



Cross-Country Mortality Modelling for Life Protection Insurance at Allianz

German Data Science
Days 2023

March 9, 2023



Who we are



Asmik Nalmpatian

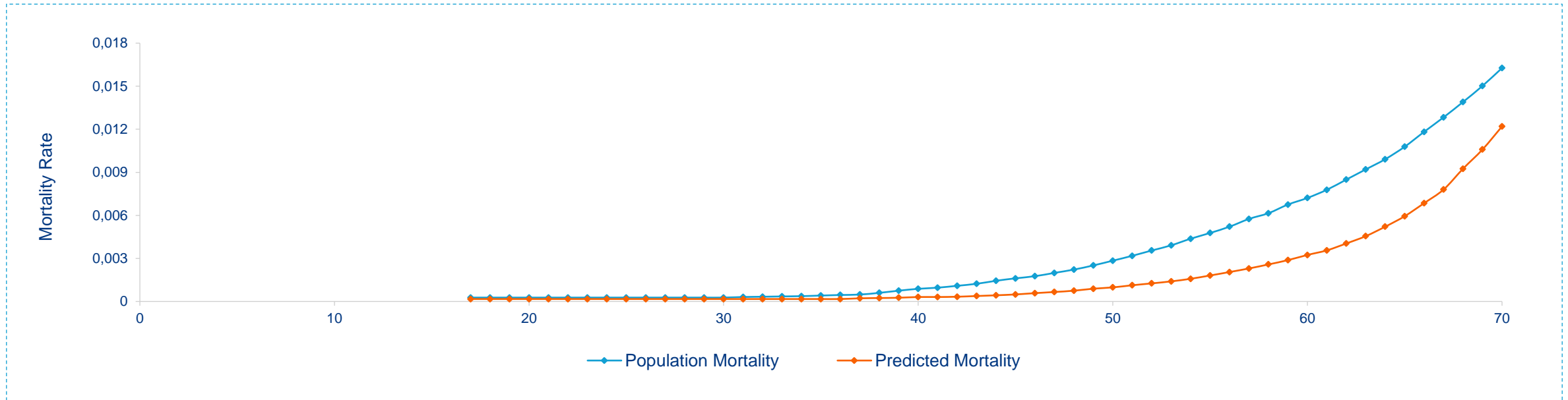
- Data scientist and Executive Assistant to Head of Group Data Analytics at Allianz SE
- Master of Science in Statistics, LMU
- Previous research expertise in interdisciplinary statistical consulting



Levent Alkaya

- Senior data scientist in Group Data Analytics at Allianz SE
- Master of science in Statistics, LMU
- 10+ years of experience in insurance industry

Motivation of the Global Data Sharing Project



- Successful pricing of life protection products relies on an accurate picture of the mortality of prospective customers, which differs significantly from the general population
- Insurance companies have historically segmented mortality estimates by age and gender, but even this is challenging if the insured population is small
- Segmenting further by e.g., Occupation Class, Sum assured etc., can give a company a better picture, but requires the right data to do so

Allianz has experience on mortality scattered around the world ...



... and only if all pieces are brought together,
we get a clear picture



Data from 8 different countries have been collected



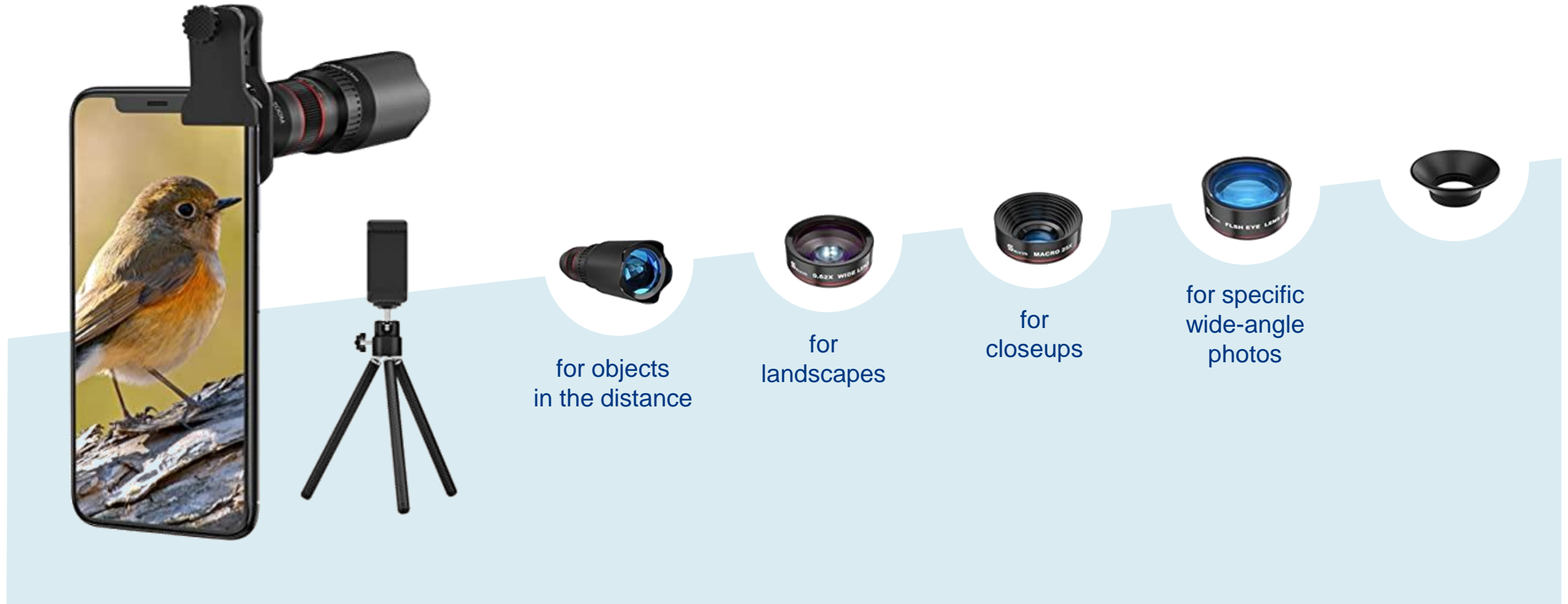
- Nearly 10mn life years of exposure and nearly 10k claims have been collected
- Covers risk factors beyond the basics of age and gender (e.g., occupation, sum assured)
- Data frame contains blocks of missing data:

| | Feature 1 | Feature 2 | ... | | | | | Feature p |
|-----------|-----------|-----------|-----|---------|---------|---------|---------|-----------|
| Country 1 | | | | | | | missing | |
| Country 2 | | | | | | missing | missing | missing |
| Country 3 | | | | missing | missing | | | |
| Country 4 | | | | | | | | missing |
| Country 5 | | | | | missing | | missing | missing |
| Country 6 | | | | | | missing | missing | missing |
| Country 7 | | | | | missing | | missing | |
| Country 8 | | | | | | | missing | missing |

Smartphones can take high quality pictures nowadays ...



... but taking the best pictures in every situation requires different specialized lenses



We can transfer this concept to the modeling of mortality by splitting into a global and multiple local models

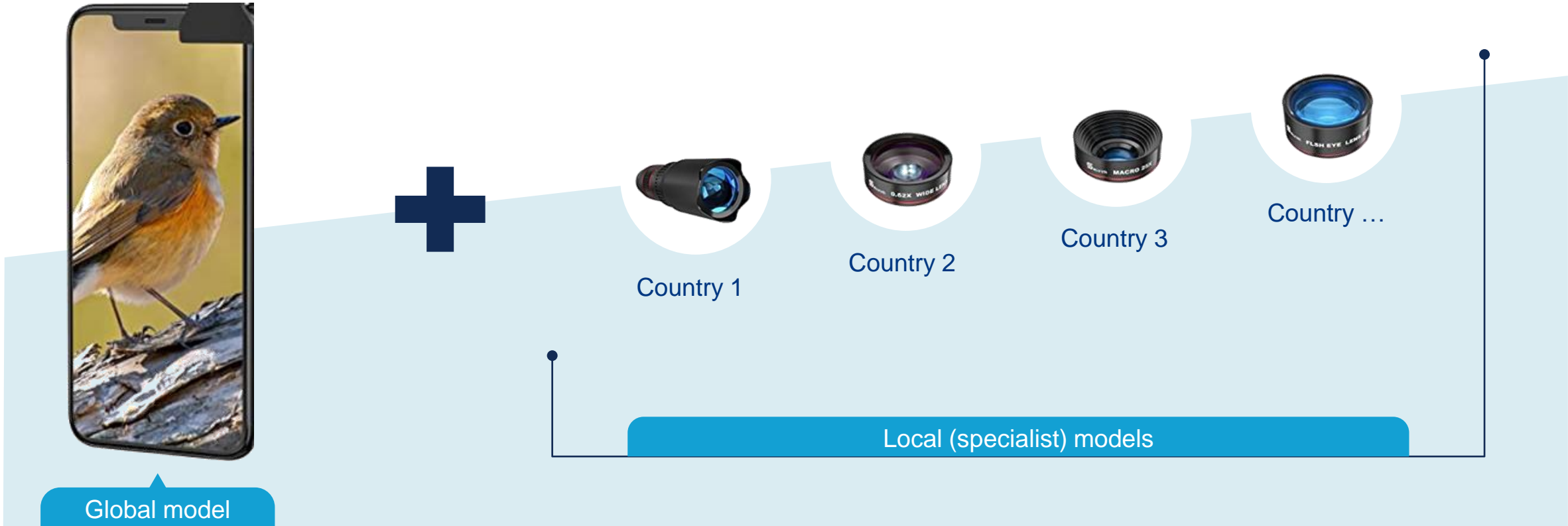


Image source: amazon

Mathematical description of the two-step modelling approach

$$y_i = f(x_i^{global}) \cdot h_j(x_i^{all}) \cdot t_i$$

- ▶ y_i : Number of deaths in group i
- ▶ $f(x)$: Global model
- ▶ $h_j(x)$: Local specialization model for country j
- ▶ t_i : Number of life years that was observed for group i

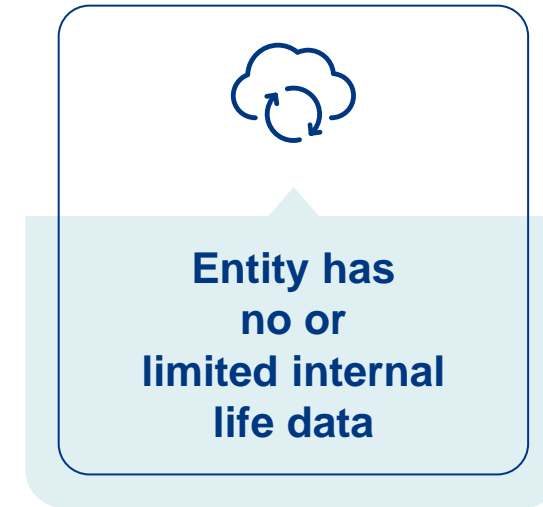
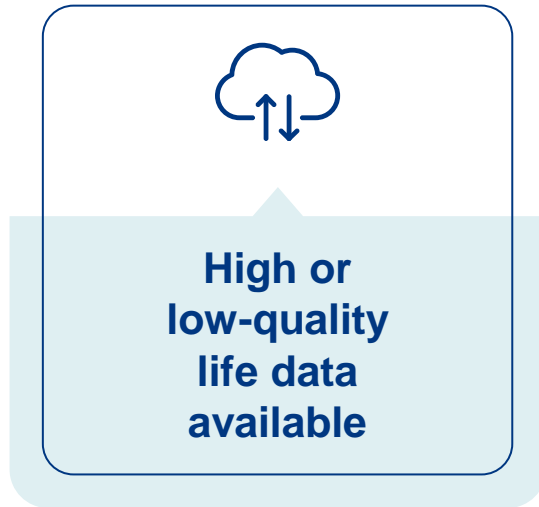
```
self. estimator. fit(  
    X=x,  
    y=y,  
    sample_weight=weight,  
    eval_metric=eval_metric,  
    init_score=np.log(self.abt.df.loc[self.abt.df.index.isin(x.index), "pred_step1"]),  
    verbose=self.abt.conf.get_verbose(),
```



Advantages of two step approach

- Allows distinction between „local“ features (e.g., geographical, UW or product information) and „global“ features (e.g., age, gender, occupation, ...)
- Calculation of models which are specialized on the different countries while at the same time including the global experience
- Incorporating new data from a single country does not change the other countries' results as only the specialist model has to be retrained

Smart Life Pricing approach ensures scalability across the globe



- In case of accepted data quality evaluation, the global model will be enriched. Otherwise only local retraining will be conducted
- High quality standards of the core model confirmed and aligned by the countries

- Smart life pricing approach identifies the most similar country based on life insurance and health(system)-related external data
- Overall population mortality data serve as a bridge to transfer our initial model to the new country with additional help of AI data augmentation

→ We can scale our pricing foundation to a new country regardless of data quality and availability

→ We support different levels of engagement and usage of our results

Building most similar country index



Insurance Statistics from OECD

Performance indicators for life insurance

Life insurance **share of the total insurance market**

Density: Ratio of life insurance premiums to whole population

Penetration: Level of development of life insurance sector in a country

Total gross premiums (life)

Retention rate



Selected dimensions of the Country similarity index

Variance in Entitlements

Health care (The health index)

Retirement pension (Minimum Pensionable Age for Men?)

Infrastructure by country

Medical doctors

Hospital beds

Basic health care access

Healthcare Funding

Risk of catastrophic expenditure for surgical care



Overall population mortality from HMD

Age- and gender specific mortality rates

Our models' insights can be used in different ways

Our models' outcomes are a basis to support or challenge each Allianz entity's own data or the respective market data. This can be especially important in markets with limited data, or mature markets lacking data on new segments



Finally, they can be used without adjusting tariffs by targeting better risks in the sales process, thereby enhancing the overall profitability of the portfolio

Additionally, they allow an Allianz entity to identify potential new segments beyond age and gender

Thank you!

