Mortality Modelling with Lévy Processes: A Cox Process with Leptokurtic Intensity

Hong-Chih Huang
Chou-Wen Wang
I-Chien Liu

Abstract

According to the mortality data of four countries, Finland, France, Italy and the Netherlands, we find that the residuals of mortality model do not follow the normal distribution and have the leptokurtic property. This paper therefore assumes that the number of deaths follows a Cox process, also known as a doubly stochastic Poisson process with leptokurtic stochastic intensity to investigate possible improvements of the Renshaw and Haberman (2006) model. This paper provides an iterative fitting algorithm to generate maximum likelihood estimates under the Cox regression model and employs the non-Gaussian distributions—Jump Diffusion distribution (JD), Variance Gamma (VG) and Normal Inverse Gaussian (NIG) distributions—to model the error terms of the Renshaw and Haberman (2006) model. With mortality data of the four countries over the period 1900–2007, both in-sample model selection criteria (e.g., Bayesian information criterion, Kolmogorov-Smirnov test, Anderson-Darling test, Cramér-von-Mises test) and out-of-sample projection errors indicate a preference for modeling the Renshaw and Haberman (2006) model with non-Gaussian innovations.

Keywords: Stochastic mortality model; Cox process; Lévy processes; Mortality jumps.