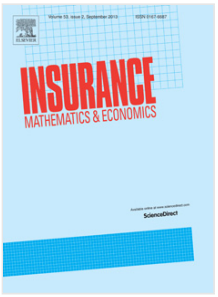
Accepted Manuscript



Forecasting mortality in subpopulations using Lee-Carter type models: A comparison

Ivan Luciano Danesi, Steven Haberman, Pietro Millossovich

PII: S0167-6687(15)00042-6
DOI: http://dx.doi.org/10.1016/j.insmatheco.2015.03.010
Reference: INSUMA 2054

To appear in: *Insurance: Mathematics and Economics*

Received date: January 2015
Revised date: March 2015
Accepted date: 10 March 2015

Please cite this article as: Danesi, I.L., Haberman, S., Millossovich, P., Forecasting mortality in subpopulations using Lee-Carter type models: A comparison. *Insurance: Mathematics and Economics* (2015), http://dx.doi.org/10.1016/j.insmatheco.2015.03.010

Forecasting Mortality in Subpopulations Using Lee-Carter Type Models: A Comparison

Ivan Luciano Danesi[a], Steven Haberman[b], Pietro Millossovich[b,*]

[a] *Department of Statistics, University of Padua, Padua, Italy.*
[b] *Faculty of Actuarial Science and Insurance, Cass Business School, City University London, London, UK.*

Abstract

The relative performance of multipopulation stochastic mortality models is investigated. When targeting mortality rates, we consider five extensions of the well known Lee-Carter single population extrapolative approach. As an alternative, we consider similar structures when mortality improvement rates are targeted. We use a dataset of deaths and exposures of Italian regions for the years 1974-2008 to conduct a comparison of the models, running a battery of tests to assess the relative goodness of fit and forecasting capability of the different approaches. Results show that the preferable models are those striking a balance between complexity and flexibility.

Keywords: Mortality Forecasting, Related Populations, Lee-Carter Model, Improvement Rates.

1. Introduction

Several aspects of modern societies are affected by the level and trend of mortality rates. For example, the private and public retirement systems, as well as other components of the social security system, are planned and modified according to the values taken by current and forecast values of death rates.

Several mortality forecasting models have been proposed in the last few decades. Among the extrapolative methods, that of Lee-Carter (see [1]) has been the most successful and has since received a great deal of attention. This model has been extensively studied and has been extended in several directions, see [2] and [3] for a review.

In many instances, one is interested in forecasting mortality rates for more than one population. Although the separate modelling of each population under scrutiny is possible, it would neglect any existing interaction that motivated the analysis in the first place. Therefore one should focus on a framework where death rates in the populations under study are jointly modelled, in order to allow for correlation between mortality dynamics. As a first example, demographers have long been interested in the study of mortality of males and females in a given population ([1]). More generally, a population could be split according to some characteristics - smoking habit, occupation, income - in order to analyse the mortality of each subgroup. A similar investigation may involve the populations of related countries or regions of a given country (see for instance [4, 5]). As a final example, the joint modelling of two populations is the key of any longevity basis risk assessment exercise, see [6].

The possibility of extending forecasting methods to related populations has been explored by several researchers, including [1, 7, 8, 9, 10, 11, 12, 13]. In the context of single population forecasting models, extensive comparisons have been carried out by [14] and [15]. In this paper we investigate the relative performance of multipopulation mortality models. More precisely, we considered five parametric structures where death rates of related populations are jointly modelled through a Lee-Carter type formulation. The models include many (but are not limited to) existing contribution in the literature and allow for varying degrees of interaction and complexities between the considered populations. We also examine the performance of five similar para-

*Corresponding author
Email addresses: danesi@stat.unipd.it (Ivan Luciano Danesi), s.haberman@city.ac.uk (Steven Haberman), pietro.millossovich.1@city.ac.uk (Pietro Millossovich)