Theoretical problems in Cause – Specific Mortality forecasting and diagnosis rates. Solutions and actuarial applications.

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Abstract

The study of cause-specific mortality in the actuarial field is one of the main sources of information for public health monitoring. Among the number of challenges that need to be addressed, two of them are the main aims of this work. First, the World Health Organization manages a cause-specific mortality database, based on the International Classification of Diseases (ICD). The ICD changed three times between 1950 and 2010 in order to account for progress in science and technology and to achieve more refined cause descriptions. Thus, the ICD revision often causes major discontinuities in trends in mortality and morbidity statistics, requiring then an appropriate correction for any time series analyses or forecasts. Second, models for trends in mortality rates for different ages and sexes as well as for different countries are often based on the assumption of independence between the causes of death. Actually, in literature we cannot find models taking into account both the questions. Our aim is to suggest a new method developed considering simultaneously the ICD changes (discontinuities in the data) and the dependence among several causes of death. To this end, basing on an extension of the Lee – Carter Model (Lee R.D. and Carter L., 1992) we mitigate the structural breaks in mortality rates and contextually the VECM (Vector Error Correction Model) is used in order to project the cause-specific time component of the Lee-Carter model. This methodology allows to include long-term stationary relations between the different causes of death, that is cause-of death dependence in the mortality forecasting model. Results are compared to the more traditional forecasting approach based on ARIMA processes. In particular we show that the proposed method produces more precise projections in order to better underst and the cause – specific mortality. This is crucial in different topics for example in social security, health, socio-economic strategies, having implications in different decision choices. The application in pricing assessment of the methodology here discussed is developed in the insurance and banking filed, in order to design tailored and more individual contracts. In particular several insured loans built within the critical illness policy model are proposed and priced. The new products insure the loan, covering the risk to suffer several dread disease and/or the event in case of death for a specific cause. The inclusion of the benefit in case of a specific cause of death does not involve additional cost to the life office beyond the critical illness benefit. On the contrary the new designs ensure less expensive conditions in comparison with the standard policy and are very appealing from the market point of view, looking for more and more personalized and cheap clauses.