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On distribution-free reserving and partial information

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Abstract

A constructive distribution-free discrete-time micro model is introduced which shares the key properties of the models introduced in Verrall et al. (2010) and Wahl et al. (2019), including multiple payments per claim and separate RBNS and IBNR reserves. The introduced model class may be thought of as a sequence of two-stage conditional linear models with general variance structure. The models are distribution-free in the sense that they only rely on assumptions made on the dependence structure and the first two moments. For this model class it is possible to explicitly compute theoretical reserve predictors as well as their process variances. Moreover, the introduced model class is possible to define in terms of differently detailed information, and depending on the information available at hand, model parameters may be fitted using least square (LS) techniques or the generalised method of moments (GMM) making all computable reserve predictors, i.e. the theoretical predictor combined with actual parameter estimators, unbiased. In particular, if one assumes that detailed data include count and payment data where one keeps track of both time of reporting and time of payments for individual claims it is possible to analytically show that the variation of the computable reserve predictors always will be larger when using parameter estimators based on reduced information. This relation can also be shown to hold for the analytical mean squared error approximation estimate introduced in Lindholm et al. (2018). Furthermore, due to the linear structure of the introduced model class it is easy to construct bootstrap algorithms based on classical Pearson residuals.

The results are illustrated in a simulation study, which, in particular, highlights that it is the covariance structure and dispersion parameter estimates when using reduced information that is the likely cause of increase of the prediction error. It is also seen that the analytical MSEP-estimates are of comparable size as to the corresponding bootstrapped ones.

Keywords: Distribution-free linear models; Generalised least squares; Estimation error; Prediction error

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