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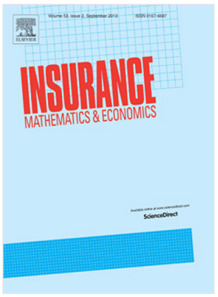

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Mortality Models and Longevity Risk for Small Populations

Hsin-Chung Wang[1] Ching-Syang Jack Yue[2] Chen-Tai Chong[3]

Abstract

Prolonging life expectancy and improving mortality rates is a common trend of the 21st century. Stochastic models, such as Lee-Carter model (Lee and Carter, 1992), are a popular choice to deal with longevity risk. However, these mortality models often have unsatisfactory results for the case of small populations. Thus, quite a few modifications (such as approximation and maximal likelihood estimation) to the Lee-Carter can be used for the case of small populations or missing observations. In this study, we propose an alternative approach (graduation methods) to improve the performance of stochastic models.

The proposed approach is a combination of data aggregation and mortality graduation. In specific, we first combine the historical data of target population, treating it as the reference population, and use the data graduation methods (Whittaker and partial standard mortality ratio) to stabilize the mortality estimates of the target population. We first evaluate whether the proposed method have smaller errors in mortality estimation than the Lee-Carter model in the case of small populations, and explore if it is possible to reduce the bias of parameter estimates in the Lee-Carter model. We found that the proposed approach can improve the model fit of the Lee-Carter model when the population size is 200,000 or less.

Keywords: Longevity Risk, Small Area Estimation, Lee-Carter Model, Standard Mortality Ratio, Graduation

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