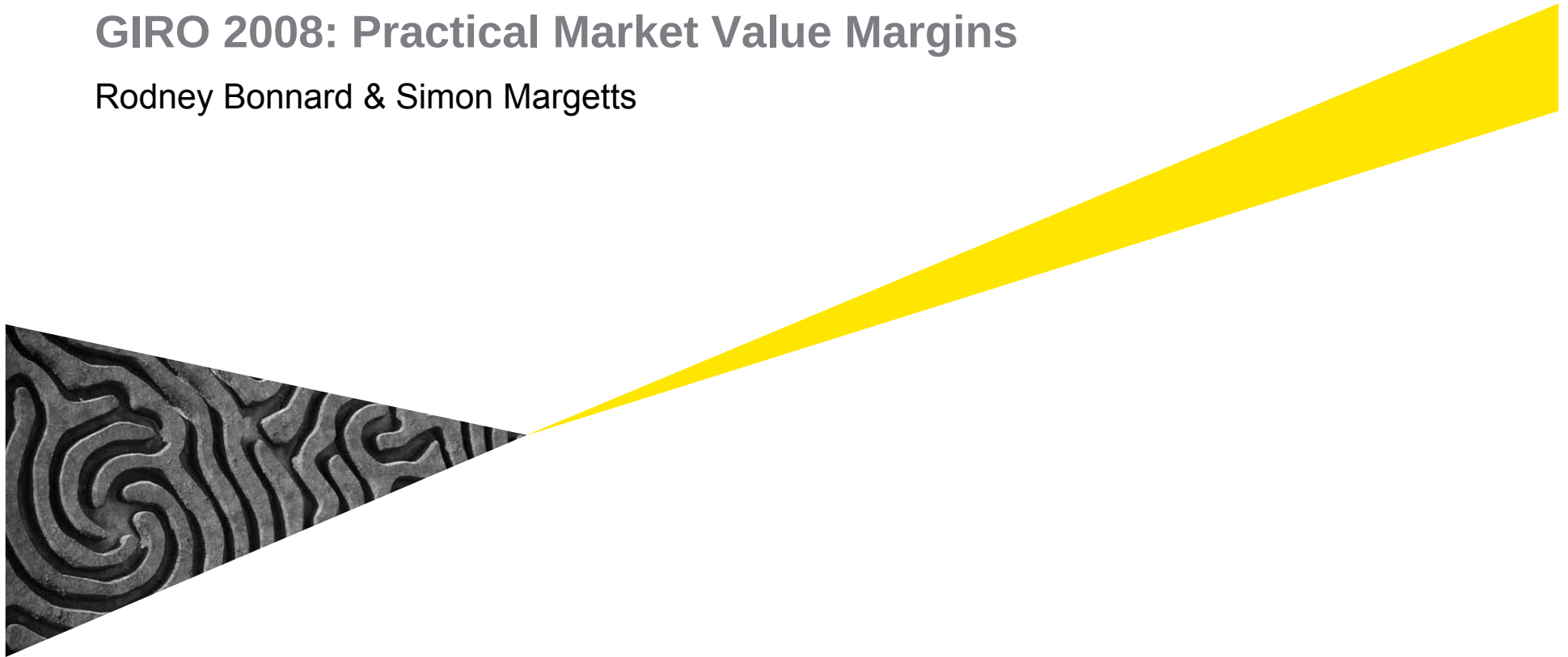


GIRO 2008: Practical Market Value Margins

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Important Information

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Solvency II definition of capital

DIFFERENCES BETWEEN SOL II AND ICA

► ICA:

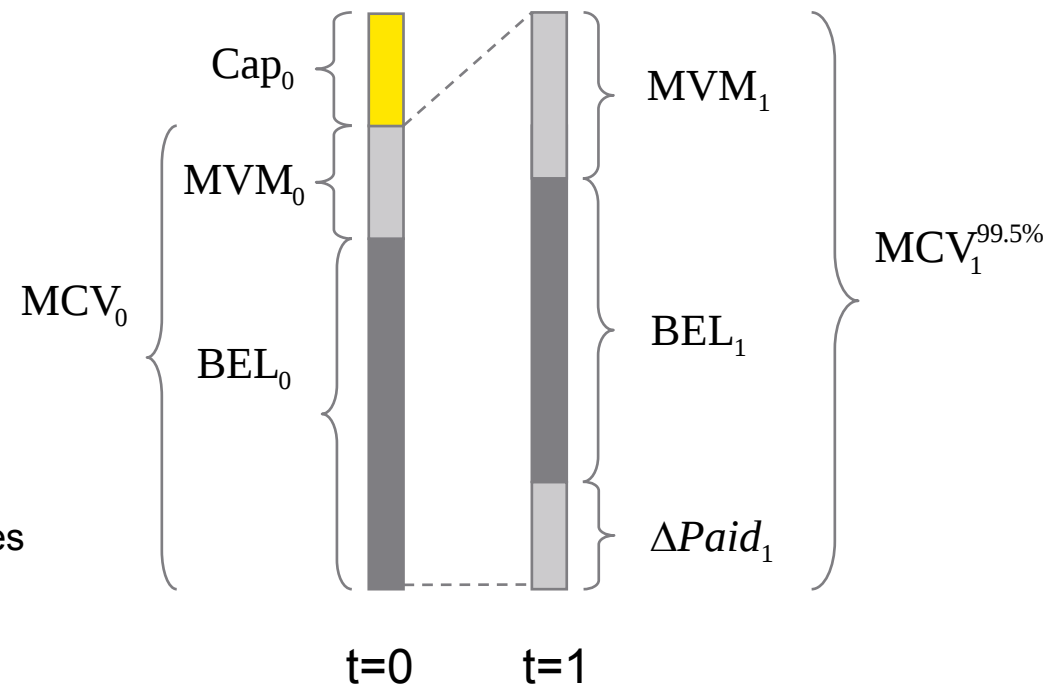
- Ultimate time horizon
- Balance sheet on GAAP basis

► SOL II:

- One year time horizon
- Balance sheet on Economic basis

ECONOMIC BALANCE SHEET

- MCV -> Market Consistent Value
- BEL -> Discounted Best Estimate Liabilities
- MVM -> Market Value Margin



Solvency II definition of MVM

- ▶ MVM is the expected (discounted) cost of current and future capital requirements.
- ▶ The first thing to realise is that future capital requirements are random and similarly future MVM amounts are random. We do not know what the future balance sheets will be and we do not know what the resultant future capital requirements will be.
- ▶ Many commentaries on this subject ignore this point in their notation and from this a some confusion has arisen.
- ▶ Capital amounts are defined in terms of the changes in economic balance sheet.
- ▶ MVM amounts are defined in terms of the cost of the capital.
- ▶ Essential in writing down the equations is the consideration of the information being used to define the distributions of the respective amounts.
- ▶ We have assumed that no diversification from writing new business is included in the calculation.

Solvency II definition of MVM

MVM is the expected (discounted) cost of current and future capital requirements, where the following assumptions are common:

$$\text{MVM}_{T|t} \sim E \left[\sum_{S \geq T} \text{CoC}_{S|T} \cdot B_{T,S} \cdot \text{Cap}_{S|t} | T \right]$$

Simplify to:

$$\text{MVM}_{T|t} \sim \text{CoC} \cdot \sum_{S \geq T} B_{T,S} \cdot E[\text{Cap}_{S|t} | T]$$

Where:

$$\text{MVM}_{T|t} \text{ and } \text{Cap}_{T|t}$$

are the distributions of the MVM and Capital respectively required at time T , given the information available at time $t \leq T$. ie in our diagram from the previous page:

$$\text{Cap}_0 = \text{Cap}_{0|0}, \text{MVM}_0 = \text{MVM}_{0|0}$$

Binomial Tree – Option pricing analogy

For now, we are making a number of assumptions:

- ▶ No discounting (although this is easy to extend for)
- ▶ Only looking at one class
- ▶ We are assuming run-off, ie, not future diversification benefit from new business

In general we have:

$$\text{Cap}_{T|t} \sim 99.5\%[(U_{T+1|t} + \text{MVM}_{T+1|t})|T] - (U_{T|t} + \text{MVM}_{T|t})$$

$$\text{MVM}_{T|t} \sim E[\text{MVM}_{T+1|t}|T] + \text{CoC}.\text{Cap}_{T|t}$$

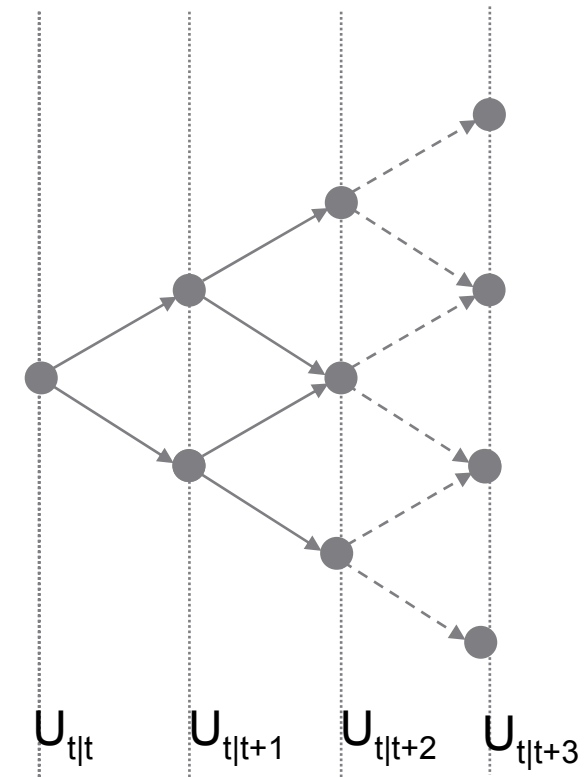
Look at full progress of Ultimate Claims estimates of time (U_t)

- ▶ At some point, U_n there is no further uncertainty, so $\text{MVM}_n=0$

▶ So:

$$\text{Cap}_{n-1|t} \sim 99.5\%[U_{n|t}|n-1] - (U_{n-1|t} + \text{MVM}_{n-1|t})$$

$$\text{MVM}_{n-1|t} \sim \text{CoC}.\text{Cap}_{n-1|t}$$



A solution – applying a mesh

While the result on the previous slide is useful in that it allows the collapse of the circularity, a basic Monte Carlo implementation would lead to an $O(n^m)$ algorithm (where n is the number of time steps and m is the number of simulations)

So the key is to find a trick which collapses this to something tractable

Various approaches have been suggested to solving this problem:

- ▶ Performing the Monte Carlo simulation with a VERY big computer
- ▶ Simplify the problem by clustering
- ▶ Various other simplifying assumptions such as those contained within QIS4 or SST.
- ▶ Fitting an analytical mesh to simulated cashflows and solving the resultant problem analytically

In this presentation we will be using this last approach and comparing the results for a particular simple company with some of the assumptions that have been suggested.

A solution – applying a mesh

One such method is to look for an analytical closed form solution by fitting a model to simulated cashflows, C_t .

The “Mesh” – Lognormal approximation

Assume that $C_t | C_{t-1}$ is lognormal, ie

$$C_t = C_{t-1} \text{Ln}N(\mu_t, \sigma_t^2)$$

Desirable features

This model has the property that the mean and volatility are path dependent.

The assumed distribution is right skewed.

We can fit this mesh to cashflows in a variety of ways so as to ensure that the resultant model behaves like the cashflows.

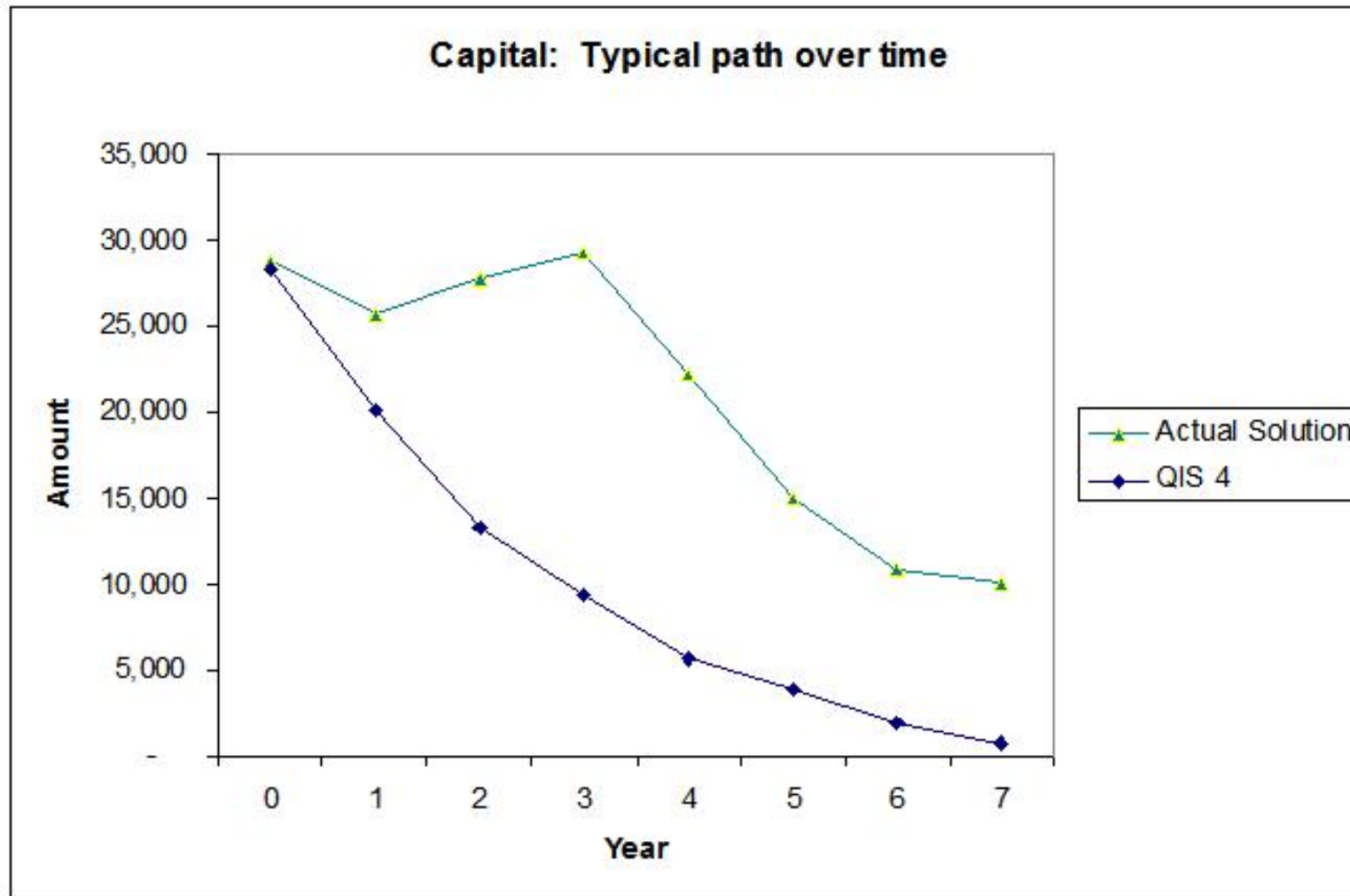
This model is analytically tractable.

Simple example – applying a mesh

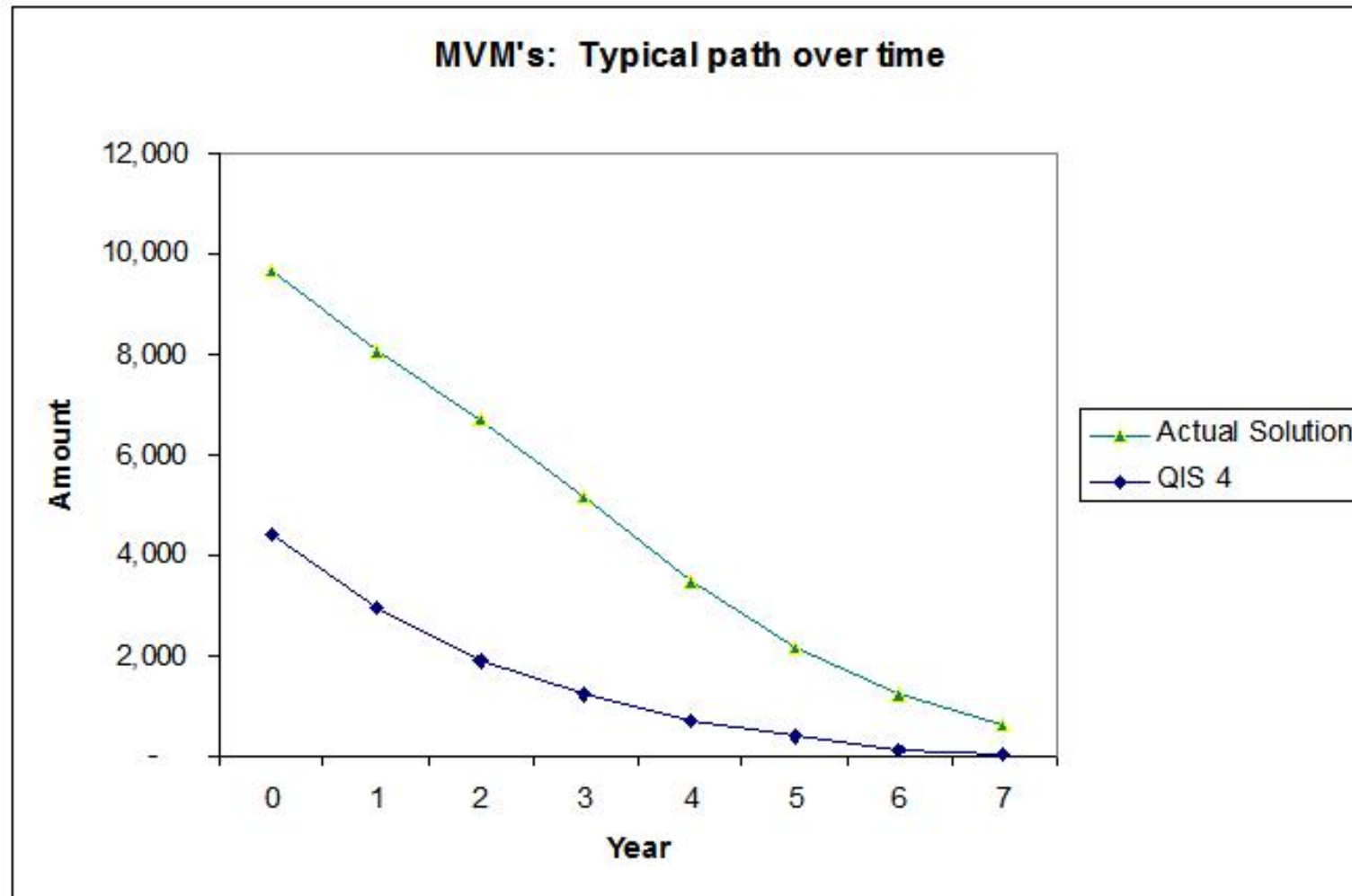
Using our simple approach, we can now:

- ▶ Evaluate Cap_t and see how it varies of time
- ▶ Understand the MVM and its materiality
- ▶ Understand the Capital and its materiality
- ▶ Compare a modelled approach to the MVM and capital to the solutions presented in QIS4
- ▶ Compare a modelled approach to the MVM and capital to other possible simplifications

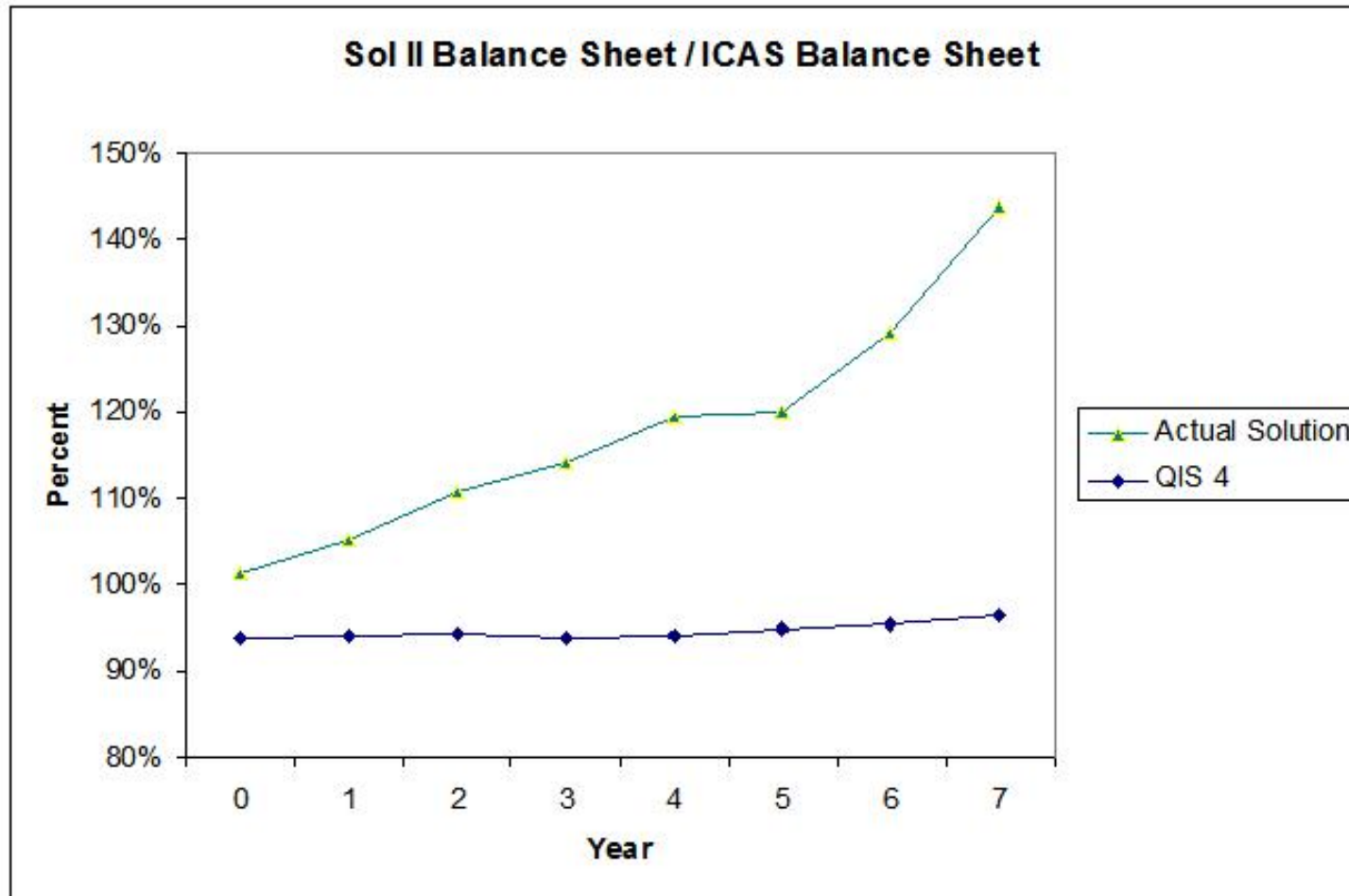
Worked example: One-year capital and MVM's for a medium tail class



Worked example: One-year capital and MVM's for a medium tail class

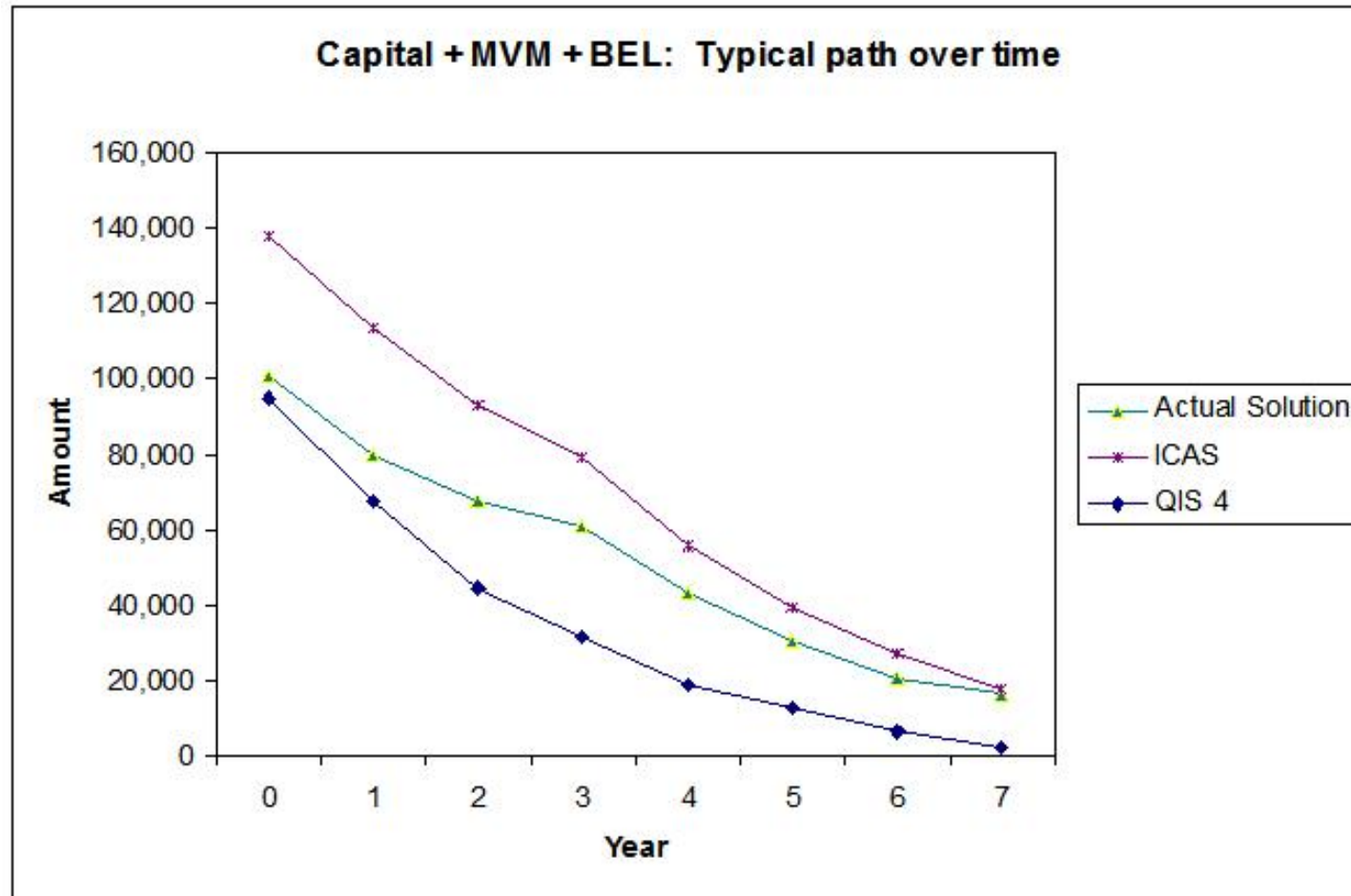


Worked example: One-year capital and MVM's for a medium tail class



Note: Ratio of Discounted BEL + MVM to undiscounted reserves

Worked example: One-year capital and MVM's for a medium tail class



Note: ICAS is undiscounted reserves + discounted capital requirement at ultimate

Worked example: Comments on the results

- ▶ QIS 4 coincidentally gives the same capital requirement as the solution to the sets of equations.
- ▶ However, at later time periods QIS4 is underestimating the capital requirements.
- ▶ This can be regarded as a parameterisation issue and one would expect a company in run-off to have a different SCR from an ongoing business.
- ▶ QIS 4 is assuming that the SCR should be proportional to the held reserves, but clearly as a company runs off this is not true.
- ▶ It is an interesting feature of the actual solution that capital often increases over time before diminishing.
- ▶ In our worked example, QIS 4 is significantly underestimating the MVM required.
 - ▶ This has the effect of overstating the available capital in the economic balance sheet.

Thank you

