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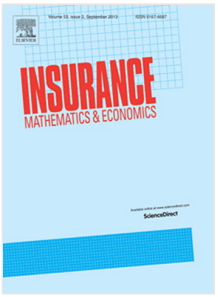

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On multivariate discounted compound renewal sums with time-dependent claims in the presence of reporting/payment delays

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Abstract

In this paper, we consider an insurance portfolio containing several types of policies which may simultaneously face claims arising from the same catastrophe. A renewal counting process for the number of events causing claims and multivariate claim severities which are dependent on the occurrence time and/or the delay in reporting or payment are assumed. A unified model is proposed to study the time-dependent loss quantities such as the discounted aggregate reported/unreported claims and the number of the incurred but not reported (IBNR) claims. We then derive the joint moments of (i) different types of discounted aggregate claims until time t; and (ii) different types of discounted aggregate reported/unreported claims (including the total numbers of IBNR as special case) until time t. Finally, some numerical examples involving covariances and correlations of the aforementioned quantities are provided.

Keywords: Multiline insurance; Renewal process; Multivariate distribution; Discounted aggregate claim costs; Reported/Unreported claims; IBNR claims; Joint moments; Covariance; Correlation.

1 Introduction

Aggregation of dependent risks in multiline insurance has attracted considerable attention in the actuarial industry. For example, different types of damages of property or casualty could be induced by the same catastrophic event such as flooding or earthquake in non-life insurance, whereas the deaths of a couple can be the result of a common accident in life insurance. Risk modeling in such cases requires the construction of multivariate probability distributions (e.g. multivariate normal distribution by Panjer (2002), multivariate Tweedie distribution by Furman and Landsman (2010), and multivariate Pareto distribution by Chiragiev and Landsman (2007) and Asimit et al. (2010)) or copulas (e.g. Joe (1997), Archimedean copula in Alink et al. (2005), Farlie-Gumbel-Morgenstern copula with mixed Erlang marginals in Cossette et al. (2013)). Similar to the class of multivariate phase-type (MPH) distributions, which has a number of nice properties and applications (e.g. Assaf et al. (1984), Kulkarni (1989), Cai and Li (2005a,b)), there are various useful results for the class of multivariate Erlang mixtures (e.g. Lee and Lin (2012), Willmot and Woo (2015)).

However, modeling aggregate losses of multiline (re)insurance in the presence of dependencies not only across policies or business lines but also on their incurral times is more complicated and challenging. It requires special attention to adequately reflect the association between stochastic assumption on the number of events causing losses and multivariate assumption on the claim amounts. For one

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