

NMFM402 – Mathematics of Non-Life Insurance 2

GLM 2 - parameter estimation

Practical 3

To review the necessary theory for this practicals, you may check the lecture notes on Moodle, [1], Chapters 2.1. and 2.2 (GLM - introduction and estimation of parameters). For further reading, see [2], Chapters 2 and 3.

Exercise 1:

Consider a GLM with dependent variables having Poisson distribution and with logarithmic link function (see Exercise 2 in Practical 2).

- (a) Write the update rule for Newton-Raphson algorithm applied directly to the equations for MLE derived in Ex 2. (c) in Practical 2.
- (b) Write the update rule for Newton-Raphson algorithm using formulas in lecture notes [1], Chapter 2.2.
- (c) Write the update rule for Fisher method of scores.

Exercise 2:

In file "data.csv" you find artificial data ($n = 40$ observations) generated from a GLM from Exercise 1 with Poisson distribution, logarithmic link function and simple linear predictor $\beta_0 + \beta_1 x$. Implement the Newton-Raphson algorithm from Exercise 1. Start with initial guess $\beta_0 = 0, \beta_1 = 0$ and calculate 20 iterations. Did the algorithm converge? What are the final estimates of β_0 and β_1 ? Compare it with the true values (used when simulating the data) $\beta_0 = 1, \beta_1 = 1$. Visualize the convergence of the algorithm and the true value of the parameters.

Reference

- [1] L. Mazurová *Mathematics of Non-life Insurance 2 - lecture notes*. Version March 2021. Available online at Moodle: https://dll.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