Experienced-Based Stochastic Mortality for Internal Models *

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Abstract

This paper is motivated by the need to evaluate mortality/longevity risks when performing an internal assessment of the life insurance business, such as a portfolio valuation or a solvency investigation based on internal models. The case of life annuities is in particular addressed.

We take the point of view of an insurer which aims at building up a (partial) internal model in order to quantify the impact of mortality/longevity risks in view of choosing appropriate risk management actions. We assume that a life table, providing a deterministic, best-estimate assessment of annuitants’ future mortality is available to the insurer. A stochastic mortality model calibrated on the best-estimate life table and the mortality experienced by the insurer’s portfolio is developed.

Mortality experience is first measured in terms of the annual number of deaths. We extend some classical results about the modeling of the number of deaths joint to the modeling of parameter uncertainty, working within a Poisson-Gamma setting. We define a Bayesian-inferential procedure for updating the parameters to experience; this way, the correlation in time among the mortality rates is implicitly accounted for. Then, we explore a possible extension of the model, measuring experience in terms of annual amounts. This way, we can also account implicitly for dependencies between the lifetime and the benefit amount.

The application of the model concerns capital allocation. We investigate the amount of the required capital for a given life annuity portfolio, based on solvency targets which could be adopted within internal models. The outcomes of such an investigation are compared with the capital required according to the Solvency 2 standard rule for the longevity risk.

Keywords: Life annuities, Process risk, Aggregate mortality/longevity risk, Solvency, Insurance risk management, Internal models.

JEL Classifications: G22, G23.


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