Introduction

The Solvency II Directive states that .... Something about FMA's and which quantity to develop in order to create the balance sheet for all periods.

State-Wise Probability Weighted Reserve

Define

$$\tilde{X}^j(t) := \mathrm{E}_{Z(0)}[X(t)\mathbb{1}_{\{Z(t)=j\}}]$$

and note that

$$\mathrm{E}_{Z(0)}[X(t)\mathbb{1}_{\{Z(t)=j\}}] = \mathrm{E}_{Z(0)}[X(t)|Z(t)=j]p_{Z(0),j}(0,t), \tag{1}$$

by the definition of conditional expectation. We can think of $\tilde{X}^j$ as the probability weighted state-wise reserves. The relation between $\tilde{X}^j$ and $\mathrm{E}[X(t)]$ is

$$\begin{aligned}
\mathrm{E}_{Z(0)}[X(t)] =& \mathrm{E}_{Z(0)}[\mathrm{E}_{Z(0)}[X(t)|Z(t)]] \\
=& \mathrm{E}_{Z(0)}\left[\sum_{j\in\mathcal{J}} \mathbb{1}_{\{Z(t)=j\}}\mathrm{E}_{Z(0)}[X(t)|Z(t)=j]\right] \\
=& \mathrm{E}_{Z(0)}\left[\sum_{j\in\mathcal{J}} \mathbb{1}_{\{Z(t)=j\}}\frac{\mathrm{E}_{Z(0)}[X(t)\mathbb{1}_{\{Z(t)=j\}}]}{p_{0j}(0,t)}\right] \\
=& \sum_{j\in\mathcal{J}} p_{0j}(0,t)\frac{\tilde{X}^j}{p_{0j}(0,t)} \\
=& \sum_{j\in\mathcal{J}} \tilde{X}^j.
\end{aligned}$$

Life Insurance Setup

The setup differs from the classical ... The dynamics of X are assumed to be affine

$$\begin{aligned}
dX(s) =& X(s)g_1(s,Z(s))ds + g_2(s,Z(s))ds \\
&+ \sum_{h\neq Z(s-)} \left(X(s-)h_1(s,Z(s-),h) + h_2(s,Z(s-),h)\right)dN^h(s).
\end{aligned}$$

Life-Death Model

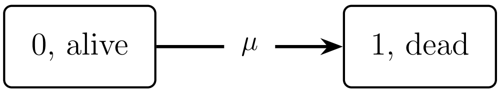
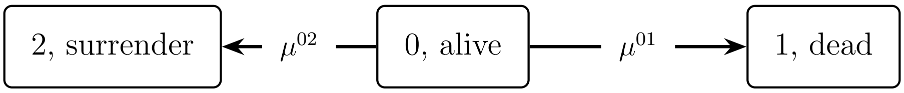
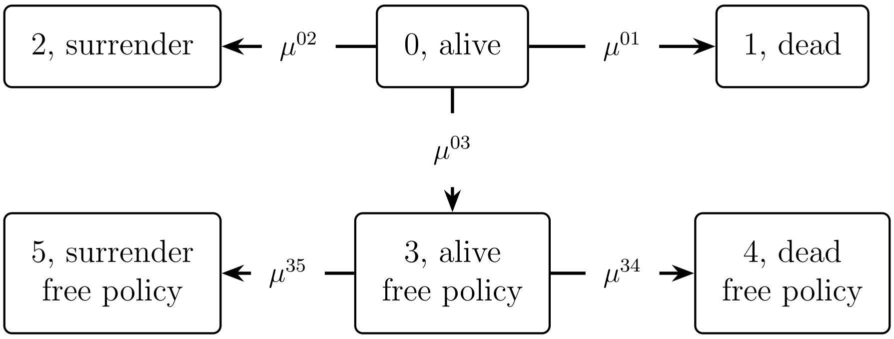


Figure 1: Life-Death model

Life-Death-Surrender



Life-Death-Surrender With Free Policy



Thoughts

- Same build-up as **?**. Hierarchical examples $\Rightarrow$ general transient.
- Refer to **?**
  - Introduction and motivation - stochastic reserve, Monte Carlo method. A little comment on the fact that the problem is still hard to solve.
  - Life-death (simple analytic solution).
  - Life-death free policy (how to deal with extra states).
  - General model without duration.
  - Life-death-surrender free policy, including discussion of free policy factor.
  - Lost all trick works.
  - General model with duration dependence.

  - Inclusion of surplus. Use independence when dividend is assigned on discrete points in time.

- Deterministic intensities.

- Market dependent intensities - allowed when directly dependent on the market.

References

Kristian Buchardt, Thomas Møller, and Kristian Schmidt. Cash flows and policyholder behaviour in the semi-markov life insurance setup. *Scandinavian Actuarial Journal*, 2015(8), 2015. ISSN 03461238. URL `http://search.proquest.com/docview/1718994569/`.

Ragnar Norberg. Reserves in life and pension insurance. *Scand. Actuar. J. 1*, pages 3–24, 1991.