with specific attention to their application to loss reserving. For example, one of the articles introduces the application of neural networks of the gated recurrent unit form to the actuarial literature, whereas another uses a penalized neural network. Neural networks are not the only form of machine learning, and two other papers outline applications of gradient boosting and regression trees respectively. Both articles construct loss reserves at the individual claim level so that these models resemble granular models. One of these articles provides a practical application of the model to claim watching, the action of monitoring claim development and anticipating major features. Such watching can be used as an early warning system or for other administrative purposes. Overall, this volume is an extremely useful addition to the libraries of those working at the loss reserving frontier.

Granular Forms and Machine Learning Forms

Reinsurance

Solutions Manual for Actuarial Mathematics for Life Contingent Risks

Proceedings of the 27th Annual Conference of the Gesellschaft für Klassifikation e.V., Brandenburg University of Technology, Cottbus, March 12-14, 2003

An Actuarial Perspective

Leading the way in this field, the Encyclopedia of Quantitative Risk Analysis and Assessment is the first publication to offer a modern, comprehensive and in-depth resource to the huge variety of disciplines involved. A truly international work, its coverage ranges across risk issues pertinent to life scientists, engineers, policy makers, healthcare professionals, the finance industry, the military and practising statisticians. Drawing on the expertise of world-renowned authors and editors in this field this title provides up-to-date material on drug safety, investment theory, public policy applications, transportation safety, public perception of risk, epidemiological risk, national defence and security, critical infrastructure, and program management. This major publication is easily accessible for all those involved in the field of risk assessment and analysis. For ease-of-use it is available in print and online.

In this monograph, authors Greg Taylor and Gr á inne McGuire discuss generalized linear models (GLM) for loss reserving, beginning with strong emphasis on the chain ladder. The chain ladder is formulated in a GLM context, as is the statistical distribution of the loss reserve. This structure is then used to test the need for departure from the chain ladder model and to consider natural extensions of the chain ladder model that lend themselves to the GLM framework.

This practical introduction outlines methods for analysing actuarial and financial risk at a fairly elementary mathematical level suitable for graduate students, actuaries and other analysts in the industry who could use simulation as a problem solver. Numerous exercises with R-code illustrate the text.

This is a comprehensive and accessible reference source that documents the theoretical and practical aspects of all the key deterministic and stochastic reserving methods that have been developed for use in general insurance. Worked examples and mathematical details are included, along with many of the broader topics associated with reserving in practice. The key features of reserving in a range of different contexts in the UK and elsewhere are also covered. The book contains material that will appeal to anyone with an interest in claims reserving. It can be used as a learning resource for actuarial students who are studying the relevant parts of their professional bodies' examinations, as well as by others who are new to the subject. More experienced insurance and other professionals can use the book to refresh or expand their knowledge in any of the wide range of reserving topics covered in the book.

Using R

From Data to Decisions

Fundamentals of Actuarial Mathematics

Modelling Mortality with Actuarial Applications

An Introduction, Second Edition

Incorporates the many tools needed for modeling and pricing infinance and insurance Introductory Stochastic Analysis for Finance and Insuranceintroduces readers to the topics needed to master and use basicstochastic analysis techniques for mathematical finance. The authorpresents the theories of stochastic processes and stochasticcalculus and provides the necessary tools for modeling and pricingin finance and insurance. Practical in focus, the book's emphasisis on application, intuition, and computation, rather thantheory. Consequently, the text is of interest to graduate students,researchers, and practitioners interested in these areas. While thetext is self-contained, an introductory course in probabilitytheory is beneficial to prospective readers. This book

evolved from the author's experience as an instructor andhas been thoroughly classroom-tested. Following an introduction,the author sets forth the fundamental information and tools neededby researchers and practitioners working in the financial andinsurance industries: * Overview of Probability Theory * Discrete-Time stochastic processes * Continuous-time stochastic processes * Stochastic calculus: basic topics The final two chapters, Stochastic Calculus: Advanced Topics andApplications in Insurance, are devoted to more advanced topics.Readers learn the Feynman-Kac formula, the Girsanov's theorem, andcomplex barrier hitting times distributions. Finally, readersdiscover how stochastic analysis and principles are applied inpractice through two insurance examples: valuation of equity-linkedannuities under a stochastic interest rate environment andcalculation of reserves for universal life insurance. Throughout the text, figures and tables are used to help simplifycomplex theory and pro-cesses. An extensive bibliography opens upadditional avenues of research to specialized topics. Ideal for upper-level undergraduate and graduate students, thistext is recommended for one-semester courses in stochastic financeand calculus. It is also recommended as a study guide forprofessionals taking Causality Actuarial Society (CAS) and Societyof Actuaries (SOA) actuarial examinations.
We describe a new approach to estimate the pure premium for automobile insurance. Using the theory of hidden Markov models (HMM) we derive a Poisson-gamma HMM and a hybrid between HMMs and generalized linear models (HMM-GLM). The hidden state is meant to represent a driver's skill thus capturing an unseen variable. The Poisson-gamma HMM and HMM-GLM have two emissions, severity and claim count, making it easier to compare to current actuarial models. The proposed models help deal with the overdispersion problem in claim counts and introduces dependence between the severity and claim count. We derive maximum likelihood estimates for the parameters of the proposed models and then using simulations with the Expectation Maximization algorithm we compare the three methods: GLMs, HMMs and HMM-GLMs. We show that in some instances the HMM-GLM outperforms the standard GLM, while the Poisson-gamma HMM under-performs the other models. Thus in certain situations it may be worth the added complexity of a HMM-GLM.
This is the only book actuaries need to understand generalized linear models (GLMs) for insurance applications. GLMs are used in the insurance industry to support critical decisions. Until now, no text has introduced GLMs in this context or addressed the problems specific to insurance data. Using insurance data sets, this practical, rigorous book treats GLMs, covers all standard exponential family distributions, extends the methodology to correlated data structures, and discusses recent developments which go beyond the GLM. The issues in the book are specific to insurance data, such as model selection in the presence of large data sets and the handling of varying exposure times. Exercises and data-based practicals help readers to consolidate their skills, with solutions and data sets given on the companion website. Although the book is package-independent, SAS code and output examples feature in an appendix and on the website. In addition, R code and output for all the examples are provided on the website.
This monograph presents a time-dynamic model for multivariate claim counts in actuarial applications. Inspired by real-world claim arrivals, the model balances interesting stylized facts (such as dependence across the components, over-dispersion and the clustering of claims) with a high level of mathematical tractability (including estimation, sampling and convergence results for large portfolios) and can thus be applied in various contexts (such as risk management and pricing of (re-)insurance contracts). The authors provide a detailed analysis of the proposed probabilistic model, discussing its relation to the existing literature, its statistical properties, different estimation strategies as well as possible applications and extensions. Actuaries and researchers working in risk management and premium pricing will find this book particularly interesting. Graduate-level probability theory, stochastic analysis and statistics are required.
Claim Models
Claims Reserving in General Insurance
Generalized Linear Models for Insurance Data
Non-Life Insurance Pricing with Generalized Linear Models
Actuarial Models
Predictive modeling involves the use of data to forecast future events. It relies on capturing relationships between explanatory variables and the predicted variables from past occurrences and exploiting this to predict future outcomes. Forecasting future financial events is a core actuarial skill - actuaries routinely apply predictive-modeling techniques in insurance and other risk-management applications. This book is for actuaries and other financial analysts who are developing their expertise in statistics and wish to become familiar with concrete examples of predictive modeling. The book also addresses the needs of more seasoned practising analysts who would like an overview of advanced statistical topics that are particularly relevant in actuarial practice. Predictive Modeling Applications in Actuarial Science emphasizes lifelong learning by developing tools in an insurance context, providing the relevant actuarial applications, and introducing advanced statistical techniques that can be used by analysts to gain a competitive advantage in situations with complex data.
Based on the syllabus of the actuarial industry course on general insurance pricing — with additional material inspired by the author’s own experience as a practitioner and lecturer — Pricing in General Insurance presents pricing as a formalised process that starts with collecting information about a particular policyholder or risk and ends with a commercially informed rate. The main strength of this approach is that it imposes a reasonably linear narrative on the material and allows the reader to see pricing as a story and go back to the big picture at any time, putting things into context. Written with both the student and the practicing actuary in mind, this pragmatic textbook and professional reference: Complements the standard pricing methods with a description of techniques devised for pricing specific products (e.g., non-proportional reinsurance and property insurance) Discusses methods applied in personal lines when there is a large amount of data and policyholders can be charged depending on many rating factors Addresses related topics such as how to measure uncertainty, incorporate external information, model dependency, and optimize the insurance structure Provides case studies, worked-out examples, exercises inspired by past exam questions, and step-by-step methods for dealing concretely with specific situations Pricing in General Insurance delivers a practical introduction to all aspects of general insurance pricing, covering data preparation, frequency analysis, severity analysis, Monte Carlo simulation for the calculation of aggregate losses, burning cost analysis, and more.
This book summarizes the state of the art in generalized linear models (GLMs) and their various extensions:

GAMs, mixed models and credibility, and some nonlinear variants (GNMs). In order to deal with tail events, analytical tools from Extreme Value Theory are presented. Going beyond mean modeling, it considers volatility modeling (double GLMs) and the general modeling of location, scale and shape parameters (GAMLSS). Actuaries need these advanced analytical tools to turn the massive data sets now at their disposal into opportunities. The exposition alternates between methodological aspects and case studies, providing numerical illustrations using the R statistical software. The technical prerequisites are kept at a reasonable level in order to reach a broad readership. This is the first of three volumes entitled Effective Statistical Learning Methods for Actuaries.
Written by actuaries for actuaries, this series offers a comprehensive overview of insurance data analytics with applications to P&C, life and health insurance. Although closely related to the other two volumes, this volume can be read independently.
Modern Actuarial Risk Theory contains what every actuary needs to know about non-life insurance mathematics. It starts with the standard material like utility theory, individual and collective model and basic ruin theory. Other topics are risk measures and premium principles, bonus-malus systems, ordering of risks and credibility theory. It also contains some chapters about Generalized Linear Models, applied to rating and IBNR problems. As to the level of the mathematics, the book would fit in a bachelors or masters program in quantitative economics or mathematical statistics. This second and.
Actuarial Models for Understanding Driver Behavior with Telematics Data
Regression Modeling with Actuarial and Financial Applications
The Mathematics of Insurance, Second Edition
Predictive Modeling Applications in Actuarial Science: Volume 2, Case Studies in Insurance
Financial Surveillance

Provides a comprehensive coverage of both the deterministic and stochastic models of life contingencies, risk theory, credibility theory, multi-state models, and an introduction to modern mathematical finance. New edition restructures the material to fit into modern computational methods and provides several spreadsheet examples throughout. Covers the syllabus for the Institute of Actuaries subject CT5, Contingencies Includes new chapters covering stochastic investments returns, universal life insurance. Elements of option pricing and the Black-Scholes formula will be introduced.
This must-have manual provides detailed solutions to all of the 200+ exercises in Dickson, Hardy and Waters' Actuarial Mathematics for Life Contingent Risks, Second Edition. This groundbreaking text on the modern mathematics of life insurance is required reading for the Society of Actuaries' Exam MLC and also provides a solid preparation for the life contingencies material of the UK actuarial profession's exam CT5. Beyond the professional examinations, the textbook and solutions manual offer readers the opportunity to develop insight and understanding, and also offer practical advice for solving problems using straightforward, intuitive numerical methods. Companion spreadsheets illustrating these techniques are available for free download.
This book teaches multiple regression and time series and how to use these to analyze real data in risk management and finance.
This book is for actuaries and financial analysts developing their expertise in statistics and who wish to become familiar with concrete examples of predictive modeling.
Fundamentals of General Insurance Actuarial Analysis
Loss Reserving
Loss Models
Computational Actuarial Science with R

This second volume examines practical real-life applications of predictive modeling to forecast future events with an emphasis on insurance.
Reinsurance: Actuarial and Statistical Aspects provides a survey of both the academic literature in the field as well as challenges appearing in reinsurance practice and puts the two in perspective. The book is written for researchers with an interest in reinsurance problems, for graduate students with a basic knowledge of probability and statistics as well as for reinsurance practitioners. The focus of the book is on modelling together with the statistical challenges that go along with it. The discussed statistical approaches are illustrated alongside six case studies of insurance loss data sets, ranging from MTPL over fire to storm and flood loss data. Some of the presented material also contains new results that have not yet been published in the research literature. An extensive bibliography provides readers with links for further study.
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Actuarial Modelling of Claim CountsRisk Classification, Credibility and Bonus-Malus SystemsJohn Wiley & Sons
Predictive Modeling Applications in Actuarial Science
Pricing in General Insurance
Financial and Actuarial Statistics
Surplus Analysis of Sparre Andersen Insurance Risk Processes
Actuarial and Statistical Aspects

This is the first book-length treatment of statistical surveillance methods used in financial analysis. It contains

carefully selected chapters written by specialists from both fields and strikes a balance between the financial and statistical worlds, enhancing future collaborations between the two areas, and enabling more successful prediction of financial market trends. The book discusses, in detail, schemes for different control charts and different linear and nonlinear time series models and applies methods to real data from worldwide markets, as well as including simulation studies.

Powered with telematics technology, insurers can now capture a wide range of data to better decode driver's behavior, such as distance traveled and how drivers brake, accelerate or make turns. Such additional information helps insurers improve risk assessments for usage-based insurance (UBI), an increasingly popular industry innovation. In this thesis, we first explore how to integrate telematics information to improve understanding of driver heterogeneity, as well as to better predict accident counts. For motor insurance during a policy year, we typically observe a large proportion of drivers with zero accidents, a less proportion with exactly one accident, and far fewer with two or more accidents. We introduce the use of a cost-sensitive multi-class adaptive boosting algorithm, which we call SAMME.C2, to handle such imbalances in a classification model. Using the SAMME.C2 algorithm, we find improved assessment of driving behavior with telematics relative to traditional risk variables. We next demonstrate the theoretical justification of the SAMME.C2 algorithm in two respects: (1) it is equivalent to Forward Stagewise Additive Modeling with exponential loss, and (2) it is a Bayes classifier. When cost-sensitive learning is added, we find the superiority of SAMME.C2 in controlling for issues related to class imbalances, especially when compared to just the SAMME algorithm. We performed numerical experiments to better understand the distinguishing characteristics of the algorithm. Finally, this thesis describes the techniques employed in the production of a synthetic dataset of driver telematics that is emulated from a real insurance dataset. The method uses a three-stage process that involves deploying machine learning algorithms. It is aimed to produce a resource that can be used to advance models to assess risks for usage-based insurance. It is the hope of this work to provide and encourage the research community to explore innovative methods relevant to such data. The synthetic dataset produced includes 100,000 observations about driver's claims experience (both claim counts and amounts were generated) together with associated classical risk variables and telematics-related variables. We further show, using visualization, model fitting, and data summarization, how remarkable the similarities are between the synthetic and the real datasets.

All property and casualty insurers are required to carry out loss reserving as a statutory accounting function. Thus, loss reserving is an essential sphere of activity, and one with its own specialized body of knowledge. While few books have been devoted to the topic, the amount of published research literature on loss reserving has almost doubled in size during the last fifteen years. Greg Taylor's book aims to provide a comprehensive, state-of-the-art treatment of loss reserving that reflects contemporary research advances to date. Divided into two parts, the book covers both the conventional techniques widely used in practice, and more specialized loss reserving techniques employing stochastic models. Part I, Deterministic Models, covers very practical issues through the abundant use of numerical examples that fully develop the techniques under consideration. Part II, Stochastic Models, begins with a chapter that sets up the additional theoretical material needed to illustrate stochastic modeling. The remaining chapters in Part II are self-contained, and thus can be approached independently of each other. A special feature of the book is the use throughout of a single real life data set to illustrate the numerical examples and new techniques presented. The data set illustrates most of the difficult situations presented in actuarial practice. This book will meet the needs for a reference work as well as for a textbook on loss reserving.

Understand Up-to-Date Statistical Techniques for Financial and Actuarial ApplicationsSince the first edition was published, statistical techniques, such as reliability measurement, simulation, regression, and Markov chain modeling, have become more prominent in the financial and actuarial industries. Consequently, practitioners and students must ac

Actuarial Modelling of Claim Counts

Encyclopedia of Quantitative Risk Analysis and Assessment

Handbook of Insurance

Introductory Stochastic Analysis for Finance and Insurance

Effective Statistical Learning Methods for Actuaries I

Actuarial Models: The Mathematics of Insurance, Second Edition thoroughly covers the basic models of insurance processes. It also presents the mathematical frameworks and methods used in actuarial modeling. This second edition provides an even smoother, more robust account of the main id and models, preparing students to take exams of the Societ

This text introduces the commonly used, basic approaches for reserving and ratemaking in General Insurance. The methods are described through de examples that are linked from one chapter to another to illustrate their practical application. Also, professionalism requirements and standards of practi are presented to set the context for the methods and examples.

The volume presents innovations in data analysis and classification and gives an overview of the state of the art in these scientific fields and applicatio Areas that receive considerable attention in the book are discrimination and clustering, data analysis and statistics, as well as applications in marketing finance, and medicine. The reader will find material on recent technical and methodological developments and a large number of applications demonstrating the usefulness of the newly developed techniques.

This carefully written monograph covers the Sparre Andersen process in an actuarial context using the renewal process as the model for claim counts. unified reference on Sparre Andersen (renewal risk) processes is included, often missing from existing literature. The authors explore recent results an analyse various risk theoretic quantities associated with the event of ruin, including the time of ruin and the deficit of ruin. Particular attention is given to the explicit identification of defective renewal equation components, which are needed to analyse various risk theoretic quantities and are also relevant other subject areas of applied probability such as dams and storage processes, as well as queuing theory. Aimed at researchers interested in risk/ruin

theory and related areas, this work will also appeal to graduate students in classical and modern risk theory and Gerber-Shiu analysis.

Stochastic Loss Reserving Using Generalized Linear Models

Computation and Modelling in Insurance and Finance

Further Topics

GLMs and Extensions

Hybrid Hidden Markov Model and Generalized LinearModel for Auto Insurance Premiums

Non-life insurance pricing is the art of setting the price of an insurance policy, taking into consideration varoius properties of the insured object and the policy holder. Introduced by British actuaries generalized linear models (GLMs) have become today a the standard aproach for tariff analysis. The book focuses on methods based on GLMs that have been found useful in actuarial practice and provides a set of tools for a tariff analysis. Basic theory of GLMs in a tariff analysis setting is presented with useful extensions of standarde GLM theory that are not in common use. The book meets the European Core Syllabus for actuarial education and is written for actuarial students as well as practicing actuaries. To support reader real data of some complexity are provided at www.math.su.se/GLMbook.

Predictive Modeling Applications in Actuarial Science: Volume 1, Predictive Modeling Techniques