Bayesian credibility methods for pricing non-life insurance on individual claims history

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Abstract

Claim frequencies in non-life insurance are typically modelled using generalised linear models (GLMs), making the assumption that all insurance policies with the same covariates have homogeneous risk. It is known in the insurance industry that there remains a relatively large heterogeneity between policies in the same tariff cell. Credibility theory is the study of how best to combine the collective prediction for a tariff cell with the experienced claim frequency of an individual policy, in order to obtain a more accurate policy-level prediction. In this thesis, we consider a credibility model in the form of a generalised linear mixed model (GLMM) which includes a random intercept for each policy, allowing us to model the correlation between repeated observations of the same policies. We compare this GLMM with a corresponding GLM which lacks the per-policy random intercepts. The claim frequency models are evaluated in the setting of third party liability (TPL) motor insurance, using a representative data set from the Swedish insurance company Trygg Hansa. The models are estimated under the Bayesian paradigm, using Markov Chain Monte Carlo methods. The main aim of the thesis is to determine whether the predictive performance of the GLMM model is better than that of the GLM model. Due to the use of Bayesian inference, the predictions obtained are not point predictions, but full posterior predictive distributions. This allows the use of proper scoring rules to evaluate and compare the predictive performance of the models. Using a panel of comparison metrics, we find that the GLMM model with per-policy random intercepts outperforms the reference GLM model, making it an attractive option for use in non-life insurance pricing. The thesis also contains a discussion on the computational difficulties encountered, and a brief overview of possible future extensions of the GLMM model.

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