Stochastic Mortality Modeling: a frailty-based approach

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Mortality projections have become one of the major issue in insurance industries, in particular in life insurance and pension fund. In literature several stochastic models have been developed, varying significantly according to a number of key elements: number of sources of randomness driving mortality improvements at different ages; assumptions of smoothness in the age and period dimensions; inclusion or not of cohort effects; estimation method and so on. Systematic mortality improvement trends vary with the risk characteristics of individuals in a population (including by age and gender) and this variation determines the degree of mortality heterogeneity within a population (Vaupel et al. 1979, Meyricke et al. 2013). Further, some authors have shown that population heterogeneity can impact on population dynamics and on aggregate mortality trends (Kakai et al. 2019). Frailty has been identified as an important latent factor underpinning the evolution of mortality rates, determining the heterogeneity in mortality. Accordingly, we propose a stochastic mortality model that incorporates the trend in frailty based on the Lee Carter family of models. We propose several versions that consider frailty both as an age-dependent and a time-dependent factor and also combining the interaction effects of age and time in comparison with the general level of mortality. Finally, we analyse the gap between the actuarial evaluations of premiums and technical provisions calculated under frailty-based and traditional stochastic mortality models.