INSA de Toulouse
Département GMM
BE - Processus de Poisson et Application en actuariat et fiabilité - 4 GMM
Encadrant: Anthony Réveillac[1]

# 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 :

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

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 be 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 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 quit difficult to obtain formulas for deriving the expression of the premium, so only some properties of the Hawkes process itself will be studied.

[1] anthony.reveillac@insa-toulouse.fr, Bureau 111 (Bâtiment GMM)

### 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.