

Evaluation of Statistical Methods for Forecasting Mortality: The Lee-Carter Method and Its Alternative

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Forecasting mortality has been a vital issue in demography and actuarial science. It has important implications for the pension plan and long-term economic forecasts of the nation. The present paper evaluates statistical methods for forecasting mortality, that is, the well-known Lee-Carter method and its alternative.

In the first place, we analytically examine forecasting properties of the Lee-Carter method. Here, it is assumed that a series of life tables represents a realization of a high dimensional cointegrated process. We find that the forecast of the Lee-Carter method converges to the optimal forecasting formula for the long term, but it deviates from the optimal one for the short term and the medium term. Secondly, we propose an alternative method which uses all principal components in forecasting and explicitly takes into account of cointegration in the process. It contrasts with the Lee-Carter method which uses only a principal component with the largest characteristic root and does not take into account of cointegration in the process.

In an appropriately designed Monte Carlo experiment, we compare forecasting accuracy of the Lee-Carter method and the proposed method in terms of mean squared forecasting errors. We find that the proposed method is more accurate than the Lee-Carter method for the short-term (say, the 1st to the 10th period ahead) and the medium-term (say, the 20th to the 30th period ahead) forecasts, although both methods have the similar accuracy for the long-term (say, the 50th period and further ahead) forecasts.

Finally, we compare forecasting accuracy of those methods using mortality data of Japanese male. We find that, in the short-term forecasts, superiority of the proposed method over the LC method is more evident than the experimental results suggest. In conclusion, we recommend our proposed method in practice because of its better performance for the short-term and the medium-term forecasts.

Key Words: Mortality forecasting, life table, cointegrated process, principal components