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Risk margins for Life Insurance Liabilities

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Abstract

This paper provides Australian actuaries practising in life insurance with an introduction to the consideration, current thinking and techniques involved in setting risk margins under the exit value framework being considered by the International Accounting Standard Board for insurance contracts.

In this paper, the authors

- Review the IASB requirement in respect of risk margins;
- Review the work that has been done internationally on this subject;
- Discuss the considerations relevant to determining risk margins for life insurance contracts; and
- Show examples of calculation of risk margins for a simple term insurance contract under two key methodologies: the cost of capital method and the quantile method, also an example of applying the quantile method to a group life IBNR reserve.

The paper briefly reviews of the experience of the Australian general insurance industry in respect of risk margins where risk margins have been required for profit reporting since 2005 and solvency since 2002

Key words : *IFRS phase 2, life insurance contracts, risk margins, cost of capital method, quantile method.*

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Introduction

In May 2007, the International Accounting Standards Board (IASB) issued a discussion paper "Preliminary Views on Insurance Contracts". A corner stone of this paper is the proposition that the value of insurance contracts liabilities be determined as their exit value. This is a radically different approach to the entry value approach used in Australia since 1995. If the general approach outlined in the discussion paper is adopted for the final accounting standard, then risk margins will need to be determined for life insurance for the first time in Australia for profit reporting purposes.

Risk margins are margins added to the best estimate liability in order to determine the value of the liability in a certain scenario. In Australia actuaries practising in life insurance would already be familiar with the concept of risk margins in the solvency and capital adequacy standards. In the solvency and capital adequacy standards, the liability at 99.5% and 99.75% probability of sufficiency is determined by adding margins to key risks such as mortality, morbidity, lapses and expenses. A risk margin need not be a margin applied to each individual risk, but could instead be a margin applied to the best estimate liability itself.

Selecting risk margins for profit reporting will involve different considerations than for solvency or capital adequacy, as the margin is required to form part of an exit value.

Much work has been done in recent times both in Australia and internationally relating to risk margins. Some of this research is considered in the Australian life insurance context in this paper.

The aim of this paper is to be an introductory level paper on risk margins in the life insurance field. As such our intention was to simply bring the key issues to light, rather than attempt to solve them. We note that whilst there are many papers on risk margins in the general insurance field, the same is not true for life insurance.

At a high level, in this paper, we will:

- Review the IASB requirement in respect of risk margins;
- Review the work that has been done internationally on this subject;
- Discuss the considerations relevant to determining risk margins for life insurance contracts; and
- Consider how one might apply the two key methods for determining risk margins, the Quantile method and the Cost of Capital method, to two typical life insurance products, retail term insurance and group life.

We will also reflect briefly on the general insurance experience in Australia, where risk margins have been used since 2002 for profit reporting and for solvency purposes with a view of applying any learnings to life insurance.

The accounting context

Although it is not the intention of this paper to discuss accounting standards in detail, it is nevertheless important to understand the context in which the risk margins will be determined.

The IASB discussion paper suggests that the insurer, be it life insurer or general insurer should determine its liabilities using three building blocks

a. *Explicit, unbiased , market consistent , probability weighted and current estimates of the contractual cash flows;*
b. *Current market discount rate that adjust the estimated future cash flows for the time value of money; and*
c. *An explicit and unbiased estimate of the risk margin that market participants require for bearing risk (a risk margin) and for providing other services if any (a service margin).*

These three elements together are referred to as an exit value model.

The first two elements are already familiar to Australian actuaries as they make up the Best Estimate Liability (BEL) component of the Margin on Services (MOS) Policy Liability.

Risk margin as part of an exit value

In setting the risk margins (and indeed the future cash flows estimates) in the IFRS 2 context, it is important to bear in mind the exit value framework. This framework means that the liabilities, together with the risk margins, should reflect what a willing buyer would pay to assume the liability in an arms' length, normal (i.e. not distressed) transaction .

A rational buyer would require a margin over and above the best estimate liability to compensate them for the risk that they are taking on. The level of that margin should be reflective of the level of uncertainty in the best estimate from the perspective of this hypothetical buyer, not from the perspective of the reporting company. It follows that the risk margin should reflect the uncertainties relating to the portfolio, but not the uncertainties that are entity specific. The hypothetical buyer is commonly referred to as the reference company or reference entity.

The reference company might have the following characteristics[1]:

- Large (i.e. stochastic risk is likely to be small)
- Multi-line (i.e. can obtain benefits of diversification across products)
- Highly rated (AA rating or better)
- Has similar business to the reporting entity (i.e. sells the same sort of products)

[1] IAA Ad Hoc Risk Margin Working Group Paper, March 2008 (page 67)

The RMWG paper noted that this is a different mind set to the way risk margins are set for general insurers in Australia, where the entity's own obligations are taken into account.[2]

Entity specific versus portfolio specific information

In the discussion that follows, it will be important to distinguish which information should relate to the reporting entity and which should relate to the reference entity.

There has been some guidance of which information should come from the reporting entity and which should come from the reference company.[3]

As we understand it, from the reporting entity should come any information that is portfolio specific, such as product nature and design, for example the fact that the product is a standard term insurance product, or disability income, underwriting methods and effectiveness, such as the fact that the product may have been fully underwritten or has been marketed using telemarketing.

From the reference company should come any information that in any exit value model would ultimately be determined by the entity that takes over the liability, the reference entity, such as diversification benefits.

The idea that portfolio specific considerations should refer to the company's experience and entity considerations should refer to the reference company's experience is clear at a high level. However when applying that theory to a detailed level, the use of a reference company impacts many otherwise obvious considerations of risks. Some examples of these considerations are:

- Should mortality/morbidity risk reflect the company's position or the reference company, who might have better claims management procedures and a larger portfolio or a combination of both?
- Should lapse risk reflect the company's experience or the reference company's, if the reference company's then should some allowance be made for the generally higher lapses that might be expected to arise if business was transferred?
- Should the expense risk reflect the company's expenses or the reference company's which might be larger and therefore have lower expenses due to economies of scale?

In practice, we expect that the best evidence of a market consistent risk margin for the portfolio would mostly come from the company's information about that portfolio. However it is important to keep the "exit value" framework and market consistent framework in mind when setting the risk margin.

Risk margin characteristics and objectives

The IASB has not prescribed a specific method for determining risk margins. Instead it has outlined certain principles that should underpin the determination of risk margins. Having stated that the purpose of risk margins is to reflect the uncertainty

[2] Risk Margins Working Group Paper (March 2008) Page 70
[3] Risk Margin Working Group Paper (March 2008), Page 67

surrounding the central estimates of future cash flows, the IASB offers the following guidance to the determination of risk margins[4]:

1. Risk margins should be consistent with the margin that would be expected if the insurer were to transfer its contractual rights and obligations to another party;
2. Risk margins should be explicit not implicit;
3. Risk margins should reflect all risks associated with the liability;
4. Risk margins should not reflect risks that do not arise from the liability (ie risks that are borne by the policyholder);
5. Risk margins should be consistent as far as possible with observable market prices;
6. The chosen approach should be implementable at a reasonable cost and auditable;
7. The approach should not ignore the tail risk in contracts with very skewed pay-offs;
8. The approach should facilitate the provision of concise and informative disclosure;
9. If more than one approach is suitable based on the above, then it would be preferable to choose the approach which builds on models already used by the insurer; and
10. The approach should not ignore model risk or parameter risk.

The IASB has further stated a number of desirable characteristics of risk margins:

1. The less that is known about the current estimate and its trend, the higher the risk margin should be;
2. Risks with low frequency and high severity will have higher risk margins than risks with high frequency and low severity;
3. For similar risks, long duration contracts will have higher risk margins than those of shorter duration;
4. Risks with a wide probability distribution will have higher risk margins than those risks with a narrower distribution; and
5. To the extent that emerging experience reduces uncertainty, risk margins will decrease and vice versa.

Purpose of Risk Margins

During the recent debates that preceded the IASB paper, there were two common views regarding the uses of risk margins:

a As a shock absorber; and
b As compensation for bearing risk.

If a risk margin acts as a shock absorber, it reduces the impact of changes from the current expectation. At the extreme, a shock absorber method could smooth out the impact of changes in assumptions as well as actual past deviation from the assumptions (i.e. experience profit and loss). Discussions to date have pretty much

[4] Appendix F, paragraph F3 of the IASB discussion paper

ruled out the smoothing of actual experience deviation from expected as being undesirable / inappropriate.

The profit margin in Australia's Margin on Services (MoS) methodology acts as a more moderate shock absorber: experience profit or loss are reflected in the current year's profit and loss, but changes to assumptions other than economic assumptions impact the profit margin first and only if the profit margin is exhausted do they impact the current year's profit and loss position. We note that under MoS, there is no minimum risk margin (or profit margin). In other words, when the profit margin is exhausted, the company is not required to hold any more than the BEL as the Policy Liability

The main advantage of a risk margin which is a shock absorber (for assumption changes) is that it reduces both profit and loss and balance sheet volatility. There is something to be said for not introducing unnecessary volatility to the reported results over and above the volatility associated with actual insurance claims experience. After all, changes in assumptions are changes in management's view of how the world may look in the future, rather than changes in the actual experience. One might say that having the risk margin as a shock absorber removes the ability of the preparer of the liability to have undue influence on the profit reported, as the profit will only reflect actual deviation from previous estimates rather than prospective, expected deviations.

The alternative view is that a risk margin should act as compensation for bearing risk. Under this view, both favourable and adverse changes in expectations of future experience would flow through to profit when the change in expectations occured. Similarly, if the amount of risk or the cost of risk changes then that will also flow through to the current year's profit and loss position.

The IASB's preliminary view is that "*the purpose of a risk margin is to convey decision-useful information to users about the uncertainty associated with future cash flows. The objective is not to provide a shock absorber for the unexpected, nor is it to enhance the insurer's solvency.*"[5]

This paper has been written assuming that the "compensation for bearing risk" view of risk margins would prevail in the final accounting standard(s).

If the shock absorber view prevails, and if there was no minimum risk margin requirement (as under MoS), then the determination of risk margins becomes trivial as long as the contract is profitable and the valuation will likely be very similar to the current methods used in Australia. On the other hand, if there was a minimum risk margin under a shock absorber view, then similar considerations will apply as under the "compensation for bearing risk" view.

The IASB discussion draft also included discussion of a service margin, over and above the risk margin. We find the role and nature of the service margin in addition to the risk margin within an exit value model very unclear. To keep this paper focused and practical, we have not covered this issue and issues relating to consistency with IAS 18 and IAS 39.

[5] IASB Discussion Paper May 2007, paragraph 86(a)

Profit Implications

Assuming the risk margin is not to act as a shock absorber then one can expect two implications for profit emergence:

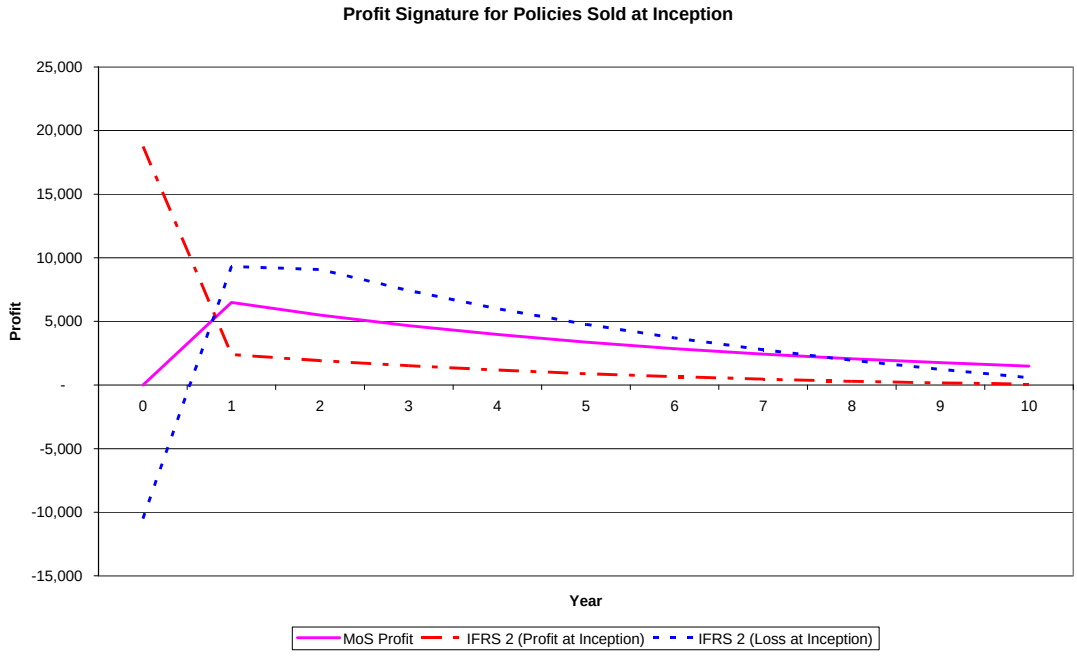
a. As there is no shock absorber, the size of the risk margin, along with the best estimate assumptions will determine profit emergence, whereas currently under MoS, the total Policy Liability is somewhat insensitive to the actual best estimate assumptions, so long as the contract is profitable.

b. As risk margins are determined without reference to the actual premium level, there will almost certainly be profit or loss emerging at inception.

The potential for profit or loss, but particularly profit emerging at inception remains one of the most contentious issues that the IASB faces.

The graphs below show the impact on the profit signature on a simple renewable term life policy under Australia's current Margin on Services method and IFRS 2 for:

A) A policy at inception; and
B) A policy where there has been a change in a non-economic assumption in year 3.

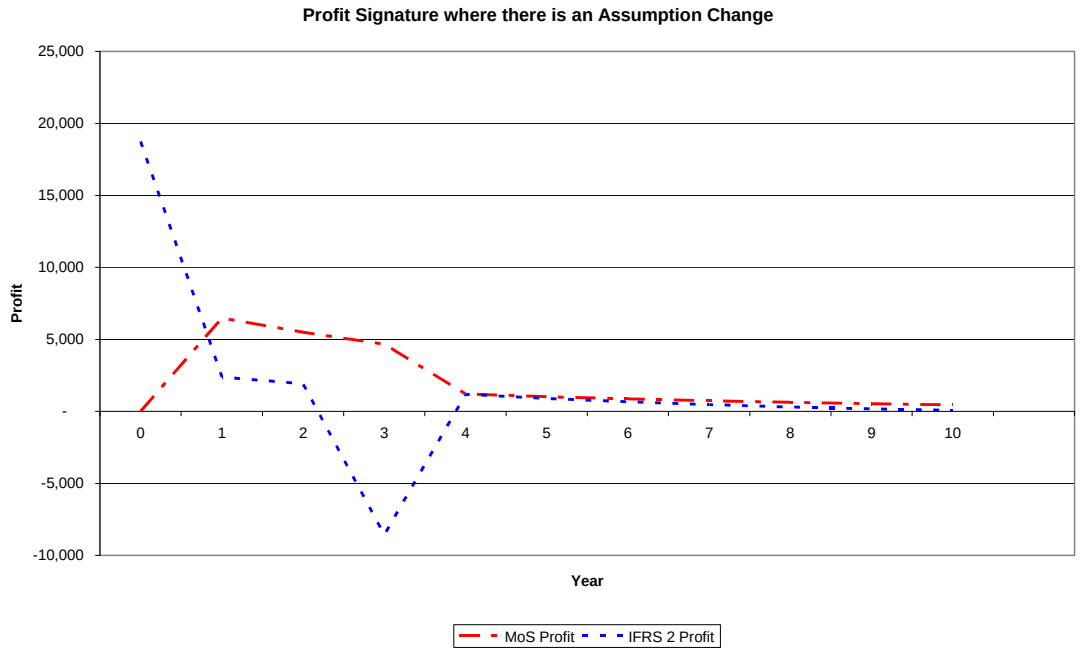


The graph above shows that:

- Under Margin on Services, for a profitable contract, profit is released as a constant percentage of claims or premium over the life of the policy. There is no profit at inception.
- Under IFRS 2, for a profitable contract, as long as the profit margin exceeds the required risk margin, there will be a profit release at inception equal to the present value of the excess of the expected profit margin over the risk margin. Over the

life of the contract, if the actual experience is exactly the same as the expected experience, the risk margin is released over the policy term, as the policy runs off.

- Conversely, for a contract where the risk margin is greater than the profit margin, IFRS 2 methodology will result in a loss at inception equal to the present value of that difference. Note that if the product was actually unprofitable, then the loss at inception is more than the expected future losses due to the need to hold a risk margin. The risk margin is then released over future years if experience turns out to be the same as expected.



The graph above illustrates the profit pattern if the best estimate assumptions change adversely in policy year 3 under MoS and IFRS 2.

- Under MoS, the BEL will increase in the year of change, and reduce the profit margin. As long as the policy is still profitable, there will be no change to the total policy liability in the year the assumption is changed. However lower profit margin will be released over the future years so that the impact of the change is spread over future years, and is not all reflected in the third year's profit.
- Under IFRS 2, the liability will increase by the full amount of the change in the assumption, resulting in the full impact of the change of assumption being reflected in the third year's profit. The risk margin rather than falling to offset the increase in the BEL, may potentially increase to reflect a greater portfolio risk associated with the assumption change. Future release of the remaining or increased risk margin can still occur if future experience turns out to be the same as the new best estimate assumptions.

The purpose of showing the profit emergence under IFRS 2 is to explain the importance and relevance of risk margins. Not only will risk margin impact the initial profit and loss at inception, it will also impact the profit emergence throughout the contract.

International literature on risk margins

There have been a number of important, recent papers published on the topic of risk margins both internationally and in Australia. Our bibliography shows a selected list of relevant papers, which themselves show further references that may be useful.

We recommend four recent publications to anyone wishing to get up to speed with the determination of risk margins. We found these publications to be the most relevant and valuable. A brief description of these publications can be found in Appendix 2.

1. Exposure draft on Measurement of liabilities for insurance contracts: current estimates and risk margins (February and November 20077) and (March 2008), *Ad Hoc Risk Margin Working Group, International Actuarial Association.*[6]

2. A global framework for insurer solvency assessment (2004), IAA Insurer Solvency Assessment working group.

3. A Market Cost of capital approach to market value margins, Discussion Paper, (17 March 2006) *The Chief Risk Officer Forum*,

4. The Swiss Experience with Market consistent technical provisions – the Cost of Capital Approach, Federal Office of Private Insurance FOPI, March 28, 2006.

[6] To assist the IASB in the formulation of accounting standards, the International Actuarial Association (IAA) formed a task force, referred to as the "Ad hoc Risk margin working group" (RMWG) . This is an international group of actuaries who worked together to provide guidance on the subject of risk margins. The latest work published by the RMWG was an exposure draft on Measurement of liabilities for insurance contracts: Current estimates and risk margins (November 2007).

Determining risk margins

General

Risk margins are required on all insurance liabilities. For some liabilities, the risk margin may be readily observable from the market. Where it is possible to fully hedge a risk in the market place, the cost of the risk margin is the cost of that hedge. An example of such a risk (albeit not an "insurance" risk) may be capital guarantees on investment account business.

For non-hedgeable risks, there are a number of possible methodologies. It is useful to be aware of the range of possible methodologies, as different methods highlight different considerations when setting risk margins.

The IASB discussion draft[7] lists a range of possibilities, which we have summarised below.

Method	**Comments**
Quantile Methods	
Confidence intervals/probability of sufficiency (PoS).	This method is often used by general insurers in Australia for profit reporting
Conditional Tail Expectation (CTE) or Tail Value at Risk. For example CTE90 is the expected value of all outcomes beyond the 90th percentile.	This type of approach is used in assessing capital in respect of operational risk by banks in Australia and is useful in considering general insurance capital requirements where more extreme events are considered.
An explicit margin within a specified range.	This is used in capital adequacy standards for life insurance in Australia.
The risk margin may be expressed as multiple of the variance, or standard deviation , for example risk margin equivalent to 2 standard deviations above the mean.	
Cost of Capital Method	
The risk margin reflects the cost of holding capital to back the risks.	This approach effectively represents embedded value principles.
Other Methods	
Capital asset pricing models.	This method can theoretically be used to determine risk margins, but the IASB noted that there was no research of how to apply asset pricing models to liabilities[8]. We will not consider this option further in this paper.

[7] Appendix F9 of the IASB Discussion Draft

[8] We note that there has been some Australian research on the topic, of which the IASB must have been unaware.

Method	Comments
Cash flows can be adjusted to place more weight on cash flows in some outcomes (e.g. market consistent, deflator or no arbitrage approaches)	This method is based on market consistent valuation methodology and/or financial economics. While this method is conceptually more elegant than capital asset pricing models, it is not clear to us that it can be used easily for many of the key life insurance risks, such as the lapse risk and mortality risk.
The discount rate can be adjusted to reflect the level of risk. For instance, use higher discount rate to reflect the impact of higher lapse rate on the cash flows of a portfolio of product relative to another.	This is part of the Embedded Value (EV) methodology, which has been used widely to assess the value of a portfolio. In the UK, the EV methodology is used for reporting life insurers' profit. The main drawback of this method is the lack of transparency: it is not always obvious how the adjustment to the discount rate can be used to make explicit allowance for certain risks, such as mortality or lapse risk. We will not consider this method further in this paper, partly for this reason but mostly because life insurance actuaries are already familiar with this method and its advantages and disadvantages.
Rejected Methods	
Implicit and unspecified confidence intervals or margins. An example is the use of the provision for adverse deviation (PAD) used in USGAAP.	The IASB discussion draft ruled out these two methodologies as being too implicit and lacking in transparency. The methods would fail the requirement for risk margins to be explicit under the IASB model.
The use of conservative assumptions which is meant to include unspecified margin above best estimates. These are often used in net premium valuation type methods applied to traditional participating business portfolios. and forms the basis ofa number of	

In the following discussion, we have focussed on two key generic methodologies: the quantile approaches and the Cost of Capital approach.

Cost of Capital approach

The Cost of Capital approach is emerging as the preferred method for setting risk margins by the Risk Working Group, and by the (European) CFO forum. The Swiss have also trialled this approach and documented case studies of setting risk margins using the cost of capital approach.

The conceptual basis of this approach is that the risk margin should be the amount sufficient to compensate the entity taking over the liability (the reference company) for the cost of holding capital against that liability. Note that the capital is the

additional capital that the reference company would be required to hold, not the capital which the reporting company holds.

This concept of valuing the cost of capital not new, as it is also one of the key concepts in the embedded value methodology. In both cases, there is an acknowledgement of the reality that capital will need to be held against the policy liability, and that this represents an economic cost to the entity. In an Embedded Value calculation, the cost of capital is deducted from the future distributable profit to arrive at the value of the portfolio.

In a risk margin determination context, the cost of capital is the discounted value of the difference between what a purchasing company would require as the rate of return on its capital and what it could earn at the risk free rate.

Reference Company and the Cost of Capital

As mentioned earlier in this paper, consideration needs to be given as to which assumptions should be driven by the characteristics of the reporting company or the characteristics of the reference company. Further consideration needs to be given as to whether there would be any material difference in the assumptions which the two companies might use.

Consideration needs to be given to the following elements:

- Cost of Capital — This should reflect the cost of capital to the reference company.
- Mortality Risk — Although in theory the claims management practices might differ, between the companies, practically this would be difficult to quantify. We think it likely that this risk will follow the underlying entity, other than adjustments for any risk due to small portfolio sizes in the reporting company.
- Lapse Risk — Although in theory the lapse experience could change significantly after a transfer, practically this would be difficult to quantify. We think it likely that this risk will follow the underlying entity.
- Expense Risk — This risk could be drawn from the reference company as a risk where diversification across a large company is particularly relevant. However, in practice, we think that objective evidence of market consistent expense levels are extremely difficult to obtain, and that expense may end up reflecting the reporting entity's expense levels. One exception may be the expense level of a start up company, where market level of expenses may be more appropriate.

What is the appropriate capital to use?

Both the CFO forum paper and the Swiss experience paper use the statutory capital in the calculation of the risk margins under the cost of capital method. It is however, possible to think of the capital as the economic capital that the reference company might hold in respect of the acquired portfolio.

There are two main possibilities for the appropriate level of capital:

1. Economic capital: This is the level of capital which a reference company might assign against the product. As an example this might be thought of as the capital adequacy liability (i.e. prior to applying the minimum of the Current Termination value) ;
2. Statutory capital: this is the level of capital that the regulator requires. In Australia , this is the capital adequacy requirement, after the application of the Current Termination Value. This is a very high level of capital for retail risk products due to the current termination value minimum.

What is the appropriate cost of capital rate to use?

If the capital requirement is set by the regulator, then once the best estimate assumptions are determined, the key unknown in this methodology is the cost of capital charge.

There is currently no generally accepted method for determining an appropriate cost of capital charge for the reference company.

Swiss Approach

The approach adopted by the Swiss regulator (the Federal Office of Private insurance, FPI) used the reference company concept in setting the cost of capital rate.

In the Swiss Solvency test, the Swiss regulator specified a cost of capital rate of 6%, consistent with rates of return required by a BBB rated company in 2005 when the field test was carried out. This rate applied to every company in the market in their calculations of the risk margin. We note that the Risk Margin Working Group uses a lower rate of 4% when conducting some of their examples. In both instances, the papers recognise that this is an area for further research and development.

Using the same cost of capital across companies means that the risk margin for two similar portfolios written by two different companies should be the same, which is in our view is an appropriate outcome. This is consistent with the cost of capital rate reflecting the required return on capital of the reference company rather than the reporting entity.

The Swiss test was based on a fixed rate of 6% over the period 2004 and 2005. Consideration should be given to over time whether this rate should be a dynamic rate across the industry, and if so, what should this rate be pegged to. A number of possibilities come to mind, such as the yield on equity, the rate of return used in portfolio transfer. To keep the paper focused, we have noted that this is an issue but have not addressed it further in this paper.

Relevance of the Swiss Approach to Australia

The cost of capital rate chosen should be considered in conjunction with the type of capital chosen.

- Economic capital: If economic capital is used as the base capital then a cost of capital rate based on shareholder required rates of return might produce reasonable results.
- Statutory capital: On the hand, if statutory capital is used, then it is worth noting that in Australia, the requirement for a CTV minimum for risk products produces quite a high level of capital. One might argue that the excess capital coming from having to meet this minimum is "less at risk" than the capital embedded within the margins of the Capital Adequacy Liability, and therefore, economically should attract a lower cost of capital.

Is the calculation of risk margins using the Cost of Capital method circular?

One of the key criticisms levelled at the Cost of Capital method for determining risk margins is that it may be circular. The concern is that the risk margins are dependent upon the capital requirement, but the capital requirement is the capital over the liability (including the risk margin) to reach the relevant level of sufficiency.

Under the Cost of Capital method, strictly speaking an iterative process is required to determine the risk margins, as the risk margins are determined as the present value of the excess of the capital requirement over the insurance liabilities, which themselves include the risk margins.

In practice, the CFO forum paper suggests that this problem can be overcome by setting the risk margin as the present value of the capital requirement over and above the Best estimate liabilities (BEL)[9]. If the risk margin is small compared to the total insurance liabilities then using the BEL will produce materially accurate results.

If this approximation were not to be used, the calculation may involve a number of iterations the first time the cost of capital is calculated, but thereafter companies should have a reasonably accurate starting point. In Australia, for retail risk products, , the difference between CTV and Policy Liability is likely to be many times larger than the risk margin, thus it is expected that determining the risk margin on the difference between CTV and Best Estimate Liability is unlikely to produce a materially different result.

If the capital requirement itself is risk based and relies on an internal model of some sort, then the relevant parameters need to be determined by the internal model before the risk margins can be calculated. The capital requirement may itself be determined using a bottom up, risk based, quantile method.

Calculating risk margins using the Cost of Capital Method

The following simple example illustrates the Cost of Capital methodology using an arbitrary capital requirement to demonstrate the calculation method.

[9] CRO Forum Paper, Page 21

We are calculating the risk margin at the end of the first year for a yearly renewable term insurance contract. Only death claims are considered and no expenses have been included.

Let us assume for the purpose of the example that

a. The economic capital requirement for the reference company is 10% of the best estimate present value of claims.
b. The cost of capital is 6% pa. This means that the reference company's shareholder demands that the capital earns 6% above the risk free rate.

The Capital Requirement is calculated in Column 6, as 10% of the present value of claims. The Capital Cost associated with each capital requirement is calculated in column 7, as 6% of the Capital Requirement (e.g. 19,033 x 6% = 1,142).

The risk margin required in each time period is the present value at a risk free rate of the **future** capital costs. Thus, at time 1 the risk margin is 4,102 or the present value of the cash flow stream of (1,142, 940, 768, 619, … 59). At time 2, the risk margin is 3,206, being the present value of the remaining cash flow stream (940, 768, 619 ... 59)

The determination of each column in the table is set out in Appendix 1.

Premium	1,000
SI	600,000
Mortality	0.0750%
Lapse	15%
Capital Req't	10%
Risk Free Rate	6%
Cost of Capital I	6.0%

Simple Example: No Expenses, based only on claims - Designed to show how Risk Margin is Calculated

Year	Number of Policies	Premiums	Claims	PV Claims	Capital Req't =10%xPV Claims	Capital Cost 6%xCapital Req't	Risk margin required at time t	Risk margin required at time t as % PV claims
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	100.0	100,000	45,000	190,327	19,033	1,142	4,102	2.16%
2	84.9	84,936	38,221	156,746	15,675	940	3,206	2.05%
3	72.1	72,142	32,464	127,930	12,793	768	2,458	1.92%
4	61.3	61,274	27,573	103,142	10,314	619	1,838	1.78%
5	52.0	52,044	23,420	81,757	8,176	491	1,329	1.63%
6	44.2	44,204	19,892	63,242	6,324	379	919	1.45%
7	37.5	37,546	16,895	47,145	4,715	283	594	1.26%
8	31.9	31,890	14,350	33,078	3,308	198	347	1.05%
9	27.1	27,086	12,189	20,713	2,071	124	169	0.82%
10	23.0	23,006	10,353	9,767	977	59	55	0.57%
Present Value		422,948	190,327					

From a practical point of view, the Cost of Capital method of determining risk margins would be a relatively easy method for most Australian life insurers to execute, regardless of their size. For some product groups, this methodology would easily build off existing functionality (e.g. yearly renewable term life policies) for other product groups (e.g. group life) simple projection models may be need to be built, if not already existing.

Calculating the risk margins for a term insurance portfolio in Australia

In this section, we will make the example a little more relevant to an Australian audience by using Australian capital requirement and by comparing the expected profit emergence under IFRS 2 and MoS.

Currently, under the Australian reporting regime (MoS), the present value of future profits at inception is calculated and released over time, with no recognition of profit at inception if the contract is profitable. If the contract is loss making, however, there would be a recognition of future losses at inception.

Under IFRS 2, a profit or loss for the same policy will be released at inception depending upon whether the risk margins associated with the policy are higher or lower than the present value of future profits, as illustrated in an earlier section of the paper.

In the example below, we show the profit signature of a typical term insurance policy under IFRS 2 if the risk margins have been calculated using the cost of capital method, using (a) an economic capital basis equivalent to the capital adequacy liability (i.e. no CTV minimum and (b) the actual capital adequacy requirement under LPS 3.04 (CTV minimum applies).

For the purpose of this example we will assume:

100 policies ($1,000 premium for $600,000 Sum Insured)

Initial Commission	100% first year's premium		
Trail Commission	10% premium		
Acquisition Expenses	$200 + 25% Premium		
	Best Estimate	Capital Adequacy	Reasons for Capital Adequacy Margin
Maintenance Expenses	$60 + 4% Premium	+2.5%	Low margin reflecting well run state of reference company.
Mortality Rate	0.075% (flat)	+30%	High margin reflecting poor knowledge of best estimate of reporting company.
Lapse Rate	15% (flat)	+25%	Low margin reflecting good knowledge of best estimate of reporting company.
Risk Free Rate	7%		
Cost of Capital	6%		For illustrative purpose only

Under MoS, this would give a profit margin of 14% of claims costs. The main cash flows are shown in the table below. Details of the calculation of each column are given in Appendix 1. For this purpose, we have used the approximation that capital is based on the excess over BEL rather than Policy Liability.

Margin on Services profit release

Year	Number of Policies (boy)	Premiums (boy)	Acq Exp /Comm'n (boy)	Maint Exp /Comm'n (eoy)	Claims (eoy)	Investment Income	BEL (eoy)	PVPM = 14% PV Claims (eoy)	Current MoS Profit
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
0						-	26,449	26,449	-
1	100.0	100,000	145,000	20,000	45,000	- 3,150	- 141,450	21,821	6,479
2	84.9	84,936		16,987	38,221	- 2,429	- 115,678	17,845	5,503
3	72.1	72,142		14,428	32,464	- 1,798	- 93,476	14,420	4,674
4	61.3	61,274		12,255	27,573	- 1,245	- 74,285	11,460	3,970
5	52.0	52,044		10,409	23,420	- 755	- 57,626	8,890	3,372
6	44.2	44,204		8,841	19,892	- 317	- 43,094	6,648	2,864
7	37.5	37,546		7,509	16,895	77	- 30,341	4,681	2,433
8	31.9	31,890		6,378	14,350	436	- 19,071	2,942	2,066
9	27.1	27,086		5,417	12,189	767	- 9,030	1,393	1,755
10	23.0	23,006		4,601	10,353	1,076			1,491
Present Value		436,786		81,642	183,695				26,449

The table above shows the profit release under the current Australian reporting regime.

Under IFRS 2, the MOS profit margins are no longer held, instead, the risk margins would be held in addition to the BEL.

If the risk margins are based on economic capital (e.g. the capital adequacy liability), then a significant profit would be released at inception. In each subsequent period, the risk margin for that period (which is much smaller than the MoS profit) is released. The main cash flows under this scenario are shown in the table below.

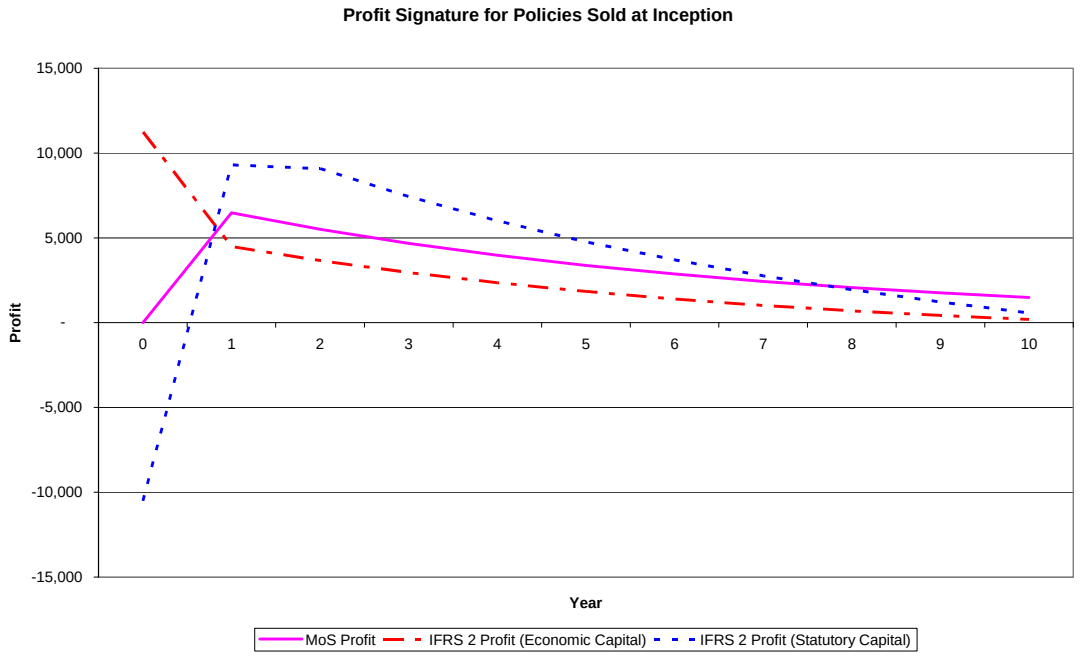
IFRS 2 profit release – risk margins based on Capital Adequacy Liability

Year	Number of Policies (boy)	Premiums (boy)	Acq Exp /Comm'n (boy)	Maint Exp /Comm'n (eoy)	Claims (eoy)	Investment Income	BEL (eoy)	Capital Req't =Ignoring min CTV	Capital Cost 6%xCapital Req't	Risk Margin = PV Capital Cost	New Profit (IFRS 2)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0						-	26,449	69,887	4,193	15,210	11,239
1	100.0	100,000	145,000	20,000	45,000	- 3,937	- 141,450	57,037	3,422	11,788	4,487
2	84.9	84,936		16,987	38,221	- 3,131	- 115,678	46,051	2,763	8,951	3,662
3	72.1	72,142		14,428	32,464	- 2,421	- 93,476	36,656	2,199	6,621	2,956
4	61.3	61,274		12,255	27,573	- 1,791	- 74,285	28,619	1,717	4,732	2,353
5	52.0	52,044		10,409	23,420	- 1,226	- 57,626	21,745	1,305	3,225	1,837
6	44.2	44,204		8,841	19,892	- 714	- 43,094	15,872	952	2,055	1,396
7	37.5	37,546		7,509	16,895	- 245	- 30,341	10,863	652	1,180	1,019
8	31.9	31,890		6,378	14,350	191	- 19,071	6,607	396	565	697
9	27.1	27,086		5,417	12,189	601	- 9,030	3,010	181	181	424
10	23.0	23,006		4,601	10,353	991			-	-	193
Present Value		436,786		81,642	183,695						26,449

If the capital base is instead set to be statutory capital, the risk margins would need to be based on the change in the Capital Adequacy Requirement (after applying the CTV minimum). Here the capital requirement is much higher than under the first scenario, therefore the risk margins based on these capital requirements are also much are higher. In the example, such risk margins are greater than the MoS profit, thus a loss can be expected to occur at inception. In each subsequent period, the risk margin for that period is released. The main cash flows are shown in the following table.

Year	Number of Policies (boy)	Premiums (boy)	Acq Exp /Comm'n (boy)	Maint Exp /Comm'n (eoy)	Claims (eoy)	Investment Income	BEL (eoy)	Capital Req't =Ignoring min CTV	Capital Cost 6%xCapital Req't	Risk Margin = PV Capital Cost	New Profit (IFRS 2)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0						-	26,449	145,000	8,700	36,955	- 10,506
1	100.0	100,000	145,000	20,000	45,000	- 2,415	- 141,450	141,450	8,487	30,233	9,309
2	84.9	84,936		16,987	38,221	- 1,840	- 115,678	115,678	6,941	23,268	9,081
3	72.1	72,142		14,428	32,464	- 1,419	- 93,476	93,476	5,609	17,470	7,427
4	61.3	61,274		12,255	27,573	- 1,031	- 74,285	74,285	4,457	12,692	6,001
5	52.0	52,044		10,409	23,420	- 668	- 57,626	57,626	3,458	8,812	4,769
6	44.2	44,204		8,841	19,892	- 323	- 43,094	43,094	2,586	5,729	3,700
7	37.5	37,546		7,509	16,895	13	- 30,341	30,341	1,820	3,363	2,767
8	31.9	31,890		6,378	14,350	344	- 19,071	19,071	1,144	1,651	1,948
9	27.1	27,086		5,417	12,189	677	- 9,030	9,030	542	542	1,224
10	23.0	23,006		4,601	10,353	1,016			-	-	580
Present Value		436,786		81,642	183,695						26,449

The profit signature difference can be clearly seen in the following graph.



The example above illustrates that under IFRS 2, using the cost of capital method of calculating risk margins and based on the current Australian capital requirement, initial losses may emerge even for profitable contracts. This does not seem to be a reasonable outcome at first, until we note that a uniform cost of capital rate (of 6%) has been used across all of the capital. If we consider that in an ongoing business, the first layer of capital (the risk margins put on mortality, lapses, and expenses etc) is much more at risk than the second layer (the Current Termination Value), then it may be reasonable to consider that a lower cost of capital rate on the second layer of capital may be justified. If a lower cost of capital rate of (say) 2% was used on the second layer of capital, then initial losses no longer emerge.

IFRS 2 profit release – risk margins based on Capital Adequacy Requirement with lower cost of capital rate on second layer of capital

Year	Number of Policies (boy)	Premiums (boy)	Acq Exp /Comm'n (boy)	Maint Exp /Comm'n (eoy)	Claims (eoy)	Investment Income	BEL (eoy)	Capital Req't =Ignoring min CTV	Capital Cost 6%xCapital Req't	Risk Margin = PV Capital Cost	New Profit (IFRS 2)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0						-	26,449	145,000	4,388	17,452	8,996
1	100.0	100,000	145,000	20,000	45,000	- 3,780	- 141,450	141,450	4,024	13,979	4,695
2	84.9	84,936		16,987	38,221	- 2,977	- 115,678	115,678	3,259	10,652	4,305
3	72.1	72,142		14,428	32,464	- 2,302	- 93,476	93,476	2,604	7,911	3,487
4	61.3	61,274		12,255	27,573	- 1,700	- 74,285	74,285	2,043	5,678	2,787
5	52.0	52,044		10,409	23,420	- 1,159	- 57,626	57,626	1,561	3,890	2,186
6	44.2	44,204		8,841	19,892	- 667	- 43,094	43,094	1,147	2,492	1,670
7	37.5	37,546		7,509	16,895	- 214	- 30,341	30,341	791	1,440	1,227
8	31.9	31,890		6,378	14,350	209	- 19,071	19,071	485	694	846
9	27.1	27,086		5,417	12,189	610	- 9,030	9,030	224	224	519
10	23.0	23,006		4,601	10,353	994			-	-	239
Present Value		436,786		81,642	183,695						26,449

Alternatively, one can decide to allow for this issue by using a uniform rate across all layers of capital. This rate should lie between 6% and 2%. In our example, a uniform cost of capital rate of 2.5% applied to a statutory capital base produces a similar risk margin to the margin produced by discounting the economic capital base at 6%. A uniform rate of 2.85% produces a similar risk margin to the margin produced by discounting the first layer at 6% and the second layer at 2%.

We note that the risk margins derived in this way represent

- about 3% to 4% of the present value of claims if economic capital is used and the cost of capital is discounted at 6%
- 15% to 20% of the present value of claims if statutory capital is used and the cost of capital is discounted at 6%
- 7% to 10% of the present value of claims if statutory capital is used and the first layer is discounted at 6% and the second layer discounted at 2%.

We have not repeated the exercise for a Group Life example as we expect no material differences in the application of the Cost of Capital method. The key difference would likely be that the margin derived using economic capital would be much closer or identical to the margin derived using the statutory capital as MTV is not a driver of capital for a group life policy where acquisition costs are minimal or not deferred.

The Quantile Approach

General

The conceptual basis of the quantile approach is that a risk margin exists to ensure that the reserve, together with the risk margin would be sufficient to meet future liabilities most of the time, as there are uncertainties in determining the central estimates of the liabilities. At the risk of stating the obvious, the quantile method can be used to determine the risk margin either for capital adequacy purposes or for profit reporting purposes. It does not depend on a prescribed set of capital requirement already in existence.

The quantile approach is the approach used by APRA for general insurers in Australia for determining outstanding claims liabilities and premium liabilities. For solvency purposes, the actuary is required to set the risk margins so that together with the central estimate is expected to have a probability of sufficiency of 75%. For profit reporting purposes, the liability is required to be increased by a risk margin to allow for uncertainty inherent in the central estimate of the liability.

The solvency and capital adequacy margins prescribed for life insurers fundamentally are also based on the same concept: The risk margins together with the BEL are to be sufficient to reduce the probability of ruin to 1 out of 200 years for solvency (or 1 out of 400 years for Capital Adequacy).

The key difference between general insurance and life insurance is that the life insurance prudential standards are much more prescriptive in nature than in general insurance. Consequently, up until now, life insurance actuaries did not have to determine risk margins from first principles on a day to day basis.

Typically, a systematic approach to setting risk margins using the quantile method involves:

1. Determining the risk margins for each product line

    1a. Considering each of the risks involved in the business and the extent to which each risk has been mitigated in some way in the reference company or whether it should be allowed for by adding a risk margin to the central estimate. For example
        a. catastrophe risk may be mitigated with catastrophe or stop loss reinsurance,
        b. operational risk may be allowed for explicitly as part of the capital, whereas
        c. volatility around the central estimate due to random fluctuations, uncertainty around the level of the best estimate and future trends may require a risk margin to be added to the central estimate.

    1b. If the conclusion is that a risk margin is the appropriate response for certain risk, then each of these risks needs to be modelled separately to determine how much they should add to the reserves for each product.

2. Aggregating risk margins for the company: when aggregating risk margin across product lines for the company, it is necessary to consider and allow for diversification benefits.

   Once the individual products' risk margins have been determined, the products of the company may be considered together to see if there are offsets that can be allowed for, these are referred to as diversification benefits.

   The example often given for diversification benefits in a life insurance context is the opposing effect of mortality increase on the risk margins for annuities and term insurance. In practice, one needs to careful about the general applicability of such a scenario, as it is possible to have lower mortality at annuitants' age group due to faster than expected mortality improvement while at the same time have unchanged mortality of the insured lives in the term insurance product. Other examples might be the correlation between economic conditions and morbidity level, and lapse and mortality/morbidity level of the remaining portfolio. By contrast, in a multi line general insurance portfolio, it is easy to envisage positive correlation between certain risks, for example, motor and building outstanding claims liabilities may be correlated as they may both be affected by the same storm.

   We note that allowance for diversification benefits is a point of contention in the IASB Discussion Draft, which states that no diversification benefits should be allowed for. The submission from the Institute of Actuaries of Australia to the IASB challenged this view and argued that diversification benefits should be allowed consistent for as a large and diversified reference company should experience diversification benefits.

   Part of the calculation of the diversification benefit involves articulating the correlation between the different risks. Although it is theoretically possible to develop an internal model that allows for all the correlations and dependencies between risks, in practice this is difficult to achieve. Indeed it is difficult to obtain sufficient relevant data to validate the parameters in the model. Attempts to allow for correlation between risks in the Blue Book involves making what could be considered fairly arbitrary assumptions.

Reference company considerations

The use of a reference company impacts many otherwise obvious statistical considerations, such as: Should the risk margin for a small portfolio be larger than the risk margin of a similar but much larger portfolio?

We would expect that the experience of the smaller portfolio would be subject to more uncertainty than the large portfolio, due to:

1. random fluctuation around the central estimate
2. uncertainty around the level of the risk,
3. uncertainty around the future trend of the risk and

4. uncertainty around the future term of the risk.

In a life insurance context, for example, a small portfolio of term insurance may be subject to random fluctuations in actual claims, as well as more uncertainty than a large portfolio because the best estimate assumptions may have been set using limited company data, or adjusted industry published statistics.

In an exit value framework, one would expect the risk margin for a small portfolio to reflect the portfolio's uncertainty around the future level and trend of the Best estimate assumptions but not the uncertainty around the random fluctuations, which would be reflective of the reference company's.

Risk margin for mortality uncertainty

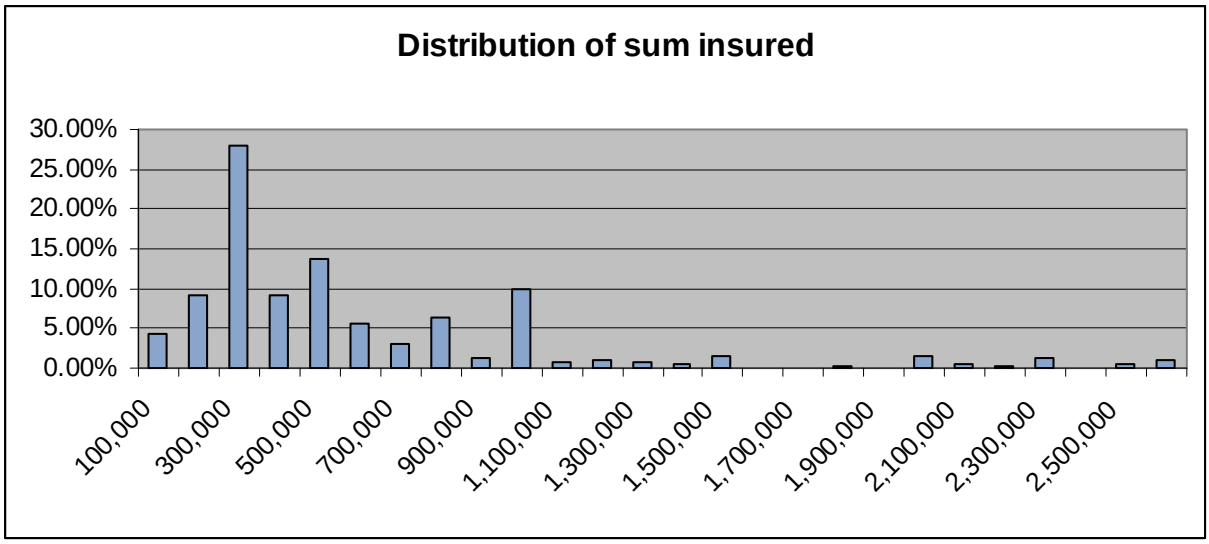
In the section below, we have shown an example of how the quantile method might be used to determine the mortality risk margin for a yearly renewable term insurance portfolio, and an IBNR risk margin for a group life policy.

Example 1: Risk margin for a yearly renewable term insurance portfolio

Description of the portfolio

We have constructed four hypothetical portfolios of yearly renewable term insurance policies. Portfolio 1 and 3 are identical in distribution but portfolio 3 is a quarter the size of portfolio 1. Portfolio 2 is 60% the size of portfolio 1 but has more extreme (large) sum insured, that is it is more skewed. Portfolio 4 is much larger than the rest and represents the reference company's portfolio.

The graphs below show the distribution of sum insured by size for the portfolios.



The portfolios can be described using the following statistical measures.

	Number of lives	Maximum / average sum insured	Skewness (Standard deviation / Average)
Portfolio 1 – typical	121,800	9.91	3.58
Portfolio 2 – skewed	60,900	44.03	7.48
Portfolio 3 – small but typical	24,360	9.91	3.58
Portfolio 4 – reference company	365,400	9.91	3.58

Determining risk margins for mortality uncertainty

Uncertainty surrounding mortality for a yearly renewable term life policy may be considered as made up of four key components:

1. random volatility (stochastic variation around mean)
2. uncertainty regarding the level of the best estimate assumption
3. uncertainty regarding the trend that have been incorporated into the best estimate assumption
4. pandemic risk. For profit reporting, we will assume that the risk margin relating to pandemic risk is negligible. For capital purpose, this will probably not be negligible.

Random volatility

It is possible to determine the appropriate risk margins due to random volatility around the mean by using stochastic simulations, or if we were willing to make simplified assumptions about the distribution of outcomes, using statistical techniques to derive an approximate formula.

The International Actuarial Association "Insurer Solvency assessment working party" (the Blue Book) shows an example of the risk margins for an overseas term insurance portfolio for a probability of sufficiency of 99.5%.

In this paper, we have repeated this exercise but using four term insurance portfolios with a typical distribution of sum insured for an Australian office, and using a lower probability of sufficiency of 75% which may be more consistent with risk margins from a profit reporting perspective rather than a solvency perspective[10]. We have shown the risk margins at 99.5% as well, for interest, and for comparison with the Blue Book's result. We have illustrated only the results using the simulation approach in this paper, but we note that the Blue Book example suggests that it is possible to obtain very similar result using a Normal Power approximation.

We have chosen a 75% percentile for illustrative purpose only. In using 75% probability of sufficiency, we are not necessarily advocating this particular level of sufficiency as suitable for profit reporting. Further work is required to determine this level. Nonetheless, it would seem to us that in a realistic profit reporting framework, the probability of sufficiency for profit reporting should be significantly less than the probability of sufficiency required for Solvency.

[10] Interestingly, we note that the general insurance perspective could be somewhat different regarding the relativities between solvency and profit reporting risk margins. This is discussed later in the paper.

In this exercise, the claims outcome of the four portfolios using a Monte Carlo process is simulated with 1000 iterations. We have assumed that the probability of death for an insured life aged x is q_x where q_x is from the expected mortality basis of 70% IA 95-97 ult, which is a typical level of mortality used in Australia for insured lives..

Results

The table below shows the risk margin required for the four portfolios described above. The risk margins represent the margin required to achieve the specified probability of sufficiency for the best estimate liability, in this case the present value of the future death benefits.

The characteristics of the portfolios are reproduced next to the risk margins for ease of reference.

Table 1- Risk margins on reserve for typical Australian portfolios

	Risk Margins (% present value of future claims)		Portfolio statistics		
	75% PoS	99.5% PoS	Size (no of lives)	Standard deviation	Skewness
Reference	1.3%	3.2%	365,400	9.91	3.58
Typical	2%	8%	121,800	9.91	3.58
Skewed Portfolio	4%	14%	60,900	44.03	7.48
Small	5%	20%	24,360	9.91	3.58

Some observations from the table above

- the risk margin under a 75% Probability of sufficiency is about a quarter to a third of the 99.5% probability of sufficiency risk margin
- Skewness adds to the risk margin, as does a smaller portfolio size. This is consistent with our expectation from a purely statistical perspective.
- The risk margin corresponding with a 99.5% probability of sufficiency range from 3% to 20% which is somewhat lower than the LPR 3.04 Capital Adequacy Requirement for a 10% to 40% mortality risk margin.

When setting the risk margin for volatility around the mean for any one of the four portfolios above, it is the margin of the reference portfolio that is relevant, rather than the margin relating to the actual portfolio being valued. In the example above, the risk margin for random volatility about the mean from mortality should be 1.3% rather than 2%, 4% or 5%.

Comparing the Australian result with overseas results

Section 6 of the Blue Book shows the following risk margin for mortality volatility around the mean, under a 99.5% probability of sufficiency.

Table 2a – Risk margin for a YRT portfolio.

Portfolio	Risk margins as % risk premium for a 99.5% PoS	Portfolio statistics		
		Size	Max SI / Average	Skewness
Typical portfolio	22.7%	125,970	11.6	0.13
Skewed portfolio	69.9%	60,777	40.3	0.77
Small but typical	57.2%	25,570	14.7	0.18

This table suggests that risk margins of between 23% and 70% risk premium are required for volatility around the mean in respect of mortality, depending on the size and the skewness of the portfolio for capital purposes. We note that the risk margin is expressed as a percentage of one year risk premium, which would be much lower than the Present value of future claims.

When the Australian table is expressed as a percentage of risk premium claims, it gives comparable figure to the Blue Book.

Table 2b- Risk margins for typical Australian portfolios as % risk premium

Australian Portfolio	Risk Margins (% risk premium)		Portfolio statistics		
	75% PoS	99.5% PoS	Size	Max SI / Average	Skewness
Typical	8.23%	26.00%	121,800	9.91	3.58
Skewed portfolio	12.99%	39.05%	60,900	44.03	7.48
Small but typical	19.61%	53.55%	24,360	9.91	3.58

Level uncertainty

Uncertainty exists around the level of the best estimate assumptions, that is the risk of misestimating the mean.

One approach to estimate the risk margin for this uncertainty is to "shock" the best estimate present value of claims. To find the magnitude of the shock, we could assume that deaths in the portfolio follow a Poisson distribution with a mean and standard deviation of qx, the probability of death at age x. If there are sufficient deaths in our sample, and if the distribution of the sum insured is not too skewed, then the Central Limit Theorem would apply, and the shock is given by

$$1 / (\sqrt{n})$$

where n is the number of expected claims, and in a Poisson distribution is given by $\sum$ E qx, where E is the exposed to risk.

As an example, a large insurer who has a portfolio with 500 expected claims a year has based the best estimate assumptions on a three year experience investigation.

Thus the total expected claims included in the study was 3 times 500 , i.e. 1500. The shock is given by :

$$1/ (\sqrt{1500}) = 2.58\%$$

If the distribution of claims is normally distributed, at 75% probability of sufficiency, 2.58% above the mean would convert to a risk margin of 1.74% (2.58% * 0.675). A smaller insurer may be relying on an experience study with 120 claims in each year of study, the risk margin may be larger at 3.56% (1/ √360 * 0.675).

Trend uncertainty

Another source of the uncertainty is the mis-estimation of the trend in the data.

We outline below one approach that might be adopted to assess the risk margin relating to trend uncertainty. For this purpose, we need to consider the experience of a portfolio over a reasonably long period, say 10 years.

- Consider the trend implied by the first three year's experience .
- Calculate the trend that may be estimated at the end of each three year period to incorporate into the following year's assumption.
- Compare this estimate with the actual experience in year 4.
- Repeat this exercise for each rolling three year period.

The trend uncertainty can be estimated based on the distribution of the "error" in trend estimation which can be observed from each rolling three year period.

If we had 10 years of experience, we would be able to make 7 observations at various ages, which may be sufficient in mapping the distribution function of the trend error, and estimate the appropriate percentile, say the 75th percentile.

We have trialled this technique based on Australian population mortality for 10 years.

Appendix 3 shows the workings and demonstrates that this technique is relatively simple to apply. The Australian Bureau of statistics records the number of people by age and sex at each year in the past up to 2006. From this data, the probability of survival (px) and the probability of death (qx) can be calculated at each age. Using standard statistical functions, derive the "expected" at each year from 1994 onwards, and calculate the deviation from expected by comparing with actual 1994 mortality. This exercise gives us the errors from the trend at each age, for 1994 to 2000, from which we can derive the 75th percentile of the errors, which are summarised below.

	75th Percentile
Male	107.20%
Female	106.38%
Total	106.87%

Thus, if our portfolio's mortality experience were the same as the population from 1991 to 2000, then the risk margin for trend uncertainty would be around 7% of the central estimate. In using the Australian population data, we looked at the trend by age to give us more data points, a company however would likely only be interested in the overall trend error.

If this exercise was performed for a series of experience studies, the observed qx would already exist as the raw data, however, a graduation exercise may need to undertaken to fill in the missing data for some ages.
Trend uncertainty should be based on the portfolio and the experience study specific to the portfolio rather the reference company.

Taking the three sources of uncertainty together, the risk margin for mortality uncertainty for a large company may be 1.3% for random fluctuations, 1.74% for level uncertainty and for example 5% for trend uncertainty. For a smaller company, the risk margin may be made up of 1.3% for random fluctuations, 3.56% for level uncertainty and 7% for trend uncertainty, for example.

Example 2: Group Life Insurance

There are a number of fundamental differences between a group life portfolio and a term insurance portfolio when considering risk margins. All group schemes are unique, nevertheless the following are characteristics shared by many industry funds and large corporate schemes.

1. Industry group insurance sum insured tends to be smaller than in a retail portfolio
2. The distribution of sum insured in an industry group insurance scheme tend to be more homogeneous, as sum insured are offered in multiple of the default cover.
3. Industry group insurance cover tends to reduce with age, as the contribution rate tend to be fixed per member.
4. Group insurance contracts tend to have a shorter term than term insurance retail business, often 3 years.

The factors above should reduce the volatility of claims experience. The following characteristics, however, increases the potential volatility of claims experience for industry group insurance schemes:

5. Lives in a group insurance scheme may be concentrated in few locations, being the employer's offices and factory or work site. Thus the exposure to concentration risk may be higher than for a portfolio of term insurance.
6. Delay in reporting claims are typically longer in a group life insurance portfolio than in a term insurance portfolio.
7. Quality of underlying data on which assumptions are based.

The acquisition costs in respect of a group insurance policy are usually relatively small and would not normally be deferred. The policy liability for a group insurance portfolio would therefore typically be made up of:

1. IBNR reserve
2. Unearned premium reserve
3. Accrued but unpaid profit share reserve
4. A premium deficiency reserve to the end of the premium guarantee period, if applicable. If the contract is profitable, this reserve is zero.

The premium guarantee period is usually 3 years, so the remaining term is usually may be even shorter.

The key uncertainty in the liabilities held for group life products is in respect of the IBNR reserve for Death and Total and Permanent Disablement cover.

A common technique used in general insurance to assess variability of outstanding claims liabilities is the Mack Method[11]. We have applied the Mack method to two group life death and TPD's reporting delay triangles for industry funds of $5M to $10M in size.

We found that the unadjusted coefficient of variance given by the mechanical application of the Mack Method to this data ranges between 14% and 20% for death and 8% to 13% for TPD, depending on whether we use monthly or quarterly data. Monthly data gives consistently higher coefficient of variance.

If a lognormal distribution is assumed, and if we were to assume a coefficient of variance of 15% , then a risk margin of 9% of the best estimate IBNR reserve is required to achieve a 75% probability of sufficiency, 26% of best estimate reserve for a 90% probability of sufficiency and 40% for a 99.5% probability of sufficiency. If we use a higher coefficient of variance for death than TPD, we get slightly higher risk margins, for example 11% at 75% probability of sufficiency and 52% at 99.5% probability of sufficiency.

Risk margin as % BEL

	CoV 15% all	CoV 15% for TPD and 25% death	Current Solvency risk margin requirement for Group risk	Capital Adequacy risk margin requirement
75% PoS	9%	11%	10%	
90% PoS	26%	25%		
99.5% PoS	40%	52%		10% to 40% (Mortality) 30% to 60% (Other insured events

The 9% to 12% risk margin for profit reporting purpose is similar to the current solvency risk margins, the risk margins at 99.5% probability of sufficiency is not dissimilar to the range of risk margins under current Australian Capital Adequacy requirement.

If the group life contract has a profit sharing clause, the IBNR reserve for a with profit group life contract should be considered together with the accrued profit share rebate for the purpose of setting the risk margin. The profit share payment acts as a cushion to reduce the uncertainty of the best estimate IBNR reserve. Indeed, one would expect that the risk margin for a group life contract with profit share would be lower than one without profit share, as some of the uncertainty has been transferred into the "certain" best estimate liability in the form of a reserve for accrued profit share.

[11] Thomas Mack , Distribution-free calculation of the standard error of the chain ladder reserve estimates, ASTIN Bulletin, Volume 23, No 2, 1993

In practice, we would expect that the Mack method may be used to obtain a first cut assessment of the risk margins of the contract without the profit share arrangement. Determining the impact of the profit share arrangement on the risk margin may need to be performed stochastically as the Mack Method is not really designed for incorporating the profit share payments.

We note that the Mack method coefficient of variance needs to be considered with care, as it relies on the same assumptions as the chain ladder method itself, that is the business volume is stable over time, and that no early data point is missing. If early data points are missing (as is often the case in group risk claims run off) or the business is growing, then the Mack Method coefficient of variance may need to be adjusted.

Summary of observations

This section of the paper has illustrated how risk margins might be calculated for two simple life insurance products, term insurance and group risk under the IFRS 2 framework. Our observations can be summarised below.

- The cost of capital example gives a risk margin of 3% to 4% of present value of claims for our sample term insurance portfolio if ecomic capital was used (i.e. ignoring CTV), 15% to 20% if statutory capital was used (i.e. allowing for CTV), and 7% to 10% if statutory capital was used but with a two tiered cost of capital rate.
- In terms of profit emergence, under the cost of capital method and using the current Australian capital adequacy requirement, the example suggests that a loss would be incurred at inception for a profitable term insurance portfolio followed by profit release in later years. This is largely driven by the CTV minimum requirement in the capital standard. This result is at first unexpected, although not illogical when the drivers for it are considered.
- The quantile method produces a risk margin for mortality uncertainty of between 10% and 12%, which appear to be higher than the cost of capital risk margins under the economic capital basis, given that the cost of capital risk margin is meant to capture all risks, whereas the quantile margin refers to only mortality risk. Having said this, the two methods are applied different portfolios, so a direct comparison is not really possible.
- The quantile margins at 75% probability of sufficiency are about 1/3 of the margins required for a 99.5% probability of sufficiency. The margin for volatility around the mean from the example for 99.5% probability of sufficiency are about half of the current capital adequacy risk margin ranges for mortality. If one considers that the current adequacy ranges also cover other uncertainties such as level and trend uncertainty, then the quantile risk margins are not inconsistent with the current capital adequacy ranges.
- A first cut estimate of risk margins for IBNR for group risk at 75% PoS give margins comparable with the current prescribed margin for Solvency. Calculation of risk margin for a with-profit group life scheme is likely to require a combination of statistical reserving technique and stochastic methods.

Cost of Capital vs. Quantile

Key Advantage of Both Methods

The key advantage of the Cost of Capital method is that once the capital requirement is known, the risk margin can be determined fairly readily. The process is simpler for the company and can be reduced to a fairly automated and indeed mechanical process.

The key attraction of the quantile method is that it puts the risk margin in context and relates it to the company's risk appetite. The "sufficiency concept" is an everyday concept. It is appealing to consider the reserves as being sufficient 3 out of 4 years, or 99 years out of 100 etc.

Practicality & Consistency between Companies

The Swiss experience demonstrated that the cost of capital approach could be readily implemented by companies regardless of size.

Applying the quantile method to setting risk margins requires more effort than using the cost of capital method. The quantile method involves making assumptions about many distribution of outcomes, independence between events and so on, for which there may be little or no data to substantiate. For example, the log normal distribution is often used as a default distribution of outcomes in insurance modelling, but the validity of these assumptions is not often tested. Under the quantile method, different assumptions made by different companies regarding the underlying probability distribution function, independence of events, skewness of claims distribution can result in quite different risk margins for the same product line.

Case studies from overseas suggest that using the quantile method for setting risk margins for life insurance is a complex process, much more so than for general insurance. This is due to the long term nature of the life insurance business and the existence of long term guarantee and options in the contracts. For example, it is necessary to consider not only the three levels of uncertainty embedded in the central estimate of the mortality assumptions (i.e. volatility, level and trend), but also the uncertainty in any improvement that should be allowed for in the 20 or 30 years to the end of contract and the correlation that may exist between the different products and different risks.

Interaction with Regulatory Capital

In a risk based capital environment, the Cost of Capital methodology is based on the presumption that the capital requirements are equally appropriate and effective for large and small companies and for all portfolios.

In a regulatory environment where capital requirements are prescriptive rather than risk based, one could envisage a scenario where the company could rely solely on the regulator to have done this thinking for the company, as a company can set the risk margins without going through the process of considering all the possible risks that the company is exposed to in writing the business.

In Australia, where capital requirements are risk based, if using the quantile method for setting risk margin for profit reporting, one should consider the risk margins

within the risk framework used for the capital requirement calculation, to avoid double counting allowances for risk, and also to ensure that all risks are captured and allowed for appropriately.

In fact, one might say that if the capital requirement already considers these risks and makes appropriate allowance for them then there is less need to reconsider these risks for profit reporting purposes and that one might as well leverage off the thinking already done for setting the capital requirement by using the Cost of Capital method.

Similarly, when Solvency II comes into force for European insurers, it will be tempting to suggest that the cost of capital method would be a preferable methodology to the quantile method, because having sufficient capital would imply that these risks have already been allowed for adequately.

International Thinking

International thinking (for example, the CFO Forum and the Swiss experiment) is leaning heavily towards using the cost of capital method to set risk margins for both general insurance, life insurance and health insurance reserves. For example, the International Actuarial Association recently issued a practice guidance note on the topic of setting risk margins and current estimates for life and general insurers. This practice note leans heavily towards the cost of capital method as well, without actually dismissing the quantile method as a credible alternative.

The Swiss paper identifies 9 advantages of the Cost of Capital method:

1. Policyholder protection : the company taking over the Policy Liability and risk margin would automatically have sufficient capital to run off the portfolio, thus ensuring policyholder's protection
2. Transparency: a constant cost of capital (6% in the case of the Swiss) across all companies and equivalent to a BBB rating. This is considered to give better transparency than risk margins determined internal models built by each company, which may vary from company to company
3. No double counting. This comment relates to the fact that the solvency capital requirement would have a 12-month horizon, and the risk margins would allow for risks beyond the 12 months, thus there would be no double counting. This comment is somewhat specific to the solvency requirement being used. We note that in Australia, the solvency requirement also has a 12 month horizon.
4. Possible to verify calculation: provided certain information is provided to the regulator, the Swiss regulator found it relatively easy to verify the calculation of the risk margins.
5. Ease of calculations
6. Consistency in application: the cost of capital method can be applied equally by life insurers, general insurers and reinsurers. Overseas experience suggests that applying the quantile method to life insurance can be very complex as contracts could last a long time (40 or 50 years) and there are many interactions involved, such as embedded options and guarantees. The quantile method is also considered too sensitive to actuarial assumptions.

7. Consistency with pricing: All companies would allow for capital when pricing the product. Thus the calculation of risk margin allowing for capital is consistent with how the products are priced.
8. Consistency with European Embedded Value (EEV) Similarly, EEV allows for capital requirement. Determining risk margins using the capital requirement is consistent with EEV.
9. Comparability with IFRS: The Swiss regulator believes that the future direction of IFRS is to require margins demanded by a buyer in an arms length transaction to assume the liability, and that the cost of capital method is more compatible with this objective than an arbitrary quantile method.

Conclusion

Within a risk based capital framework, the cost of capital method seems to have many practical and philosophical advantages over the quantile method. However, we do not believe that the quantile method should be ignored; it is still a useful tool kit in the actuarial range of tools, and it can provide a sanity check to the cost of capital risk margins.

The Australian General Insurance experience

In Australia, general insurers have been required to hold risk margins since July 2002 for solvency purposes and since 2005 for profit reporting. Although it is not the purpose of this paper to discuss general insurance risk margins, it is nevertheless an interesting exercise to reflect on the experience of Australian general insurers to see if there are learnings that can be applied to life insurance when implementing risk margins for life insurers.

It goes without saying that the Australian general insurance actuarial fraternity has been considering the issue of risk margins determination for much longer than the life insurance actuaries in Australia, and that there are many techniques in the general insurance toolkit that will be useful in life insurance also, as we have seen above. Issue of techniques aside, some questions come to mind:

1. What should be the relationship between the risk margins used for profit reporting and that used for solvency capital adequacy?

2. What is the comfort level around setting risk margins from practitioners who have worked with these requirements since 2002?

The requirement

To understand the learnings, it is necessary to understand the requirement for risk margins for general insurers.

The requirement for risk margin for profit reporting for Australian general insurers is specified in the accounting standard AASB 1023, General insurance contracts, Clause 5.1.

"*An outstanding claims liability shall be recognised in respect of direct business and reinsurance business and shall be measured as the central estimate of the present value of the expected future payments for claims insured with an additional risk margin to allow for the inherent uncertainty in the central estimate."*

Risk margins are required in general insurance essentially to allow for uncertainty around the central estimate. In our opinion, fundamentally, it is not that different to the requirement of IFRS 2, even though the discussion draft of the IASB may express it in a slightly different way, i.e. exit value and compensation for holding risk. In real economic terms, the reason an entity can demand a margin is precisely because they are prepared to take on the uncertainty.

We are aware that this issue is being discussed both at the IASB level and within the general insurance industry in Australia. For the purpose of this paper, we have not attributed much more into this difference, other than to acknowledge that an exit value approach imply an element of validating the risk margins to an industry benchmark or market transactions.

AASB 1023 provides the following guidance on how to set risk margins.

Clause 5.1.8

The risk margin is applied to the net outstanding claims for the entity as a whole. The overall net uncertainty has regard to:

(a) the uncertainty in the gross outstanding claims liability;

(b) the effect of reinsurance on (a); and

(c) the uncertainty in reinsurance and other recoveries due.

For solvency purposes, the requirement for risk margins is specified in GPS 310 by APRA, clauses 57 and 58. Generally speaking, in terms of risk margins, general insurers in Australia are required to hold risk margins over and above the best estimate outstanding claims liability and premium liabilities equivalent to 75% probability of sufficiency, subject to a minimum of 50% of the standard deviation above the mean.[12]

We note that there is no prescribed relationship between the risk margin level for profit reporting and for solvency reporting for general insurers. For example there is no requirement that the risk margin for profit reporting must be less than the solvency risk margin. In practice, it is common for companies to hold the same risk margin for profit reporting as for solvency, both being equal to a 75% probability of sufficiency. This is an interesting contrast with the life insurance approach where realistic profit reporting has been in place since 1995, and where risk margins may have been expected to be lower for (realistic) profit reporting than under solvency scenarios.

It is a matter of public record that the leading general insurance companies have been holding risk margins for profit reporting well in excess of the 75th percentile. In its 31 December 2007 annual report, QBE states that it holds a risk margin equivalent to a 94% probability of sufficiency. Suncorp Group Financial statement for 30 June 2007 states that "the group applies a risk margin to the central estimate of net outstanding claims to achieve a 94% confidence level". These levels are well above the solvency level of 75%. It may be no coincidence that the period from 2002 to 2008 was also a period of high profitability for the industry so that a relatively stronger risk margin for profit reporting was not of undue concern to shareholders.

The General Insurance Practice Committee (GIPC), a committee of the Institute, conducted a survey in 2006 on reserving practice and risk margins. 42% of respondents held risk margin for profit reporting purpose at 75% probability of sufficiency. 37% held risk margin at higher level of sufficiency. It is not obvious from the survey whether any respondents held risk margins lower than the Solvency probability of sufficiency.

It is interesting to note that general insurers held risk margins over the best estimates well before the risk margins were actually required by the latest change in the accounting standard AASB 1023.

Methodologies

What methodologies are used by general insurers in Australia to determine risk margins?

The same survey by the GIPC asked questions about the respondents reserving practices[13] in 2006, 4 years after risk margins were introduced in 2002. The key points of interest from the survey are:

- The majority of respondents (85%) use recommendations from research papers to determine risk margins at least some of the time
- 85% of respondents stochastically analyse their data; and
- Only 47% of respondents used deterministic quantitative analysis to analyse their own data at least some of the time

When quantitative analyses are performed on either own data or industry data, deterministic methods are used, use is made of the Mack method, the Central Limit Theorem and common statistical distributions, such as the log normal distribution, the Poisson distribution and the gamma distribution. Most companies allow for diversification benefits and larger insurers allow explicitly for correlations between risks.

Using statistical probability distribution functions is convenient as only the first two moments of the distribution need to be estimated in order to set the risk margins. Using stochastic methods however, does not require an assumption regarding the resulting probability distribution, which removes one approximation.

[13] Australian reserving practices, Gibbs and Hu on behalf of the GIPC, published in 2007 by the Institute of Actuaries of Australia.

Are the risk margins for each class of business consistent between insurers?

In October 2005, APRA issued a Risk Margin Industry Report, in which it provided a comprehensive summary of the APRA returns submitted by companies in terms of the risk margins adopted across various classes of general insurance business to assist the industry in benchmarking risk margins.

The report's key finding was that the relativities of risk margins between different classes of business were reasonable. For example, longer tail classes have higher risk margins than shorter tail classes, premium liabilities have higher risk margins than outstanding claims risk margins for the same class of business. However, it also showed that the risk margins can differ significantly between the companies within each class of business. "Risk margins levels in some classes of general insurance business have converged over the past years, however, significant variations are still easily identifiable."

APRA acknowledges that actuaries note the difficulty of calculating risk margins given the lack of data and recognised methodologies and that a number of insurers have increased the level of analysis of the experience of their portfolios with a view to provide better assessment of the uncertainty.

It is worth noting that the APRA survey was based on net of reinsurance risk margins, after allowance for diversification benefits. As reinsurance arrangements can vary a great deal between companies and portfolios and there is an allowance for diversification benefits, one would expect these margins to vary somewhat between companies.

Summary of observations

General insurers in Australia have been using the quantile method for 5 years for determining risk margins for profit and solvency purpose. While there are many techniques that could be useful in determining life insurance risk margins, the general insurance experience sheds little light on the relativities of risk margins for profit reporting as opposed to solvency. This dichotomy may have arisen partly due to the non-prescriptive nature of the accounting standard wording, and partly due to how risk margins evolved in general insurance. We note that some general insurers already held risk margins well in excess of the 75th percentile when the legislative requirements were introduced in 2002.

In terms of methodology, general insurers use a combination of research papers, stochastic and deterministic methodologies to derive risk margins, largely using the quantile methods. After five years of operation, there is evidence of significant variations in risk margins in the market. However, it is unclear from the available information whether this variation is due to justifiable variation in reinsurance arrangements, diversification benefit allowances and genuine differences between portfolios, or due to differences in judgement involved in setting the risk margins.

Conclusion

Under proposed accounting standards being considered for IFRS Phase 2, life insurance liabilities will be determined under an exit value method, with risk margins.

The key purpose of this paper is to provide life insurance actuaries with an introduction to the considerations, thinking and current techniques involved in setting risk margins under the IFRS 2 framework, with a view that it would encourage more debate, thinking and research in this area.

In the course of writing this paper, we have found that the Cost of Capital method was relatively easy to apply in our simple example, while the quantile method was much harder to apply.

We like the clearer link between the Cost of Capital methodology and the "exit value" model, as the idea that you are compensating the purchasing company for the capital they will have to hold is an easy concept to understand and explain. Our main concern centred on the fact that the cost of capital method is heavily reliant upon all relevant risks being incorporated in the regulatory capital requirements and that the regulatory parameters apply equally well to large and small companies or portfolios.

We found the theory behind the quantile method to be appealing. Each risk is identified, accounted for and modelled. The "exit value" idea that a purchasing company would want to be (say) 75% certain that they would not lose money is also an easy concept to understand and convey. Considerably more research would be required however to determine what level of sufficiency would be appropriate for profit reporting.

The practical application of the quantile method was an area of greater concern to us. There seem to be little information to support some of the assumptions required with respect to distributions of risks.

As the accounting standards for insurance contracts develop further and the requirements become clearer, there are clearly room for much research in the area of determining risk margins for insurance contracts. This paper should be used as a thought starter for life insurance actuaries and to assist them in thinking further about this issue.

We wish to acknowledge the valuable comments of our peer reviewer, Mr Greg Martin and the assistance from our colleagues at KPMG Actuaries, Felix Tang. Laurel Kong, Natalie Lun and David Nuutinen. Any errors and omissions are, however, our own. Further, the views expressed in this paper are our own and do not necessarily reflect those of our colleagues or employer.

Appendix 1

Details of Columns from IFRS 2 Cash Flow Analysis on Page 15

Column 1	Year of projection
Column 2	Number of policies remaining at the end of year t
Column 3	Premium received in year t. For example in year 4, $61,274 is received from 61.3 policies expected to be still in force at that time.
Column 4	Present value of future claims, that is claims expected to incurred from time t + 1 to the end of the policy.
Column 5	the amount of capital required at the end of year t. This is equal to 10% of the PV of claims at time 1 (column 4). For example, at the end of year 2, the capital required is 15,612.
Column 6	shows the cost of holding this required capital, and is simply 6% of column 6 at each point in time.
Column 7	at time t, the risk margin is the present value of the cost of capital in year t + 1 to the end of the policy at a discount rate of 6%, being the cost of capital rate. At the end of year 1, the risk margin required is $4,102, which can be expressed as 2.16% of the PV claims
Column 8	expresses column 7 as a % of the PV of claims.

Details of Columns from MoS CashFlow Analysis on Page 17

The table below sets out the step by step calculation of the MoS profit.

Column 1	Year of projection
Column 2	Number of policies remaining at the end of year t
Column 3	Premium received in year t. For example in year 4, $61,274 is received from 61.3 policies expected to be still in force at that time.
Column 4	Acquisition expenses and initial commission paid at policy inception. ($200 x Number of Policies + 25% x Premium + 100% x Premium)
Column 5	Maintenance expenses and trail commission paid in year t, assumed to occur at the end of the year. (4% x Premium + $60 x Number of Policies + 10% x Premium).
Column 6	Claims expected to incurred from time t to time t+1. Assumed to occur at the end of the year.
Column 7	Investment Income on cash flows during the year and policy liability.
Column 8	Best Estimate Liability (PV of future policy cash flows)
Column 9	Present Value of Future Profit Margins. Which equates to 14% of PV Claims.
Column 10	MoS Profit, which is the release of profit margins during the year. If all occurs as expected this will be 14% claims during the year.

Details of Columns from IFRS 2 CashFlow Analysis on Pages 17, 18 and 19

The table below sets out the step by step calculation of the risk margins and IFRS 2 Profit.

Columns 1-8	As per MoS Profit above. Note that the investment income (Column 7) values will differ from the MoS Profit example due to the difference in the policy liability.
Column 9	Capital Requirement: Difference between Solvency Liability and BEL at each point in time. Table 3: Excludes allowance for DAC, so solvency liability is the present value of future cash flows after allowing for the specified adverse margins. Table 4: Includes allowance for DAC. At inception it is therefore the acquisition expenses and thereafter the negative BEL.
Column 10	Shows the cost of holding this required capital, and is simply 6% of column 9 at each point in time.
Column 11	Risk Margin is the PV of the cost of capital at time t (column 10) at the risk free rate (7%).
Column 12	Profit release under IFRS 2

Appendix 2

International literature on risk margins

There has been a number of important and recent works done on the topic of risk margins both internationally and in Australia. Our bibliography shows a selected list of relevant works, which themselves show further references that may be useful.

Given the breadth of work which has been done in this area, we wish to recommend four recent publications to anyone wishing to get up to speed with the determination of risk margin. We found these publications to be the most relevant and valuable out of those we read. A brief description of these work can be found in appendix 2.

A. Exposure draft on Measurement of liabilities for insurance contracts: current estimates and risk margins (November 2007) & (March 2008), *Ad Hoc Risk Margin Working Group, International actuarial association.*[14]

This paper covers both life and non life insurance contract risk margins determination, and show a number of examples of risk margin calculations under a range of methods.

C. A global framework for insurer solvency assessment (2004), IAA Insurer Solvency Assessment working group.

This publication is often referred to as the Blue Book. Although written in a solvency context, this work is useful in that it considers the risk margins for many life products and covers many issues that are relevant to both solvency and profit reporting risk margins

C. A Market Cost of capital approach to market value margins, Discussion Paper, (17 March 2006) *The Chief Risk Officer Forum*,

This paper advocates the use of the cost of capital approach to determine risk margins, which it refers to as market value margins. It explains why the cost of capital is a more practical methodology than the quantile method and specifically refers to the Australian general insurance experience.

E. The Swiss Experience with Market consistent technical provisions – the Cost of Capital approach, Federal Office of Private Insurance FOPI , March 28, 2006.

This paper is valuable in that it sets out:

a. The concept behind the cost of capital approach to calculating risk margins;

[14] To assist the IASB in the formulation of accounting standards, the International Actuarial Association (IAA) formed a task force, referred to as the "Ad hoc Risk margin working group" (RMWG) . This is an international group of actuaries who worked together to product guidance on the subject of risk margin. The latest work published by the RMWG was an exposure draft on Measurement of liabilities for insurance contracts: current estimates and risk margins (November 2007).

b. The reasons behind selecting the cost of capital in favour of the quantile method; and
c. The findings of two field tests conducted in Switzerland in 2004 and 2005, in which over 90 companies in the market participated in calculating risk margins using the cost of capital method.

The conclusion of the paper is that:

b. Companies of all sizes were able to calculate the risk margins using the cost of capital approach;
c. The margins were risk sensitive and can distinguish between low risk and high risk best estimates; and
d. The regulators are able to review the risk margin calculation effectively, and were able to detect errors. This is an indication that the risk margin calculation can be transparent to an informed reader.

Appendix 3

Trend Uncertainty

The Australian Population data, by sex and by age, was obtained from the Australian Bureau of statistics.

For each year of data and each age, the probability of survival is calculated as well as the probability of death.

The expected probability of death between exact age x and exact age x+1 in year t+3, $\hat{q}_{x,t+3}$, is calculated by linear extrapolation and is as follows:

$$\hat{q}_{x,t+3} = \bar{q}_x - \left(q_{x,t} - q_{x,t+2}\right)$$

where

$\bar{q}_x$ is the average of the probability of death between exact age x and exact age x+1 across the 3 years i.e. $q_{x,t}, q_{x,t+1}, q_{x,t+2}$.

$q_{x,t}$ is the probability of death between exact age x and exact age x+1 in year t.

The expected probability of death is then divided by the actual probability of death at year t+3 and the 75th percentile is taken.

The results are set out below:

Sex	Age	1997	1998	1999	2000	2001	2002	2003
M	20	100.56%	101.14%	106.91%	109.43%	115.97%	117.23%	114.12%
M	21	97.29%	100.00%	105.22%	108.79%	116.50%	117.39%	116.67%
M	22	98.92%	100.00%	103.99%	105.85%	117.67%	118.64%	117.62%
M	23	99.73%	99.19%	101.10%	106.38%	116.18%	118.95%	118.56%
M	24	101.36%	98.66%	100.00%	104.52%	115.87%	121.40%	119.10%
M	25	100.54%	96.06%	99.20%	105.04%	115.58%	119.39%	118.68%
M	26	99.21%	95.87%	98.70%	106.39%	115.29%	120.20%	115.09%
M	27	98.94%	95.90%	98.19%	105.19%	114.41%	118.30%	115.12%
M	28	96.88%	97.18%	98.21%	106.01%	113.69%	117.80%	112.33%
M	29	97.93%	97.96%	98.47%	105.11%	111.88%	116.35%	113.86%
M	30	96.67%	97.24%	97.74%	104.76%	111.68%	117.13%	113.27%
M	31	96.74%	99.50%	99.25%	105.56%	109.80%	116.67%	111.01%
M	32	97.26%	99.75%	98.77%	104.95%	109.37%	115.32%	112.15%
M	33	97.30%	100.99%	99.26%	105.17%	108.40%	114.45%	110.61%
M	34	99.03%	101.96%	99.52%	105.64%	107.73%	114.91%	109.82%
M	35	97.87%	101.92%	100.00%	106.06%	107.87%	112.71%	109.28%
M	36	100.23%	102.35%	100.47%	106.72%	108.27%	111.85%	108.47%
M	37	99.77%	102.99%	100.91%	106.81%	107.27%	110.05%	107.32%
M	38	102.41%	103.58%	100.88%	106.86%	108.09%	108.08%	106.51%
M	39	100.42%	102.14%	101.94%	106.35%	107.51%	107.25%	105.43%
M	40	101.64%	102.90%	101.03%	104.52%	107.66%	105.44%	104.90%

M	41	101.17%	102.16%	101.78%	103.66%	106.12%	104.91%	104.82%
M	42	100.93%	102.81%	101.50%	101.52%	105.56%	103.57%	104.07%
M	43	99.82%	103.39%	101.60%	99.47%	103.11%	102.20%	104.14%
M	44	100.50%	103.35%	102.54%	98.03%	100.84%	101.18%	103.28%
M	45	99.53%	103.93%	103.19%	99.07%	98.91%	99.69%	101.26%
M	46	98.71%	105.16%	103.27%	101.49%	97.68%	99.56%	100.44%
M	47	99.20%	105.46%	104.17%	103.23%	98.50%	99.31%	99.59%
M	48	98.53%	105.66%	104.89%	105.29%	99.49%	100.00%	99.74%
M	49	99.44%	106.50%	105.10%	105.76%	101.45%	101.22%	99.88%
M	50	99.18%	106.79%	105.88%	106.31%	103.15%	102.86%	101.15%
M	51	99.72%	107.05%	106.57%	106.03%	104.79%	104.14%	102.89%
M	52	99.58%	107.21%	106.70%	105.85%	106.24%	105.29%	103.77%
M	53	99.46%	106.75%	107.16%	105.98%	106.54%	106.29%	104.93%
M	54	99.51%	107.20%	107.14%	105.69%	106.89%	106.86%	105.93%
M	55	98.75%	106.87%	107.26%	106.12%	107.17%	106.87%	106.38%
F	20	110.26%	97.56%	104.27%	104.39%	112.38%	116.67%	106.06%
F	21	101.71%	93.50%	101.71%	101.71%	113.33%	114.14%	115.05%
F	22	104.50%	94.17%	98.29%	101.75%	114.71%	119.35%	110.75%
F	23	100.00%	94.87%	96.58%	100.88%	110.48%	120.43%	111.83%
F	24	98.15%	91.67%	91.06%	100.00%	114.29%	119.79%	113.98%
F	25	100.88%	95.83%	94.31%	101.71%	111.11%	120.83%	111.46%
F	26	95.83%	92.86%	93.02%	101.63%	110.53%	116.19%	111.76%
F	27	107.50%	96.83%	93.18%	102.44%	108.55%	114.81%	107.41%
F	28	99.22%	96.21%	95.56%	102.33%	107.32%	113.16%	107.02%
F	29	107.58%	95.04%	99.28%	101.48%	109.52%	108.13%	109.40%
F	30	103.55%	97.92%	97.28%	104.35%	105.93%	111.11%	108.13%
F	31	100.00%	98.69%	102.00%	105.56%	107.97%	106.67%	107.75%
F	32	104.94%	101.89%	102.52%	106.67%	106.12%	105.56%	106.52%
F	33	101.17%	99.42%	102.38%	104.94%	109.15%	107.33%	105.44%
F	34	98.91%	100.56%	102.82%	105.26%	106.67%	103.64%	107.05%
F	35	96.41%	99.48%	102.12%	104.92%	106.21%	105.17%	105.95%
F	36	97.10%	100.00%	101.99%	103.03%	106.35%	105.38%	106.11%
F	37	94.52%	96.85%	99.54%	103.29%	106.86%	105.47%	105.64%
F	38	98.27%	97.47%	100.87%	102.19%	105.94%	103.20%	105.71%
F	39	94.05%	97.25%	99.21%	101.61%	105.00%	105.56%	104.33%
F	40	97.38%	97.80%	98.17%	100.37%	105.43%	104.71%	104.82%
F	41	95.49%	96.63%	97.31%	101.03%	104.61%	103.94%	105.19%
F	42	95.87%	97.82%	98.13%	102.24%	103.92%	104.33%	104.08%
F	43	96.17%	97.70%	97.70%	100.88%	103.90%	104.28%	103.09%
F	44	95.43%	99.20%	98.67%	101.36%	102.75%	103.36%	103.42%
F	45	96.57%	100.49%	100.25%	102.01%	103.59%	102.84%	102.89%
F	46	96.40%	100.90%	100.23%	103.26%	102.82%	102.86%	102.66%

F	47	96.14%	102.28%	101.89%	104.09%	102.81%	103.31%	102.91%
F	48	97.94%	102.84%	102.50%	105.82%	103.41%	102.64%	102.06%
F	49	97.29%	103.82%	104.28%	107.26%	103.33%	102.25%	102.29%
F	50	97.39%	105.10%	104.39%	108.98%	103.23%	103.66%	103.39%
F	51	97.34%	105.39%	105.23%	109.00%	103.76%	104.69%	104.48%
F	52	97.71%	106.40%	106.17%	108.95%	103.58%	105.68%	105.53%
F	53	97.80%	107.08%	106.39%	108.96%	103.12%	107.19%	106.38%
F	54	98.00%	107.25%	107.13%	108.51%	102.85%	107.60%	107.03%
F	55	98.16%	107.24%	106.81%	107.84%	103.26%	107.01%	107.89%

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