Forward Looking Assessments - Solvency Projections for New Zealand Insurers

A paper to be presented at the conference of the New Zealand Society of Actuaries – November 2014 by John Feyter.

1. Introduction

The Insurance (Prudential Supervision) Act 2011 (“IPSA”) has for the first time imposed a regulatory requirement upon New Zealand insurers to perform a formal projection of their solvency requirements.

The purpose of this paper is to outline the author’s views on the minimum requirements that are imposed by IPSA. A simple stochastic model was developed to identify the amount of initial solvency margin required in order for a hypothetical insurer to meet the Section 24 test under IPSA. Generic risks were considered with the aim that these may be able to be applied to individual company situations.

A survey of appointed actuaries was also carried out to determine current practice in relation to the Section 24 requirement. The results of the survey are shown in the appendix. The author is grateful to those actuaries who participated in the survey.

The views expressed in this paper are solely those of the author.

2. IPSA and RBNZ Solvency Requirement

2.1 Regulatory requirements relating to solvency forecasts include:

- direct reference within IPSA, and
- requirements within the RBNZ solvency standards, and
- requirements within the capital adequacy sections of the NZSA’s FCR professional standards (the RBNZ solvency standards require that all work is carried out in accordance with NZSA professional standards).

2.2 Section 24 of IPSA states:

> *“If a licensed insurer has reasonable grounds to believe that a failure to maintain a solvency margin is likely to occur at any time within the next 3 years, the insurer must report the likely failure to the Bank as soon as is reasonably practicable”.*

2.2 The IPSA requirement is expanded on within the Life and Non-Life Solvency Standards. The wording from the Life Insurance Solvency Standard is reproduced below (the requirement is identical in the Non-Life Solvency Standard).

> *“140. Section 24 of the Act requires that, if a licensed insurer has reasonable grounds to believe that a failure to maintain a Solvency Margin is likely to occur at any time within the next three years, the licensed insurer must report the likely failure to the Bank as soon as is reasonably practicable.*

141. In order to comply with Section 24 of the Act a licensed insurer will need to consider a forward looking assessment of its compliance with the solvency standard in addition to the calculations at the most recent balance date.

142. The forward looking assessment must extend at least three years from the current date and must take into account known aspects of the licensed insurer's business plan.

143. Because Section 24 of the Act applies continuously, not just once a year, a licensed insurer will need to be satisfied that it has adequate procedures in place to identify and escalate circumstances that may give rise to a reporting obligation under Section 24. Those procedures must include timely advice to the licensed insurer's appointed actuary."

[Note: in September the RBNZ issued new draft versions of both the Life and Non-Life Solvency Standards for consultation. The wording in the consultation documents is different from above but there is no change to the effective requirement].

The Solvency Standards also include requirements for what must be included in a Financial Condition Report. The relevant section of the Non-Life Solvency Standard says the appointed actuary must:

"151(k) advise the licensed insurer on whether, in the appointed actuary's opinion, the licensed insurer needs to consider reporting to the Bank under Section 24 of the Act, taking account of the licensed insurer's forward looking assessment of the licensed insurer's business plans, its enterprise risk management practices and the external environment".

2.3 Paragraph 151(k) actually appears to impose an additional requirement on the appointed actuary because enterprise risk management practices and the external environment are mentioned separately from the forward looking assessment. However the NZ Society of Actuaries have removed this distinction by requiring (in their FCR standards) that business plans, enterprise risk management and the external environment are all taken into account in the forward looking assessment. In addition the FCR standards say that variation in key assumptions must be considered

2.4 The regulatory requirement relating to forecasts of the solvency position can be summarised as:

(i) A requirement to perform a forward-looking assessment that takes into account:
- business plans, and
- risk management practices, and
- the external environment, and
- variations in key assumptions.

(ii) A responsibility for the actuary to consider the results of the forward-looking assessment in the context of Section 24 of the Act. In certain circumstances the Actuary will need to advise the insurer that they should consider reporting likely failure to maintain a solvency margin to the RBNZ.

A key requirement of the forward looking assessment is that it gives information that allows the user to form a view on whether the Section 24 reporting requirements apply.

3. What does "failure to maintain a solvency margin is likely to occur…." mean?

The construction of this likelihood statement is unusual in that the undesirable event (failure) needs to be likely to occur. Actuaries are familiar with the context of best estimates (equally likely that the outcome is favourable or unfavourable) and they are familiar with prudent reserves where they may have a 75% or higher probability of sufficiency.

So what probability should we assign to "failure likely to occur"?

A dictionary definition of 'likely' is *'probable, such as well might happen'.*

Common English usage would equate this with a probability > 50%. There may be arguments that a greater percentage threshold could be used, for example > 75% because the common English of the opposite "not likely" or "improbable" would usually be associated with percentages somewhat below 50%. However there would be common agreement that percentages of 50% or lower would not be described as 'likely'. Therefore a boundary condition of > 50% is the lowest threshold that could reasonably be argued in my opinion.

[Note the "strength" of the solvency test reduces for higher threshold percentages. If the test requires a high probability of failure then conditions can generally be poorer before the test is failed compared with another test that requires a lower probability of failure. For example a company with a likelihood of failure of 60% (say) would fail a test set at a threshold of 50% but would pass a test if the threshold was 75%]

For the purposes of this paper I have assumed that "failure to maintain a solvency margin is likely to occur" means there is a greater than 50% probability that a solvency margin is not maintained. This is effectively the "strongest" test that can be argued from the wording of the Act and associated regulations in my opinion.

4. Stochastic Modelling – Risk Characteristics

Stochastic modelling has been carried out for a variety of risk characteristics. Interest rate risk has been considered separately using historical New Zealand experience. Other risks were considered more generically by considering the impact of various risk patterns. Risk patterns considered were:

4.1 Normally distributed random risk:

This might be associated with deviation from an expected mean value – for example the average expected claims for a portfolio might be normally distributed about a mean.

4.2 Skewed distribution – applicable when outcomes are not evenly distributed, for example portfolio claim outcomes may have low very adverse outcomes with low probability, but more frequent small good outcomes. For this purpose a simple "triangle" distribution was used. (In practice extreme risks are likely to be more heavily skewed than this but can be ignored for the purposes of the Section 24 Test because their frequency is too low to affect outcomes in the middle of the probability distribution where the test applies).

4.3 Shock risk – used to represent on-off shocks that may occur at any time. Shocks with an expected frequency of 1 in 3 years, 1 in 5 years and 1 in 10 years were considered. For shock scenarios I considered two different possibilities:

(i) The shock is adequately priced or reserved for. In this case the company is effectively receiving income to cover the risk of the shock. Therefore the projection model assumes a small amount of income in months when the shock does not occur.

(ii) There is no existing reserve or premium income to cover the shock. Therefore the shock risk represents a net expected loss to the company.

I would expect most insurance related risks such as claim risks to fall into category (i). Other risks like fraud, mismanagement of expenses, investment losses might fall into category (ii).

4.4 Combinations of different risks were also considered. The combination of a normal distribution of base risk plus a shock risk effectively gives another skewed distribution.

5. Hypothetical Company

Projections were performed for a hypothetical general insurance company. Liabilities of the company were assumed to remain the same over the projection period (3 years) in all cases. Assets varied according to the effect of expected profit or loss, random deviations around expected profit, and the effect of shock events.

I have only considered variance in relation to profit but believe the results can be interpreted more generally because the solvency effect of profit or loss in the context of the scenarios I have modelled is similar to solvency strain in the situation where liabilities or minimum solvency capital requirements change.

Details of the hypothetical company are:

Assets:	\$73,995 set so as to give a nil initial solvency margin. Higher amounts of initial assets were also modelled.
Liabilities:	\$60,000
Minimum Solvency Capital:	\$13,995. MSC was assumed to be 6.75% of assets + 15% of liabilities.
Base Expected Claims:	\$50,000 p.a. Shock scenarios were also considered which has the effect of increasing the level of expected claims.
Expenses:	\$20,000 p.a.
Base Premiums:	\$70,000 p.a. Set so as to give nil expected profit in the base scenario. Scenarios including a level of expected profit (or loss) were also modelled.

Nil tax has been assumed throughout.

6. Stochastic Projection Results

6.1 Interest Rate risk only – Nil investment income

Assume the hypothetical insurer is not exposed to any risks other than interest rate risk. The insurer has sufficient capital to cover the RBNZ Minimum Solvency Capital ("MSC") level and a nominal $1 solvency margin in excess of MSC. The insurer is not exposed to any risks other than interest rate risk.

There is a 50% chance that interest rates will move either up or down so you would not argue that it is **likely** the company will fail to maintain a solvency margin instantaneously. In practice, however, the requirement to consider the solvency margin **continuously** over the next three years does establish a minimum amount of capital required for this hypothetical company over and above the RBNZ MSC requirement.

A model of future interest rate movements was constructed based on historical monthly movements taken from the RBNZ website for the period January 1999 to August 2014. Frequencies were adjusted to take out the negative bias (interest rates had reduced in total by 1.25% over the period chosen). The resulting distribution of monthly interest rate movements was:

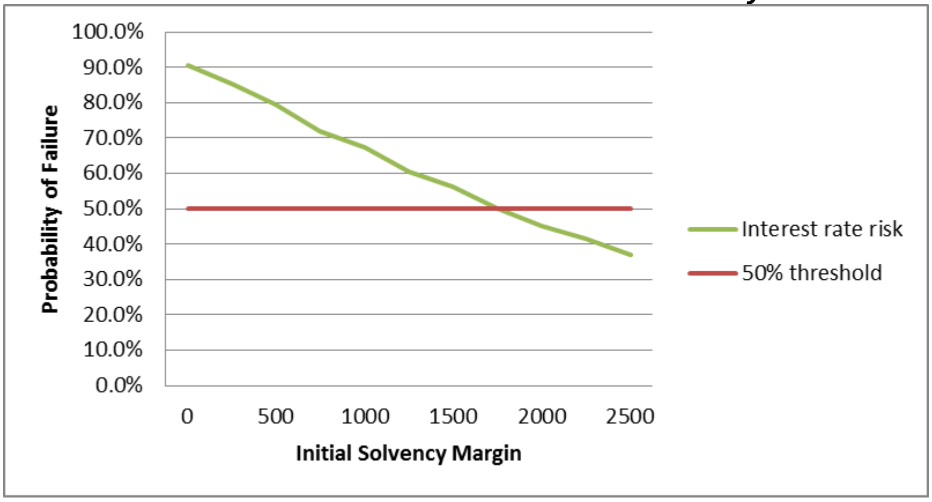
Table 1: Assumed Interest Rate Movements based on historical experience

Interest Rate Movement for Month	Proportion of Sample
-1.0% to -0.9%	0.01
-0.9% to -0.5%	0.00
-0.5% to -0.4%	0.02
-0.4% to -0.3%	0.07
-0.3% to -0.2%	0.07
-0.2% to -0.1%	0.16
-0.1% to 0%	0.18
0% to 0.1%	0.20
0.1% to 0.2%	0.11
0.2% to 0.3%	0.07
0.3% to 0.4%	0.05
0.4% to 0.5%	0.03
0.5% to 0.6%	0.02
0.6% to 0.7%	0.01
Total	**1.00**

I calculated cumulative positive and negative interest rate deviations over 36 months using expected monthly interest rate movements from the historical distribution in Table 1.
I assumed all assets were exposed to interest rate risk with an average duration of three years in order to estimate the dollar effect of interest rate movements. Liabilities were assumed to have nil interest rate exposure (this is a conservative treatment by assuming there is no offset for interest rate risk in respect of asset holdings)..

The results for 10000 scenarios are as follows:

Chart 1: Scenario outcomes for Interest Rate Risk only



The result shown is for upshock risk. The result for downshock risk (if applicable) was almost identical due to the symmetrical distribution of interest rate movements assumed so was not considered further.

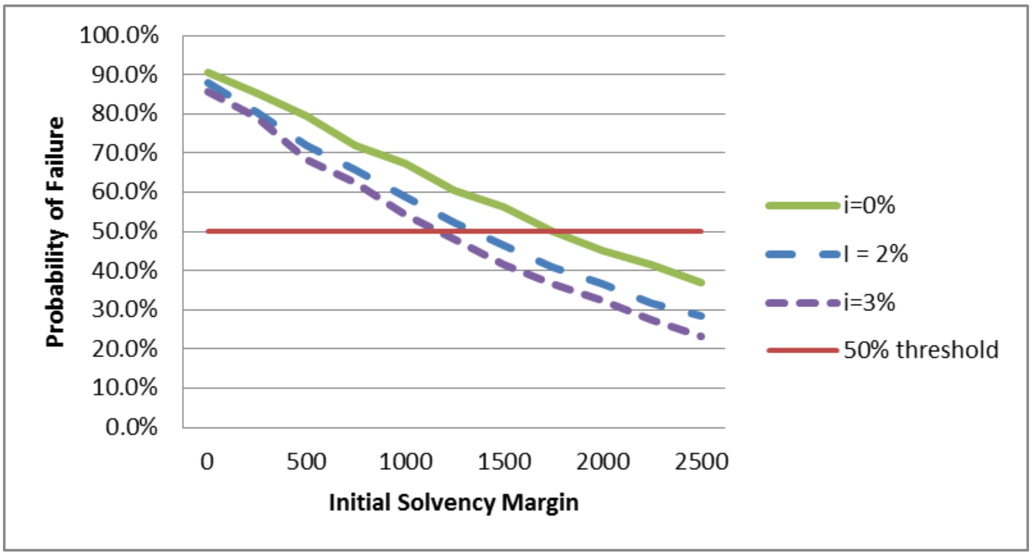
The outcome in the context of the section 24 solvency test is that the hypothetical company has a probability of 90% of failing to maintain a solvency margin unless some additional capital is held. Additional capital of about $1,800 would be required to reduce the probability of failure to below 50%. This is equivalent to an initial solvency margin sufficient to cover a movement in interest rates of about 80 basis points.

6.2 Interest Rate Risk + Investment Income

It is not unreasonable to expect some assumed investment income if interest rate risk is being assumed. I have assumed the whole asset base of the hypothetical company is exposed to interest rate risk but investment earnings are only earned on excess assets.

Results are shown for assumed investment earnings rate of 2% p.a. and 3% p.a.

Chart 2: Scenario outcomes for Interest Rate Risk + Assumed Investment Earnings



The outcome of the projections is now improved materially assuming just nominal levels of investment income on a proportion of the asset base.

6.3 Risk from Random Variation

For this purpose I have considered risk in the terms of generic probability patterns rather than situations representative of a particular type of business. I hope the generic results are able to be applied to individual business situations.

6.3.1 Random variation only

In this hypothetical example there is no risk other than claims risk. Total claims are assumed to be exactly equal to premiums with two patterns of random variation.

(i) Assume total claims are normally distributed around the mean of $50,000 with a standard deviation of $2500. I have purposefully set this standard deviation at a high level relative to expected claims to exaggerate the risk profile of this company.

(ii) A slightly skewed distribution of claims with a larger number of favourable outcomes expected and smaller number of adverse outcomes. The standard deviation of this distribution is also about $2500. The graph below shows the frequency distribution obtained in a stochastic simulation.

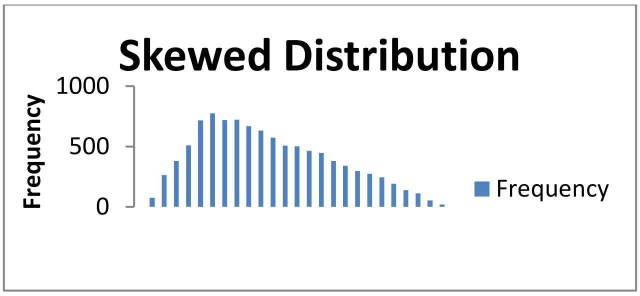
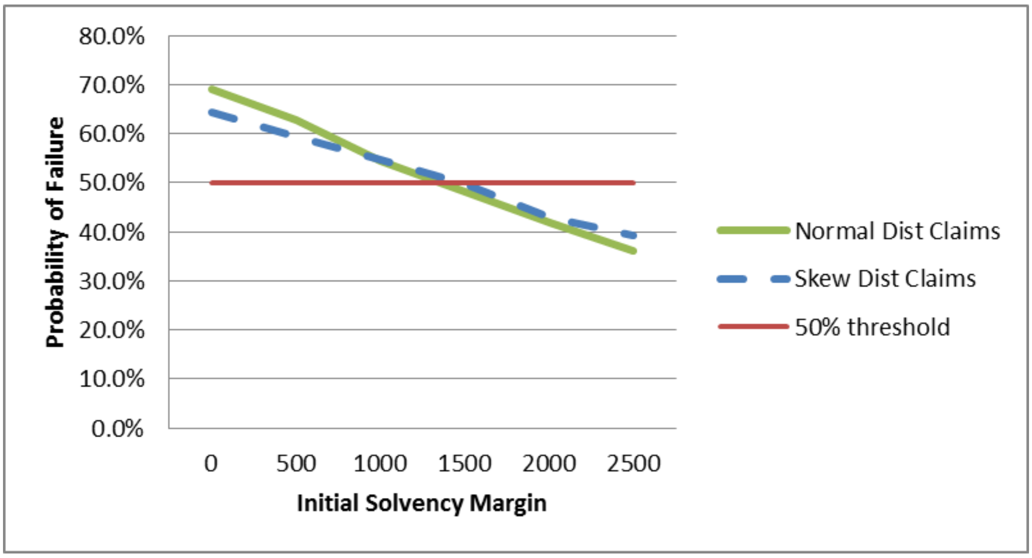


Chart 3: Scenario outcomes for Random variation of Total Claims



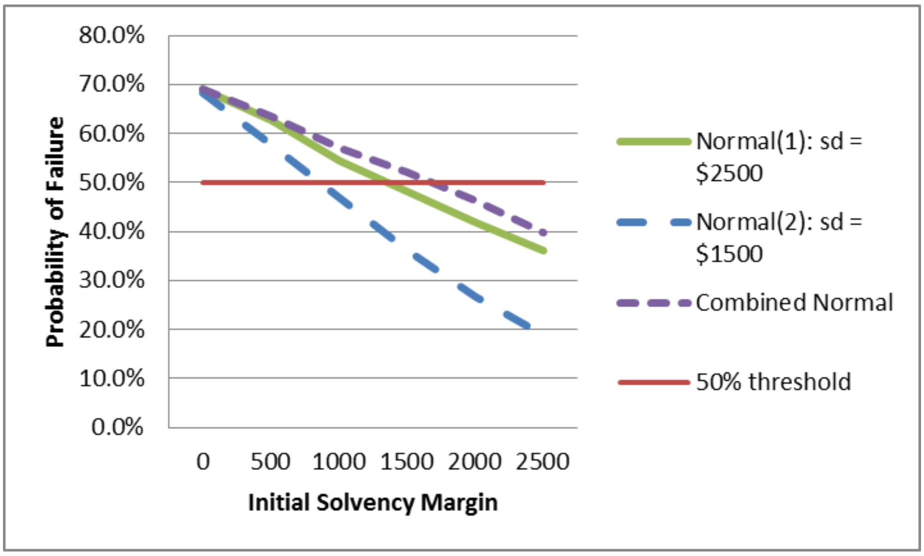
The initial probability of failure (with $1 solvency margin at commencement) is about 70% for a normal distribution of claim outcomes. An initial solvency margin of about 60% of the standard deviation of claims is required in order to reduce the probability of failure below 50%.

The initial probability of failure for the skew distribution of claims is slightly lower than for the normal distribution but a similar amount of initial capital is required to achieve a probability of failure below 50%.

6.3.2 Two different random risks

Consider the situation where there is random claim risk (with a standard deviation of $2,500 as per above) but also a second source of random risk. I have assumed there is an additional (independent of the claim risk) random risk with a standard deviation of $1,500.

Chart 4: Scenario outcomes for Combined Distributions



Statistical theory tells us the combined distribution should be normally distributed with a standard deviation of about $2,900 p.a. The initial solvency margin required to maintain a probability of failure below 50% is now about 17% higher than that required for the original claims risk as would be expected (the variance of the combined distribution is equal to the sum of the two variances).

A combination of multiple risk types was shown to further generalise the results of this paper. It would be unlikely for a company to be exposed to just one random risk. The result above shows that multiple independent random risks can be considered as one risk with a higher standard deviation as derived from basic statistics.

6.4 Shock Risk

I also considered the effect of claim shocks. Three shock frequencies were considered:

- 1 in 3 -year shock of $4,200 (chosen to give approximately $2,500 p.a. standard deviation of claims).
- 1 in 5 -year shock of $7,000
- 1 in 10-year shock of $14,000

The possibility of a claim shock was assumed to occur monthly.

Two types of shocks were considered:

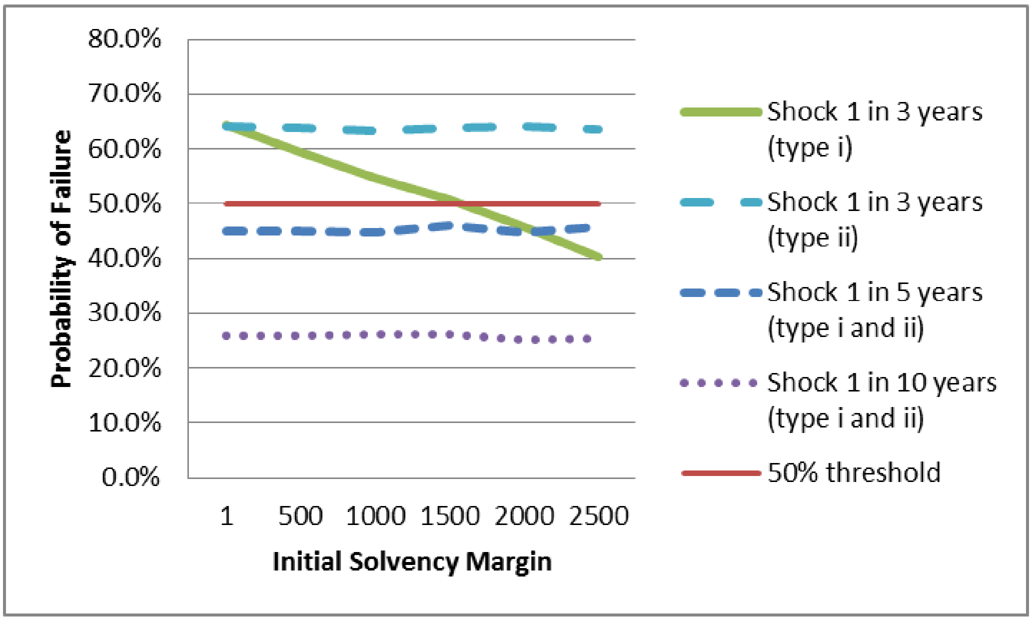
(i) Shocks which are covered by revenue (or the release of reserves) in order to maintain nil expected profit. For example, in the case of a 1 in 5-year shock the monthly claim variance was assumed to either be +$117 in a month when there was no shock or -$6,883 in a month when there was a claim shock.

This type of shock might apply for claims risk where premiums (if adequate) are set so as to cover both high and low frequency risk events.

(ii) Shocks that are expected to result in a net expected loss to the business. For the same 1 in 5-year shock these were assumed to have nil effect in a month when there was no shock and a -$7,000 effect in month when there was a nil shock effect.

This type of shock might apply in the case of risky investments (credit risk), although there would be an argument that the nominal return on risky investments is higher than risk-free to allow for the risk.

Chart 5: Scenario outcomes for Shock scenarios



The result for the 1 in 3-year shock has a probability of failure of about 65% if there is initially a nil solvency margin. This is simply equal to the probability of one or more shock events occurring in the 36 month projection period. The probability of failure reduces with small amounts of extra initial for type (i) shock risk because the additional capital plus risk premiums received is sufficient to offset those shocks occurring late in the projection period.

Results for 1 in 5-year and 1 in 10-year shocks both have a probability of failure below 50% even with nil initial solvency margin. The probability of failure for these shock scenarios does not change when there are small amounts of extra initial capital because the extra amounts of capital together with accumulated premiums (if any) for shock risk are not sufficient to cover the cost of a shock event. A similar situation exists for the 1 in 3-year type (ii) shock where additional capital of $4,200 would be required before any change to the risk profile would be seen.

In the interests of reducing the number of projection combinations to use – it is obvious that a type(ii) shock scenario is equal to a type (i) shock **plus** an expected monthly loss equal to the expected shock per month. The effect of varying levels of expected business profit are considered below, so only type (i) shocks are modelled with no loss of generality.

6.5 Combination of Random Claim Variance plus Claim Shocks
I have created a combined claims distribution using the assumed normal distribution above plus each of the claim shock distributions.

Chart 6: Scenario outcomes for Random variance + 3 year shock

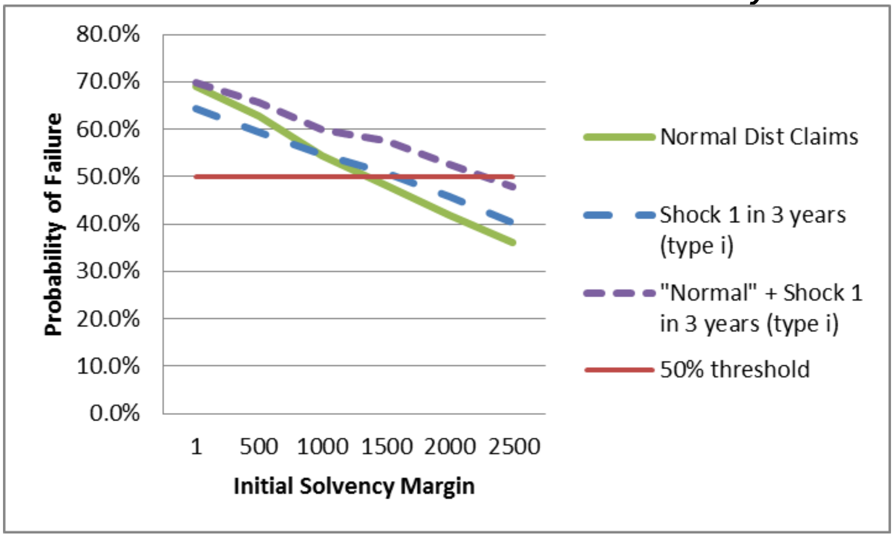


Chart 7: Scenario outcomes for Random variance + 5 year shock

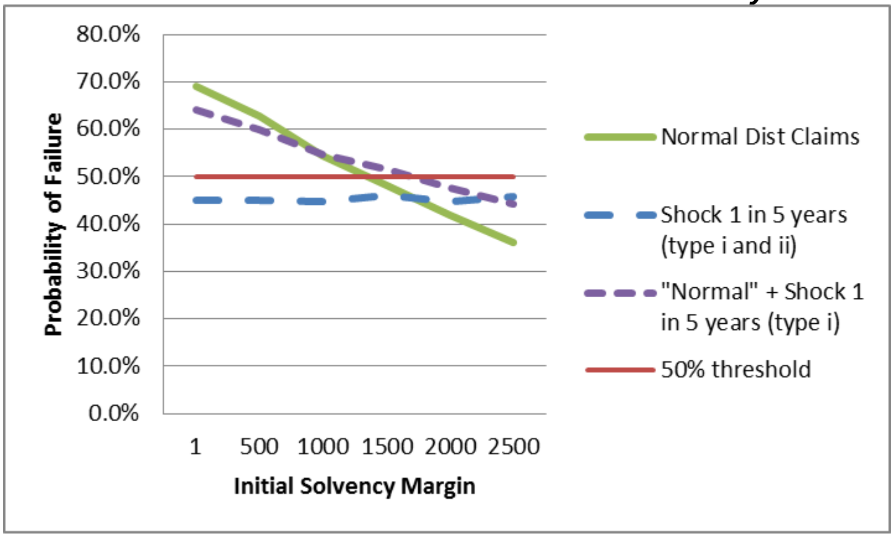
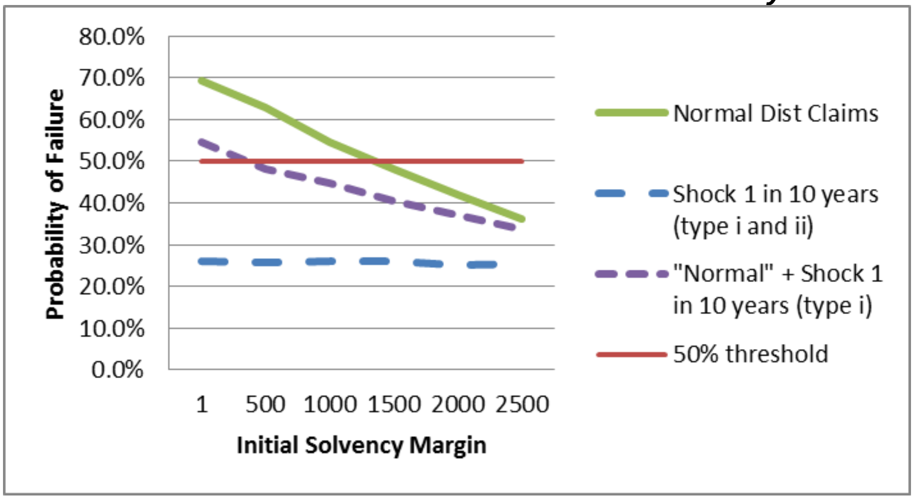


Chart 8: Scenario outcomes for Random variance + 10 year shock



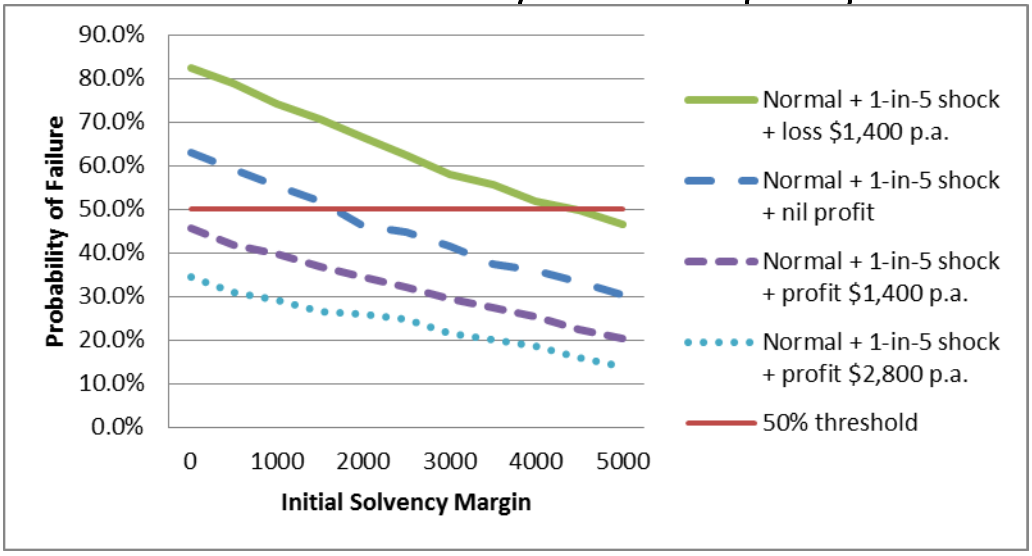
It can be seen that adding additional shock claims has the effect of “flattening out” the curve, with the effect that more additional capital is required to achieve a given improvement in the probability of failure.

However the probability of low frequency events (for example, the 1-in-10 year shock risk) is too low to have any significant impact on the probability of failure at the 50th percentage level. In fact, properly funded low frequency risks have the effect of reducing the probability of failure within 36 months because premiums to cover those risks give an expected increase in the capital position within the 3-year projection period.

6.6 Effect of Expected Profit.
So far I have ignored expected underwriting profit. For a base scenario I have assumed the hypothetical company is subject to random (normal) claims variance plus an expected shock of $7,000 every five years. Profit scenarios considered were:

(a) Nil profit for comparison purposes
(b) -$1,400 p.a. loss. This is the expected amount of annual shock so this scenario can also be considered as a type (ii) shock plus nil expected profit.
(c) +$1,400 p.a. profit. This is a profit of about 2.8% of claims, but only 56% of the random normal standard deviation of claims. So the planned profit is modest relative to the underlying expected deviation.
(d) +$2,800 p.a. profit.

Chart 9: Scenario outcomes for multiple risks with expected profit



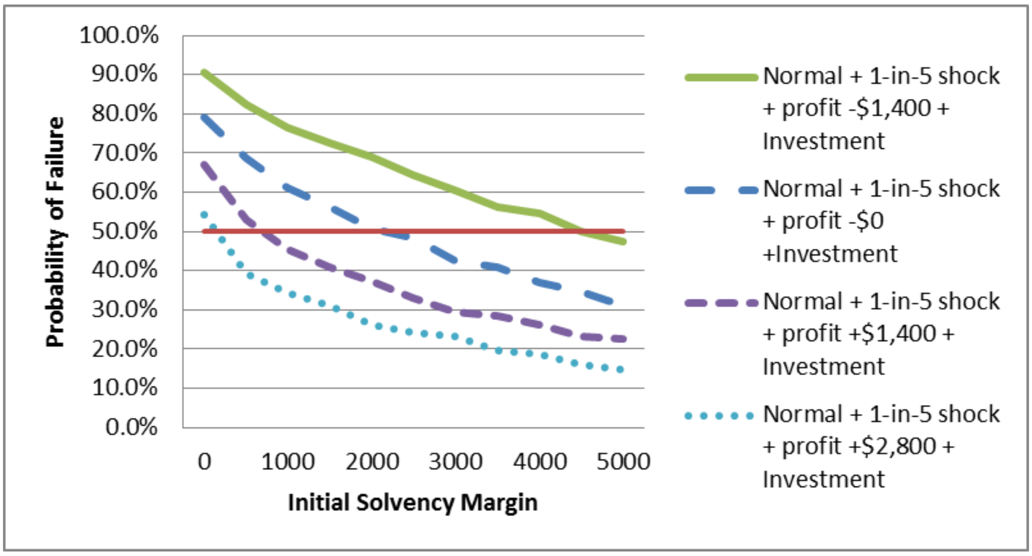
As expected additional capital is required to cover expected losses in the loss-making scenario, although the amount of additional capital required is only about 60% of the expected 3-year loss. (This is not unexpected and can be rationalised by thinking about the reverse situation where $4,200 of initial capital is clearly a bigger buffer over a three year period than expected profits of $1,400 p.a.).

Profit-making scenarios reduce the profit of failure significantly and, in fact, nil initial solvency margin is required for this combination of risks plus a nominal profit of $1,400 per annum.

6.7 Combining with Investment Risk

The same profit scenarios as before were repeated but adding in investment risk and expected investment return in line with the projections in 6.1 and 6.2. A 2% expected investment return was assumed. Note for these scenarios the expected return is increased from the base amount by the expected investment return (approximately $280 p.a. when there is nil solvency margin).

Chart 10: Scenario outcomes for multiple risks with expected profit and investment risk



The additional investment risk has the effect of increasing the probability of failure. A nominal amount of initial solvency margin (approx. $1000) is required to satisfy the Section 24 test under the $1,400 profit scenario.

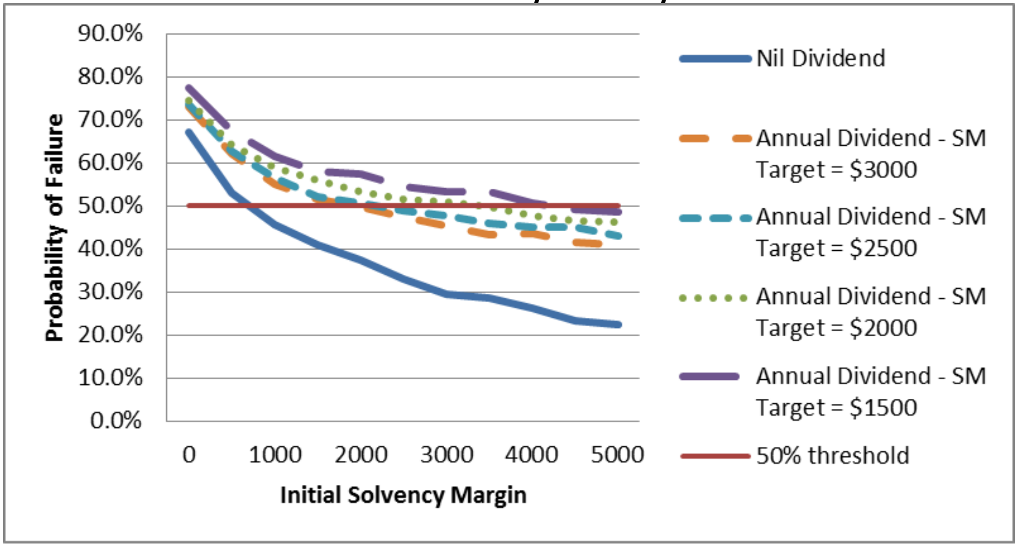
6.8 The Effect of Dividends

So far all projections have assumed that any surplus from profit and/or the effect of random favourable deviation accumulates and is available to offset future unfavourable outcomes.

I have taken a base projection to be the $1,400 p.a. profit scenario in 6.7 above and now assumed the hypothetical company has a capital policy whereby all solvency margin in excess of a target solvency margin is distributed by way of dividend. Dividends were assumed to occur annually with the first dividend occurring after 12 months. The effect of varying target levels is shown.

As can be seen, dividends have a material effect on the outcome because excess returns are now distributed in any favourable scenario, reducing the capacity to absorb future shocks. For example a policy to maintain a target solvency margin of $1,500 would fail the Section 24 test, irrespective of the amount of initial solvency margin, whereas an initial solvency margin of $1,500 only has a 40% probability of failure if nil dividends are assumed.

Chart 11: Scenario outcomes for multiple risks plus the effect of dividends



Runs were also performed assuming half-yearly dividends and, as expected, showed an even bigger impact on the probability of failure because the period during which favourable outcomes can accumulate is reduced.

It should be noted that, in my view, the target surplus policy shown here is unlikely to be a real case situation. The standard deviation of annual profits for the scenario chosen is approximately $4,600 p.a. so there is a good chance in any given year of having a loss $3,000 or more (after taking into account expected profit of about $1,700 p.a). It would not be likely for any company to have a target surplus policy at such a low level. In practice a much higher target solvency level would be established by the directors so that the payment of dividends does not result in a likelihood of failure that would threaten the Section 24 test.

7. Conclusion

The projections have purposefully been structured to have what I hope others would regard as a high level of risk relative to the size of the business. However the results show that even with nil expected profit, only a nominal initial solvency margin is required in order to satisfy the Section 24 test (as long as there are no dividends payable under a target surplus policy which is not prudent). Under the scenarios modelled a business expected to make nil profit would need to hold an initial solvency margin of the order of 55% of the standard deviation of expected profits (derived from the stochastic model output) in order to have a probability of failure below 50% within the next three years.

Other results were:

(i) A business with low frequency skew risk that is properly reserved or priced for may be able to have a lower initial solvency margin.

(ii) Businesses that have expected profits can have a lower solvency margin. Only a nominal amount of initial solvency margin is required where expected profit (or solvency surplus) is reasonable relative to the risk undertaken.

(iii) Loss making businesses (or businesses with an expected solvency strain) need to have an initial solvency margin equal to the amount of expected strain over the next three years plus the amount for a nil profit making business per (i) above.

The actual capital situation for such a business is likely to be a matter discussed between that business and the regulator and is not within the scope of this note.

(iv) Dividends can have the effect of increasing the probability of failure substantially. A company with low levels of initial capital cannot expect to pay dividends until a more satisfactory long-term capital level is achieved.

I found that in order to fail the Section 24 test a company would need to have a very low-level of initial solvency margin and/or be loss-making (or experiencing solvency strain) and/or have expected capital outflows and/or have a target surplus policy that was not set at a prudent level. In all cases I think there would be agreement that the financial position of such a company is unsatisfactory.

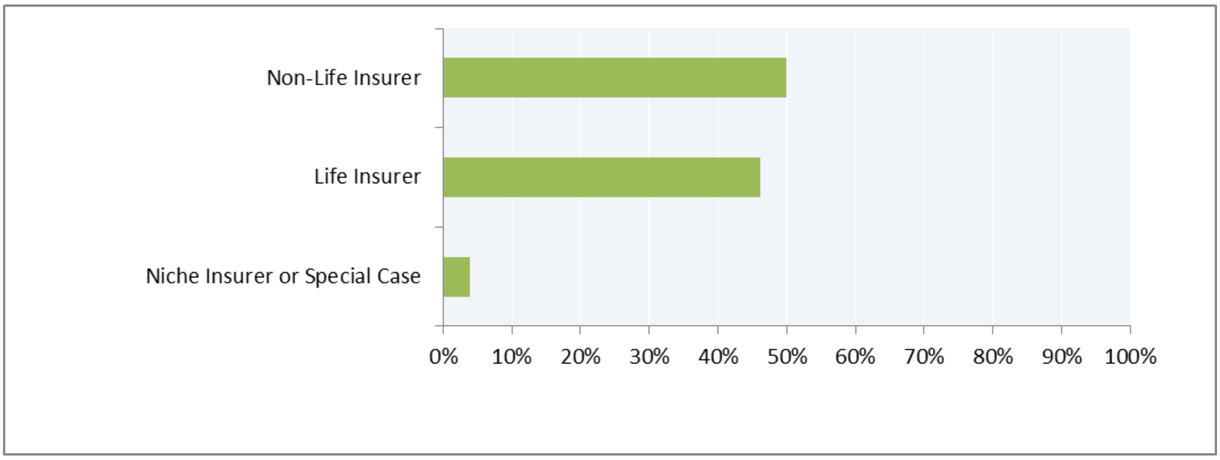
My conclusion is that the Section 24 test is unlikely to be onerous for any well managed and well capitalised business and does not add any practical additional capital requirement.

APPENDIX: Survey of Appointed Actuaries

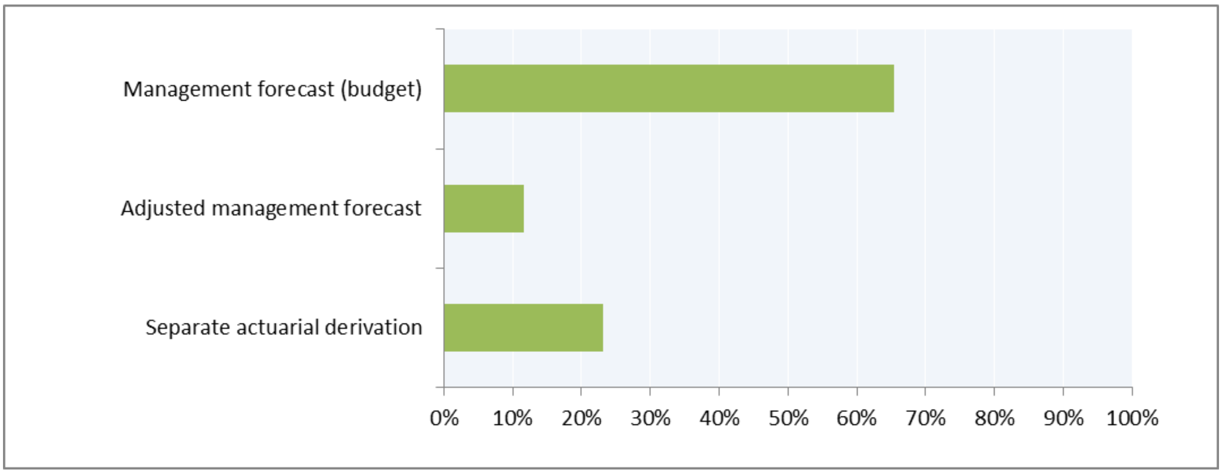
I carried out a brief survey of appointed actuaries to see what approaches are currently being taken in respect of the Section 24 solvency test.

26 responses to the survey were received.

1. ***Type of Insurer:***
   There was a good mix of life and non-life business.



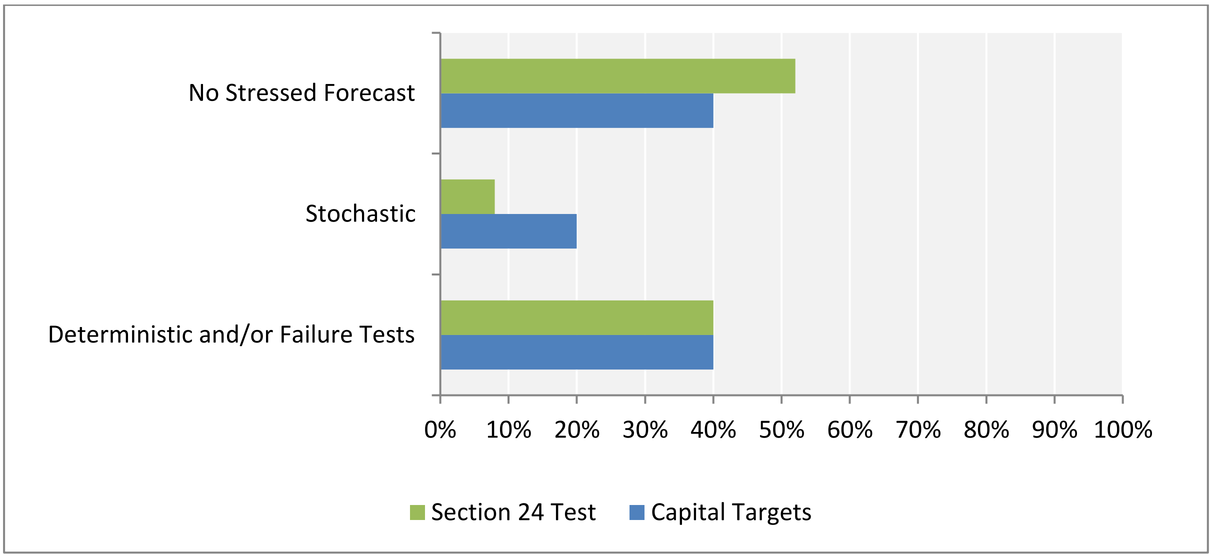
2. ***Basis of Preparation of Central Estimate Projection:***
   The majority of actuaries are using company budgets as a basis for the central estimate projection.



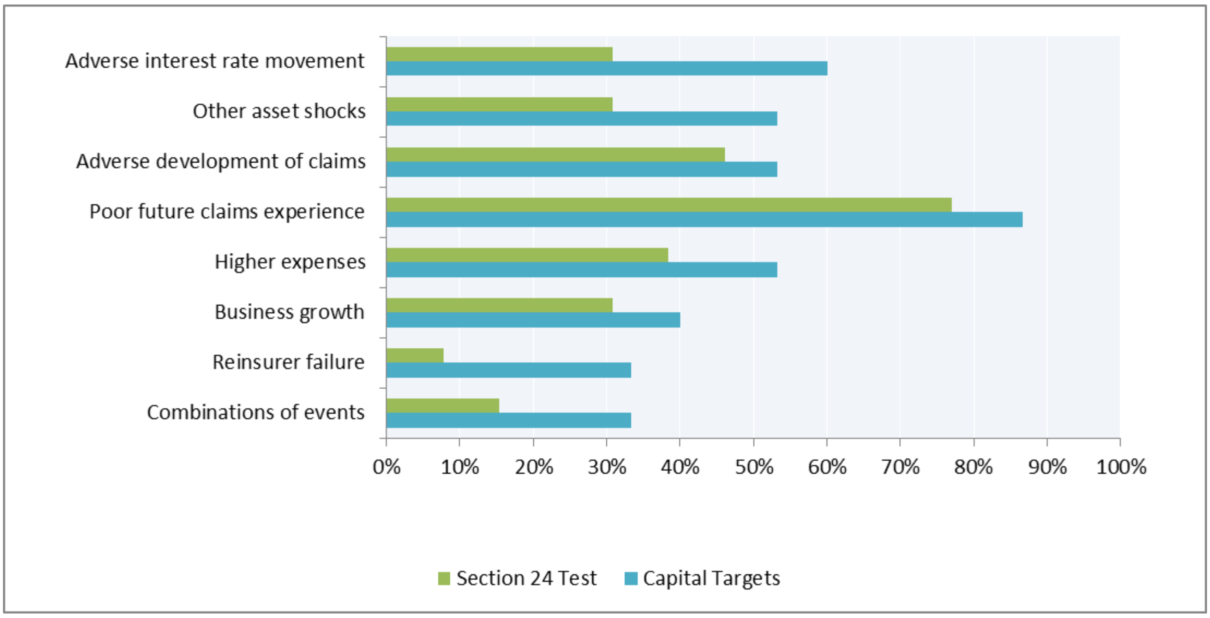
3. Stressed Forecasts

The survey asked whether stressed forecasts were prepared and, if so, whether they were done on a deterministic or stochastic basis. The approach used for the Section 24 test was contrasted with that for other work that may be performed in connection with capital targets.

Less stochastic modelling is being performed for the Section 24 test compared with that for setting capital targets. A significant proportion of actuaries are not preparing stressed forecasts in which case the approach taken is presumably to apply stresses to the central estimate outcomes.



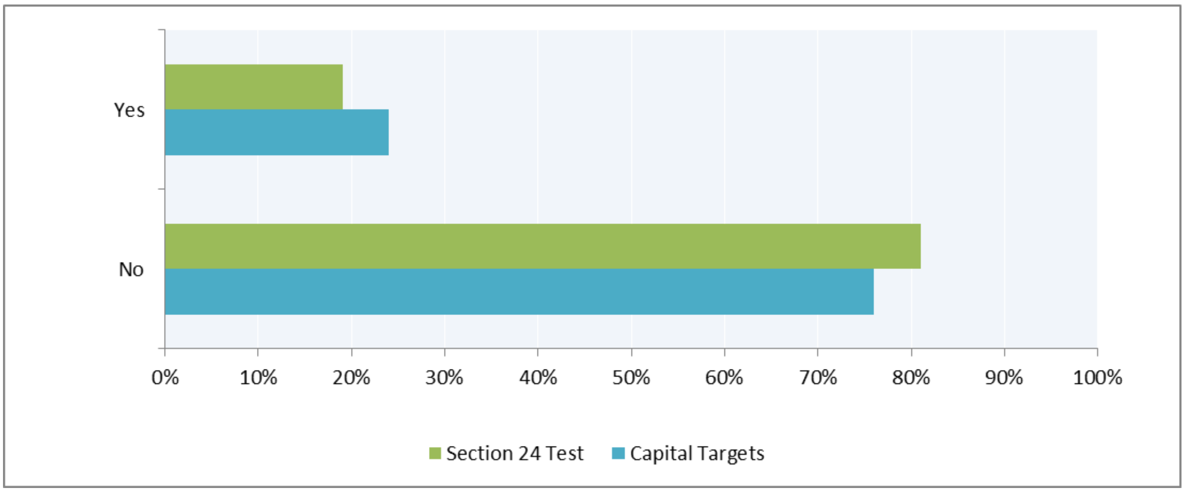
4. What Stressed Scenarios were Assumed?



In general, a fewer number of scenarios are being considered for the purposes of the Section 24 test. This is consistent with the results of the stochastic modelling for the hypothetical company - the Section 24 test is not onerous so a straightforward approach is reasonable for most companies.

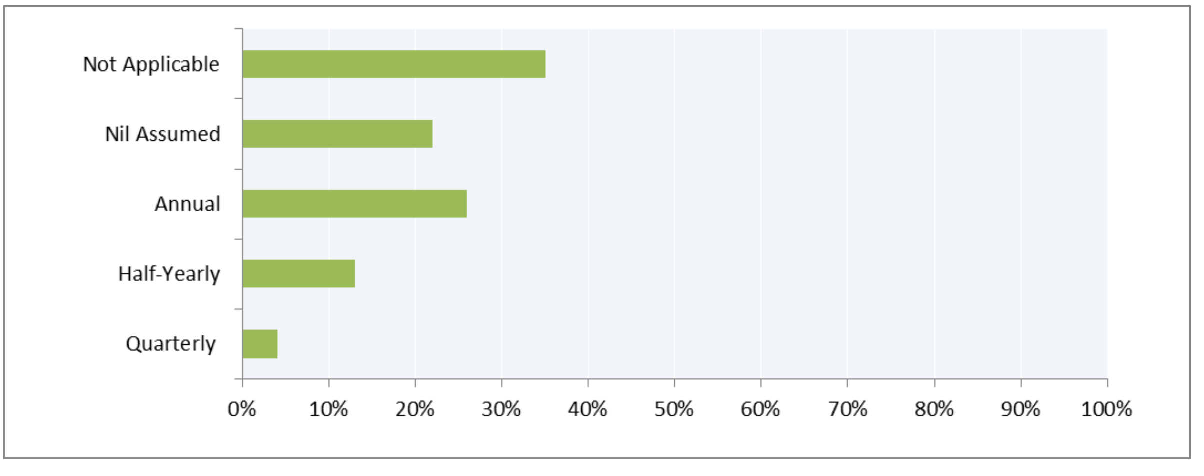
5. Were Future Capital Injections Assumed?

Capital injections are assumed in some instances. I suspect this will be in circumstances where a company is expecting to make a loss or is experiencing solvency strain (for example, in the case of business growth).



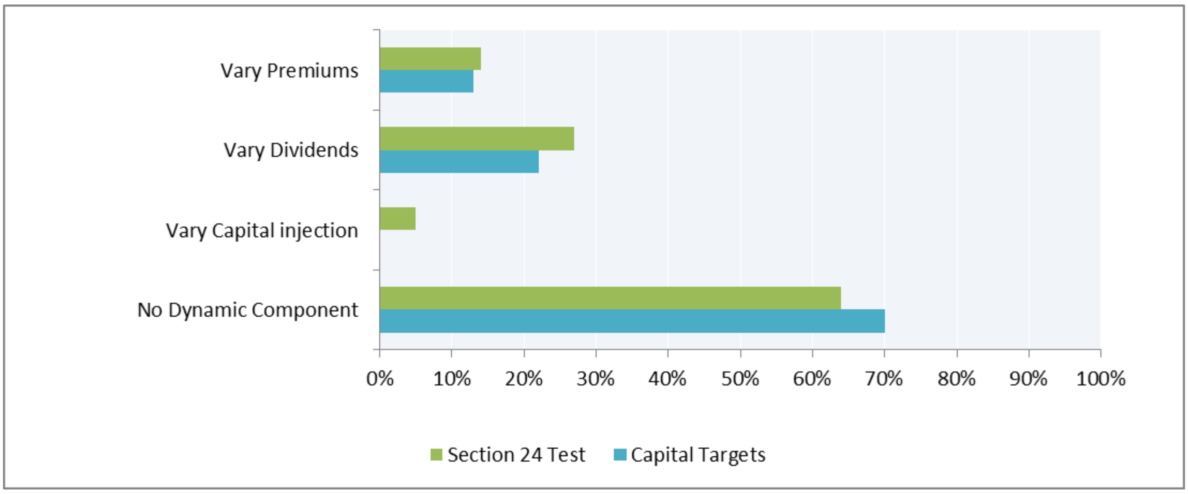
6. Frequency of Dividend Payments

Responses were similar for Section 24 test purposes and other capital adequacy work. Some respondents indicated nil dividends were assumed for companies that may be for profit. The individual circumstances of this are not known but modelling for the hypothetical company shows that future dividends in situations where the company is poorly capitalised materially affect the risk of failure.



7. Dynamic Modelling

The survey asked whether there was a dynamic aspect to the modelling that had been performed, in particular whether premium dividends or capital injections were varied in response to certain outcomes. For the majority of insurers there is no dynamic component, which is appropriate in my view considering the Section 24 test is not onerous. I would expect the majority of insurers are well-capitalised relative to the level necessary to meet the Section 24 test.



8. Solvency Forecast for submission to RBNZ

It is industry practice to submit a central estimate projection for the purposes of the solvency return submitted to RBNZ.