Risk adjustments for life insurers:
Using a GI approach in a life insurance context

Prepared for: New Zealand Society of Actuaries 2016 conference
Prepared by: Ben Coulter, PwC
E-mail: ben.a.coulter@nz.pwc.com
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1 Executive Summary

IFRS 4 Phase II, or expected to be known as IFRS 17 when finalised, will change the way profits under insurance contracts will be reported. The final standard is expected in early 2017 with adoption required by 2021, which does not give much time for insurers to prepare.

Key changes are likely in the areas of the acquisition costs that can be deferred, how interest rate changes are presented and the level of aggregation of contracts. Risk adjustments will also be required for all outstanding claims provisions (expired risk) as well as policy liabilities calculated under the default measurement model, the Building Blocks Approach (BBA). The concept of a risk adjustment is new to life insurers and a method for determining the risk adjustment is not specified.

This paper used the Australian general insurance (GI) framework for assessing risk margins to estimate a reasonable range of risk adjustments for a typical yearly renewable term (YRT) life portfolio in New Zealand. It is assumed that the YRT contracts will be accounted for using the BBA and a contract boundary to the end of the policy term is assumed.

The approach used split the risk adjustment into two components – Independent Error and Systemic Risk – then express the result as a percentage of the value of future claims so that the risk adjustment can be released over time. The Independent Error allowances were derived from a stochastic version of a typical projection model for YRT contract liabilities and it estimated the variability around the mean liability (otherwise known as the Best Estimate Liability). The Systemic Risk allowances make an additional allowance for mis-estimation of the best estimate assumptions, their trends and any other relevant risk factors.

The key findings of this paper were:

- applying the GI framework to a life insurance context may be useful as life insurers move to IFRS 17 because it means actuaries don’t need to ‘reinvent the wheel’,
- stochastic modelling of the Independent Error risk within the long-term liability for a portfolio of YRT contracts can be done using Bernoulli distributions for lapses and mortality as well as a parametric approximation to the “ultimate liability” of a single contract,
- lapse risk is particularly important in the New Zealand market with the prevalence of high upfront initial commissions but it is not very well understood or modelled,
- systemic risk allowances are quantitative estimates fitted to largely qualitative risk assessments so they are very subjective and rely on significant judgement and knowledge of the individual insurers’ business, and
- it is estimated that a large, mature YRT portfolio could expect a risk adjustment of 10-15%, at a 75th percentile, expressed as a percentage of the value of future claims. Naturally portfolios that are smaller, riskier or target a higher probability of sufficiency will require higher risk adjustments.

Coupled with the potential for more granular levels of aggregation or product grouping, this means that adding risk adjustments may force some portfolios into onerous contract territory (loss recognition). The likelihood of loss recognition may be offset by allowing for diversification benefits across other products or by deferring less acquisition costs. However, it is an issue that needs to be considered sooner rather than later, particularly in the New Zealand market where it is common to have long-term guaranteed premium rates on level premium life products.
Overall it is hoped that this paper provides the foundation for assessing the risk adjustments of life insurance contract liabilities going forward. I hope the contents of this paper are useful to members of the NZSA who are about to embark on estimating risk adjustments in their own business. I’d like to work with other interested members of the NZSA during 2017 to establish a working party to provide NZSA members further guidance in this particular area.

However, whether you use the findings or conclusions in this paper for estimating risk adjustments or not, what is clear to me is that life insurers in New Zealand generally do not understand their lapse risk as well as they could. The concepts in this paper may be able to help in this regard as follows.

A common problem of a life insurance valuation actuary is being required to explain a large lapse experience loss immediately after a balance date with limited time and resource available. I would encourage practitioners to use more stochastic modelling of their profitability to move the lapse risk conversations from being reactive to being proactive. Stochastic approaches do not need to be complex and it is suggested that insurers start small with a stochastic projection for next year’s profit. In turn, this could help set budgets, targets and thresholds for lapse experience profits along with managing expectations of Executives and Boards in an increasing dynamic environment and compressed reporting deadlines.
2 Background

Changes to the International Financial Reporting Standard (IFRS) for insurance contracts, IFRS 4, have been underway for over a decade now. These changes are more commonly referred to as “IFRS 4 Phase II” and are expected to be known as IFRS 17 when they are finalised.

Since the last exposure draft standard was issued in 2013, the Insurance Accounting Standards Board (IASB) has been consulting industry members, carrying out testing to validate parts of the standard and clarifying any issues raised during the process. The latest deliberations suggest that they are closer than ever to finalising the standard and the final standard is expected to be released in early 2017 (with adoption required by 2021).

Life insurers, in particular, need to be prepared for significant changes. The countries impacted will be transitioning from different starting positions and accounting regimes, so the level of change and communication will depend on the existing local requirements. While New Zealand life insurers have an advantage in that the default model for all insurance contracts will be similar to the existing “margin on services” approach, there are subtle changes that require thought, implementation planning and communication of the results to stakeholders. The key changes include:

- clarity on the types of expenses that can be deferred (i.e. “direct” or variable expenses only),
- level of aggregation of products (a more granular product grouping is likely),
- requiring the impact of changes in interest rates since inception to be recognised separately, and
- an allowance for a risk adjustment to reflect the uncertainty in future cashflows.

The default model for the valuing the insurance contracts is known as the “Building Blocks Approach” (BBA). Figure 1, below, presents a diagram of how the balance sheet is expected to look with the new standard. For those of you familiar with the existing Margin on Services (MoS) approach, it is clear that the BBA is similar to MoS with the main difference being the split of the value of future profit margins into an explicit risk adjustment and a contractual service margin.

![Figure 1: Summary of the Building Blocks Approach (BBA)](image-url)
In some circumstances, contracts may be eligible for a simplified “Premium Allocation Approach” (PAA) under the new standard. The PAA is similar to current accounting requirements for general insurers (Appendix D of NZ IFRS 4) with an unearned premium provision for unexpired risk and outstanding claims provisions for expired risk. It is expected that most general insurance contracts will be eligible for the PAA, but practitioners need to be aware that not all general insurance contracts automatically qualify for the PAA.

The eligibility criteria for PAA is based on the contract boundary. Contracts with coverage periods of one year or less or contracts with the ability to re-price and reassess risks within a year are likely to be eligible for PAA. It is debatable as to whether yearly-renewable term (YRT) life contracts have one year contract boundaries and are eligible for the PAA because pricing takes account of risks in future periods. In this paper, I assume that insurers will use the BBA over the entire policy term (like MoS).

### 2.1 Risk adjustments

The purpose of this paper is to consider the practical aspects of setting risk adjustments for unexpired risk in a YRT life insurance portfolio. Risk adjustments will be a new requirement for life insurers and are not going to act as a shock absorb like current profit margins. The IASB is not going to prescribe a method for calculating risk adjustments and, therefore, it is critical for any actuary anticipating to use the BBA to consider how they might go about estimating their risk adjustments.

In the guidance notes of the draft standard, the IASB has set out a number characteristics that the risk adjustments must exhibit. For example, risks with high severity and low frequency should have higher risk adjustments than risks with low severity and high frequency. Taking account of diversification benefits between risks is permitted and insurers must be able to disclose the probability of sufficiency of their risk adjustments to allow appropriate comparisons to be drawn against other insurers. Refer to Appendix 1 for the specific wording and guidance from the draft standard.

European insurers have some advantages in determining risk adjustments because they have recently implemented the Solvency II framework. This framework includes a stochastic model for capital purposes and, in theory, this cost of capital framework could be applied to estimate risk adjustments.

However, it is understood that few life insurers in the New Zealand market have any stochastic models for capital purposes or otherwise. Capital models, in general, may be of little use as they do not usually consider lapse risk given that the current termination value (CTV) option usually dominates in regulatory capital requirements. If you are a life insurance actuary, where do you start?

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**The risk adjustment therefore raises a number of practical issues.**

*How do you estimate a risk adjustment for a portfolio of life contracts with time horizon of over 50+ years? What probability of sufficiency is likely to be acceptable in the market? Does New Zealand have other unique market features that make it different to other countries?*

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2.2 **Other literature on risk adjustments or risk margins**

There are number of other good papers on risk adjustments or risk margins. The three referred to further in this paper, all published in 2008 or 2009, are as follows:

- **Bui & Cummings**: This paper, titled ‘Risk margins for Life Insurers’, was written by Hoa Bui and Briallen Cummings in 2008 and presented to an Institute of Actuaries of Australia conference. They calculated risk adjustments based on a cost of capital approach and quantile methods, based on statistical distributions for mortality risk. The paper was largely a starting point for thinking about risk adjustments in life insurance and concluded that the cost of capital approach was easier to apply in practice than other quantile / confidence interval methods.

- **RMWG paper**: This paper, titled ‘Measurement of Liabilities for Insurance Contracts: Current Estimates and Risk Margins’, was written by the ad-hoc Risk Margin Working Group (RMWG) in 2009 on behalf of the International Actuarial Association. It is a long paper that covers more than just risk margins, but it has a detailed discussion on the various approaches to calculating risk margins with an overall preference for the cost of capital approach.

- **GI framework**: This paper, titled ‘A Framework for Assessing Risk Margins’, was written by the Actuaries Institute’s Risk Margin Taskforce in 2008. It sets out a solid framework that many general insurers have adopted when setting their risk margins applied to outstanding claims or premium liabilities (unexpired risk). The framework includes allowances for independent error, internal systemic and external systemic risks.

Further to the last reference, it is noted that risk margins have been well ingrained in the thinking of general insurance actuaries across Australasia for some time now. This is because risk margins are important for both financial reporting and capital standards because all general insurance capital standards rely on 75th percentile estimates. The main criticism of risk margins in general insurers has been a lack of consistency in approaches and differences in probabilities for financial reporting, which makes comparisons difficult.

It is further noted that some of the distributions identified in this paper are very skewed. In some cases, this means the 75th percentile can actually be lower than the mean of the distribution. APRA address this issue in their GPS 320 whereby they require the estimate to be used for capital purposes to be the higher of the 75th percentile or the mean plus half the standard deviation. This is a good practical approach, although it may make disclosing the actual probability of sufficiency difficult.

2.3 **New Zealand specific considerations**

There are three key features of the New Zealand life insurance market that, collectively, make it unique to other markets around the world. These are:

- **Solvency II framework does not apply**. This means that advanced capital models, or stochastic models in general, are not used by most life insurers. Therefore, life insurers in New Zealand may need to consider their approach more than insurers in Europe.

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- **High upfront initial commissions.** On YRT life business, initial commission rates can exceed 200% of the first year premium in New Zealand with low renewal commission rates. This means that lapse risk is a much larger risk in New Zealand compared with other countries. Would you expect the risk adjustment to increase immediately after the initial commission claw-back (or responsibility) period to account for this risk?

- **Long-term level premium products with premium guarantees.** A level to age 80 product is commonly available in New Zealand with guaranteed premium rates. These products behave differently to YRT with long-term lower lapse rates being worse for the insurer. This means that these products are likely to be required to be split out from YRT business into a separate product grouping under the level of aggregation rules in the new standard. Some policy wordings have clauses whereby the premium rates can be changed upon significant changes in tax or legal position, but it is not clear whether this applies to accounting standards.

On top of these key differences, New Zealand generally lacks the scale that other larger countries have. This is likely to impact the level of diversification possible, which means that you would expect risk margins to be slightly higher in New Zealand on a standalone basis (that is, ignoring any additional diversification benefits that may arise when consolidating results with overseas parents).

### 2.4 Structure of this paper

This paper is structured with three main sections:

- Section 3 – discusses the potential approaches for assessing risk adjustments and develops a stochastic approach for modelling the risk adjustment for a single YRT life contract,
- Section 4 – uses the results from Section 3 to estimate a reasonable range for a risk adjustment across a portfolio of YRT contracts at a 75th percentile, and
- Section 5 – outlines other key considerations for an actuary when determining risk adjustments for life insurance contracts in practice. These considerations include correlation, diversification, comparisons against other risk margins and other potential uses for stochastic models in life insurance.

The final section presents the key conclusions and additional content is attached as appendices.

### 2.5 Reliances and limitations

Other than the work referenced, all content in this paper is my own work and represents my personal opinions. It does not necessarily reflect the views of my employer, PricewaterhouseCoopers or PwC, or the views of any of my previous employers.

I will not accept any liability for any loss caused as a result of relying on the methods, results or conclusions drawn in this paper.
3 Estimating the risk adjustment for a single YRT contract

Estimating risk adjustments for a long-term life insurance contract is more challenging than estimating risk margins for outstanding general insurance claims. This is because the life insurance liabilities are very long-term (over 50 years in some cases) and include more than just claims amounts with assumptions necessary for future premium rates, lapses and expenses.

Previous papers (Bui & Cummings and the RMWG paper) have considered a number of approaches to estimating risk adjustments (or risk margins) for long-term life insurance contracts. The two approaches that are considered the most appropriate are the cost of capital and quantile methods. Other approaches, including using a lower discount rate, were options but would be challenging in the low interest rate environments that we are experiencing recently.

Another approach seen in Canada, for example, sees explicit prescribed margins on each assumption applied in the calculation of the liability. Guidance for the range of margins applied is provided by the regulator but the actuary uses judgement to decide where in the range to set those assumptions. The assumptions used are then documented in a report to the regulator. This approach was discussed in the RMWG paper, but was not expected to be popular with the IASB because it won’t necessarily achieve consistency as it involves some form of agreement with the regulator in each jurisdiction.

This paper considers a stochastic approach, which is the basis for the quantile (or confidence interval) methods. However, before we set up a stochastic model, let’s review the cost of capital approach and check that a stochastic approach is in line with guidance provided by the IASB.

3.1 Cost of capital approach

The cost of capital approach conveniently fits with work done to implement Solvency II in Europe. In simple terms, it requires the actuary to set the risk adjustment to the long-term cost of holding capital – regulatory or otherwise – if you had purchased the portfolio of insurance contracts. For Solvency II, a fixed 6% cost of capital is assumed but there would naturally be discretion to choose another percentage, particularly for YRT life contracts where the CTV minimum applies under regulatory capital standards.

This approach has its advantages in terms of the simplistic explanation and linkage with other jurisdictions. It may be appropriate for traditional participating and non-participating life contracts. However, there are three key disadvantages when applying this approach to term life business:

1) It will not produce a probability of sufficiency for IFRS disclosure purposes,
2) Capital models generally do not consider lapse risk well enough and lapse risk is an important consideration because lapse / persistency usually represents the single largest experience variance under the current margin on services (MoS) accounting regime, and
3) It is likely to be too reliant on regulatory capital standards, which creates circular errors and may not be specific enough for the risks of smaller, unique portfolios within the relatively small New Zealand market due to the application of the CTV minimum.

The CTV minimum applied in regulatory capital standards effectively writes off the implicit deferred acquisition costs on the balance sheet. As a result, basing the risk adjustment on some percentage of regulatory capital will mean the risk adjustment is not as sensitive to the lapse risk as it could be. This
is a key disadvantage in the New Zealand market where lapse or persistency is typically the single largest experience profit or loss for life insurers.

These points, and the fact that stochastic methods and quantile approaches have been successful in getting general insurers to understand their risks better, is the reason why I have chosen to explore a stochastic approach (with some adjustments) to estimating risk adjustments.

### 3.2 What about a stochastic approach?

In this context, a stochastic method is one whereby each assumption determining the net present value of a life insurance contract has a statistical distribution. The model is iterated many times to produce a statistical distribution of the output. Values at specific probabilities of sufficiency can be determined (that is, Value at Risk or VaR) and you could also determine conditional tail expectations as well. Collectively these techniques have been referred to as “quantile methods” in other papers.

This paper considers an approach similar to that proposed in the GI framework. A stochastic model is constructed to estimate the **Independent Error**, which represents the variability around the mean long-term liability (i.e. the best estimate liability). Adjustments are then made for **Systemic Risk** to allow for mis-estimation of the mean, its trend and other sources of uncertainty.

Variability of the stochastic output is described using standardised statistical measures, such as a coefficient of variation (CoV) or skewness. The end result, at any probability of sufficiency, will be expressed as a percentage of the present value of expected claims so that risk adjustments can be released over time. This is similar to the existing profit margins with claims as the profit carrier.

Table 1, below, considers whether this stochastic approach (with adjustments) would meet the five characteristics set out in the IASB’s current guidance. This is discussed further below.

**Table 1: Scorecard for a stochastic method with an adjustment for systemic risks**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Does a stochastic model meet this?</th>
<th>Why?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Risks with low frequency and high severity will result in higher risk adjustments than risks with high frequency and low severity</td>
<td>✔️</td>
<td>Low frequency and high severity risks have a more skewed distribution and higher volatility, which will lead to a higher risk adjustment for any given probability of sufficiency</td>
</tr>
<tr>
<td>2. For similar risks, contracts with a longer duration will result in higher risk adjustments than contracts with a shorter duration</td>
<td>✔️</td>
<td>Expressing as a percentage of the present value (PV) of claims will achieve this because longer durations have higher PV of claims and risk adjustments will be held for over a longer period</td>
</tr>
<tr>
<td>3. Risks with a wide probability distribution will result in higher risk adjustments than risks with a narrower distribution</td>
<td>✔️</td>
<td>This is a natural outcome of a stochastic approach where the risk adjustment is based on the CoV of the distribution, which is a standardised measure of the spread (or width) of a distribution</td>
</tr>
<tr>
<td>4. The less that is known about the current estimate and its trend, the higher the risk adjustment</td>
<td>✔️</td>
<td>This requires judgement and is addressed within the adjustments for systemic risk to reflect the factors that may affect the mean of the distribution</td>
</tr>
<tr>
<td>5. To the extent that emerging experience reduces uncertainty, risk adjustments will decrease and vice versa</td>
<td>✔️</td>
<td>Expressing as a percentage of the PV of claims will achieve this because the PV will reduce as experience emerges and more is known</td>
</tr>
</tbody>
</table>
The main criticism of a stochastic approach in the RMWG paper is that it does not meet the second characteristic from the previous table (that is, for similar risks, contracts with a longer duration will result in higher risk adjustments). However, I believe that this characteristic is met when expressing the risk adjustment as a percentage of the present value of claims. This is because a longer duration contract would have a higher present value of claims and therefore a higher risk adjustment in dollar terms.

In the case where a risk has a similar distribution as another risk, but one has a longer duration, we are not talking about similar risks any longer. Furthermore, a risk with the same CoV as another risk will have a risk adjustment on the balance sheet for a longer period if it has a longer duration. Therefore, I believe a stochastic approach does meet the second characteristic. If it does not, then this presents an issue for the existing approach set out in the GI framework too.

### 3.3 Ultimate Liability concept

Let’s define the **Ultimate Liability** as the discounted net cash outflow for a single life insurance contract. The Ultimate Liability is a random variable that depends on details of the contract (premium, sum insured, age, gender, smoking status, term) as well as lapse, mortality, expense and tax assumptions. The expected outcome, or mean, of the Ultimate Liability is the **Best Estimate Liability**, which is currently used in financial reporting and defined further in New Zealand Society of Actuaries’ Professional Standard 20 (PS 20). While PS 20 allows members to calculate the Best Estimate Liability on a gross or net of tax basis, this paper calculates all liabilities on a net of tax basis.

Life insurers calculate the Best Estimate Liability using assumptions that are probability weighted “best estimates”, which is intended to be broadly equivalent to the mean of the range possible outcomes. The Best Estimate Liability is typically a **large negative number** for yearly-renewable term (YRT) contracts – that is, an asset on the balance sheet. This reflects the fact that future cash inflows are expected to exceed future cash outflows. Alternatively, one may think of the large negative number as being an implicit allowance for acquisition costs that were deferred at the contract’s inception.

Upon lapse or cancellation of a contract, life insurers write off this asset and it generates an experience profit or loss depending on whether the negative liabilities written off exceed expectations set at the start of the year. For those accounting for their YRT liabilities under the BBA going forward, this lapse experience profit or loss will continue to be a feature of reported results.

Life insurers generally do not consider the distribution of the Ultimate Liability, presumably because this is adds computational complexity to an already time-consuming valuation process and simple sensitivity tests generally suffice to illustrate the potential variability. However, in theory, a stochastic model can be constructed to model the Ultimate Liability for a single life insurance contract. This paper does this and uses it to assist the estimation of risk adjustments under the BBA within the new IFRS 4 standard.

A stochastic model may also provide further insights into the distribution of lapse and claim experience losses in any given year, even under the existing IFRS 4 standard. This would involve projecting the value over one year period, as opposed to the end of the contract, which is an easier task. The results could be used to help evaluate performance and manage expectations by saying. This is considered further in the Other Considerations section of this paper.
3.4  Stochastic model for the Independent Error of a single contract

When constructing any stochastic model, it can be difficult to estimate the distribution and variability of key assumptions. However, in the case of a model for the Ultimate Liability of a single life insurance contract, it becomes reasonably straight-forward because the two key assumptions – lapses and mortality rates – are effectively a Bernoulli distribution (that is, a Binomial distribution with n = 1).

A Bernoulli distribution is appropriate for lapses and claims because, in any given period, the policyholder either lapses or it doesn’t and they either claim or they don’t. Variability is inherent within the Bernoulli distribution and the mean for lapse and claim rates can be set equal to the best estimate assumption derived from traditional valuation and experience analysis techniques. The model constructed assumed annual time-steps with a total projection period of 50 years, but it could be extended to more frequent time-steps if required.

Normal distributions were assumed for the annual inflation rate and the uninflated per policy renewal expense assumption. This reflects the random nature of inflation over time as well as the impact of variations in unit costs as the business grows faster or slower than anticipated. However, the choice of distribution for these assumptions is not material to the overall results (see below).

The charts in Figure 2, below, show probability density functions (PDF) from the stochastic output of the Ultimate Liability for a single YRT contract for a 40 year old male non-smoker with $500,000 sum insured with a duration of two years. Each PDF is based on 100,000 simulations and the mean is the orange line. Detailed assumptions are set out in Appendix 2.

*Figure 2: Summary of the Building Blocks Approach (BBA)*

PDF with stochastic expenses only  
PDF with stochastic claims only  
PDF with stochastic lapses only  
PDF with stochastic expenses, claims and lapses
What is clear is that making expenses stochastic in isolation does not add much volatility to the Ultimate Liability (circa 1% CoV). Therefore this further supports the earlier statement that the choice of distribution and assumptions relating to expenses is not material.

Making the lapse assumptions stochastic does change the distribution quite significantly and gives the distribution a body. There is a good proportion of the simulations with an Ultimate Liability slightly higher than the mean (the orange vertical line) and a small proportion of simulations spread out into the left tail, which represents a negative liability (or asset). The CoV is 242% and skewness is -10.

The PDF with stochastic claims (mortality) assumptions also changes the distribution with a tail on the right. The last bar on the chart therefore represents the cumulative probability of the Ultimate Liability exceeding $8,400 (net of tax). The extent of the tail is difficult to present in a single chart because the tail includes simulations with a claim far out into the future (which has a low value in present value terms) as well as a very small probability of an early $500,000 claim. The CoV is 914% and skewness is +12, which illustrates the variability compared to other distributions.

With all variables stochastic, the distribution becomes a blend of the stochastic claims and lapses PDF. The tail on the left (an asset position) is less extreme and relates to the probability the contract persists for many years without a claim. The tail on the right is more extreme and relates to simulations where a claim occurs at some point during the life of the contract. Overall the CoV is 1445% (i.e. the most volatile out of all the distributions) and skewness is +10, which is still highly positively skewed due to the extreme claims risk.

Note that no variability was assumed for the interest rate used for discounting cashflows. The guidance provided by IASB explicitly stated that potential changes in market assumptions (i.e. interest rates) is not to be considered as part of the risk adjustment.

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**Key point #1:** The distribution of the Ultimate Liability of a single YRT contract is highly positively-skewed due to the small probability of a large loss. Claims risk gives the distribution a tail, while lapse risk gives the distribution a body.

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Overall it would be very difficult to set a risk adjustment for a single contract. This is because the additional margin required, over and above the mean, for a rational person to take on a distribution of potential outcomes presented above would be very high. **Life insurance fundamentally relies on the pooling of risk to create less volatility in outcomes.**

Therefore, it is important to consider how one might go about modelling the distribution of the Ultimate Liability across a portfolio of contracts. The key considerations for doing this are discussed in the next section. The results at a portfolio level will then allow us to ask other questions on how the risk adjustment could be expected to behave. For example:

- Should the risk adjustment vary by duration due to the high initial commissions paid in New Zealand and the fact that lapse risk increases immediately after the responsibility period?
- Should the risk adjustment change based on the commission structure – i.e. full upfront versus level commission options?
- What impact does the pooling of risk (diversification) have on the risk adjustment?
3.5 Considerations for modelling multiple contracts

Latest industry statistics state that there are approximately 1.4 million annual premium term life contracts in force\textsuperscript{5}. Therefore, for the results of this paper to be of practical significance to any small-to-medium sized life insurer, the distribution of the Ultimate Liability across a large number of contracts is needed.

One option would be to run 100,000 simulations for every single contract and add up the results. However, with a number of stochastic items for each annual time-step and a projection period of 50 years, this would take a significant amount of time and effort for a large portfolio of contracts.

A key observation when looking at the output from the stochastic model of a single contract is that there is a low probability of a very large loss and a high probability of a small profit. The simulations with a loss are those where there is a claim at some point over the duration of the contract, whereas the simulations with a profit are those where no claim is made over the duration of the contract. By separating the simulations into two groups – those with a claim at some point over the duration of the contract and those without – it is possible to parameterise the distribution of the Ultimate Liability of a single YRT contract using a handful of variables from the traditional deterministic method.

Figure 3, below, presents the simulated output for the stochastic model from the previous section but only includes simulations where there is no claim during the life of the contract. While it’s not a perfect fit, an exponential distribution fits reasonably well to the output where the horizontal axis is -1 x Ultimate Liability (i.e. the liability is greater on the left and less on the right). This distribution makes sense as the effect of lapses gradually reduces the frequency associated with a lower liability (or higher asset as the contract persists for longer without any claim).

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure3.png}
\caption{Fitted distribution to simulations without a claim during the life of the contract}
\end{figure}

\textsuperscript{5} FSC industry statistics at June 2016: http://fsc.org.nz/site/fsc/FSC%20Trad%20Risk%20Summary%202016-06.pdf
Figure 4, below, presents the simulated output from the stochastic model where there is a claim during the life of the contract. This distribution was not immediately obvious in the previous section as it relates to the extreme part of the tail. However, again, an exponential distribution fits reasonably well to the output where the horizontal axis is -1 x Ultimate Liability. The simulated value of the ultimate liability reduces over time because more premium income is received when the claim occurs later in the life of the contract.

Putting both of these distributions together, it is possible to define the entire distribution using five variables from the usual deterministic valuation approach. These variables are: the number of expected deaths over the life of the contract \( (p) \); the sum insured less an allowance for tax \( (S) \); the Best Estimate Liability \( (BEL) \); the present value of claims \( (PVC) \); and the initial expenses including commission less an allowance for tax \( (C) \). Figure 5, below, presents the definition of the resulting approximated cumulative probability distribution.

### Figure 4: Fitted distribution to simulations with a claim during the life of the contract

Putting both of these distributions together, it is possible to define the entire distribution using five variables from the usual deterministic valuation approach. These variables are: the number of expected deaths over the life of the contract \( (p) \); the sum insured less an allowance for tax \( (S) \); the Best Estimate Liability \( (BEL) \); the present value of claims \( (PVC) \); and the initial expenses including commission less an allowance for tax \( (C) \). Figure 5, below, presents the definition of the resulting approximated cumulative probability distribution.

### Figure 5: Parametric approximation of the distribution of the Ultimate Liability (UL) for a single YRT contract

\[
Pr(UL > X) = \begin{cases} 
    p \int_0^{S+C-X} e^{-ax}dx + (1-p)\int_0^{C-X} \beta e^{-\beta x}dx & \text{if } X < C \\
    p \int_0^{S+C-X} e^{-ax}dx & \text{if } C \leq X < S + C \\
    0 & \text{if } S + C \leq X 
\end{cases}
\]

where:  
\[a = \frac{1}{((PVC-BEL) \times (1-p) - BEL) / p + S + C}\]
\[\beta = \frac{1}{(PVC - BEL + C)}\]

\(BEL\) and \(PVC\) are positive if they represent a liability to the insurer (i.e. net outgo).

The approximation includes adjustments for the sum insured \( (S) \) as well as initial commission and expenses \( (C) \). The latter adjustment only applies when estimating the Ultimate Liability at inception. Both adjustments are designed to shift the starting point of the distribution because the standard exponential distribution starts at zero.
In the parametric approximation above, the first part with $S$ in the formula relates to the exponential distribution fitted to the simulations where there is a claim during the life of the contract. The second part in the formula, without the $S$, relates to the exponential distribution fitted to the simulations where there is no claim during the life of the contract.

The probability of the Ultimate Liability exceeding the sum insured plus initial expenses and commission, less an allowance for tax, is zero. This makes intuitive sense because $S + C$ represents the maximum liability to the insurer assuming the policyholder claims immediately and there is no commission claw-back.

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**Key point #2:** It is possible to construct a parametric approximation to the Independent Error distribution of the Ultimate Liability for a single YRT contract using two Exponential distributions and five key output variables from the traditional deterministic valuation model.

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Given that both parts are exponential distributions, it was possible to express in a closed form and estimate the probability distribution easily within packages like Microsoft Excel. This is therefore very useful for estimating the total Ultimate Liability across a large number of contracts.

Overall the cumulative probability distribution across a small portfolio of contracts appears to be a very good fit to the simulated output of the cumulative stochastic models. Refer to Appendix 3 for goodness of fit charts relating to the cumulative probability distribution of the total Ultimate Liability.

### 3.6 Adjustments for systemic risk

The stochastic modelling thus far has estimated the variability of results around the best estimate assumption – that is, the Independent Error. The entire risk adjustment needs to take account of the mis-estimation of the mean, its long-term trends and any other external factors that may cause the actual experience to deviate from the best estimate assumption. In the GI framework, these risks are captured within allowances for Systemic Risk and it is important to do the same for life insurers. One would also expect that this allowance is bigger than the allowance for Independent Error for a large portfolio of contracts.

The GI framework sets out a good approach for making adjustments for systemic risk. It splits systemic risk into two categories – internal and external – and utilises a balanced scorecard approach to convert a largely qualitative assessment of risk into a quantitative addition to the CoV of the distribution before determining the risk margin.

I personally like the approach set out in the GI framework for systemic risk. Allowances will vary from insurer to insurer depending on the quality of their data, actual experience and adequacy of processes as well as their exposure to external market factors. It is more subjective than the stochastic approach used for independent error in this paper up to this point, but my view is that this is necessary to capture the nuances of each insurer’s business. It is therefore difficult to estimate the likely impact of systemic risk on risk adjustments as it will depend on the individual insurer.
The split between *internal* systemic risks and *external* systemic risks can be viewed as the ones that are influenced by the insurers’ own decisions and ones that are not. For example, data quality and modelling approaches are under an insurer’s control and, therefore, those risks are internal systemic risks. Conversely, major technology advancements and changes in legislation affecting the insurer would be external systemic risks.

Table 2, below, provides some examples of internal and external systemic risks for a YRT life portfolio. These examples are not designed to be exhaustive and are simply some suggestions to begin the development of a balanced scorecard within an insurer.

<table>
<thead>
<tr>
<th>What is it for?</th>
<th>Internal systemic risk</th>
<th>External systemic risk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What is it for?</strong></td>
<td>Risks that are within an insurer’s control and affect the accuracy of the best estimate assumptions, in terms of both the mean and the long-term trends</td>
<td>Risks that are external to the company and beyond an insurer’s direct control and would have impact the experience of multiple insurers in the market</td>
</tr>
<tr>
<td><strong>Categories of risk</strong></td>
<td>Model error</td>
<td>Economic and commercial environment</td>
</tr>
<tr>
<td></td>
<td>Assumption error (mean or trend)</td>
<td>Legal, regulatory, political or geopolitical</td>
</tr>
<tr>
<td></td>
<td>Data error</td>
<td>Natural catastrophe</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social and cultural shifts</td>
</tr>
<tr>
<td><strong>Examples for a YRT life portfolio</strong></td>
<td>Known issues with actuarial models or poor documentation</td>
<td>Severe economic downturn leading to higher lapses</td>
</tr>
<tr>
<td></td>
<td>New product, new distribution channel or loss of key broker group</td>
<td>Failure of an insurer leading to distrust in the industry</td>
</tr>
<tr>
<td></td>
<td>Recent changes to pricing or reinsurance</td>
<td>Future changes to tax rules</td>
</tr>
<tr>
<td></td>
<td>Lack of credible company experience to set assumptions</td>
<td>Unexpected entry of a new aggressive competitor</td>
</tr>
<tr>
<td></td>
<td>Large unexplained losses in the sources of profit</td>
<td>Influenza pandemic</td>
</tr>
<tr>
<td></td>
<td>Data reconciliation issues (e.g. following a move to a new IT system or datawarehouse)</td>
<td>Societal changes towards purchasing this product over another alternative product (e.g. peer-to-peer)</td>
</tr>
</tbody>
</table>

The qualitative assessment of risk would begin with asking what could happen in the future to affect the reliability of the best estimate assumptions or their long-term trends. The conversion of qualitative assessments into quantitative adjustments may be able to be assisted by the outcomes of sensitivity tests on key assumptions. In the long-term, surveys of risk adjustments can be conducted to benchmark each insurer against their peers.

The systemic risk allowances should, in theory, take account of the insurer’s practical ability to mitigate the risks, which includes reinsurance or re-pricing in the likely market conditions at the time. That is, the risk allowances should be the “residual” risk after (realistic) risk mitigation.

The allowances need to reflect the known changes or issues that impact the ability of an actuary to set an accurate best estimate as well as any unknown issues that may arise in the future and cannot be mitigated by premium rate changes. Overall significant judgement is required in this area and the results are likely to be unique to each insurer.
4 Risk adjustments across a portfolio of contracts

Using the parameterised probability distribution and an assumed policyholder mix, it is possible to simulate the distribution of the Ultimate Liability aggregated across a large number of contracts. Due to the law of large numbers, more contracts results in a tighter, more normal shaped distribution. In practice, this reflects the pooling of risk, or diversification, that is a fundamental principle of insurance.

Figure 6, below, shows the Independent Error distributions of the Total Ultimate Liability across a portfolio of 10 and 100,000 YRT contracts, respectively. The two key standardised measures of the shape of the distribution are also shown. However, it is clear that the skewness reduces markedly with a large number of contracts and the distribution becomes almost normal. Note that the mean of the distribution is shown by the vertical orange line and the bars at the left and right represent the cumulative frequency above selected cut-off percentiles (0.5% and 99.5%).

<table>
<thead>
<tr>
<th>No. of contracts</th>
<th>CoV</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>315%</td>
<td>3.7</td>
</tr>
<tr>
<td>100,000</td>
<td>6%</td>
<td>0.0</td>
</tr>
</tbody>
</table>

The charts above were based on YRT contracts with full upfront commission and a duration of two years, which was assumed to be beyond the initial commission claw-back period. Other options were considered, including level commission options and a duration of zero (i.e. at inception), to assess whether the likely risk adjustment would differ based on commission structure or duration.

The findings were that, for small portfolios, the risk adjustment did differ by commission structure and the risk adjustment was higher for the full upfront initial commission model. The risk adjustment was also higher for longer durations too in most cases. This presumably reflects the higher lapse risk of lapses in the early years with high upfront commission. However, as the number of contracts increased to 10,000 or more, there were no clear differences in the implied risk adjustment based on commission structure or duration due to the increased pooling of risk (or diversification).

**Key point #3:** With a large number of contracts, the Independent Error distribution of the Total Ultimate Liability becomes more normal and is not expected to differ significantly for different commission structures or durations.
It is perhaps not surprising that there are no significant differences in the Independent Error when considering a large number of contracts at different durations or different commission structures (that is, high upfront and low renewal versus a pendulum or level commission option). These different options have more impact on the mean, but have little impact on the variability around the mean. The higher lapse risk from writing business with higher upfront commission should therefore be captured within the systemic risk allowance.

Based on the stochastic model constructed, the 6% CoV from the portfolio with 100,000 contracts converts to a 3% risk adjustment, before systemic risk, at a 75% probability of sufficiency. The CoV represents the variability of the Ultimate Liability while the 3% is the equivalent 75th percentile expressed as a percentage of the present value of expected claims. If you currently use claims as the profit carrier under MoS, this means that you could expect the final profit margin to be more than 3% different to your estimate approximately 50% of the time purely due to statistical volatility.

In terms of systemic risk, the GI framework notes, on page 35, that the minimum CoV associated with internal systemic risk for a ‘perfect’ model is unlikely to be much less than 5%. One might suggest that a projection model for YRT contract liabilities have more risk given the number of assumptions required and the long-term nature of the liabilities. External systemic risk is often of a similar size to internal systemic risk. In my view, systemic risk would add at least 10% to the CoV, expressed as a percentage of the value of future claims, and would be expected to be higher for products with limited experience or higher upfront acquisition costs (due to the larger impact from lapses).

Assuming a 10-15% CoV for systemic risk will add 7% to 12% to the risk adjustment based on a normal distribution and 75% probability of sufficiency. Adding this to the 3% risk adjustment above gives a potential total risk adjustment of 10-15% for a large, mature portfolio. Figure 7, below, shows this range at a 75% probability of sufficiency, but also shows that the risk adjustments would be expected to be much higher with just a small number of contracts. The impact of the prescribed RBNZ margins from the Solvency Standard for Life Insurance Business are also plotted, which are expected to be at a much higher probability of sufficiency.

*Figure 7: Estimated range of risk adjustments for YRT life portfolios*
Overall the systemic risk allowance is clearly bigger than the allowance for independent error, despite being the more subjective item. This is not surprising given that the best estimate assumptions are often difficult to get right with continual changes to the business and the environment the life insurer operates in. However, I still find it surprising the level of risk generated from pure statistical volatility around the mean and this explains why there is such variability in the experience profits and losses of life insurers.

**Key point #4:** The 75th percentile risk adjustment for YRT life portfolios is estimated to be 10-15% of the present value of claims for a large, mature portfolio. Significant judgement is required to make an appropriate allowance for systemic risk based on the business profile and the insurer’s view of risk.

Note that the margins implied by the prescribed stresses under the RBNZ’s Solvency Standard for Life Insurance Business are an increase in the lapse rates by 40%, an increase in mortality rates by 10% and a 7.5% increase in renewal expense assumptions. It is understood that the solvency standard targets a 1 in 200 year probability of default, or a 99.5% probability of sufficiency. If you assume a normal distribution, a 10% risk adjustment broadly corresponds to the impact of the RBNZ margins on a standard commission basis in the previous chart.

Furthermore, it is noted that the impact of the RBNZ margins does not vary significantly by portfolio size. This suggests that the RBNZ margins applied may not be sufficient for businesses with a very small number of contracts if the RBNZ wants to achieve a high probability of sufficiency. It is also why a prescribed margin approach to estimate risk adjustments may not be appropriate for insurers of different sizes.

It is interesting to note the difference between the RBNZ margin for standard (upfront) commission and level commission. This is the result of higher lapse risk in the former and the fact that getting the best estimate lapse assumptions wrong makes much more difference to the Ultimate Liability. As a result, an insurer primarily writing contracts with upfront commission should have a higher systemic risk allowance, with all else being equal, to reflect that the risk of an error in the estimation of its best estimate lapse assumptions is higher than an insurer with most contracts on a level commission basis.
5 Other considerations

When deciding on the final risk adjustments within a life insurer, there are a number of other factors to consider. Section 5.8 presents an additional opportunity to use a stochastic approach to understand short-term profit volatility as well to better manage performance expectations.

5.1 Other products

This paper considered a portfolio of YRT life contracts only. As an extension of this paper, further work may be able to be carried out to use similar approaches for level premium life contracts and non-life risk products.

One would expect the risk adjustments for level premium life (including the direct ‘funeral plan’ types of cover) to be higher than that of YRT due to the additional risk of mismatching premiums and claims. However, the extent of this difference is unclear and it may depend on how mature the portfolio of level contracts is. For example, if the portfolio is very mature where a high proportion of contracts have expected claims exceeding premium income, then the risk adjustment may be higher than a less mature portfolio.

A potential approach to estimating the risk adjustment for level premium life business would be to adopt the same approach in this paper with YRT premium rates and all other assumptions aligned with the level premium basis. The ability to construct a parametric approximation to the distribution of the Ultimate Liability would still apply. An adjustment could then be made for the distribution in outcomes representing the present value of the difference in the expected level premium income and the expected YRT premium income. However, given that the result would heavily depend on the level premium term and the maturity of the portfolio, the results are not likely to be able to be generalised enough to include in this paper.

In terms of non-life risk products, it is less clear as to whether the risk adjustment would be higher or lower than YRT life. With these types of products, the distribution of outcomes includes some more frequent and less severe events, which suggests a lower risk adjustment on the policy liability itself. However, this may be more than offset by the addition of a risk adjustment on the outstanding claims reserves, particularly for disability income products.

5.2 Future assumption changes

Some literature on risk adjustments suggest that they should be reviewed upon significant assumption changes. For example, if the mortality rates have been increased or decreased substantially as a result of recent experience, perhaps this suggests that there is less risk in the future.

This is an area to think carefully about. While a change in assumptions may mean that the best estimate assumptions may reflect future experience more closely, the risk adjustment is not designed to be a shock absorber under the new standard. In theory, the risk adjustment should only be adjusted if the assumption review indicates that a change in the systemic risk allowances is warranted.
5.3 Correlation

The results in this paper did not allow for any correlation between mortality, lapse and expense risk. It did not allow for any correlation between contracts either. This assumption is likely to underestimate the risk adjustments but is not likely to be material to the overall results.

For a single contract, all variables were assumed to be independent of each other. This makes sense in broad terms given that lapses and mortality are generally uncorrelated. There may be some evidence of weak negative correlation in practice as the unhealthy policyholders are more likely to retain their policies than healthy policyholders; however, this is assumed to be immaterial as the negative correlation would be the highest over a short period immediately prior to a claim.

Across a portfolio of contracts, it was assumed that different contracts are not correlated with each other. In practice, this is not realistic, particularly in an intermediated market where relationships between the insurer and the intermediary has been known to affect lapse rates across a number of policyholders. Adjustments could be made to allow for this correlation, but it may be easier to allow for this in the systemic risk allowances instead.

5.4 Diversification

Diversification benefits arise when an entity is exposed to risks that are not perfectly correlated. The benefit is calculated as the difference between the value of aggregated portfolio of risks and the sum of the value of individual risks.

Risk adjustments are required to be set at the entity level, not the portfolio level. Therefore, the risk adjustment needs to reflect the diversification benefit across the entire entity. In general insurance companies, it is common to see diversification benefits of 30% or more for diversified portfolios. It would be possible to achieve diversification benefits for life insurance products as well, but it is unclear as to the level of diversification given that lapse and claims risks can be highly correlated across products. Given that some of the other product lines are intuitively more risky than YRT life, it will be difficult to justify diversified risk margins of much less than 10% at a 75% probability of sufficiency.

Financial services groups with multiple insurance entities have further considerations because risk adjustments will need to be determined for each entity plus another risk adjustment will be required at the group level. The level of diversification across entities becomes important and could create complications if it is the difference between loss recognition or not.

5.5 Probability of sufficiency

The previous section of the paper assumed a 75% probability of sufficiency for estimating risk adjustments. This was chosen based on the fact that it is the default probability of sufficiency for general insurers as it corresponds to what is used for regulatory solvency calculations. Based on a recent survey of New Zealand life insurance actuaries, 75% also seems to be a popular target in terms of probability of sufficiency, although it is noted that many life actuaries are adopting a “wait and see what early movers do” stance.
It has been noted in a previous 2012 paper that the adoption of risk margins in the general insurance industry had “no marked improvement in transparency”\(^6\). Given that insurers have the freedom to choose their approach as well as the probability of sufficiency, it makes comparisons difficult. Other jurisdictions such as Singapore achieve consistency because insurers, for the most part, hold the same insurance liabilities used for their financial statements and regulatory capital calculations. A similar approach could be considered in New Zealand and further work would be required, involving the New Zealand Society of Actuaries and the RBNZ, to achieve this.

5.6 **Comparison to GI lines of business**

Figure 8, below, presents a chart of the interquartile range and averages (represented by the black dots) from recent risk margin surveys across Australia and New Zealand. Classes of business that are the most relevant to the life insurance sector are included. The 75\(^{th}\) percentile risk margin applying to premium liabilities, or unexpired risk, is presented as this is the most comparable to the risk adjustments considered in this paper.

\(^6\) Risk margins – Have we come full circle?, November 2012, by Win-Li Toh and Chris Latham

tends to be long-term bodily injury claims, which is similar to disability income (even though this risk is primarily covered by ACC in New Zealand).

The average outcomes sit within a 10-17% range, which makes the 10-15% guideline provided for YRT life contracts in this paper appear reasonable. However, it is noted that it is difficult to compare to these classes directly given that they are different types of business and the risk adjustment covers the entire YRT life liability over a long time horizon, which leads to a higher risk adjustment. It is not known to what extent the ability to re-price YRT contracts in the event of poor experience can offset this and this requires further consideration based on the business and market conditions.

5.7 Comparison to other research

In the Bui & Cummings paper, the authors presented some analysis based on mortality risk only to suggest that the independent error of life insurance contracts is merely 1.3% at a 75th percentile (compared to the 3% in this paper). Allowances for mean and trend uncertainty brought the risk adjustment up to 10-12%, which is more consistent with the overall guideline set out in this paper.

The same paper also considered a cost of capital approach, which gave a lot lower risk adjustment when the CTV minimum is applied (3-4%) and a higher risk adjustment without any CTV minimum (15-20%). A “tiered” approach to calculate the cost of capital by applying a lower expected return on capital to the impact from applying the CTV gave a risk adjustment of 7-10%. However, the probability of sufficiency is not measured in this approach, so it’s not clear whether it’s comparable to the 75th percentile estimates in this paper.

It is noted that this paper considers both lapse risk and mortality risk, which appears to at least double the variability in the liability purely due to randomness (Independent Error). As a result, the 10-15% guidance provided in this paper appears reasonable compared to the cost of capital approach set out in the Bui & Cummings paper, if not slightly on the low side.

5.8 Other uses for stochastic approach

As part of this paper, it is my view that there are clear opportunities for life insurers to consider a stochastic approach with a time horizon of one year. Lapse risk and how this affects reported profit in New Zealand life insurers is not very well understood. As a result, lapse experience profits and losses are the focus of much investigation and interrogation after valuation results are produced.

A stochastic model projecting all contracts out one year, in terms of their cashflows and changes in best estimate liability, will help insurers understand the financial risk of better or worse persistency. A confidence interval around the potential experience profit or loss, along with key sources of variability, could be used to better manage expectations of insurance executives or directors before it becomes an issue. The quantitative analysis could also be used to set performance targets too.

This is an area where further work is required. The approach and outcomes would be specific to the insurer involved, so generic examples have not been provided in this paper.
6 Key conclusions

Life insurers are about to enter into a new world as risk adjustments will be required to be calculated as part of the life insurance contract liability under the default accounting model. This paper concludes that a stochastic approach based on the GI framework for risk margins is appropriate for estimating risk adjustments for the unexpired risk for YRT life contracts.

This paper assumed the Building Blocks Approach would be used for YRT with a contract boundary to the end of the term of the contract. The GI framework for risk margins provided a very good platform to estimate risk adjustments for the unexpired risk for YRT portfolios by splitting the risk adjustment into the Independent Error and Systemic Risk components. This led to four key points in the paper:

1. The distribution of the Ultimate Liability of a single YRT contract is highly positively-skewed due to the small probability of a large loss. Claims risk gives the distribution a tail, while lapse risk gives the distribution a body.
2. It is possible to construct a parametric approximation to the Independent Error distribution of the Ultimate Liability for a single YRT contract using two Exponential distributions and five key output variables from the traditional deterministic valuation model.
3. With a large number of contracts, the Independent Error distribution of the Total Ultimate Liability becomes more normal and is not expected to differ significantly with different commission structures or durations.
4. The 75%ile risk adjustment for YRT life portfolios is estimated to be 10-15% of the present value of claims for a large, mature portfolio. Significant judgement is required to make an appropriate allowance for systemic risk based on the business profile and the insurer’s view of risk.

Practically this means that risk adjustments may be higher than life insurers had been anticipating and loss recognition for some portfolios is a real possibility. Loss recognition, otherwise known as the onerous contracts test, will create much more profit volatility and is a signal of unprofitable business. The likelihood of loss recognition may be increased on level premium or other non-life products due to anticipated more granular product grouping criteria in the new standard. However, this likelihood may be offset by allowing for diversification benefits across products or by deferring less acquisition costs. The latter obviously has other consequences for the profit signature of future business written and there may be little discretion on what ‘direct’ costs can be deferred in the final standard anyway.

One further conclusion of this paper is that life insurers appear to understand little about the lapse risk and how that impacts reported profit. Capital models tend to ignore lapse risk due to the CTV minimum, but lapse experience often comprises a significant component of an insurer’s profit and loss in the New Zealand market. Life insurers tend to be reactive in this regard and look at explaining persistency results after a balance date. However, basic stochastic approaches that consider a one year horizon could be used to better understand the potential variability in the results and help manage expectations or set targets. This could also be used to estimate the impact of key broker groups or estimate the return on investment for particular retention campaigns too.

Overall it is hoped that this paper provides a strong starting point for life insurance actuaries to think about how to estimate risk adjustments under the new IFRS accounting standard. It has done so by leveraging the work already used in the general insurance industry and we should continue to work together as an entire profession as the accounting requirements become closer aligned.
Appendices

Appendix 1: IFRS 4 exposure draft wording

The following sections are draft wording from the 2013 exposure draft, published by the IASB. The sections shown are the most relevant for the paper, including: contract boundary, criteria for the simplified approach and guidance for the risk adjustment. The full document can be found on the www.ifrs.org website (titled ED-Insurance-Contracts-June-2013.pdf).

A.1.1 Contract boundary

23 Cash flows are within the boundary of an insurance contract when the entity can compel the policyholder to pay the premiums or has a substantive obligation to provide the policyholder with coverage or other services. A substantive obligation to provide coverage or other services ends when:

(a) the entity has the right or the practical ability to reassess the risks of the particular policyholder and, as a result, can set a price or level of benefits that fully reflects those risks; or

(b) both of the following criteria are satisfied:

(i) the entity has the right or the practical ability to reassess the risk of the portfolio of insurance contracts that contains the contract and, as a result, can set a price or level of benefits that fully reflects the risk of that portfolio; and

(ii) the pricing of the premiums for coverage up to the date when the risks are reassessed does not take into account the risks that relate to future periods.

24 An entity shall determine the boundary of an insurance contract by considering all of the substantive rights that are held by the policyholder, whether they arise from a contract, law or regulation. However, an entity shall ignore restrictions that have no commercial substance (ie no discernible effect on the economics of the contract).

A.1.2 Criteria for simplified approach

35 An entity may simplify the measurement of the liability for the remaining coverage using the premium-allocation approach set out in paragraphs 38–40 if:

(a) doing so would produce a measurement that is a reasonable approximation to those that would be produced when applying the requirements in paragraphs 18–32; or

(b) the coverage period of the insurance contract at initial recognition (including coverage arising from all premiums within the contract boundary determined in accordance with paragraphs 23–24) is one year or less.

A.1.3 Risk adjustment

27 When determining the fulfilment cash flows, an entity shall apply a risk adjustment to the expected present value of cash flows used.

B76 The risk adjustment measures the compensation that the entity would require to make the entity indifferent between:

(a) fulfilling an insurance contract liability that has a range of possible outcomes; and

(b) fulfilling a liability that will generate fixed cash flows with the same expected present value as the insurance contract.

For example, the risk adjustment would measure the compensation that the entity would require to make it indifferent between fulfilling a liability that has a 50 per cent probability of being CU90 and a 50 per cent probability of being CU110 and fulfilling a liability that is fixed at CU100. As a result, the risk adjustment conveys information to users of financial statements about the entity’s perception of the effects of uncertainty about the amount and timing of cash flows that arise from an insurance contract.
Because the measurement of the risk adjustment reflects the compensation that the entity would require for bearing the uncertainty about the amount and timing of the cash flows that arise as the entity fulfils the contract, the risk adjustment also reflects:

(a) the degree of diversification benefit that the entity considers when determining the compensation it requires for bearing that uncertainty; and

(b) both favourable and unfavourable outcomes in a way that reflects the entity’s degree of risk aversion.

The purpose of the risk adjustment is to measure the effect of uncertainty in the cash flows that arise from the insurance contract. Consequently, the risk adjustment shall reflect all risks associated with the insurance contract, other than those reflected through the use of market consistent inputs (see paragraph B44). It shall not reflect the risks that do not arise from the insurance contract, such as investment risk relating to the assets that an entity holds (except when that investment risk affects the amounts payable to policyholders), asset-liability mismatch risk or general operational risk that relates to future transactions.

The risk adjustment shall be included in the measurement in an explicit way. Thus, in principle, the risk adjustment is separate from the estimates of future cash flows and the discount rates that adjust those cash flows for the time value of money. The entity shall not double-count the risk adjustments by, for example, including the risk adjustment implicitly when determining the estimates of future cash flows or the discount rates. The estimates of future cash flows and the discount rates that are disclosed to comply with paragraphs 73–85 shall not include any implicit adjustments for risk.

The [draft] Standard does not specify the technique that is used to determine the risk adjustment. However, to meet the objective in paragraph B76, the risk adjustment shall have the following characteristics:

(a) risks with low frequency and high severity will result in higher risk adjustments than risks with high frequency and low severity;

(b) for similar risks, contracts with a longer duration will result in higher risk adjustments than contracts with a shorter duration;

(c) risks with a wide probability distribution will result in higher risk adjustments than risks with a narrower distribution;

(d) the less that is known about the current estimate and its trend, the higher the risk adjustment; and

(e) to the extent that emerging experience reduces uncertainty, risk adjustments will decrease and vice versa.

An entity shall apply judgement when determining an appropriate risk adjustment technique to use. When applying that judgement, an entity shall also consider whether the technique provides concise and informative disclosure so that users of financial statements can benchmark the entity’s performance against the performance of other entities. Paragraph 84 requires an entity to translate the result of that technique into a confidence level if it uses a different technique to determine the risk adjustment.
### Appendix 2: Detailed assumptions for stochastic model

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Basis</th>
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</table>
| **Premiums** | • Market median premiums for $500,000 sum insured at 5 year age bands were obtained from the Quotemonster price comparison tool  
• An allowance for a policy fee of $6 per month was made  
• The base premium rates were set such that the total premium matched the market median (and premium rates were interpolated between the 5 year age bands)  
• No allowance for large sum assured discounts was made |
| **Mortality** | • NZ10 insured lives, non-accelerated term business, up to age 69; NZ 05-07 population mortality for age 70 and over, multiplied by a factor of between 62% and 75%  
• Non-smoker rates were the base rate divided by 1.15 while the smoker rates were the base rate multiplied by 2.00  
• Selection adjustment of 50% in the first year and 75% in the second year (i.e. 25% less claims) |
| **Lapses** | • Lapse rates were set by reference to the actuarial disclosures in the publicly available financial statements of Sovereign Assurance as at 30 June 2015  
• Lapses differed by age only, not duration or any other variable |
| **Commission** | • Standard (upfront) commission model assumed 200% initial and 7.5% renewal  
• Level commission model assumed 120% initial and 20% renewal  
• Clawback 100% of initial commission upon lapse in the first year and 50% of initial commission upon lapse in the second year |
| **Expenses** | • Initial expenses of 100% of the first year’s premium  
• Renewal expenses of $30.00 per benefit with a standard deviation of $1.50 in the stochastic model, which reflected the potential variability in real unit costs  
• The renewal expenses were inflated by the stochastic inflation rate as well |
| **Inflation** | • Base inflation assumption of 2% per annum with a CoV of 50% in the stochastic model  
• This applied to expenses, but not the sum insured (i.e. the sum insured was assumed to be level for the entire duration) |
| **Interest rate** | • A fixed 3% per annum for the life of the contract |
| **Tax** | • Tax of 28% was assumed to apply to the net cashflow in each year |
| **Projection term** | • Annual time steps, projecting out 50 years |

The charts below show the age and sum insured mix for the portfolio of contracts used in this paper. Overall the portfolio comprised 5,000 contracts and 20 simulations were run to get the equivalent of 100,000 contracts.
Appendix 3: Goodness of fit tests

The following charts illustrate the goodness of fit for parameterised solution to the stochastic simulations in terms of the cumulative probability distribution (CDF). Three examples are presented and they included a selected set of 21 contracts.

Overall it was concluded that the parameterised solution was a very good fit to the stochastic output, particularly at percentiles above the mean (best estimate liability).

Figure 9: CDF for standard commission option at duration = 2 years

Figure 10: CDF for standard commission option at inception (duration = 0)
Figure 11: CDF for level commission option at duration = 2 years
### Appendix 4: Glossary of terms

The following table provides a glossary of abbreviated terms used throughout this paper.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>ACC</td>
<td>Accident Compensation Corporate, the government department that acts as the insurer of all accident-related injuries in New Zealand</td>
</tr>
<tr>
<td>APRA</td>
<td>Australian Prudential Regulatory Authority, the regulator of the insurance industry in Australia</td>
</tr>
<tr>
<td>BBA</td>
<td>Building Blocks Approach, which will be the default measurement model in the new IFRS standard for insurance accounting and is similar, in principle, to MoS</td>
</tr>
<tr>
<td>BEL</td>
<td>Best Estimate Liability as defined in the NZSA Professional Standard 20</td>
</tr>
<tr>
<td>CDF</td>
<td>Cumulative probability function – i.e. the cumulative probability distribution of a random variable</td>
</tr>
<tr>
<td>CoV</td>
<td>Coefficient of variation, which is a standardised measure of volatility (calculated as the standard deviation divided by the mean)</td>
</tr>
<tr>
<td>CTV</td>
<td>Current Termination Value or the value paid to a customer upon voluntary termination</td>
</tr>
<tr>
<td>GI</td>
<td>General insurance (i.e. property and casualty insurance industry)</td>
</tr>
<tr>
<td>IASB</td>
<td>International Accounting Standards Board</td>
</tr>
<tr>
<td>IFRS</td>
<td>International Financial Reporting Standard</td>
</tr>
<tr>
<td>MoS</td>
<td>Margin on services approach, which an accounting approach currently used by life insurers under NZ IFRS 4 to recognise profits in line with services provided (e.g. claim payments)</td>
</tr>
<tr>
<td>PAA</td>
<td>Premium Allocation Approach, which is an optional simplified model permitted in the new IFRS standard and reserves for unexpired risk using the unearned portion of premiums less expenses</td>
</tr>
<tr>
<td>PDF</td>
<td>Probability density function – i.e. the incremental probability distribution of a random variable</td>
</tr>
<tr>
<td>RBNZ</td>
<td>Reserve Bank of New Zealand, the regulator of the insurance industry in New Zealand</td>
</tr>
<tr>
<td>UL</td>
<td>Ultimate Liability, which is a random variable representing the discounted expected value of future cashflows from a single life insurance contract (and where the BEL is the mean)</td>
</tr>
<tr>
<td>YRT</td>
<td>Yearly renewable term life insurance, which is the most common form of life insurance in New Zealand and is non-participating</td>
</tr>
</tbody>
</table>