Oblig 5: Solvency II longevity and currency risk

Background The Solvency II evaluation of longevity risk and currency risk are handled in the modules for Life insurance risk and Market risk. This means that their combined impact is added and diversified through a correlation offered in Solvency II documentation. Yet their relationship through the Best Estimate BE is more complicated. Indeed, if C is the current exchange rate, the value put on the liabilities in domestic currendcy is $C \times \text{BE}$ which is far from being two sources of risk that can be added, and to aggregate them for their combined 99.5% percentile we need a joint model and Monte Carlo. The aim of this project is to offer calculations of this kind and compare them with the recipe in Solvency II in order to judge how accurate the latter is.

Cooperation You are allowed to and encouraged to cooperate with the students analysing longevity and interest rate risk (Oblig 3) and asset/liability management (Oblig 4).

Objective: Determine whether the Solvency II approach yields the 99.5% certainty that is the target.

Material: Chapters on Solvency modelling offered the STK4520 students as handouts, especially Chapter 5 on Market Risk and Chapter 6 on Life insurance risk. You may like to take inspiration from Section 15.2 in Bølviken, E. (2014). *Computation and modelling in Insurance and Finance*, Cambridge University Press.

Details and simplifications We need models that describe random variation in mortalities and currency flutuations. The former is in Solvency II defined by a downwards, flat shock $s_0 = 20\%$ that is seen as a 99.5% percentile. One possibility that accords with this condition is to assume that the relationship between current mortalities q_j (for individual j) and the stressed ones q_j^s is of the form

$$q_j^s = (1 - S)q_j \qquad \text{where} \qquad S \sim \xi \times \text{ Gamma}(\alpha).$$

Here Gamma(α) stands for a Gamma distribution with mean 1 and shape α. Determine ξ for given α so that the 99.5% percentile becomes s_0.

A possible model for the stressed exchange rate is

$$C^s = Ce^{-\tau^2/2+\tau N(0,1)}$$

where C is the current rate, $N(0,1)$ the standard normal and τ is calibrated to make the Solvency II upturn of 25% the 99.5% percentile.

You have to invent a pension portfolio with a given age distribution and introduce baseline mortalities q_j. If you like, take ideas from Section 15.2 in Bølviken (2014).

Main points: The presentation (45 minutes) should cover

1 How Solvency II calculates the Solvency Capital Requirement for longevity and currency risk which are in two different main modules.

2 The pension portfolio with age distribution and the default mortalities assumed. Use two different age distributions, one for a young portfolio and one for an old one.

3 How the Best Estimate is calculated under default conditions

4 The stochastic models that adapt to the Solvency II specifications.

5 How the stochastic model and the results it yields is simulated.

6 Comparisons between the 99.5% percentiles under the simulations and those returned by Solvency II.