Oblig 3 Solvency II longevity and discount risk

Background The Solvency II evaluation of longevity risk and discount risk (also called interest rate risk) are handled in different modules; i.e. in the Life insurance risk and the Market risk modules respectively. 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 much more complicated and highly non-linear, and to aggregate them to obtain 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 asset/liability manangement (oblig 4) and longevity and currency risk (oblig 5).

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 the interest rate curve. 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

$$q_j^s = (1 - S)q_j \qquad \text{where} \qquad S \sim \text{ exponential}(\theta), \quad \theta = s_0/5.298.$$

Explain that s_0 becomes the 99.5% percentile. Then there is the model for interest rate risk. Solvency II presents this through upwards and downwards 99.5% shock curves s_k^+ and s_k^- on the current interest rate curve r_k . A full stochastic stressed model could be

$$r_k^s = r_k(1 - S) \qquad \text{where} \qquad S = \frac{1}{2}(s_k^- + s_k^+) + \frac{1}{2}(s_k^+ - s_k^-)\frac{N(0,1)}{2.576}$$

where $N(0, 1)$ is the standard normal. Again argue that this specification accords with the Solvency II assumption. You have to invent a pension portfolio with a given age distribution and introduce baseline mortalities q_j. You may here utilize 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 dicount 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 How the stochastic model can be simulated

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