SYNOPSIS

COHERENT LONGEVITY CAPITAL FRAMEWORK
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Purpose of your paper:
This paper aims to propose a coherent framework for the capital that would be required to protect against the adverse risks over the lifetime of longevity products. By "coherent" we mean

(i) a systematic and principle based approach to the proposed capital framework from a comprehensive and logically coherent view of longevity risk;
(ii) the approach will be applicable to both regulatory capital and the capital buffer above the minimum regulatory requirement;
(iii) the capital framework will consider business issues such as raising capital and tailoring the capital amount appropriate to the company's portfolio; and
(iv) the capital amount will be determined by a coherent risk measure.

The time horizon will be extended beyond one year horizon, as the management actions that companies can take are limited for long-term annuities with guaranteed benefits.

In addition, it is difficult to distinguish whether the risk arises from a change in trend or a random fluctuation. We note that deterioration in one period may indicate further deterioration subsequently, and this is referred as the momentum effect of mortality movements. A Bayesian forecasting technique will be deployed to assess the adverse impact from continual mis-estimation of the best estimate mortality rates and trends over time.

Synopsis:
Forecasting mortality rates is critical to annuity pricing and reserving. Mortality rates during the past decades have evidenced a noticeable reduction, especially at the older ages. This was caused by a range of factors, including medical and technological advances and societal transformations.

There are many reasons why mortality may be mis-estimated over the long term. Not only may central estimates and standard errors be unreliable, but the trends of the mortality rate are likely to change over time. Short term mortality fluctuations increase the chance of mis-estimating long term projections of mortality rates as random variation can be mistaken for changes in trend and vice versa. The future trend may deviate from the past in an evolutionary or revolutionary manner.

The current regulatory capital framework LAGIC in Australia targets a one-year horizon and prescribes a simple one-off factor-based method to stress the mortality rates for longevity risk. The factor is assumed to be a permanent reduction of the mortality rates and is applied at the time of valuation date. In contrast, the approach to calibrate the mortality and morbidity stresses for other risk products is principle-based under LAGIC, as reflected in Life Prudential Standard (LPS) 115 (APRA 2013). The principles aim to address the risks arising from statistical fluctuation from the mean, the mis-estimation of the mean, adverse trends, and catastrophe events.

The capital framework proposed under Solvency II is also one-year and requires companies to shock the mortality rates with a single factor for annuity products bearing longevity risk, according to the Committee of European Insurance and Occupational Pensions Supervisors (CEIOPS) Quantitative Impact Study (QIS) 5 (2010). This approach may not fully capture the increasing uncertainty of the projected mortality rates over time, nor does it address the trend of mortality improvement.

For long term annuity products, such as immediate lifetime annuities and deferred life annuities, the capital adequacy needs to target for a longer period and even for run-off if significant amount was sold with guaranteed payments, as the management actions that companies can take are limited. Internal capital methods may be adopted instead of the prescribed regulatory capital formula to cater for the specific risks to which the annuity book is exposed.

The paper proposed capital framework should also take into consideration the need to raise additional capital in event of losses. If potential capital providers approach the historical data with a more pessimistic Bayesian prior, which is likely if actual experience is worse than expected (as would have been if more capital is required), then they will value the business at a lower amount than the insurer. While this may not impact the solvency of the insurer, it reduces the value of writing annuity business if additional capital should be held to prevent the risk of future dilution.

Another issue that should be addressed is for new or fast growing companies with limited data and experience which has to rely on population and other companies' data. Conservatism is needed for the initial capital amount. For example, the initial selection factor needs to be first assumed from the population and industry information, as a prior. As experiences emerge, the prior assumptions may need to be updated. The portfolio mean is likely to be very different from the wider population, while the trend of improvement is not likely to deviate substantially from the population.

Furthermore, for an established life company the annuity book typically comprises a pool of heterogeneous lives with different ages, gender, cohorts, and socioeconomic classes. This portfolio heterogeneity must be taken into account when determining the appropriate stress margin for a company as a whole in practice. This is different from the approaches in the earlier academic papers such as Borger (2010), Plat (2011), and Richards et al (2012) that focused on the individual age modelling.

In this paper, the proposed approach to calibrate the longevity risk capital will be based on a Bayesian rationale, and the methodology's main theme is around the mortality momentum defined as "the risk of mortality mis-estimation in one period may flow on to the next" when the prior assumptions are updated.

Specifically, the risks considered in the proposed capital calculations involve:

i. Volatility risk – the future mortality rates will fluctuate around the projected estimates.
ii. Modelling risk – the selected model is not appropriate leading to an incorrect mortality forecast, which may also be caused by parameters not calibrated accurately.
iii. Trend risk – the past trend may change in the future.

These are consistent with the principles under the Solvency II regime and also in line with the Australian regulatory capital framework (APRA LPS115).

The results are to be compared with the current regulatory methods and applied to both immediate and deferred lifetime annuities.