

# GENERAL and GEOGRAPHICAL RISK FACTORS in HEALTH INSURANCE

H2020 SOCIETAL CHALLENGES: Health, demographic change and wellbeing

PRODUCTIVE SECTOR: Insurance

## PROBLEM DESCRIPTION

The change from fixed amount to service covering health insurances needs to be supported by **exploring risk factors and groups** on the basis of legally permissible, readily available, inexpensive and accurate data, covering the whole country.

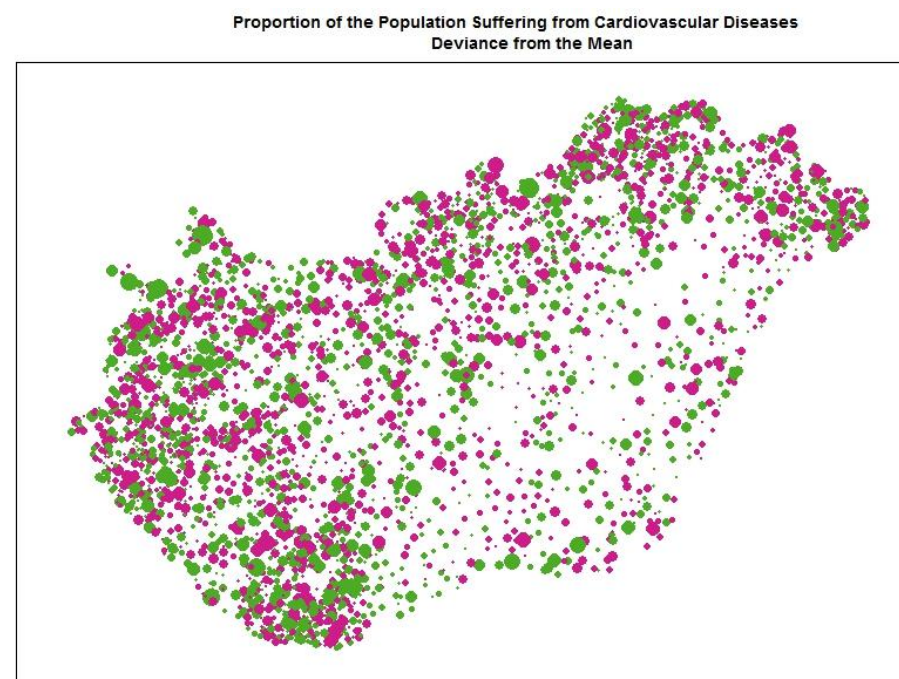
## CHALLENGES AND GOALS

- Specification of a few universal risk classes are needed for transparency of premium calculation, while no segmentation of disease incidence data is available by population or location attributes.
- Risk, changing with age cohorts and the spatial deviation of predicted and observed risk are of special concern for the company.

## MATHEMATICAL AND COMPUTATIONAL METHODS

In a transformed Poisson/quasi-Poisson generalized linear model the disease incidence intensities are additive on population related, and multiplicative on supplementary risk factor data.

The direct estimation by generalized linear model is analytically intractable, instead, consecutive split is applied by conditional likelihood that is not available in literature, and is derived in the current study. Implementation and R code is also elaborated.



Proportion of the population suffering from cardiovascular diseases. Deviances from the mean are displayed. Bubble sizes are proportional to the magnitude of deviance.

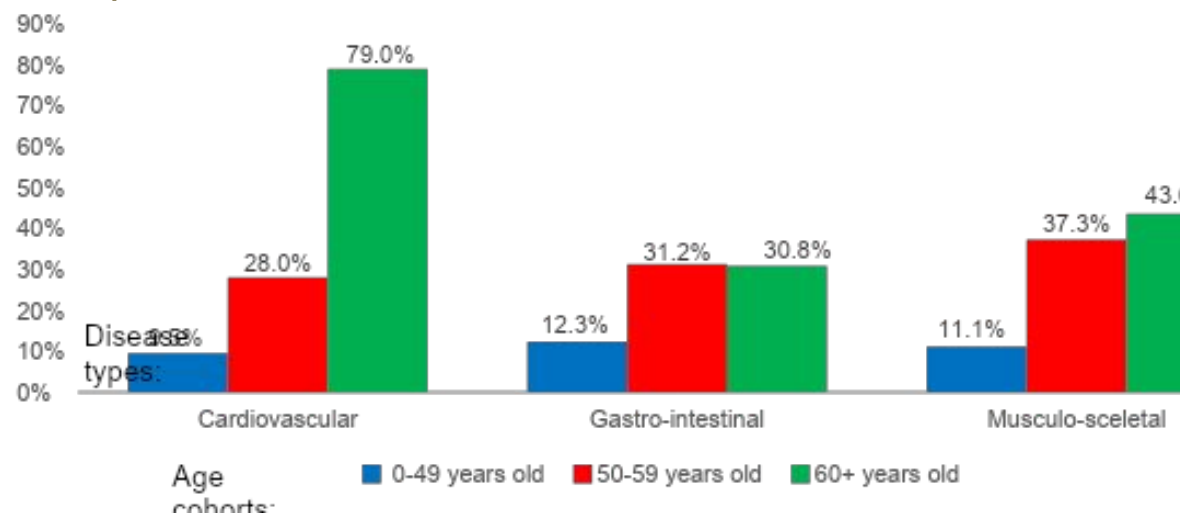
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## Results and Benefits

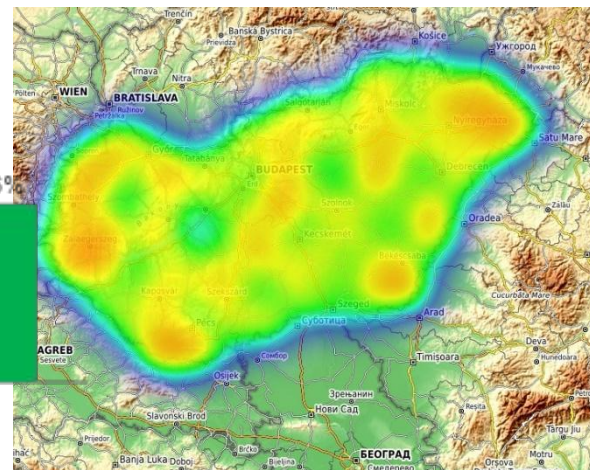
Age is significant for gastro-intestinal and musculo-skeletal disease groups and particularly so for cardiovascular diseases. Further significant factors are income, divorce and ammonium contamination in drink-water. Nitrate contamination of drink-water is significant in decreasing the cardiovascular risk.

A remaining spatial risk component is signified by a map of deviance of predicted risk from risk factors and estimated risk from incidence data.

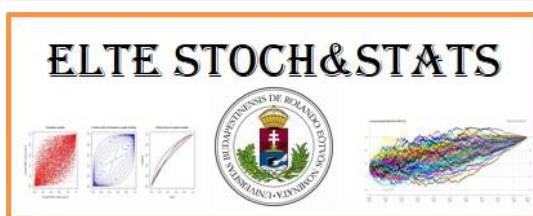
The company becomes capable of creating homogeneous hazard groups and hence, can compute more competitive premiums and acquire less risky clients.



Percentage of age cohorts affected by disease groups.



Spatial distribution of deviance of predicted and estimated risk.



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