LIVING TO 100 AND BEYOND

Discussion to:

Applying Mortality Models to Japan
M. Ozeki

The Lee-Carter Model
for
Forecasting Mortality Revisited
S. H. Li and W. S. Chan

Discussion by

Robert L. Brown
University of Waterloo

Copyright 2005 by the Society of Actuaries.
All rights reserved by the Society of Actuaries. Permission is granted to make brief excerpts for a published review. Permission is also granted to make limited numbers of copies of items in this monograph for personal, internal, classroom or other instructional use, on condition that the foregoing copyright notice is used so as to give reasonable notice of the Society's copyright. This consent for free limited copying without prior consent of the Society does not extend to making copies for general distribution, for advertising or promotional purposes, for inclusion in new collective works or for resale.

Introduction

I want to start by offering some general comments on models and modeling. I will then proceed to discuss each paper in turn.

I believe that different models are built for different primary purposes. Some models are built for interpolation and fit. These models may carry a large number of parameters or may be designed to be used with different parameters for different parts of the life table. I would include the Heligman-Pollard model and the mixed Weibull model in this family.

Other models are built for extrapolation and/or forecasting. They tend to be built with a smaller number of parameters, which makes them more robust. I would include the Lee-Carter model in this family (it has three parameters).

Interpolation/fit models may not do a very good job at extrapolation and forecasting. Why would we expect that? Similarly, one may find the use of a forecasting model not to be optimal if the purpose of your exercise is interpolation/fit.

In general, the search for a single model to describe mortality patterns from birth to the end of life is difficult because the underlying physiological processes, environmental influences and accidental influences vary so much across the lifespan. If the aim is to forecast or estimate some aspect of the curve, the relevant data for that forecast can come from a part of the curve, rather than the whole curve.

I have a second general issue with certain forecasting methods. This is the use of population life tables as the basis for the forecast.

It is almost impossible to get life-table data on a seriatim basis. The data available from the Census Bureau are almost always grouped. You may be given only access to abridged data. This is especially true at the advanced ages (certainly beyond age 95). In fact, data at the very advanced ages may not be "real life" data at all. Many life-table agencies close out their life tables by artificial means so as to arrive at $l_w = 0$ at a specified (and arbitrary) age. For example, the Japanese life tables that are referred to later are closed in a subjective manner using a Makeham curve at the advanced ages.

Most life-table data are also published only after much massaging and smoothing. Thus, the data may be remarkably different than the crude data from which the life table was constructed.

In my opinion, researchers who wish to forecast future mortality should at least start with crude data. If one cannot get such data from the life-table agency, then one should look for another source. One source that I would recommend is the local social security agency. That is, in Canada, if I were trying to forecast future mortality, I would start with mortality indicators from the Old Age Security database. If I were doing the same assignment in the United States, I would try to get data either from the Social Security Administration (OASDI data) or from the Medicare/Medicaid database.

Now on to the particular papers in question.

Applying Mortality Models in Japan (Ozeki)

The author presents forecasts of mortality using a variety of models. He uses the Heligman-Pollard model, which has eight parameters, and the mixed Weibull model, which (in this instance) has 16 parameters. He also presents the analysis using the Lee-Carter model (three variables).

I would point out that a four-component mixed Weibull model is an extremely difficult model to fit. In the paper it appears that some of the Weibull parameters were chosen using graphical methods. This destroys the capability of the fitting procedures being independently replicated by other researchers.

I would encourage the author to attempt the following in choosing an optimal forecasting model. First, fit a possible model to data from 1980 and 1990. Then use the resulting model to "predict" mortality in the year 2000. Since Y2000 mortality data already exist, measure the "goodness" of the model against the actual Y2000 data. Then use the resulting choice to forecast the future.

I think the author should give his definition of the Evolutionary and Wear-and-Tear aging theories. I have seen a variety of definitions, and it is not clear which one the author is using.

The Lee-Carter Model for Forecasting Mortality Revisited (Li and Chan)

The Li-Chan paper is much more detailed than the Ozeki paper. This is not a criticism. The tail of the distribution is becoming much more important as pricing margins narrow and as the importance of the cost of capital to back new products increases.

The Li-Chan paper hints that longevity improvements may exceed those now being anticipated in the annuity reserving models. Again, this is an extremely important matter.

The authors use life-table data that have been massaged and graduated (in this case using a "Pollard" disaggregation and an exponential force of mortality). I would suggest that the authors attempt to source crude data to use in their future research.

Original mortality rates above age 85 were ignored, and rates determined by the method of Coale and Guo were substituted to the termination of the table. This lowers my faith in any extrapolated values beyond age 85 in the sense that the data are "contaminated."

I liked the idea of a "penalty function," AIC = $n \ln(\sigma^2) + 2M$, where M is the number of model parameters. This automatically penalizes models with a large number of parameters, with which I agree.

Conclusion

The above comments are meant to be constructive, not critical. These are both solid papers that do much to add to our knowledge base. I eagerly look forward to future work from these fine authors.