Using Life Table Techniques to Model Mortality Rates for Small Populations

Jack C. Yue

National Chengchi University, Taipei, Taiwan

Hsin Chung Wang

Aletheia University, Taipei, Taiwan

Presented at the Living to 100 Symposium

Orlando, Fla.

January 4–6, 2017

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Jack C. Yue[1] and Hsin Chung Wang[2]

Abstract

The study of human longevity has been a popular research topic due to the prolonging of life. However, the limited availability and poor quality of elderly data increase the difficulty of mortality modeling. It is particularly challenging if the size of the target population is small, and the parameter estimation of stochastic mortality models can be distorted. For example, the famous Lee-Carter model (Lee and Carter 1992) would have biased estimates for age-related parameters α_x and β_x in the case of small populations. In this study, we aim to provide a possible solution to deal with the parameter estimation of mortality models when the population size is small.

We propose graduation methods to modify the parameters' estimates of mortality models, similar to the process of constructing life tables where mortality rates are smoothed to remove the irregularity of some observed values. The graduation methods, including Whittaker graduation and partial standard mortality ratio (SMR), will be applied to the Lee-Carter model to smooth the parameters' estimates and compared to the coherent Lee-Carter model (Li and Lee 2005). We use computer simulation to evaluate the proposed approach, and we find that it does have smaller fitting errors when the population size is small.

Keywords: small area estimation, standard mortality ratio, graduation methods, Lee-Carter model, longevity risk

[1] Professor, Department of Statistics, National Chengchi University, Taipei, Taiwan
[2] Associate Professor, Department of Statistics and Actuarial Science, Aletheia University, Taipei, Taiwan