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Micro-Level Loss Reserving Models for Insurance

Xiaoli Jin

University of Wisconsin-Madison, USA; xjin22@wisc.edu

Accurate loss reserves are essential for insurers to maintain adequate capital and to efficiently price their insurance products. Loss reserving for Property & Casualty insurance is usually based on macro-level models with aggregate data in a run-off triangle. The macro-level models may generate material errors in the reserve estimates when assumptions underlying the estimates evolve over time in an unanticipated way. In recent years, a small set of literature has proposed reserving models that use underlying individual claims data to estimate outstanding liabilities based on individual claim level information, analogous to approaches used in the life insurance industry. These models are referred to as ``micro-level models''.

In this study, I implement a micro-level model on a portfolio of workers compensation claims from a large U.S. P&C insurer. The model has a hierarchical structure with five blocks, each modeling an aspect of the claim development process, including claim occurrence, reporting delay, transaction occurrence, transaction type and payment amount. The model is calibrated with historical data and used to project the future development of open claims. Macro-level models are performed for comparison. The performance of models is evaluated through an out-of-sample validation. For actuaries responsible for setting reserves, this study demonstrates how to implement micro-level models in practice and the benefits that one receives from them.