Ruin probabilities in multivariate risk models with periodic common shock

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Abstract

In an insurance company, for a given portfolio of insurance policies of different types such as health, automobile, or house insurance, it is advantageous to have an accurate forecast of the expected liability of these policies. In practice, there are situations in which the assumption of independent policies is not verified. Therefore, it is desirable to develop models which assume that different policies are dependent in order to increase the accuracy of the estimation of the costs associated to different policies.

We assume that an insurance company has m different classes of insurance business allowing for dependence between claim sizes and dependence among the numbers of claims across classes. As a method to model the dependence between the number of claims, we consider that the common shock which affects all classes of business is arriving according to a non-homogeneous periodic Poisson process. The reason of considering the common shock as a non-homogeneous periodic Poisson process is due to the fact that events such as hurricanes, tornadoes appear with some periodicity, specific to some seasons during the year term, which may cause claims on all types of insurance classes.

In this multivariate setting, we derive upper bounds of Lundberg-type for the probability that ruin occurs in all classes simultaneously. These results are numerically illustrated in a bivariate risk model considering special cases for the periodic claim intensity function. Assuming dependent heavy-tailed claims, asymptotic estimates for the finite-time ruin probabilities associated to three types of ruin in this multivariate framework are also obtained.