Title: Robust Estimation for Mortality Models in the Presence of Outliers

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ABSTRACT

This paper examines the impact of outliers, particularly exogenous shocks such as the COVID-19 pandemic, on classical mortality models of the Lee–Carter type and their extensions. These models, widely used in demography and actuarial science, rely on assumptions of temporal smoothness that are severely challenged by abrupt disruptions in mortality rates. In this context, we conduct a comparative assessment of alternative strategies for handling outliers, (i) the removal or exclusion of affected periods, (ii) the interpolation of "smoothed" values, and (iii) the use of robust estimators, such as those proposed by Ma and Genton (2000).

Methodologically, the analysis focuses on how these approaches influence the estimation of the model's key components, particularly the time index kt, and, consequently, mortality and life expectancy projections. We show that ad hoc procedures, such as interpolation or data omission, introduce systematic biases and distort the underlying dynamics, thereby compromising the temporal coherence of the model.

In contrast, robust methods mitigate the disproportionate influence of extreme observations without discarding valuable information. In particular, robust estimators preserve the latent structure of the model and yield trajectories of the index kt that are more stable and consistent with long-term trends.

The results suggest that the adoption of robust techniques not only improves model fit in the presence of outliers, but also enhances the reliability of projections, thus providing a methodologically superior framework for mortality analysis under conditions of heightened uncertainty.

Keywords: Mortality modeling; Outliers; Robust estimation; Lee–Carter model

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