KU LEUVEN

UNIVERSITY OF AMSTERDAM

RESPONSIBLE ACTUARIAL LEARNING

115th annual general meeting of the SAA

Katrien Antonio

katrienantonio.github.io

Bern

September 7, 2024

RESPONSIBLE ACTUARIAL LEARNING

THE ACTUARIAL PROFESSION

“ A data-driven and model guided, critical and socially responsible financial decision-maker, in an ever changing world governed by uncertainty.

prof. Embrechts, Annals of Actuarial Science (2022, Editorial)

source: Swiss Association of Actuaries (2018), see https://actuarialdatascience.org/ADS-Strategy/

RESPONSIBLE ACTUARIAL LEARNING

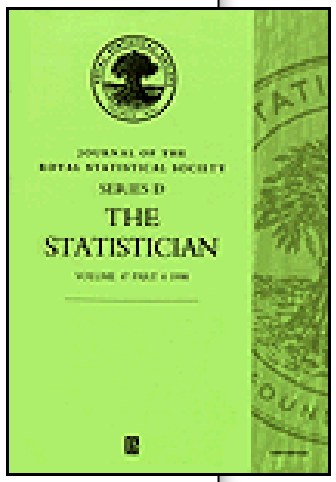
The Statistician (1996)
45, *No.* 4, *pp.* 407–436

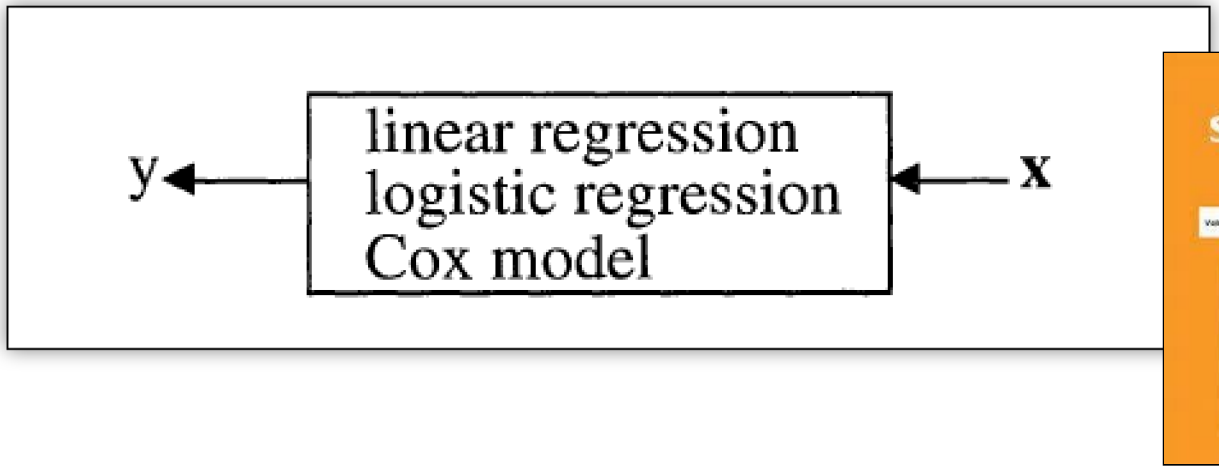
Generalized linear models and actuarial science

By STEVEN HABERMAN† and ARTHUR E. RENSHAW

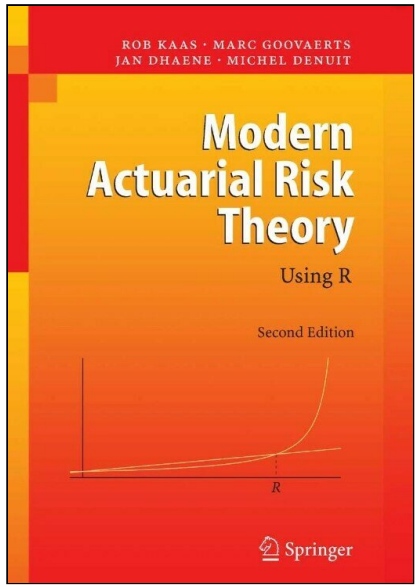
City University, London, UK

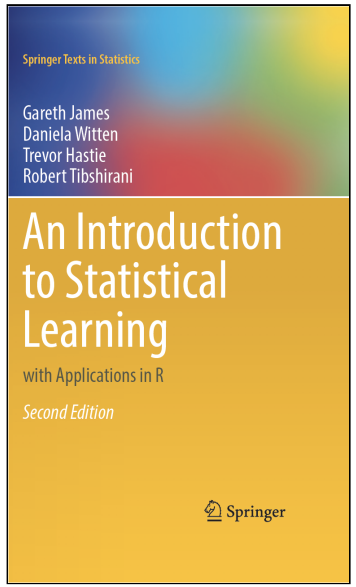
[Received July 1996. Revised August 1996]





source: Breiman (2001). Statistical modeling: the two cultures. *Statistical Science.*





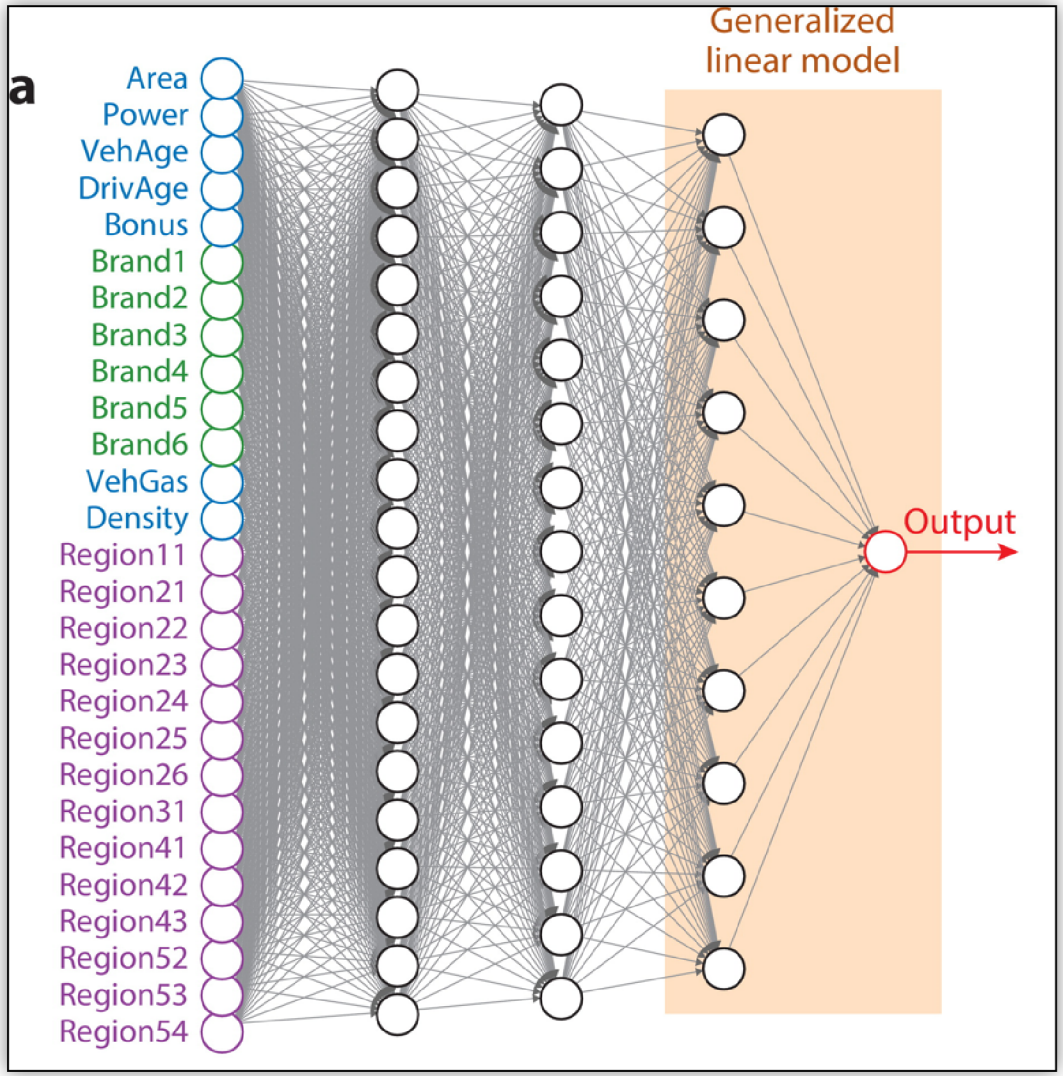
from Statistical Learning ...

... to Machine Learning

Embrechts & Wüthrich (2022). Recent challenges in actuarial science. *Annual Review of Statistics and its application.*

The Economist, May 2017.

Nature Machine Intelligence, January 2020.

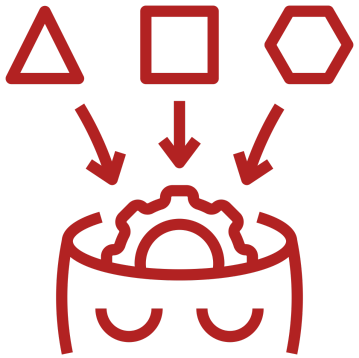


RESPONSIBLE ACTUARIAL LEARNING

AN OPINIONATED GUIDE TO ACTUARIAL LEARNING

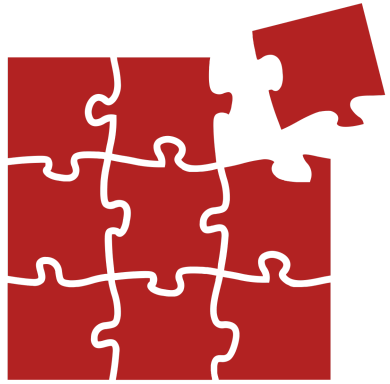
Target variables

time-to-event, (low) frequency, (high impact) severity



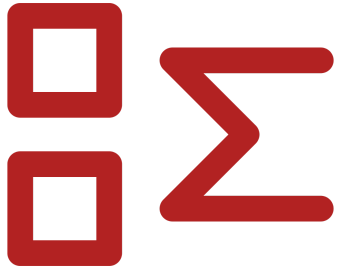
Multi-type input features

continuous, spatial, (high cardinality) factor, compositional data



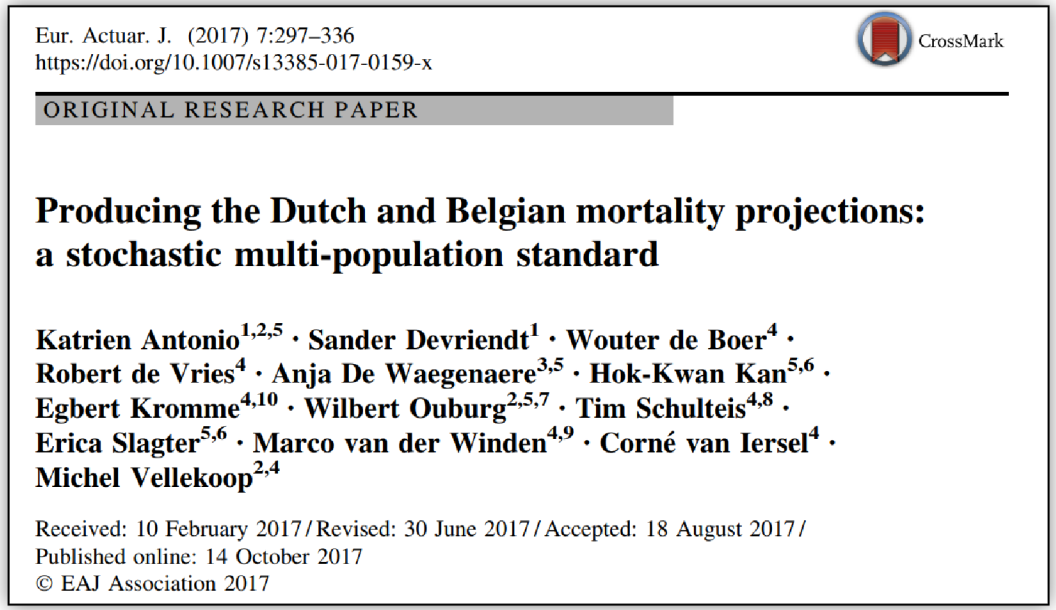
(In)complete

due to (reporting or settlement) delay, policy modifications



Fine-grained or aggregate

MODELLING MORTALITY RATES



Eur. Actuar. J. (2017) 7:297–336
https://doi.org/10.1007/s13385-017-0159-x

CrossMark

ORIGINAL RESEARCH PAPER

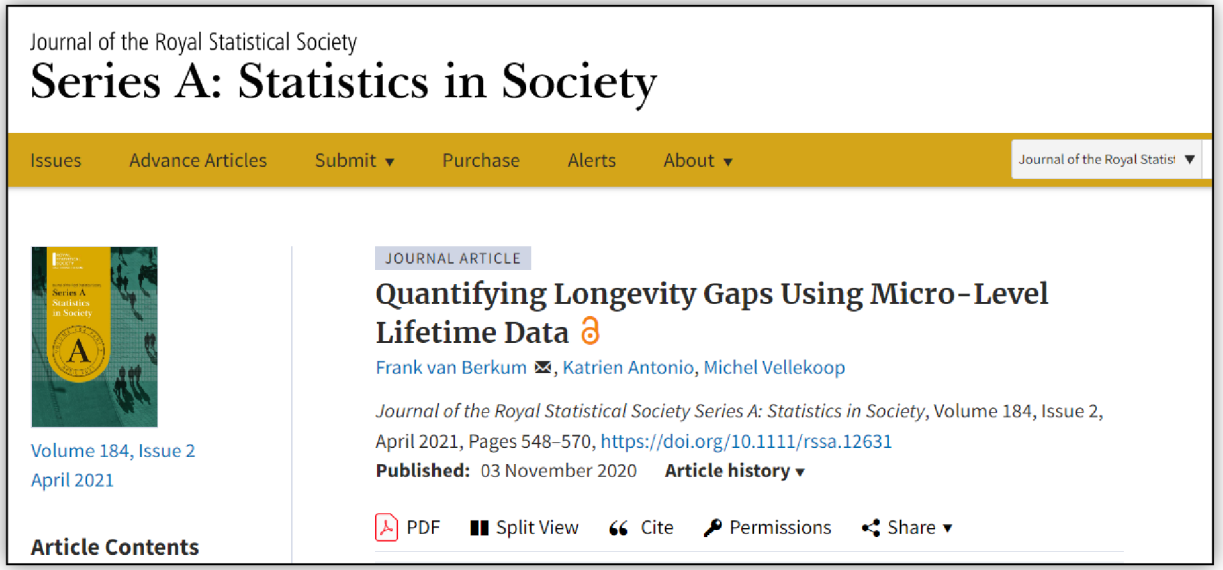
Producing the Dutch and Belgian mortality projections: a stochastic multi-population standard

Katrien Antonio[1,2,5] · Sander Devriendt[1] · Wouter de Boer[4] · Robert de Vries[4] · Anja De Waegenaere[3,5] · Hok-Kwan Kan[5,6] · Egbert Kromme[4,10] · Wilbert Ouburg[2,5,7] · Tim Schulteis[4,8] · Erica Slagter[5,6] · Marco van der Winden[4,9] · Corné van Iersel[4] · Michel Vellekoop[2,4]

Received: 10 February 2017 / Revised: 30 June 2017 / Accepted: 18 August 2017 /
Published online: 14 October 2017

*How to generate **scenarios for future mortality rates** at population level?*

*How to quantify **longevity gaps** among members of a Dutch pension fund?*



Journal of the Royal Statistical Society
Series A: Statistics in Society

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Volume 184, Issue 2
April 2021

Article Contents

JOURNAL ARTICLE

Quantifying Longevity Gaps Using Micro-Level Lifetime Data

Frank van Berkum, Katrien Antonio, Michel Vellekoop

Journal of the Royal Statistical Society Series A: Statistics in Society, Volume 184, Issue 2, April 2021, Pages 548–570, https://doi.org/10.1111/rssa.12631
Published: 03 November 2020 **Article history**

PDF | Split View | Cite | Permissions | Share

An initiative of

RCLR Research Centre for Longevity Risk

University of Amsterdam
Amsterdam School of Economics

NN

CLAIMS RESERVING

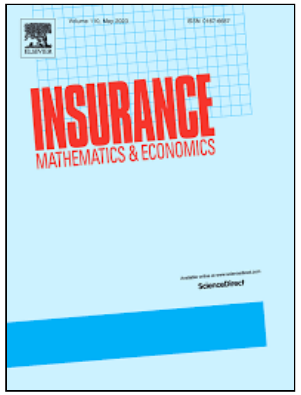
Astin Bulletin (2023), pp. 1–28
doi:10.1017/asb.2023.14

International Actuarial Association
Association Actuarielle Internationale

RESEARCH ARTICLE

BRIDGING THE GAP BETWEEN PRICING AND RESERVING WITH AN OCCURRENCE AND DEVELOPMENT MODEL FOR NON-LIFE INSURANCE CLAIMS

Jonas Crevecoeur[1,*], Katrien Antonio[2,3,4,5], Stijn Desmedt[6] and Alexandre Masquelein[6]



A hierarchical reserving model for reported non-life insurance claims

Jonas Crevecoeur [a c], Jens Robben [a c], Katrien Antonio [a b c d]

*How to estimate the **outstanding claim amount** on a (re)insurance portfolio?*

INSURANCE PRICING VIA RISK CLASSIFICATION

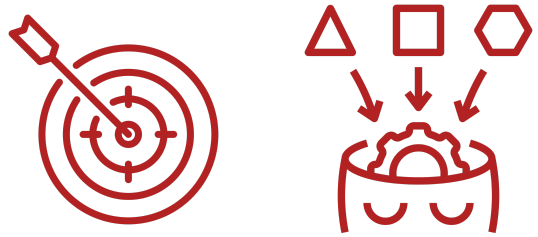
SCANDINAVIAN ACTUARIAL JOURNAL, 2018
VOL. 2018, NO. 8, 681–705
https://doi.org/10.1080/03461238.2018.1429300

Taylor & Francis
Taylor & Francis Group

Check for updates

A data driven binning strategy for the construction of insurance tariff classes

Roel Henckaerts[a,b], Katrien Antonio[a,b,c], Maxime Clijsters[a] and Roel Verbelen[a,b]



*How to **(technically) price** an insurance contract?*

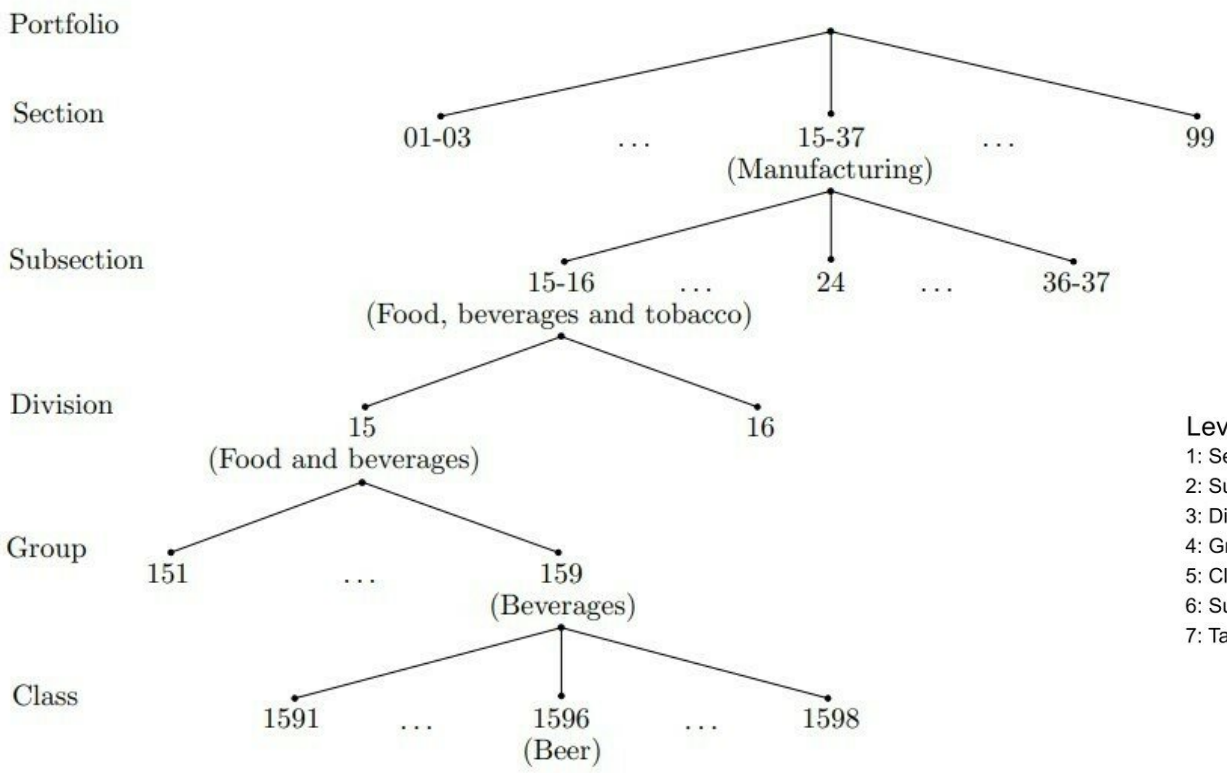
Research Article

Insurance pricing with hierarchically structured data an illustration with a workers' compensation insurance portfolio

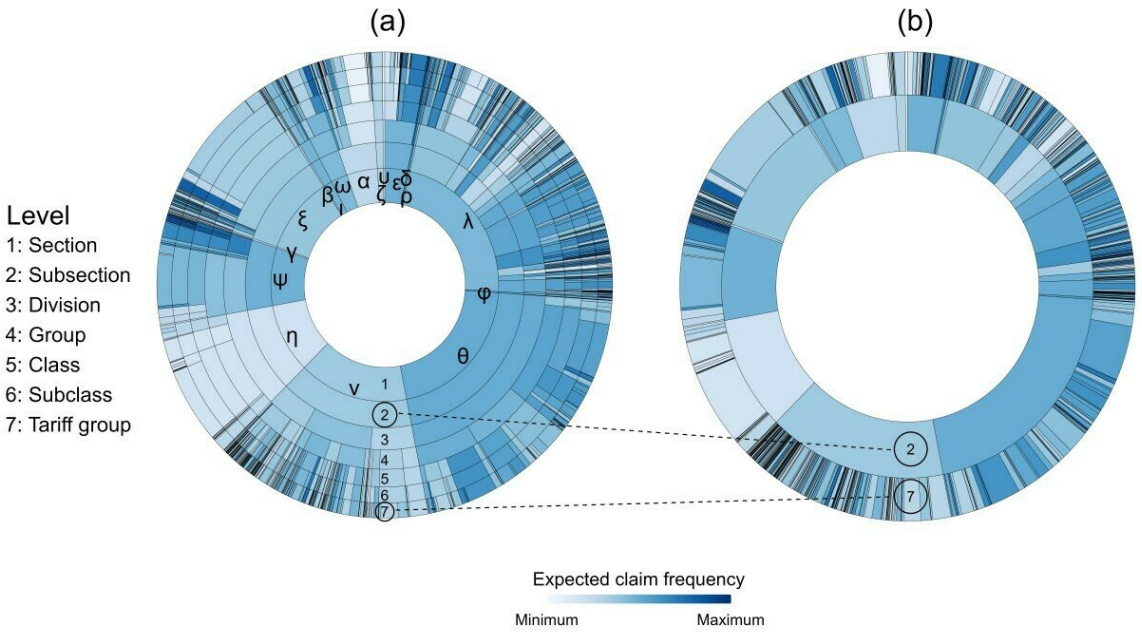
Bavo D. C. Campo & Katrien Antonio

Received 29 Jun 2022, Accepted 11 Dec 2022, Published online: 30 Jan 2023

ENGINEERING NEW TYPES OF FEATURES



*How to leverage insights from **hierarchical** and **text** input data?*



Campo & Antonio (2024, Annals of Actuarial Science). On clustering levels of a hierarchical categorical risk factor.

Wilsens, Antonio & Claeskens (2024, arxiv). Reducing the dimensionality and granularity in hierarchical categorical variables.

ROYAL STATISTICAL SOCIETY
DATA | EVIDENCE | DECISIONS

Journal of the Royal Statistical Society
Applied Statistics
Series C

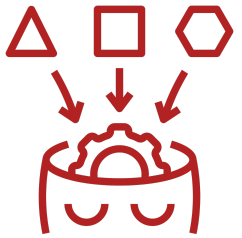
Appl. Statist. (2018)
67, *Part* 5, *pp.* 1275–1304

Unravelling the predictive power of telematics data in car insurance pricing

Roel Verbelen,
KU Leuven, Belgium

Katrien Antonio
KU Leuven, Belgium, and University of Amsterdam, The Netherlands

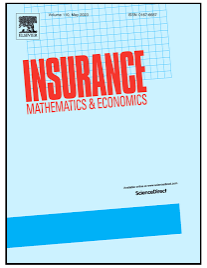
and Gerda Claeskens
KU Leuven, Belgium



*How to use **compositional driving habits data** as input features when modelling claim counts?*

The added value of dynamically updating motor insurance prices with telematics collected driving behavior data

Roel Henckaerts [a,c,*], Katrien Antonio [a,b,c]



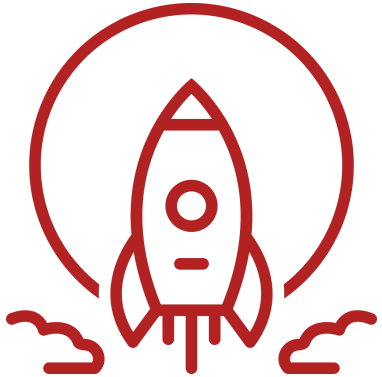
*How to design a **usage-based insurance** product from **driving habits and style** telematics data?*

RESPONSIBLE ACTUARIAL LEARNING

AN OPINIONATED GUIDE TO RESPONSIBLE RESEARCH ON ACTUARIAL LEARNING

High-stakes decisions in a highly regulated industry

Explainable and transparent



Reproducible, with impact on other domains

EXPLAINABLE AND TRANSPARENT

Boosting Insights in Insurance Tariff Plans with Tree-Based Machine Learning Methods

Roel Henckaerts,[1,2] Marie-Pier Côté,[3] Katrien Antonio,[1,2,4] and Roel Verbelen[1,2]

*Focus on **tree-based learners** ...*

*... more recently (combined actuarial) **neural networks** (see Schelldorfer & Wüthrich, 2019)*

Holvoet, Antonio & Henckaerts (2024, arxiv). Neural networks for insurance pricing with frequency and severity data: a benchmark study from data preprocessing to technical tariff.

www.theactuarymagazine.org, April 2023

EXPLAINABLE AND TRANSPARENT

ELSEVIER

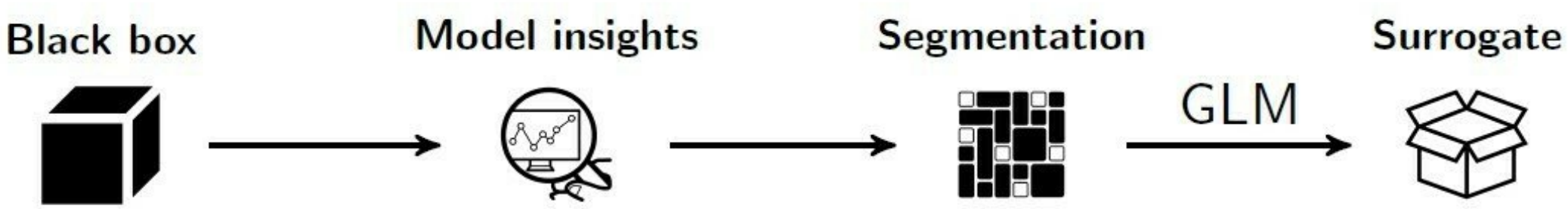
Expert Systems with Applications

Volume 202, 15 September 2022, 117230

When stakes are high: Balancing accuracy and transparency with Model-Agnostic Interpretable Data-driven suRRogates

Roel Henckaerts [b d], Katrien Antonio [b c d], Marie-Pier Côté [a]

*Smart engineering of a GLM as a **global surrogate** for a black box model*



REPRODUCIBLE

Package 'smurf'

March 22, 2023

Type Package

Title Sparse Multi-Type Regularized Feature Modeling

Version 1.1.5

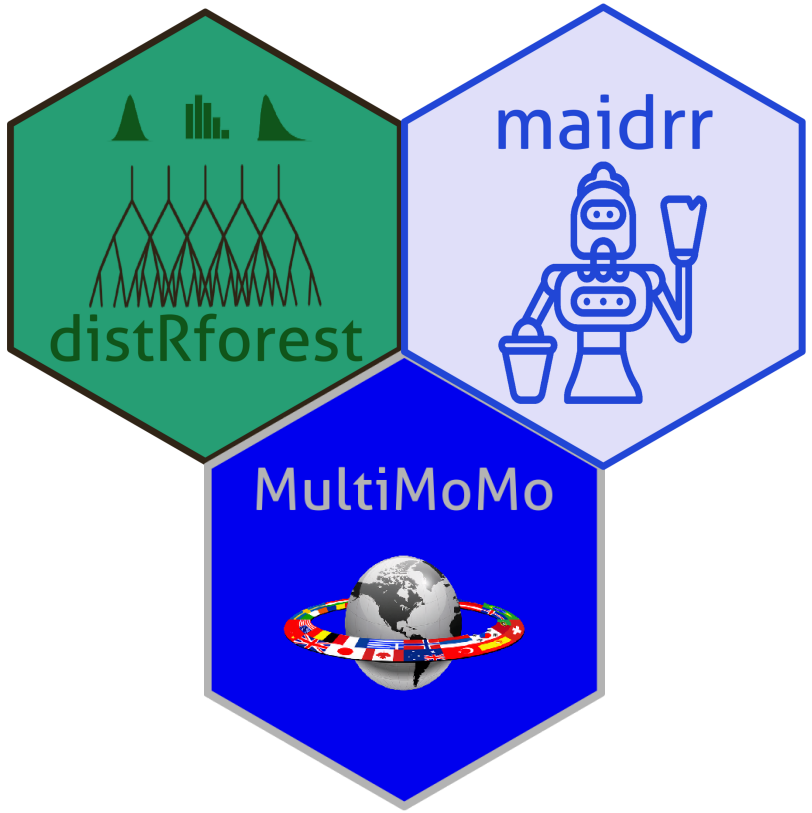
Date 2023-03-22

Description Implementation of the SMuRF algorithm of Devriendt et al. (2021) <doi:10.1016/j.insmatheco.2020.11.010> to fit generalized linear models (GLMs) with multiple types of predictors via regularized maximum likelihood.

```
require(hirem)
data("reserving_data")

model <- hirem(reserving_data %>% dplyr::filter(calendar_year <= 6)) %>%
  layer_glm('close', binomial(link = logit)) %>%
  layer_glm('payment', binomial(link = logit)) %>%
  layer_glm('size', Gamma(link = log),
            filter = function(data){data$payment == 1})

model <- fit(model,
             close = 'close ~ factor(development_year)',
             payment = 'payment ~ close + factor(development_year)',
             size = 'size ~ close + factor(development_year)')
```



LOOKING OVER THE HEDGE

Statistical Science
2022, Vol. 37, No. 3, 394–410
https://doi.org/10.1214/21-STS831

Modeling the Occurrence of Events Subject to a Reporting Delay via an EM Algorithm

Roel Verbelen, Katrien Antonio, Gerda Claeskens and Jonas Crevecoeur

ELSEVIER

European Journal of Operational Research
Volume 304, Issue 2, 16 January 2023, Pages 476-493

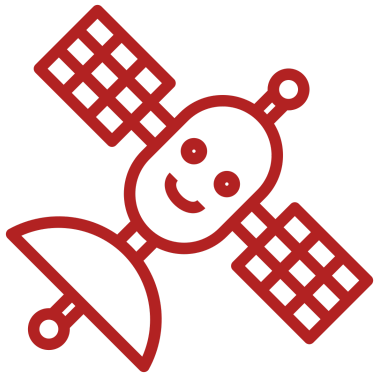
Production, Manufacturing, Transportation and Logistics

Empirical risk assessment of maintenance costs under full-service contracts

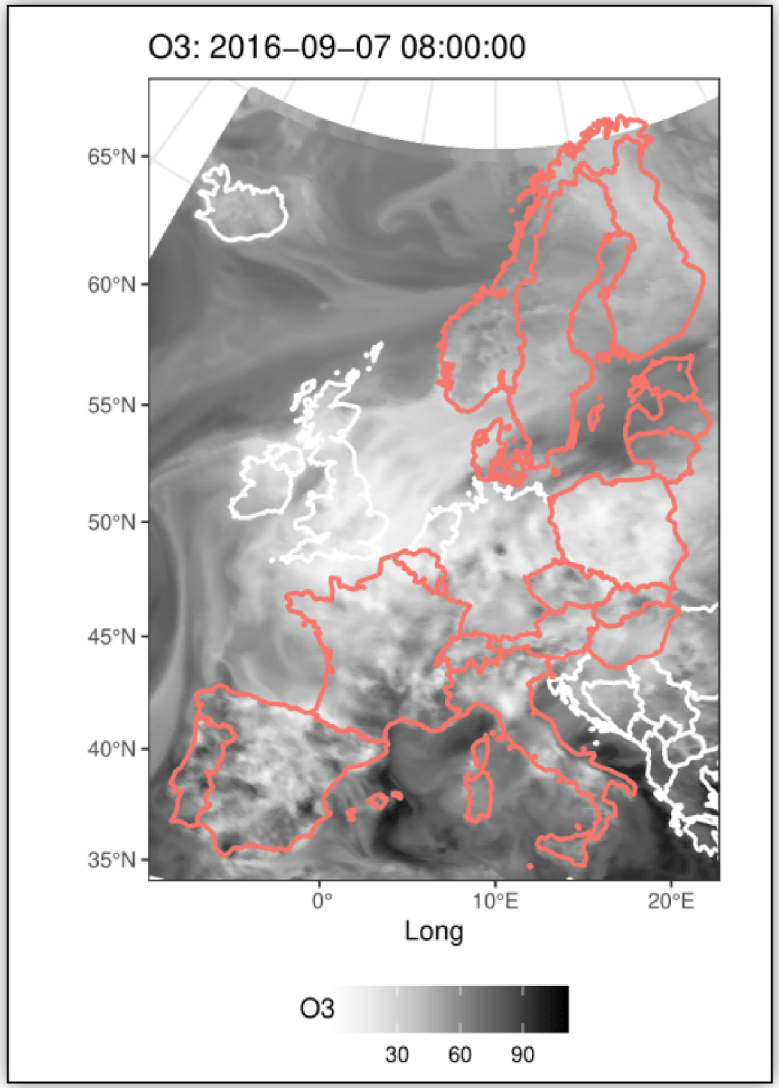
Laurens Deprez [a f], Katrien Antonio [b c g], Robert Boute [b d e g]

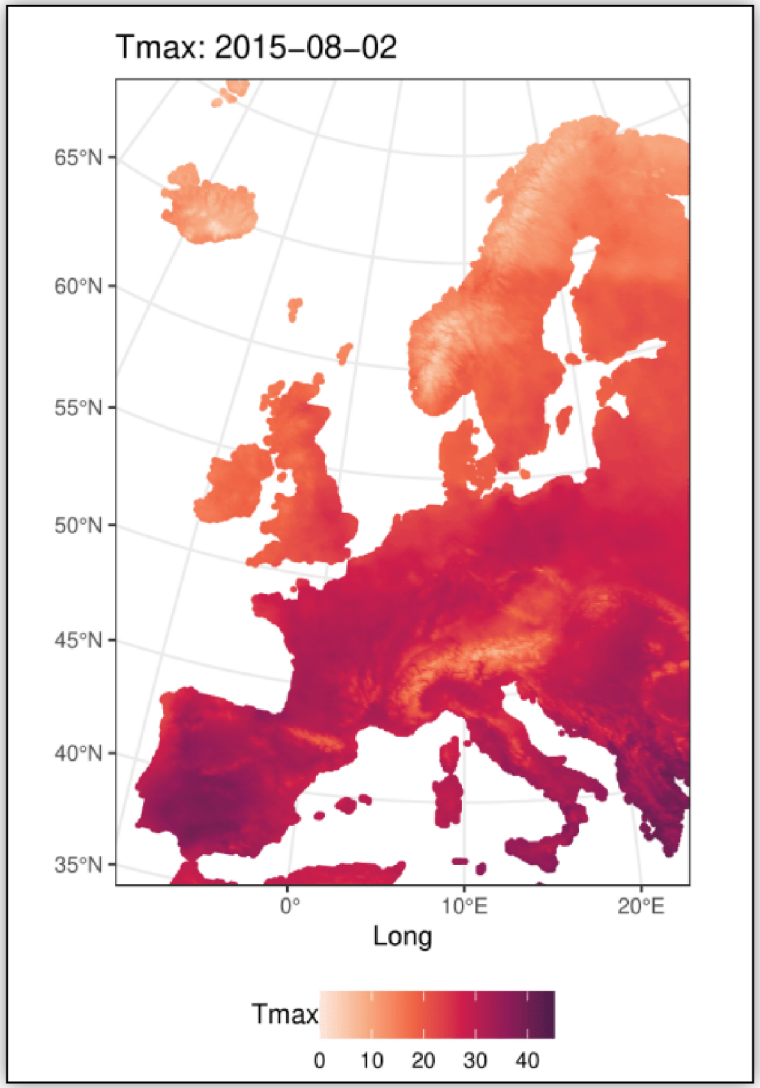
WHAT'S NEXT?

Inclusive insurance, including fairness concepts, survival analysis



Satellite data e.g., weather and environmental features





Robben, Antonio & Kleinow (2024, on arxiv). The short-term association between environmental variables and mortality: evidence from Europe.

LEARNING RESPONSIBLE ACTUARIES

RESPONSIBLE ACTUARIES LEARN

THANKS TO …