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Machine Learning in GI Reserving

Nigel Carpenter





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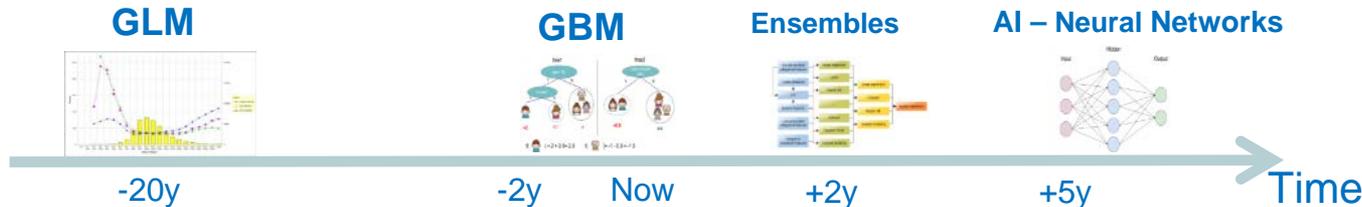
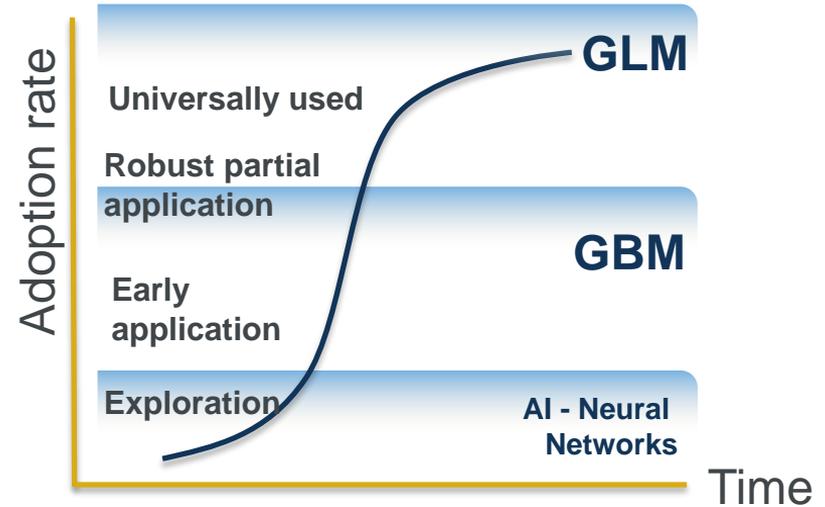
Contents

- Context from Pricing
- Reserving as a GLM
- Reserving & Machine Learning
- Interesting Papers
- IFoA Working Party

Context from GI Pricing

Analytic Innovation: The imperative for accurate pricing drives the development and adoption of new analytic techniques.

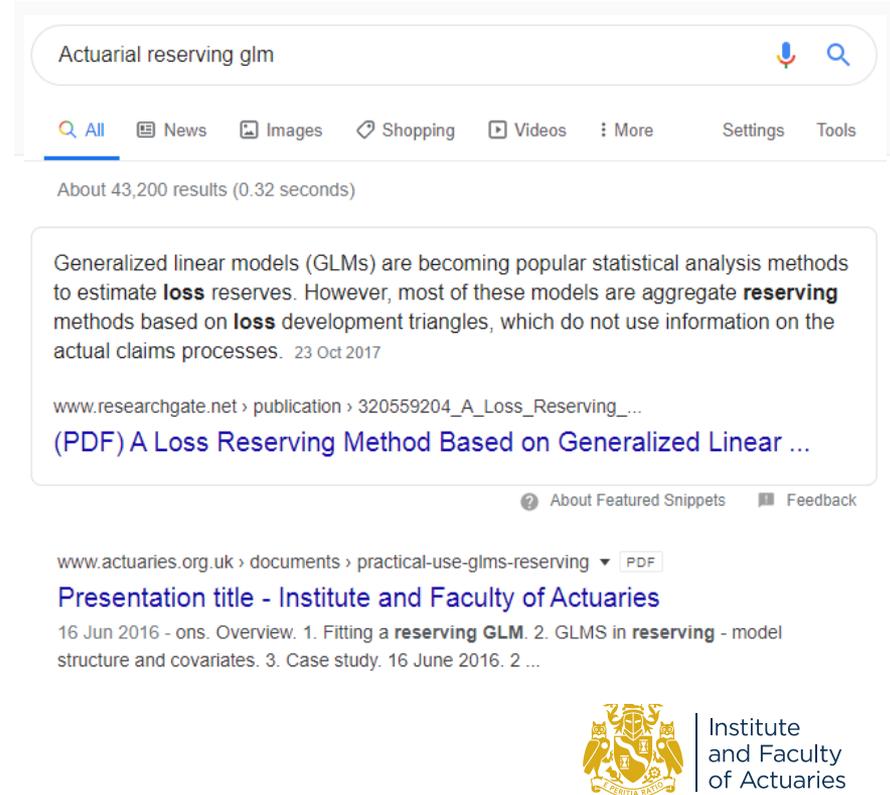
- GLMs used for 20 years; now universal
- GBMs starting to be adopted
- Ensembles becoming possible
- Neural Networks some way off



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Reserving as a GLM

- Plenty of actuarial reserving research to show that the Chain-ladder can be formulated as a GLM.
- From GI Pricing we know that Machine Learning (GBMs and Neural Networks) outperforms GLMs.
- So where are all the Machine Learning in reserving papers?



Actuarial reserving glm

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About 43,200 results (0.32 seconds)

Generalized linear models (GLMs) are becoming popular statistical analysis methods to estimate **loss** reserves. However, most of these models are aggregate **reserving** methods based on **loss** development triangles, which do not use information on the actual claims processes. 23 Oct 2017

www.researchgate.net › publication › 320559204_A_Loss_Reserving_...
[\(PDF\) A Loss Reserving Method Based on Generalized Linear ...](#)

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www.actuaries.org.uk › documents › practical-use-glms-reserving ▾ PDF

Presentation title - Institute and Faculty of Actuaries

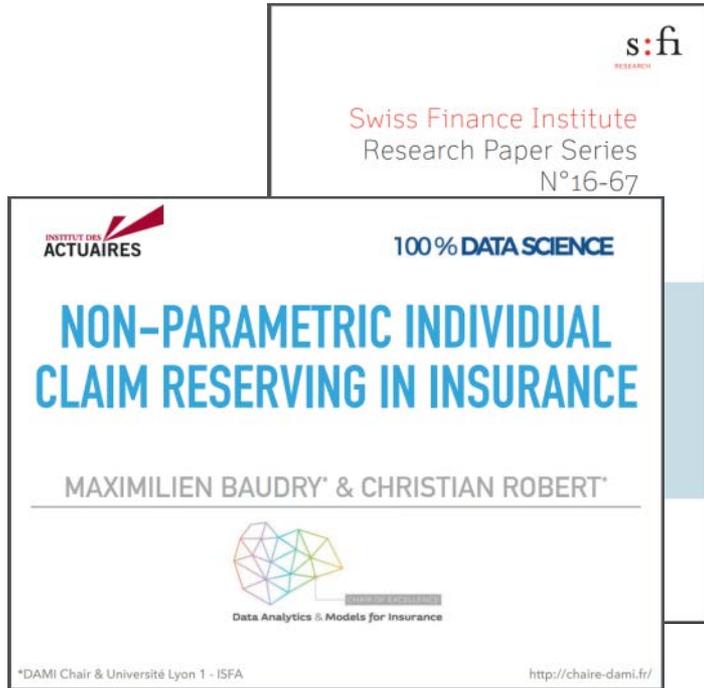
16 Jun 2016 - ons. Overview. 1. Fitting a **reserving GLM**. 2. GLMs in **reserving** - model structure and covariates. 3. Case study. 16 June 2016. 2 ...



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Reserving & Machine Learning

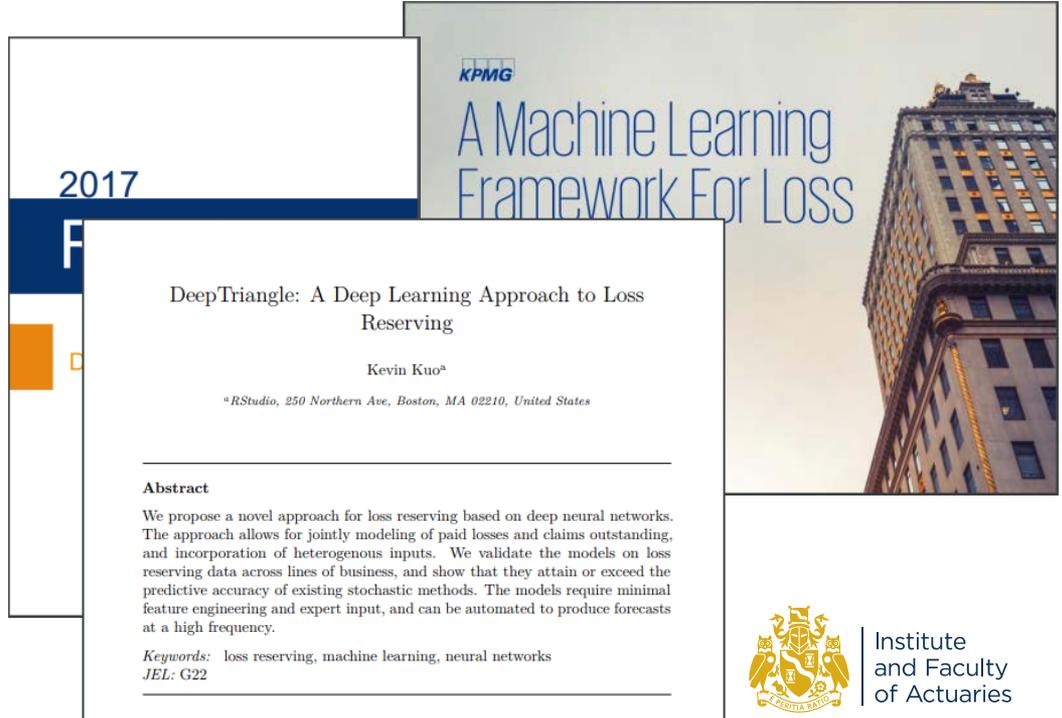
- 2017 to 2019 have been vintage years



The cover features the logo of the Institut des Actuaires (IFA) at the top left, with the text '100% DATA SCIENCE' at the top right. The title 'NON-PARAMETRIC INDIVIDUAL CLAIM RESERVING IN INSURANCE' is prominently displayed in blue. Below the title, the authors' names 'MAXIMILIEN BAUDRY* & CHRISTIAN ROBERT*' are listed. A colorful geometric logo is at the bottom, with the text 'Data Analytics & Models for Insurance' underneath. At the very bottom, it says '*DAMI Chair & Université Lyon 1 - ISFA' and 'http://chaire-dami.fr/'.



The logo for the Swiss Finance Institute Research Paper Series, featuring the 's:fi' logo and the text 'Swiss Finance Institute Research Paper Series N°16-67'.



The cover features the KPMG logo at the top left, with the title 'A Machine Learning Framework For Loss Reserving' in blue. The year '2017' is displayed in a blue box on the left. The author's name 'Kevin Kuo*' is listed below the title. The abstract text is in the center, and the keywords 'loss reserving, machine learning, neural networks' and 'JEL: G22' are at the bottom. The background shows a tall building.

2017

F

DeepTriangle: A Deep Learning Approach to Loss Reserving

Kevin Kuo*

*RStudio, 250 Northern Ave, Boston, MA 02210, United States

Abstract

We propose a novel approach for loss reserving based on deep neural networks. The approach allows for jointly modeling of paid losses and claims outstanding, and incorporation of heterogenous inputs. We validate the models on loss reserving data across lines of business, and show that they attain or exceed the predictive accuracy of existing stochastic methods. The models require minimal feature engineering and expert input, and can be automated to produce forecasts at a high frequency.

Keywords: loss reserving, machine learning, neural networks

JEL: G22



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Reserving & Machine Learning

Date	Title	Author	Rating	Comment
2016_09	Machine Learning Framework for Loss Reserving	KPMG	✓	GBMs with aggregated data old approach to tuning and validation
2017_03	Machine Learning in Individual Claims Reserving	WUTHRICH	✓	Individual claim transactions with decision trees but no IBNR
2017	Individual claim Development with Machine Learning	ASTIN	✓	Old school Neural Networks on claim transactions
2017_12	Non parametric individual claim reserving in insurance	BAUDRY	✓✓	ML plus external data and IBNR, no code!
2018_05	Deep Triangle	KUO	✓✓	RNNs and code shared but complex!

Growing number of good papers available up to 2018

Even more during 2019

But awareness and accessibility can be difficult especially if you are new to Data Science.



BAUDRY: Non Parametric individual claim reserving



Maximilien@DAMI

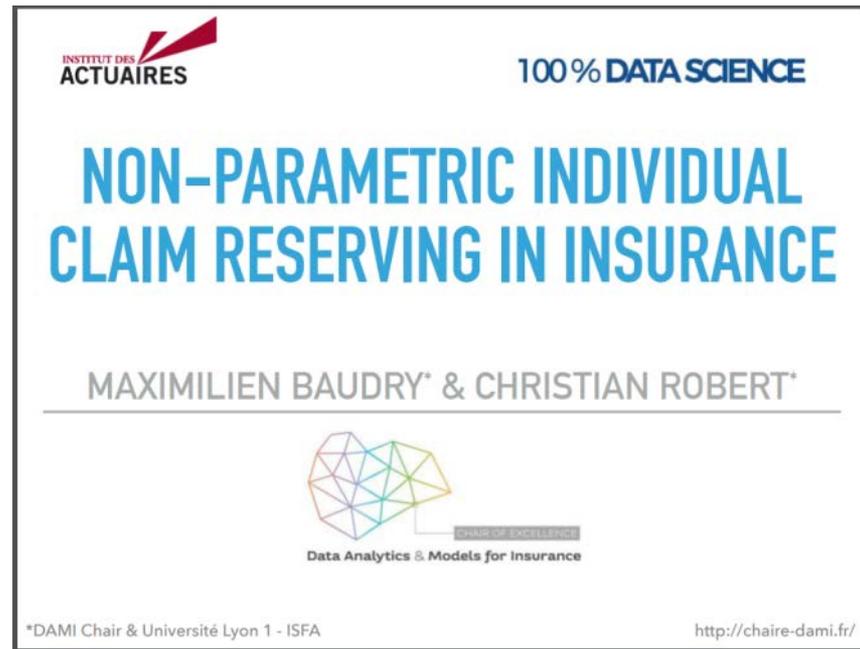
PhD Student
Paris, Île-de-France, France
Joined 4 years ago · last seen 5 days ago

in Followers 75

Competitions Master

Home Competitions (7) Kernels (2) Discussion (18) Followers Contact User Follow User

- Kaggle Master and PhD Student @ DAMI Paris.
- Expert knowledge in Machine Learning and Natural Language
- Supervisor Prof Christian Y Robert, provides Actuarial background.



INSTITUT DES ACTUARIES

100% DATA SCIENCE

NON-PARAMETRIC INDIVIDUAL CLAIM RESERVING IN INSURANCE

MAXIMILIEN BAUDRY* & CHRISTIAN ROBERT*



CHAIR OF EXCELLENCE
Data Analytics & Models for Insurance

*DAMI Chair & Université Lyon 1 - ISFA <http://chaire-dami.fr/>

BAUDRY: Non Parametric individual claim reserving

Baudry's approach uses extra info beyond traditional “triangle” style claims data.

$T_{0,p}$	Underwriting date
$t_i - T_{0,p}$	Exposure to reserve date
$F_{t_i,p}$	Policy Risk factors
$E_{T_{0,p}}$	External info at UW date
$E_{T_{1,p}}$	External info at Occurrence date
$E_{T_{2,p}}$	External info at Report date
$I_{t_i,p}$	Claim history up to valuation date

- Explicit use of this extra data, provides opportunities...
 - for the method to give improved results
 - to aid better understanding of influences on claim development

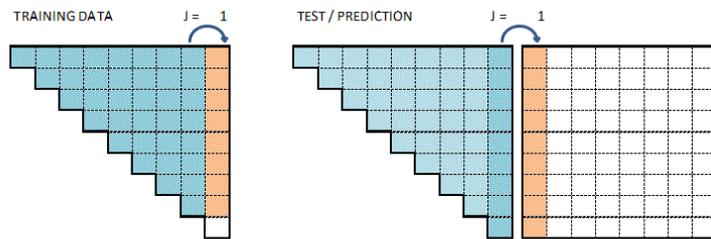
RBNS uses $(T_{0,p}, t_i - T_{0,p}, F_{t_i,p}, E_{T_{0,p}}, E_{T_{1,p}}, E_{T_{2,p}}, I_{t_i,p})$

IBNR uses $(T_{0,p}, t_i - T_{0,p}, F_{t_i,p}, E_{T_{0,p}})$



BAUDRY: Non Parametric individual claim reserving

Transactions and claims relating to individual policies are binned into discrete time periods, by
UW time = rows and Calendar time = cols.



Presenting triangular data in a way machine learning can use is essential to success.

Format of data can be difficult to get used to if you come from a traditional triangle world.



KUO: Deep Triangle



Kevin Kuo

About

I'm a software engineer and R evangelist building open source tools for big data analytics, machine learning, and productionizing ML models. Prior to working on software full-time, I was in insurance, and I still actively participate in actuarial science research and present at industry conferences.

- Software engineer at R Studio (references JJ Allaire and Francois Chollet).
- Associate of CAS, previous employment in Insurance with KPMG.
- Co-author of 2016 KPMG Machine Learning Framework for Loss Reserving paper.

DeepTriangle: A Deep Learning Approach to Loss Reserving

Kevin Kuo^a

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We propose a novel approach for loss reserving based on deep neural networks. The approach allows for jointly modeling of paid losses and claims outstanding, and incorporation of heterogeneous inputs. We validate the models on loss reserving data across lines of business, and show that they attain or exceed the predictive accuracy of existing stochastic methods. The models require minimal feature engineering and expert input, and can be automated to produce forecasts at a high frequency.

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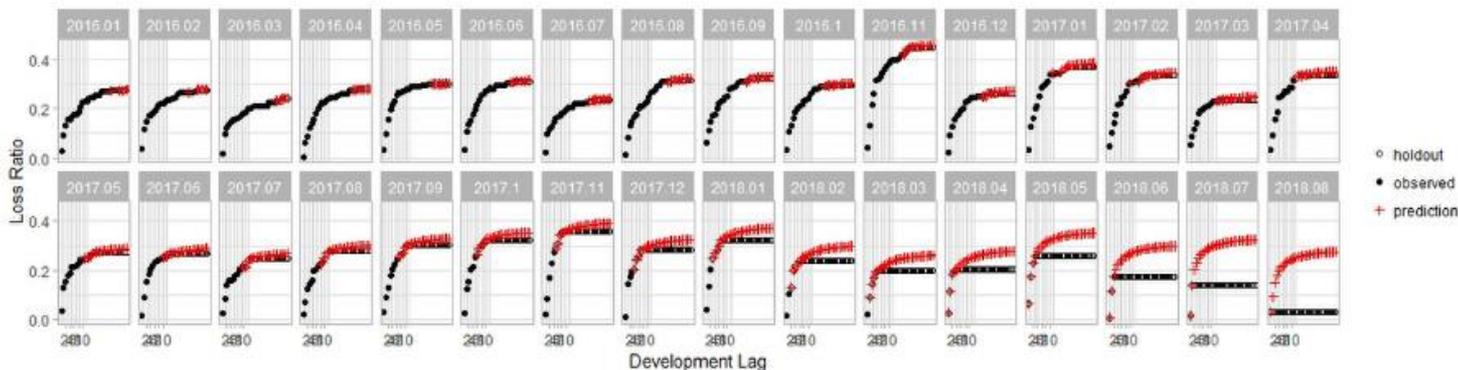


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KUO: Deep Triangle

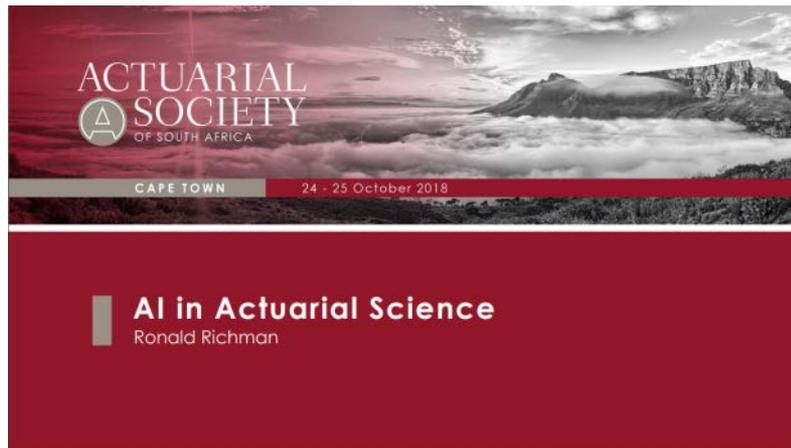
Kuo's approach uses a special form of Neural Network which is ideally suited to sequential data.

- Applied to aggregated triangular industry data and code shared.
- Able to apply to own company data and replicate the results.



IFoA Machine Learning in Reserving WP

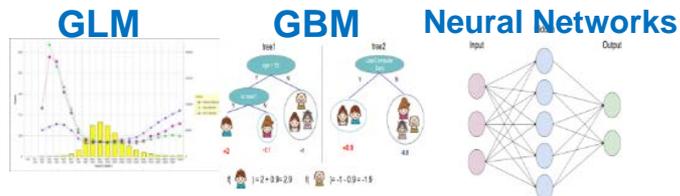
- Member interest in ML and AI continues to grow.
- Many more papers have been released since those highlighted here.
- Working party set up to:
 - Understand market position in ML adoption
 - Perform literature review
 - Undertake new areas of research
 - Answer common questions on ML techniques
 - Consider data requirements and source for ML
 - Consider Trust and Ethics implications



Closing remarks



- Exciting opportunities ahead with clear parallels to GI Pricing.
- GLM , GBM and Neural Network approaches to reserving all maturing rapidly.
- Path to adoption in Reserving could well be easier than Pricing.



Time



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Questions

Comments

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