

# Modeling Mortality for Countries with Small Populations

Hong-Chih Huang<sup>1</sup>, Jack C. Yue<sup>2</sup>, and Hui-Ting Wang<sup>3</sup>

## Abstract

The prolonging longevity is a common phenomenon in the 21<sup>st</sup> century and it becomes important and necessary to forecast the mortality rates for the elderly. However, the data available for the elderly usually are very limited, with respect to the sample size and period. The small sample size, especially for a country with few populations, incurs high volatility in mortality and finding a good mortality model would be more challenging. In this study, we propose a method for reducing the volatility in small countries, by taking advantage of other countries' mortality data with similar mortality experience. First of all, we adopt cluster analysis to select countries with similar mortality profiles as the target country. Next, we apply the principle component analysis for the selected countries and use the data reduction skills to reduce the mortality volatility for the small country. We use the mortality data from the human mortality database (data period: 1970–2008) to evaluate the proposed method, and we found that the proposed method produces significant smaller prediction errors than the Lee-Carter model for almost all illustrated countries. We also use the proposed mortality model in pricing and valuation for Taiwan data.

Keywords: Cluster Analysis, Longevity Risk, Small Area Estimation, Principle Component Analysis, Data Reduction

---

<sup>1</sup> Professor, Department of Risk Management and Insurance, National Chengchi University, Taipei, Taiwan, R.O.C.

<sup>2</sup> Professor, Department of Statistics, National Chengchi University, Taipei, Taiwan, R.O.C.; Corresponding Author

<sup>3</sup> Master, Department of Risk Management and Insurance, National Chengchi University, Taipei, Taiwan, R.O.C.