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Reserve Risk Modelling under Solvency II: Established Models and a Gradient Boosting Approach

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Abstract

Under the Solvency II framework, insurers are required to hold capital equal to the 99.5% Value-at-Risk (VaR) of their one-year loss distribution, with reserve risk representing a key component. This study compares several models for estimating reserve risk. A bootstrap one-year risk framework is applied to established stochastic reserving models, including the Mack model under different distributional assumptions and the Over-Dispersed Poisson (ODP) model, as well as to a machine-learning extension of the ODP model based on a Gradient Boosting Machine (GBM). All models are evaluated using synthetic claims data generated for several Lines of Business (LoBs).

The results reveal clear differences across models. For some LoBs, the GBM-ODP model produces narrower loss distributions and lower VaR estimates, whereas the Mack models yield more conservative results, with the ODP model positioned between them. Although the results suggest potential advantages of the GBM-ODP model in terms of both accuracy and capital efficiency, certain results indicate a need for further analysis to improve robustness in reserve risk applications.

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