

# NMFM402 – Mathematics of Non-Life Insurance 2

## Simple tariffication methods

## Practical 1

To review the necessary theory for this practicals, you may check the lecture notes [1], Chapter 7 (Tariffication with Regression Models), namely sub-chapters 7.1 Pricing of heterogeneous insurance portfolios, 7.2 Simple tariffication methods, and 7.3 Log-normal approximation.

### Exercise 1 (cf. Exercise 21 in [1]):

Consider the total claim amounts ( $S_{i,j}$ ) sorted into the table below according to the risk classes of the two risk factors (vehicle type and driver age).

	21-30y	31-40y	41-50y	51-60y
passenger car	2000	1800	1500	1600
delivery van	2200	1600	1400	1400
truck	2500	2000	1700	1600

Assume (for simplicity) unit volumes  $v_{i,j} = 1$  for each  $i, j$  and consider multiplicative tariff structure.

- Write down the minimization function for the method of Bailey & Simon. Use a software (of your own choice) to solve the minimization problem and find corresponding tariff factors  $\mu$ ,  $\chi_{1,i}$  and  $\chi_{2,j}$ . Determine the resulting tariffs for each class.
- Write down the system of equation for the method of total marginal sums (method of Bailey & Jung). Solve this system numerically in a software (of your own choice). Determine the resulting tariffs for each class.
- Determine the design matrix  $Z$  of the log-linear Gaussian regression model. Using an appropriate software (for example R) calculate the tariffs using the MLE method within the log-linear Gaussian regression model framework.
- Compare the resulting tariffs from parts (a), (b) and (c). Which vehicle type is the least risky? Which age group of the driver is the most risky?

## Reference

- [1] M. W. Wuthrich *Non-Life Insurance: Mathematics and Statistics*. Lecture Notes. Version December 17, 2020. Available online at: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2319328](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2319328)