Mini-project 2

Predicting insurance claim aggregates during a policy period

Synopsis

Modelling insurance claims using a compound probability distribution

A certain insurance company is interested in predicting the total aggregate of all claims made during a fixed policy period from a portfolio of insurance products. Such an exercise will enable the company to make an assessment of its financial risks while charting out product launch schedules for the upcoming financial year.

A consultant to the company designs the following mathematical model to accomplish this task. Consider that the firm expects a certain number (N) of claims, from amongst its clients, during a fixed period. Since there is no reason for this number N to be deterministically computable,[1] it is reasonable to assume N to be a random variable. Now there are N of these claims, each claim amount is independent of the other and is also independent of N. This is also reasonable because each claim is made by a different client acting independent of the other. Further, each claim amount is also a random number which possibly corresponds to a common probability distribution. Let the claim amount by the i^{th} client be denoted by X_i. X_i corresponds to a probability distribution function $F_X(x)$. The aggregate claim for the policy period under consideration is also a random quantity

$$Y = X_1 + X_2 + X_3 + \cdots X_N = \sum_{i=1}^{N} X_i$$

that obeys a compound probability distribution. Based on this model, a quantity of interest to the insurance firm is $E(Y)$ that you as the consultant will have to estimate in this project.

Moreover, consider there are four policy periods in a given financial year. The total premium collected at the beginning of the year by the insurance firm is $\$\ m$. Let λ be the rate at which claims are received per policy period. Now consider Y_k is the aggregate claim at the end of the k^{th} policy period, where $k = 1,2,3,4$. The company incurs a loss if $Y_4 > \$\ m$. In this project, you will simulate a certain compound stochastic process in Matlab and compute the associated risk for the insurance firm in terms of a probability $P(Y_4 > \$\ m)$. Concurrently, you will learn about a composite stochastic model known as the compound Poisson process that is used by insurance companies to assess their risks. Before we urge the readers to work on this aforementioned project, let us first learn some of the essential and fundamental elements of probability distributions.

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[1] A multitude of external factors may determine the value of N. The complex inter-relationship between these factors may further enhance the uncertainty in knowing what the exact value of N might be.