Testing Deterministic versus Stochastic Trends in the Lee-Carter Mortality Indexes and Its Implications for Projecting Mortality Improvements at Advanced Ages

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Abstract

In recent years, mortality has improved considerably faster than had been predicted, resulting in unforeseen mortality losses for annuity and pension liabilities. As a result, projection of mortality improvements has become an increasingly important issue among actuaries. Among all projection methods, the Lee-Carter approach has been widely accepted by the actuarial community. In this paper, we investigate the dynamics of the Lee-Carter mortality index (parameter kt). Specifically, we perform statistical hypothesis tests to examine whether the mortality indexes for Canada, England and Wales and the United States are best described by stochastic trends (difference stationary models) or deterministic trends (trend stationary models). Such a distinction is important because mortality forecasts generated from these two classes of time-series models could be highly different. The empirical results favor broken-trend stationary models over difference stationary models, which are used in most previous applications of the Lee-Carter method. The results also give strong statistical evidence that the rates of mortality decline for the three populations have significantly accelerated in mid-1970s.

We further analyze the impact of the acceleration of mortality decline on the probability of survival to an advanced age, and provide several recommendations to users of the Lee-Carter approach.