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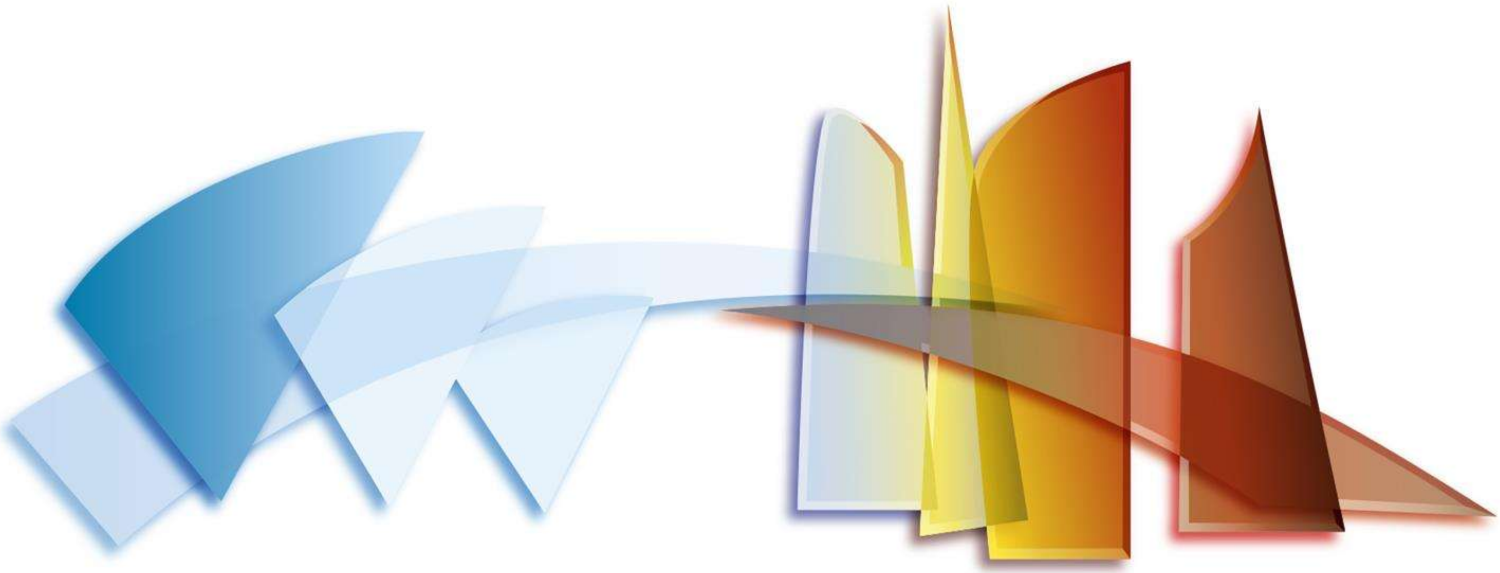

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Actuaries Institute Australia

IAA AAI International Actuarial Association Association Actuarielle Internationale

Jochen Kneiphof, Daniel König, Ina Kühnel,
Dr. Michael Schüte, Dr. Stefan Wetzel, Dr. Wiltrud Weidner

IMPACT OF THE COVID-19 PANDEMIC - MODELING AND FORECASTING USING AFFECTEDNESS VARIABLES

forecast

cause → effect

forecast

cause → effect

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Actuarial Questions

- Is this a simple level adjustment?
- Are there structural changes to the data?
- How can we derive a good forecast?
- How can we incorporate our expectation for the „new normal“?

Possible sources of trouble

- Segment specific changes
- Changes in the composition of the portfolio
- Changes to the shape of distributions
- Changes in the meaning of co-variables

Resulting problems

- Data might not be representative
- Data might not describe the risk correctly
  - in affected periods
  - in future periods
- Data cannot be used for prediction

The cause is missing!

Affectedness variables

Find variable → Apply to data → Modell using the variable → Predict using the variable

Affectedness variables

Find → Apply → Modell → Predict

- Variables, that could be used:
  - Should describe a probable cause for changes
  - Should be reasonably connected to the response
  - Should be predictable for themselves
  - Will at least be time-dependent

Affectedness variables

Find → Apply → Modell → Predict

- Add variable to exposure data:
  - Use time to match
  - and other information if applicable
- Caution: your data set will grow!

Affectedness variables

Find → Apply → Modell → Predict

- Modell using your favorite modell class
- Example GLM:

$$\eta = \beta_0 + \sum_i \beta_i x_i + \boldsymbol{\gamma a}$$

Affectedness variables

Find → Apply → Modell → Predict

- Predict future affectedness variable
- Insert prediction in modell
- Check with other method

Affectedness variables

It's not about Covid-19!

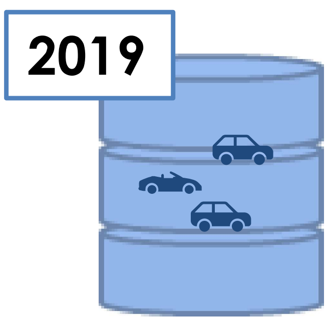
Find → Apply → Modell → Predict

Motor Insurance in Germany

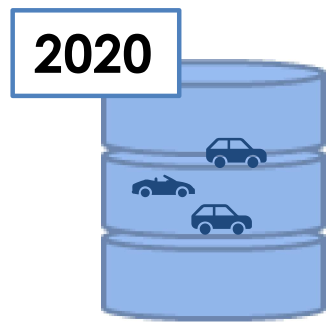
USE CASE

Use case: Motor Insurance in Germany

Extract from Gen Re motor insurance data pool



Pre-pandemic data



Affected by COVID-19

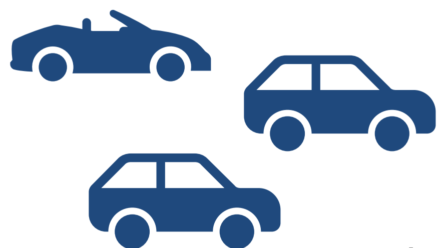
in each data set:

- 1 million data records
- ~700,000 vehicle years
- Claim frequency
- Claim date
- 9 commonly used covariates
- Start and end of policy

Potential affectedness variables

Use case: Motor Insurance in Germany

Daily new confirmed COVID-19 cases
(https://ourworldindata.org/coronavirus)

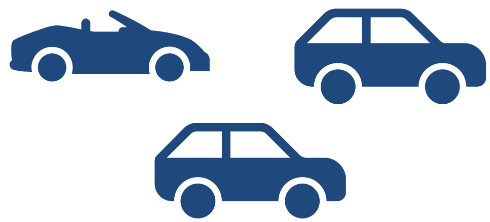


Stringency index
(https://ourworldindata.org/covid-stringency-index)

Mobility change based on mobile phone evaluations
(https://www.covid-19-mobility.org/)

Potential affectedness variables

Use case: Motor Insurance in Germany



Mobility change based on mobile phone evaluations (https://www.covid-19-mobility.org/)

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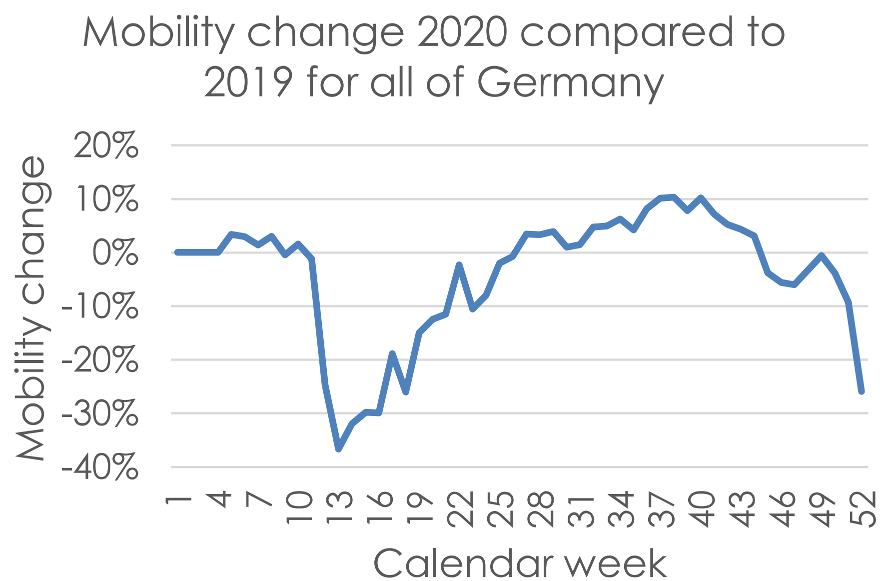
Mobility change

Use case: Motor Insurance in Germany

- **Daily** mobility change 2020 compared to **base values 2019**
- Differentiated according to **approx. 50 regions** in Germany
- Summarised to **weekly values** to avoid weekday effects

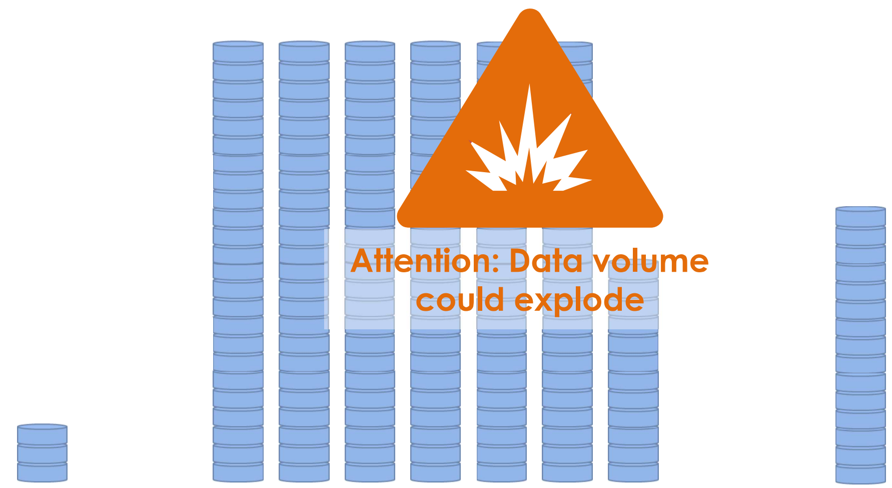


Mobility change

Use case: Motor Insurance in Germany

Data preparation:

- **Splitting** each data set into **n data sets**
- Trade-off between **granularity and size** of the 2020 database
- Ward **clustering** to group weeks of 2020



Original data

With Weekly Mobility Change

Clustered weeks

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Mobility change

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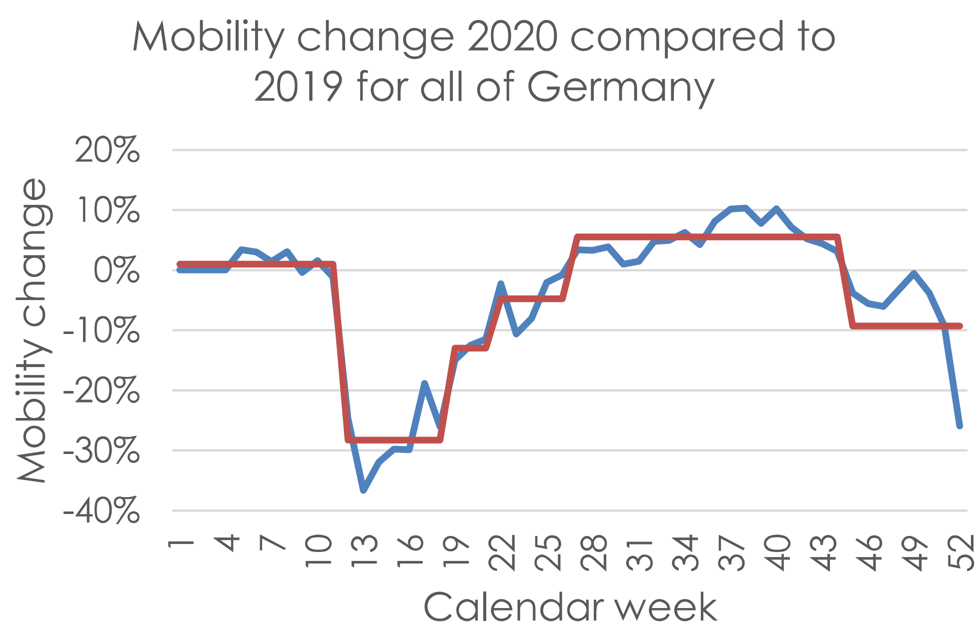

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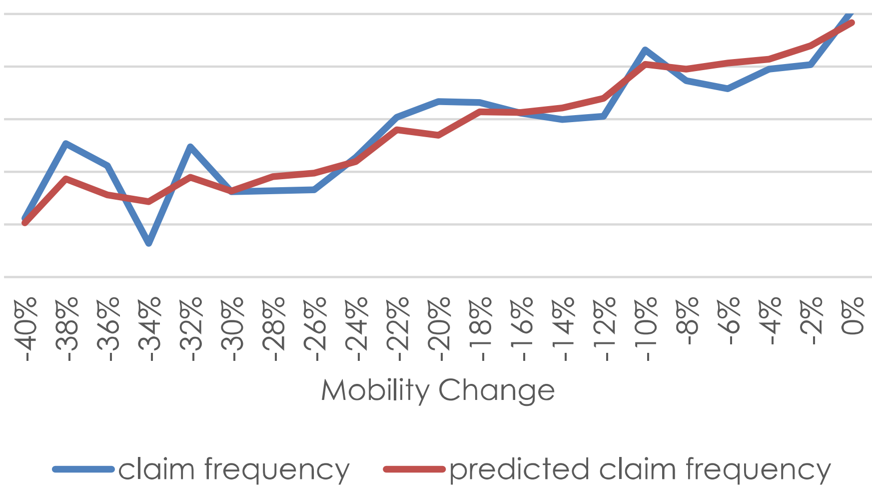
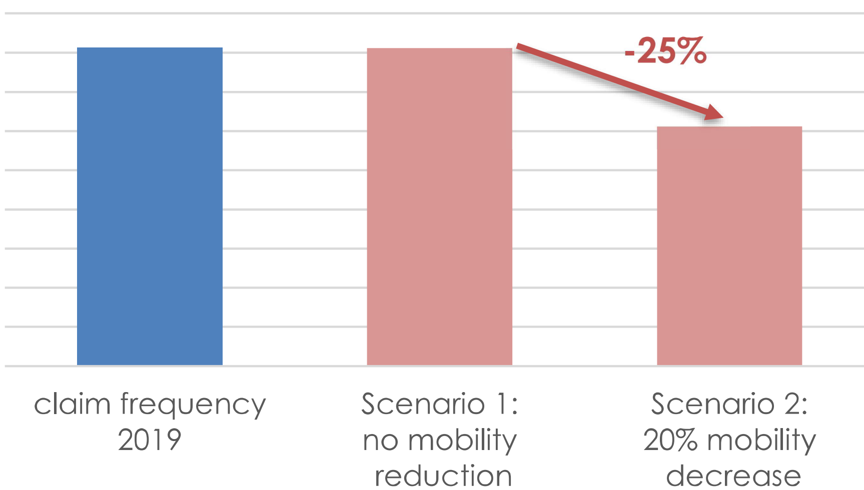
Modelling results

Use case: Motor Insurance in Germany

Empirical and predicted claim frequency on holdout data



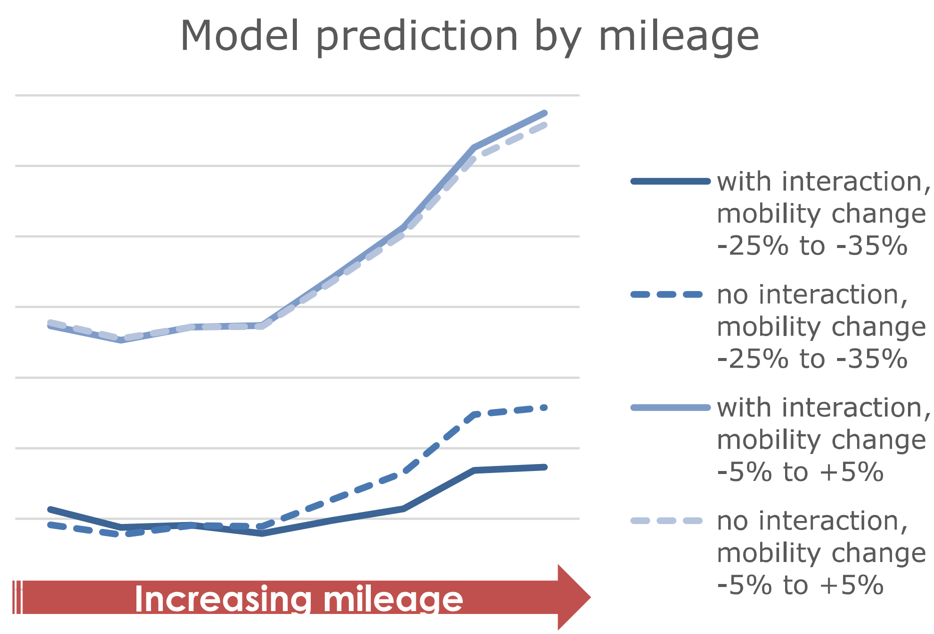
Prediction of claim frequency compared to 2019



Modelling results

Use case: Motor Insurance in Germany

- Effects of mobility on the feature **mileage**
- Modelled using GLM through **interactions** between mileage and mobility change



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Summary

- The **forecast after the pandemic** is crucial, not the description of the pandemic.
- It's a **new tool** in our actuarial toolbox, so **try it out and use it!**

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Thank you