A Copula Model for Marked Point Process with A Terminal Event: An Application in Dynamic Prediction of Insurance Claims

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Abstract

Accurate prediction of an insurer's outstanding liabilities is crucial for maintaining the financial health of the insurance sector. We aim to develop a statistical model for insurers to dynamically forecast unpaid losses by leveraging the granular transaction data on individual claims. The liability cash flow from a single insurance claim is determined by an event process that describes the recurrences of payments, a payment process that generates a sequence of payment amounts, and a settlement process that terminates both the event and payment processes. More importantly, the three components are dependent on one another, which enables the dynamic prediction of an insurer's outstanding liability. We introduce a copula-based point process framework to model the recurrent events of payment transactions from an insurance claim, where the longitudinal payment amounts and the time-to-settlement outcome are formulated as the marks and the terminal event of the counting process, respectively. The dependencies among the three components are characterized using the method of pair copula constructions. We further develop a stage-wise strategy for parameter estimation and illustrate its desirable properties with numerical experiments.

In the application, we consider a portfolio of property insurance claims for building and contents coverage obtained from a commercial property insurance provider, where we find intriguing dependence patterns among the three components. The superior dynamic prediction performance of the proposed joint model enhances the insurer's decision making in claims reserving and risk financing operations.

Keywords: Conditional copula, Joint model, Lifecyle of insurance claims, Longitudinal and survival outcomes

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