

Rethinking Age-Period-Cohort Mortality Trend Models

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Abstract

Longevity risk from uncertain mortality improvement has been recognized as the major risk facing annuity providers and pension funds. In this paper we apply trend models from non-life claims reserving to model age-period-cohort mortality trends, providing a new perspective on estimating mortality improvements and quantifying its respective uncertainty. The approach is developed in a generalized linear models (GLM) setting. Age, period and cohort effects are modelled with distinct parameters for each age, calendar year, and birth year. In the GLM framework, mortality models for age-period, age-cohort, and age-period-cohort effects are considered and assessed using national population mortality data from Norway and Australia. Results are compared with the traditional Lee-Carter model as well as a GLM Lee-Carter approximation model. We find that age and cohort trends are sufficient to capture the mortality behaviour, effectively removing the need for a period trend. The bilinear component in the commonly used Lee-Carter model is shown to confound true age and period effects and to be equivalent to a cohort or birth year effect. The modelling approach in the paper is proposed as a more consistent methodology for estimating trends in mortality rates. Extensions to the approach to allow for time varying trends and parameter uncertainty are readily incorporated into the methodology.

Keywords: Mortality Modelling, Age-Period-Cohort Models, Generalized Linear Models, Lee-Carter Models

JEL classifications: G22, G23, C51, C18