

NMFM402 – Mathematics of Non-Life Insurance 2

GLM 3 - multiplicative tariff structure

Practical 4

To review the necessary theory for this practicals, you may check the lecture notes on Moodle, [1], Chapter 2.3. For further reading, see [2], Chapters 2 and 3.

Exercise 1:

In statistics, increasing number of observation (data) typically improves accuracy of estimates of unknown parameter. Consider the Poisson model for claim frequency (see 2.3.1. in [1]). Assume that the number of policies in each risk class multiplies K -times, with number of claims per policy in each class being unchanged. Determine the approximate effect of this change on the variance of the estimators

- (a) of parameters β_k
- (b) of multiplicative risk factors $\exp \beta_k$
- (c) of the expected number of claims per policy $\mathbb{E}Y_m$ in the m -th risk class.

Exercise 2:

Recall Exercise 1 from Practical 1: Consider the 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 exposition, i.e. number of claims are $v_{i,j} = 1$. Determine average claim amount for each risk class using GLM methodology with

- (a) Gamma error distribution and logarithmic link function.
- (b) Gamma error distribution and canonical link function (the inverse function).
- (c) Normal error distribution and logarithmic link function.
- (d) Normal error distribution and canonical link function (the identity function).
- (e) Inverse Gaussian error distribution and logarithmic link function.
- (f) Inverse Gaussian error distribution and canonical link function (the function $1/\mu^2$).

Compare the results of individual models. Add comparison also to the simple tariffication methods from Practical 1.

Reference

- [1] L. Mazurová *Mathematics of Non-life Insurance 2 - lecture notes*. Version March 2021. Available online at Moodle: https://dl1.cuni.cz/pluginfile.php/1162656/mod_resource/content/2/MNP2LectureNotes.pdf

- [2] E. Ohlsson, B. Johansson: *Non-Life Insurance Pricing with Generalized Linear Models*, 15 EAA Lecture Notes, DOI 10.1007/978-3-642-10791-7_2, Springer-Verlag Berlin Heidelberg, 2010