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R in Insurance

Statistical computing for the insurance community

11th July 2016



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Welcome to the 4th R in Insurance conference

We are delighted to welcome you to the 4th R in Insurance conference, at Cass Business School.

This one-day conference will focus once more on applications in insurance and actuarial science that use R, the lingua franca for statistical computation. Topics covered range from insurance pricing and econometric modelling, to data science, computation and the use of R in a production environment. All topics are discussed within the context of using R as a primary tool for insurance risk management, analysis and modelling.

The conference programme consists of invited talks and contributed presentations discussing the wide range of fields in which R is used in insurance.

We hope that you find the conference enjoyable and stimulating.

Thanks

An event like this is not possible without the help of many. Our special thanks go to:

- Katrien Antonio, Christophe Dutang and Giorgio Spedicato, who joined us on the scientific committee
- The Cass Faculty Administration team, who have worked tirelessly to make the conference a success.

Finally, we are grateful to our sponsors ISO, Mirai Solutions, Applied AI, CYBAEA, OASIS, and RStudio. Without their generous support, this conference would not have been possible.



Andreas Tsanakas
(Cass Business School)



Markus Gesmann
(Vario Partners)

Programme

9:00 - 10:00	Keynote 1: (New) Challenges in Actuarial Science (Mario Wüthrich, RiskLab ETH Zurich)
10:00 - 11:00	Session 1: Data and Technical Solutions <ol style="list-style-type: none"> 1. Acquiring External Data with R (Mark Chisholm, XLCatlin) 2. Efficient, consistent and flexible Credit Risk simulation with TRNG and RcppParallel (Riccardo Porreca, Mirai Solutions) 3. Grid Computing in R with Easy Scalability in the Cloud (Jonathan Adams, ARMtech Insurance Services)
11:00 - 11:30	Coffee
11:30 - 12:30	Session 2: Lightning talks <ol style="list-style-type: none"> 1. Investigating the correlation between month of birth and diagnosis of specific diseases (David Smith, Cass Business School) 2. Measuring the Length of the Great Recession via Lapse Rates: A Bayesian Approach to Change-Point Detection (Michael Crawford, Applied AI) 3. Data Science vs Actuary: A Perspective using Shiny and HTMLWidgets (Richard Pugh, Mango) 4. estudy2: an R package for the event study in insurance (Iegor Rudnytskyi, University of Lausanne) 5. R as a Service (Matt Aldridge, Mango Solutions) 6. RPGM, an example of use with IBNR (Nicolas Baradel, PGM Solutions)
12:30 - 13:30	Lunch
13:30 - 14:30	Session 3: Insurance and statistical modelling in R <ol style="list-style-type: none"> 1. Telematics insurance: Impact on tarification (Roel Verbelen, KU Leuven) 2. Modelling the impact of reserving in high inflation environments (Marcela Granados, EY) 3. An R package of a partial internal model for life insurance (Jinsong Zheng, Talanx AG / University of Duisburg-Essen)
14:30 - 15:00	Panel discussion: Analytics: Transforming Insurance Businesses
15:00 - 15:30	Coffee
15:30 - 16:30	Session 4: Case studies with R in action <ol style="list-style-type: none"> 1. Global Teleconnections (Sundeep Chahal, Lloyd's) 2. Probabilistic Graphical Models for Detecting Underwriting Fraud (Mick Cooney, Applied AI) 3. R, Shiny and the Oasis Loss Modelling Framework – a toolkit for Catastrophe modelling (Mark Pinkerton, OASIS)
16:30 - 17:30	Keynote 2: Persuasive Advice for Senior Management: the Three-C's (Dan Murphy, Trinostics)
18:00 - 22:00	Conference dinner, Ironmongers Hall

Abstracts

Keynote 1

(New) Challenges in Actuarial Science

Mario Wüthrich, RiskLab ETH Zurich

Currently, the actuarial functions go through massive changes. Many of these changes are data driven, in particular, data analytics and machine learning techniques will likely be playing a key role in actuarial science.

This talk gives actuarial examples of these (new) challenges and it will highlight where the R community can support the actuarial profession.

Session 1: Data and Technical Solutions

Acquiring External Data with R

Mark Chisholm, XLCatlin

Many web sites provide data that may be relevant to insurers. This presentation will demonstrate how R can be a helpful tool for acquiring external data that is available on the Internet.

Data is a scarce asset in many classes of business in the insurance industry, which makes it difficult to perform multivariate analysis. One reason this problem arises is because an insurer's internal databases may only accurately record a handful of policy attributes, which limits the number of variables that can be studied. Another reason is that a company may have only recently entered a new class of business, which limits the number of policyholders that can be included in an analysis.

Underwriters can benefit from data available in web sites, but extracting this information can be manual and time-intensive. There are packages available to R users who wish to gather data from web sites without having to learn a new programming language. For example, the R Selenium package provides R bindings for the Selenium WebDriver. While this tool is commonly used for testing web applications, its ability to automate web browsers makes it useful for obtaining data from web sites. In addition, the rvest package can be helpful in extracting tables in web sites and storing them in R data frames. Once this information is downloaded and organised, it can then be used to enrich an insurer's internal data.

Attendees will learn:

- How R packages can be used to extract data from web sites, and their relevance to insurance
- Examples of RSelenium and rvest in action
- Considerations when accessing data from web sites

Efficient, consistent and flexible Credit Risk simulation with TRNG and RcppParallel

Riccardo Porreca, Mirai Solutions

We will show how we have combined RcppParallel with TRNG (Tina's Random Number Generation) to achieve efficient, flexible and reproducible parallel Monte Carlo simulations in modelling credit default risk in correlation with market risk.

For rare yet correlated default events of large portfolios (with securities from several thousands of counter-parties) a substantial simulation effort is required to produce meaningful risk measures. Running frequent simulations of sub-portfolios to gain extra insight under stressed conditions or perform impact assessments and what-if scenarios, while possibly maintaining exact reproducibility of full-portfolio results (i.e. such a stand-alone simulation should be identical to extracting results of a corresponding subset from a full simulation run), poses a further complication.

It is typically desired – although often not achieved for various reasons – to have a solution that is “playing fair”, meaning that a parallel execution on a multi-core architecture yields results independent of the architecture, parallelisation techniques and number of parallel processes. At the same time, (Pseudo) Random Number Generators used to draw random numbers in Monte Carlo simulations are intrinsically sequential.

TRNG together with RcppParallel addresses and resolves all these challenges with speed and elegance. RcppParallel offers in-memory, thread-safe access to R objects from its workers. This example stems from the context of Solvency II Internal Model (Economic Capital Model, Solvency Capital Requirements) and was originally carried out as a project for a large global insurer. What we present here shares the ideas and concepts but is a newer model and implementation.

We are hosting a new R package on Github (<https://github.com/miraisolutions/rTRNG>), which embeds TRNG C++ sources and headers, provides simple examples of how to use parallel RNG with RcppParallel, and exposes some functionality from TRNG into R for easier access, testing and benchmarking.

Grid Computing in R with Easy Scalability in the Cloud

Jonathan Adams, ARMtech Insurance Services

Parallel computing is useful for speeding up computing tasks and many R packages exist to aid in using parallel computing. Unfortunately it is not always trivial to parallelise jobs and can take a significant amount of time to accomplish, time that may be unavailable. Several modelling tasks have arisen in my line of work that have required lots of compute time, but the results of which have been needed in a short amount of time. These tasks have ranged from building multiple neural network models for crop yields to running many realisations of a catastrophe model.

My presentation will demonstrate an alternative method that allows for processing of multiple jobs simultaneously across any number of servers using Redis message queues. This method has proven very useful since I began implementing it at my company over two years ago. In this method, a main Redis server handles communication with R processes on any number of servers. These processes, known as workers, inform the server that they are available for processing and then wait indefinitely until the server passes them a task.

In this presentation, it will be demonstrated how trivial it is to scale up or down by adding or removing workers, and how cheap and easy it can be to perform this scaling in the cloud. This will be demonstrated with sample jobs run on workers in the Amazon cloud. Additionally, this presentation will show you how to implement such a system yourself with the rminions package I have been developing. This package is based on what I have learned over the past couple of years and contains functionality to easily start workers, queue jobs, and even perform R-level maintenance (such as installing packages) on all connected servers simultaneously!

GitHub Repository: <https://github.com/PieceMaker/rminions>.

Lightning Talks

Investigating the correlation between month of birth and diagnosis of specific diseases

Ben Rickayzen, David Smith, Leonel Rodrigues Lopes Junior, Cass Business School, City University London

There has been a number of studies into whether the month of birth of an individual affects the probability of them developing particular diseases later in life. The conclusions of these studies though are contradictory with some finding correlations and others not.

Using data from a group of insured lives from Unimed-BH Medical Cooperative, located in southeast Brazil we investigate the possible links in month of birth with the following diseases; diabetes, asthma, cardiovascular, chronic kidney disease, chronic obstructive pulmonary disease, nephrolithiasis and mental health.

To improve the detection of seasonal influence we use R to carry out the Rayleigh test on our data after transforming it into directional data. We also discuss the appropriateness of using the Bonferroni correction for our investigations.

Measuring the Length of the Great Recession via Lapse Rates: A Bayesian Approach to Change-Point Detection

Michael Crawford, Applied AI

Many life insurance companies in Ireland noticed a marked increase in the lapse rates of their policies during the “Great Recession”. Various techniques can be employed to analyse this, but simple graphical and visualisation methods are not particularly revealing for determining a reasonable estimate of when this increase in lapses started and when it ended.

This is important, as any analysis based on data including this period of time will tend to overestimate the future predicted lapse rate. Some careful data manipulation can help measure this effect but fixing a start and end point is important for adjusting models to remove this effect.

In this talk a Bayesian approach to change-point detection is proposed, with an implementation in Stan. Simple visualisations are discussed, along with ideas for how to use the output of this model in subsequent predictive models such as survival analysis.

Data Science vs Actuary: A Perspective using Shiny and HTMLWidgets

Richard Pugh, Mango Solutions

The advent of “Data Science” is having a profound effect on the role of analytics within organisations. In some respects, sectors where analytics as a concept is unused are able to use data science more strategically than in “analytically mature” industries such as insurance. Building on the work presented jointly by Richard Pugh (Mango) and Chris Reynolds (PartnerRe) at the LIFE Conference in 2015, this presentation will:

- Contrast the anticipated skills of a “Data Scientist” vs Actuaries
- Outline possible opportunities for proactive data science in the insurance sector
- Look at the ways in which bodies such as the IoFA are promoting “Data Science” skills
- Discuss ways in which insurance companies are looking to add “Data Science” to supplement actuarial teams
- Suggest key challenges ahead

To compare the skills of “Data Scientists” and Actuaries, we will present Mango’s “Data Science Radar”, a Shiny app with embedded JavaScript using HTMLwidgets. This will be used during the presentation to illustrate the ease with which bespoke R-based applications can be created as an intuitive way to communicate complex ideas. The full Shiny code, based on the radarchart package will be made available.

estudy2: an R package for the event study in insurance

Igor Rudnytskyi, University of Lausanne

The impact of relevant events on the stock market valuation of companies has been the subject of many studies. An event study is a statistical toolbox that allows to examine the impact of certain events on the firms’ stock valuation.

Given the rationality of market participants, the prices of securities immediately incorporate any relevant announcements, information, and updates.

The idea of the event study is to compare the market valuation of the companies during periods related to an event and other (non-event linked) periods. If the behavior of stocks is significantly different in the event-period, then we conclude that an event produces an impact on the market valuation, otherwise we conclude that there is no effect.

The major stream of research is focused on the insurance industry and catastrophe events, therefore, the cross-sectional dependence cannot be neglected. Furthermore, the returns typically are not normally distributed. These points lead to misspecification of the classical parametric tests, and require to validate the results by more tailored and accurate tests (both parametric and nonparametric).

In order to incorporate all these issues we developed the package `estudy2` (planned to be submitted to CRAN by August 2016). First, `estudy2` incorporates all technical aspects of the rate of return calculation (the core computation is done in C++ by using `Rcpp`). Also the package incorporates 3 traditional market models: mean-adjusted returns, market-adjusted returns, single-index market model.

Finally, 6 parametric and 6 nonparametric tests of daily cross-sectional abnormal return have been implemented. In addition, the package contains the tests for cumulative abnormal returns (CAR).

In the proposed talk we demonstrate an example from current research, namely, the impact of major catastrophes on insurance firms’ market valuation in order to validate the specification of the tests.

R as a Service

Matt Aldridge, Mango Solutions

Building “R as a Service” to support Production Applications: A Health Insurance Use Case

R is an incredibly powerful language for data analysis, providing a wealth of capabilities to support an analysts’ workflows. However, when we instead look to use R in production systems, there are a number of challenges that arise, such as:

- Big Data – R must scale to enable the application of R modelling approaches to large data sources
- Scale – how could R be used in a scalable, parallel, “always available” manner?
- Centralised – R code must be centralised, versioned and managed to enable change without disruption of a the wider applications
- Integration – to be part of a production “capability”, R must be easily integrated into a wider set of systems

We will propose and describe some ways in which the above challenges can be overcome. In particular, we will present a real-world use case where R was used “as a service” to support a Health Insurance production application for a major insurer.

RPGM, an example of use with IBNR

Nicolas Baradel and William Jouot, PGM Solutions

We present a method in order to estimate the number of claims - above a specific threshold, called large claims - with the IBNR using the method of Schnieper. We show its application with RPGM. RPGM is a software which enables to create R programs by developers without any extra knowledge. The developers build a sequencer, alternating R code execution with GUIs (Graphical User Interfaces). Then, those RPGM programs can be used by everyone: no knowledge in R is needed. RPGM executes each step of the sequencer ; the user only sees the GUIs and the results. By using such a program, we display the methodology of estimating the IBNR with graphics and outputs automatically generated - different sets of data from csv and xlsx files are used.

Session 3: Insurance and statistical modelling in R

Telematics insurance: impact on tarification

Roel Verbelen, Katrien Antonio, and Gerda Claeskens, KU Leuven

Telematics technology - the integrated use of telecommunication and informatics – may fundamentally change the car insurance industry by allowing insurers to base their prices on the real driving behavior instead of on traditional policyholder characteristics and historical claims information. Telematics insurance or usage-based

insurance (UBI) can drive down the cost for low-mileage clients and good drivers.

Car insurance is traditionally priced based on self-reported information from the policyholder, most importantly: age, license age, postal code, engine power, use of the vehicle, and claims history. Over time, insurers try to refine this a priori risk classification and restore fairness using no-claim discounts and claim penalties in the form of the bonus-malus system. It is expected that these traditional methods of risk assessment will become obsolete. Your car usage and your driver abilities can be better assessed based on telematics data collected, such as: the distance driven, the time of day, how long you have been driving, the location, the speed, harsh or smooth breaking, aggressive acceleration or deceleration, your cornering and parking skills... This high dimensional data, collected on the fly, will force pricing actuaries to change their current practice. New statistical models will have to be developed to adequately set premiums based on individual policyholder’s motoring habits instead of the risk associated to their peer group.

In this work, we take a first step in this direction. We analyze a telematics data set from a European insurer, collected in between 2010 and 2014, in which information is collected on the amount of meters insureds drive. Besides the number of meters driven, we also registered how this distance is divided over the different kind of road types and time slots. This data allows car insurers the use of real driving exposure to price the contract. We build claims frequency models combining traditional and telematics information and discover the relevance and impact of adding the new telematics insights.

List of R packages used: mgcv, data.table, ggplot2, ggmap, compositions, parallel.

Modelling the impact of reserving in high inflation environments

Marcela Granados, EY

An insurance company needs to keep sufficient reserves for fulfilling its long term future payments. However, reserving methods which rely on historical payments, fail in the case of volatile inflation scenarios. This is more profound for long tailed classes involving inflation sensitive cashflows such as litigation expenses, indemnity/medical payments etc. This is because Chain Ladder methods assume that

expected incremental losses are proportional to reported losses, and losses in an Accident year are independent of losses in other accident years. High and volatile inflation produces Calendar year effect which invalidates these assumptions.

In such cases, historical payments might not be truly representative of future payments. The reserves in such situations are highly sensitive to inflation, making it the most critical assumption. Therefore, future payments need to be explicitly adjusted for inflation and discounted appropriately, for which actuaries need to get comfortable with inflation rate assumptions. Thus, projecting future inflation rates becomes important for the entire reserve estimation process. This also has implications in pricing, where losses need to be trended and developed to devise rate indications. Explicit recognition of inflation in reserve risk projections is also crucial for capital modelling.

This research study explores the use of Time Series for forecasting inflation rates, especially in countries like Argentina, which are infamous for highly volatile inflation rates. Due to the dynamic nature of inflation volatility, non-linear time series models that account for the changing variances over time, such as ARCH and GARCH are used. Model performance is assessed on how well the model captures the stochastic volatility in the data. Statistical tests are performed to assess the goodness of fit, accuracy of results and model stability. Based on these tests, the appropriate model is selected and its parameters then used to forecast inflation over a longer time horizon.

An R package of a partial internal model for life insurance

Jinsong Zheng, Quantitative Methods, Group Risk Management, Talanx AG / Chair for Energy Trading and Finance, University of Duisburg-Essen

Under Solvency II framework, in order to protect the benefit of shareholder and policyholder, the insurance company should be adequately capitalised to fulfil the capital requirement for solvency. Therefore, two main components should be taken into account, the available capital and the solvency capital requirement.

For the available capital, it refers to shareholder's net asset value and is defined as the difference between the market value of assets and liabilities. In general, a stochastic model is used to perform the market consistent valuation of the assets and liabilities. We then develop a stochastic cash flow projection model (i.e. asset portfolio consists of coupon bonds and stocks while liability portfolio consists of life insurance products with profit sharing and interest rate guarantee) to capture the evolution of cash flows of assets and liabilities, as well as an Economic Scenario Generator (ESG) (consisting of interest rate model and equity model) to generate economic scenarios including the financial market risk factors through Monte Carlo simulation after calibrating to the market data. Under this framework, we calculate the available capital for a life insurance company through Monte Carlo simulation.

For the Solvency Capital Requirement (SCR), the distribution of available capital at $t=1$ is taken into account. In principle, the so called nested stochastic simulation should be applied, however, it results quite high computational time and is not quite practical to use this approach. Here we develop the proxy method of replicating portfolio which is widely used in insurance industry to determine the SCR and compare to the nested simulation to check the estimation quality.

In all, we construct a partial internal model to illustrate the calculation of available capital and SCR for a life insurance company by given market data. All the implementation is done in an R-package with Rcpp.

Session 4: Session 4: Case studies with R in action

Global Teleconnections

Sundeep Chahal, Lloyd's

Lloyd's has worked with the Met Office to model in R the global connections between natural perils such as hurricanes, tornadoes, flooding and wildfire. This has been done by first defining a mathematical relationship between global climate drivers such as El Niño Southern Oscillation (ENSO) and the Atlantic Multi-decadal Oscillation (AMO). Once defined, the relationship between individual perils and climate drivers were established and Monte-Carlo simulations calculated to express the complex

interconnectivity amongst sixteen perils of interest. These simulations have then been used to sensitivity test the parameters of the Lloyd's Catastrophe Model.

Probabilistic Graphical Models for Detecting Underwriting Fraud

Mick Cooney, Applied AI

Medical non-disclosure is a major cost in underwriting life insurance. This is where the applicant lies, omits or is unaware of information about pre-existing medical conditions of relevance to an underwriter. Medical exams help mitigate non-disclosure, but tend to be expensive in both time and money, and may result in the applicant not taking up the policy, even in the event of no health issues of concern.

Probabilistic Graphical Models in general, and Bayesian Belief Networks in particular, are a way to help the underwriters with this process. This talk proposes a simple and basic initial model to serve mainly as a proof of concept for the approach. Methods for dealing with incomplete and missing data will be discussed, as well as discussing realistic expectations for what such a model could reasonably produce, along with possible avenues of improvement for model, such as scaling it to larger networks of variables.

R, Shiny and the Oasis Loss Modelling Framework – a toolkit for Catastrophe modelling

Mark Pinkerton, OASIS

Oasis is a not-for-profit initiative to create a global community around catastrophe modelling, based around open standards and software. The core Oasis system has been designed to be agnostic in that it can execute models from many different suppliers. A unique feature of the Oasis architecture is that it provides a core set of components that can be used directly by modellers or analysts, embedded in other software or deployed in enterprise risk management systems.

R is a great fit for running analytics using the Oasis components, and Shiny is a powerful tool for deploying R's data visualization and geo-spatial capabilities. R is already

widely used in the model development and actuarial communities, and we are starting to see some adoption by the catastrophe modelling community.

This talk will cover:

- The catastrophe modelling problem space
- The Oasis technical architecture
- The use of R in Oasis and potential uses by the catastrophe modelling community

Code examples will be provided for operating Oasis within R, as well as a demo of the Oasis user interface developed in RShiny.

Keynote 2

Persuasive Advice for Senior Management: the Three-C's

Dan Murphy, Trinostics

You are the analyst whom Senior Management named to the 2016 strategic team. While collaborators and Management may not appreciate the technical foundations for your conclusions, how can you nevertheless persuade them to see the value in your message? Persuasive analysts use analytical tools that help them deliver advice with three C's: Context, Confidence, and Clarity.

For decades, spreadsheets have been the insurance analytical tool of choice primarily because they can prototype models relatively quickly (high Context). But spreadsheets can be difficult to tech-check and audit (low Confidence) and time-consuming to modify for refocused objectives (low Clarity). More recently, R and derivative products are evolving into a computing tool that is particularly well-honed to deliver Three-C analytical advice to insurance Senior Management.

Biographies of presenters



Jonathan Adams

Jonathan Adams has worked for four years in the United States crop insurance industry as the Systems & Actuarial Analyst for ARMtech Insurance Services. His tasks and interests include mathematics- and statistics-based automation, catastrophe modeling, and building models for corporate decision-making. He frequently uses R in his daily work and has been developing methods for grid computing with R and making R accessible in other languages, primarily Node.js. Jonathan holds a B.S. in Mathematics and an M.S. in Statistics from Texas Tech University and is on the ACAS track of the Casualty Actuarial Society. He is a member of the Lubbock, Tx R user group. In his spare time he enjoys trail running and riding.



Matthew Aldridge

Matthew is the Managing Director at Mango Solutions. He has worked for some of the major business intelligence and data mining vendors including Business Objects, Cognos, Insightful and Accrue. Working primarily in sales related roles Matthew has worked with and solved problems for a variety of blue chip and start-up companies implementing business intelligence and data mining solutions. In his spare time, Matt makes full use of his managerial talents to run a ladies football team.



Nicolas Baradel

Nicolas Baradel is a former student of ENSAE and a member of the French Institute of Actuaries (Institut des Actuaire). He is assistant in Actuarial science at ENSAE-CREST and is preparing a PhD in applied mathematics at Université Paris-Dauphine. Previously, he worked at the Group Risk Management of AXA in casualty insurance and their applications to R. He is the author of the French book on R : “Langage R : Application à la statistique, à l’actuariat et à la finance”.



Sundeep Chahal

Sundeep is the Manager of the Lloyd's Catastrophe Model and is responsible for the analytics across Exposure Management and Reinsurance at Lloyd's of London. The Lloyd's Catastrophe Model is a model built and maintained in-house by his team at Lloyd's and is written using a combination of R and SQL. Sundeep has a degree in Mathematics from University College London and has worked at Lloyd's since graduating five years ago. Outside of work his interests include football, hockey and developing Android applications.



Mark Chisholm

Mark is a Business Data Scientist with XL Catlin and has 10 years of experience in different pricing roles in the US and UK. His background is in helping underwriters at general insurers use data to determine prices for their policies and better understand the risk characteristics of their insureds. You can reach him at mark.chisholm@xlcatlin.com.



Mick Cooney

Michael is highly experienced in probabilistic programming and financial modelling for derivatives analysis and volatility trading. His backgrounds in stochastic and high performance computing, theoretical physics and as organiser of technical user groups ensure a great scientific and academic strength within the team.

Michael Crawford



Michael trained as an actuary and has over twenty years experience designing, developing and managing bespoke IT solutions for a broad range of financial companies throughout Europe. He understands the complexities of IT-enabled change and brings a wealth of actuarial, financial and practical expertise.

Marcela Granados



Marcela has 10 years of experience working in the insurance industry in both Commercial and Consumer lines in all actuarial areas (Predictive Modelling, Pricing and Reserving). Prior to joining EY, Marcela worked for four years at AIG and five years at Liberty Mutual, where she held leadership positions in Predictive Modeling and Pricing, managing a \$2B book of business. Marcela is a Fellow of the Casualty Actuarial Society (“CAS”) and serves on the CAS Committee on Reserves.

Marcela has presented on a variety of reserving and modelling to industry audiences and has been featured in actuarial magazines.

Dan Murphy



Dan Murphy is an independent Property/Casualty (Non-Life) consulting actuary in the San Francisco Bay Area. He is a Fellow of the Casualty Actuarial Society and a member of the American Academy of Actuaries. He has over 35 years of experience in the insurance and transportation industries since receiving his masters in statistics from the University of Illinois. Dan has published papers in the CAS Proceedings and the journal Variance, primarily in the area of stochastic reserving. He is the author of the mondate package and a coauthor of the ChainLadder package, both on CRAN. Dan uses R as much as possible in his consulting projects.



Mark Pinkerton

Mark Pinkerton is the Chief Technology Officer at Oasis Loss Modelling Framework Ltd, a not-for-profit initiative to create a global community around catastrophe modelling based on open standards and software. He leads the development team in London and is responsible for all aspects of technical design and implementation. Prior to Oasis Mark spent ten years at Risk Management Solutions, the leading catastrophe model vendor, where he has worked on a wide spectrum of analytic software projects across direct, treaty and ILS business, and on portfolio management and underwriting applications. Mark holds an MSc in Statistical Science from University College London, where his thesis was on statistical approaches to modeling extreme flood depths in the UK, and an MA in Natural Science (Physics) from the University of Cambridge.



Riccardo Porreca

Riccardo holds a master degree in Computer Science Engineering and a PhD in Bioengineering and Bioinformatics. During his academic experience in the domain of Systems Biology, he focused on modeling and identification of biochemical networks. After working as a post-doc at ETH Zurich, Riccardo joined Mirai Solutions in 2013. Since then he has been involved in several consulting projects for the Insurance industry, where he has designed and implemented technical solutions for areas such as financial risk modeling, general insurance pricing or stochastic quantification of aggregate capital requirements (using copulas). The vast majority of the analytic code written during these engagements is done in R, with performance-critical elements programmed in C/C++ and Java. Besides coding, Riccardo is a regular guest at the Engadin ski marathon and enjoys cooking Italian dishes.



Richard Pugh

Richard is the Chief Data Scientist at Mango Solutions. He has many years experience working with data analysis products and specializes in SAS and S-PLUS. He has a BSc in mathematics and statistics from Bath University and has worked in the pharmaceutical and financial sectors as a technical consultant. Prior to setting up Mango Solutions with Matt, Richard held a Pre Sales role for Insightful working with customers, running training courses and managing projects. Richard is a keen and talented member of Bath Light Operatic Group.



Iegor Rudnytskyi

Iegor is a first-year PhD student in the research group of Professor Joël Wagner at HEC, University of Lausanne. Carrying a BSc and MSc in Applied Mathematics, Iegor also obtained a MSc in Actuarial Science from University of Lausanne. Apart from his mathematical background, he did an internship in an IT company. His current scientific interests include risk management, risk theory, ALM, and loss models.



David Smith

David is a Senior Lecturer in Actuarial Science at Cass Business School. Over the last three years his research focused on developing new methodologies of predicting changes in population sizes and in addition looking at developing products to tap into the housing wealth of the UK population to help fund long term care needs.



Roel Verbelen

Roel Verbelen joined the Research Center for Operations Research and Business Statistics of KU Leuven in September 2013 as a doctoral researcher. His research is supervised by Gerda Claeskens and Katrien Antonio and he obtained an IWT Doctoral Grant from the Agency for Innovation by Science and Technology. The main focus in his research is the use of advanced statistical methods in non-life insurance, in particular in loss modeling, telematics insurance and reserving. He has published articles in *Astin Bulletin* and *Lifetime Data Analysis*. For his thesis during the Master of Statistics at KU Leuven, Roel was awarded the 2013 IA|BE price from the institute of actuaries in Belgium for the best thesis concerning an actuarial topic. As a researcher, he received prizes for best presentation at the IBS Channel Network Conference of 2015 in Nijmegen and at the ARC conference of 2015 in Toronto. More information can be found on his website.



Mario Wüthrich

Mario Wüthrich is Professor in the Department of Mathematics at ETH Zurich, Honorary Visiting Professor at City University London, Honorary Professor at University College London and Swiss Finance Institute Professor. He holds a Ph.D. in mathematics from ETH Zurich. From 2000 to 2005, he held an actuarial position at Winterthur Insurance and was responsible for claims reserving in non-life insurance, as well as for developing and implementing the Swiss Solvency Test. He is a fully qualified Actuary SAA, serves on the board of the Swiss Association of Actuaries, and is editor of ASTIN Bulletin.



Jinsong Zheng

Jinsong Zheng is currently working in the Quantitative methods team of the Group Risk Management at Talanx AG. He has six years experience of quantitative risk management related to internal model and is now responsible for the modelling of biometric risks and validation of replicating portfolio for life entities. Parallel to his work, he is also pursuing his PhD degree with topic of “stochastic methods in risk management” at University of Duisburg-Essen under supervision of Prof. Rüdiger Kiesel and Prof. Gerhard Stahl. He holds a master degree in Finance focusing on financial mathematics from Ulm University.

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Cass Business School

In 2002, City University's Business School was renamed Sir John Cass Business School following a generous donation towards the development of its new building in Bunhill Row. The School's name is usually abbreviated to Cass Business School.

Sir John Cass's Foundation

Sir John Cass's Foundation has supported education in London since the 18th century and takes its name from its founder, Sir John Cass, who established a school in Aldgate in 1710. Born in the City of London in 1661, Sir John served as an MP for the City and was knighted in 1713.