

INSA de Toulouse
 Département GMM
 BE - Processus de Poisson et Application en actuariat et fiabilité - 5 ModIA
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Use of Hawkes processes in a Cramér-Lundberg type model

Keywords : insurance, Hawkes processes, thinning method

Context of the project

The main goal of this project is to study a modification of the Cramér-Lundberg model where the counting process is a so-called Hawkes process. More precisely, recall the classical Cramér-Lundberg model for modelling the risk process (wealth) as :

$$R_t = u + ct - \sum_{i=1}^{N_t} Y_i, \quad t \geq 0. \quad (1)$$

In this model it is assumed that the claim sizes Y_i 's and the counting process N are independent. In addition, the counting process has a constant intensity. However, in some practical situations, this last feature is not completely realistic. For instance, one main issue lies in the fact that for some contracts, the arrival of a claim increases the probability that another claim will occur shortly after. This property is captured by so-called "self-exciting" Poisson process such as the Hawkes process which has initially been introduced for modelling the arrival of earthquakes.

The main purpose of this project is to study a model of the form (1) where N is a Hawkes process (this process will be defined in [1]) both on a theoretical and on a numerical side, and to analyse the impact of such a model on the premium compared to the classical model.

Work to be performed

The work asked to the students goes in two different directions.

Theoretical results

First it is asked to the students to understand the model and the definition of a Hawkes process. Usually, it is quite difficult to obtain formulas for deriving the expression of the premium, so only some properties of the Hawkes process itself will be studied.

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Numerical results

The second types of results is to perform numerical simulations for the premium in this model (using the thinning method, see for instance [1]). It will asked to compare them with the one obtained in the classical Cramér-Lundberg model. The numerical simulations, will be presented in a Notebook Python (only).

References

- [1] Y. Chen. Thinning algorithms for simulating point processes, 2016.