Solvency Assessment and Management:
Steering Committee
Position Paper 66[1] (v 4)
Life SCR - Mortality Risk

EXECUTIVE SUMMARY

This document discusses the structure and calibration of the Mortality risk sub-module of the Life underwriting risk module. The paper includes discussion of the Solvency II developments, consideration of the approaches within other jurisdictions, highlights issues, considers alternatives and recommends an approach going forward.

The task group recommends that the Solvency II calibration be adopted for the Mortality risk sub-module, for comparability across companies and consistency with the way other sub-modules are treated. While the application of the Mortality SCR sub-module is considered suitable in general, based on industry feedback an adjustment is proposed for SAM:

- The requirement that a floor of zero be applied at the level of the contract if the net result of the sensitivity is favourable to the insurer, should be replaced by a requirement of a zero floor at a product type level (e.g. pure risk products, universal life products, immediate annuities, pure endowments, endowment assurance, etc.).

The task group notes that further work is still needed around the following areas:

- An allowance for mortality fluctuation risk in the mortality catastrophe risk SCR sub-module.

1. INTRODUCTION AND PURPOSE

This document sets out the recommendations of the life underwriting risk working group with respect to the standard formula capital requirement in respect of mortality risk.

2. INTERNATIONAL STANDARDS: IAIS ICPs

IAIS is the international standards setting body for insurance supervisors. The FSB as a member of the IAIS aims to adhere to these standards. The standards are principle based and set out high level guidance on the setting of solvency capital requirements. There is no reference to detailed capital requirements of individual risk sub-modules such as mortality risk. However, the following are relevant within the broad framework of the capital requirements, of which underwriting risk and mortality risk in particular form part (reference: **"Insurance Core Principles, Standards, Guidance and Assessment Methodology – 1 October 2011"):**

ICP 17 Capital Adequacy

[1] Position Paper 66 (v 4) was approved as a FINAL Position Paper by Steering Committee on 5 December 2014.

The supervisor establishes capital adequacy requirements for solvency purposes so that insurers can absorb significant unforeseen losses and to provide for degrees of supervisory intervention.

Some sub-points in this standard that should be considered includes:

17.7 The solvency requirements address all relevant and material categories of risk and are explicit as to where risks are addressed, whether solely in technical provisions, solely in regulatory capital requirements or if addressed in both, as to the extent to which the risks are addressed in each. The requirements are also explicit as to how risks and their aggregation are reflected in regulatory capital requirements.

Types of risks to be addressed

17.7.1 The supervisor should address all relevant and material categories of risk - including as a minimum underwriting risk, credit risk, market risk, operational risk and liquidity risk. This should include any significant risk concentrations, for example, to economic risk factors, market sectors or individual counterparties, taking into account both direct and indirect exposures and the potential for exposures in related areas to become more correlated under stressed circumstances.

17.8 The supervisor sets out appropriate target criteria for the calculation of regulatory capital requirements, which underlie the calibration of a standardised approach…

17.8.1. The level at which regulatory capital requirements are set will reflect the risk tolerance of the supervisor. Reflecting the IAIS's principles-based approach, this ICP does not prescribe any specific methods for determining regulatory capital requirements…

Calibration and measurement error

17.8.9. The risk of measurement error inherent in any approach used to determine capital requirements should be considered. This is especially important where there is a lack of sufficient statistical data or market information to assess the tail of the underlying risk distribution. To mitigate model error, quantitative risk calculations should be blended with qualitative assessments, and, where practicable, multiple risk measurement tools should be used. To help assess the economic appropriateness of risk-based capital requirements, information should be sought on the nature, degree, and sources of the uncertainty surrounding the determination of capital requirements in relation to the established target criteria.

17.8.10. The degree of measurement error inherent, in particular, in a standardised approach depends on the degree of sophistication and granularity of the methodology used. A more sophisticated standardised approach has the potential to be aligned more closely to the true distribution of risks across insurers. However, increasing the sophistication of the standardised approach is likely to imply higher compliance costs for insurers and more intensive use of supervisory resources (for example, in validating the calculations). The calibration of the standardised approach therefore needs to balance the trade-off between risk sensitivity and implementation costs.

3. EU DIRECTIVE ON SOLVENCY II: PRINCIPLES (LEVEL 1)

Relevant extracts from the Solvency II level 1 principles are provided below. As is the case with the IAIS core principles, these requirements are in nature of a higher level than required for the establishment of detailed requirements in the Mortality Risk sub-module of the Life

Underwriting risk module within the capital requirements. However, it provides the broad framework within which these requirements are to be considered.

Article 101

Calculation of the Solvency Capital Requirement*1.*

…
2. The Solvency Capital Requirement shall be calculated on the presumption that the undertaking will pursue its business as a going concern.
3. The Solvency Capital Requirement shall be calibrated so as to ensure that all quantifiable risks to which an insurance or reinsurance undertaking is exposed are taken into account. It shall cover existing business, as well as the new business expected to be written over the following 12 months. With respect to existing business, it shall cover only unexpected losses.

It shall correspond to the Value-at-Risk of the basic own funds of an insurance or reinsurance undertaking subject to a confidence level of 99,5 % over a one-year period.

4. The Solvency Capital Requirement shall cover at least the following risks:

(a) non-life underwriting risk;

(b) life underwriting risk;

(c) health underwriting risk;

(d) market risk;

(e) credit risk;

(f) operational risk.

5. When calculating the Solvency Capital Requirement, insurance and reinsurance undertakings shall take account of the effect of risk-mitigation techniques, provided that credit risk and other risks arising from the use of such techniques are properly reflected in the Solvency Capital Requirement.

Article 104

Design of the Basic Solvency Capital Requirement

1. The Basic Solvency Capital Requirement shall comprise individual risk modules, which are aggregated in accordance with point (1) of Annex IV.

It shall consist of at least the following risk modules:

(a) non-life underwriting risk;

(b) life underwriting risk;

(c) health underwriting risk;

(d) market risk;

(e) counterparty default risk.

2. For the purposes of points (a), (b) and (c) of paragraph 1, insurance or reinsurance operations shall be allocated to the underwriting risk module that best reflects the technical nature of the underlying risks.
3. The correlation coefficients for the aggregation of the risk modules referred to in paragraph 1, as well as the calibration of the capital requirements for each risk module, shall result in an overall Solvency Capital Requirement which complies with the principles set out in Article 101.
4. Each of the risk modules referred to in paragraph 1 shall be calibrated using a Value-at-Risk measure, with a 99,5 % confidence level, over a one-year period.
Where appropriate, diversification effects shall be taken into account in the design of each risk module.

5. The same design and specifications for the risk modules shall be used for all insurance and reinsurance undertakings, both with respect to the Basic Solvency Capital Requirement and to any simplified calculations as laid down in Article 109.
6. With regard to risks arising from catastrophes, geographical specifications may, where appropriate, be used for the calculation of the life, non-life and health underwriting risk modules.

Article 105

Calculation of the Basic Solvency Capital Requirement

…
3. The life underwriting risk module shall reflect the risk arising from life insurance obligations, in relation to the perils covered and the processes used in the conduct of business.

It shall be calculated, in accordance with point (3) of Annex IV, as a combination of the capital requirements for at least the following sub-modules:
…
(a) the risk of loss, or of adverse change in the value of insurance liabilities, resulting from changes in the level, trend, or volatility of mortality rates, where an increase in the mortality rate leads to an increase in the value of insurance liabilities (mortality risk);
…

Article 109

Simplifications in the standard formula

Insurance and reinsurance undertakings may use a simplified calculation for a specific sub-module or risk module where the nature, scale and complexity of the risks they face justifies it and where it would be disproportionate to require all insurance and reinsurance undertakings to apply the standardised calculation.

Simplified calculations shall be calibrated in accordance with Article 101(3).

4. MAPPING ANY PRINCIPLE (LEVEL 1) DIFFERENCES BETWEEN IAIS ICP & EU DIRECTIVE

No differences – the EU Directive is in line with the IAIS core principles.

5. STANDARDS AND GUIDANCE (LEVELS 2 & 3)

5.1 IAIS standards and guidance papers

This was covered in section 2 above[2].

5.2 CEIOPS' Advice for Level 2: (Former CP 49):

The following is an extract from Former CP49

[2] The IAIS Insurance Core Principles, Standards, Guidance and Assessment Methodology issued October 2011 has superseded previous Standards and Guidance (in this case Standard No. 2.1.1 and Guidance paper No. 2.1.1 on the structure of regulatory capital requirements).

3.2.2. CEIOPS' advice

3.23. Based on the assumptions contained in the explanatory text, CEIOPS has calibrated the sub-module according to 99.5% VaR and a one year time horizon.

3.24. The mortality risk sub-module is applicable for (re)insurance obligations contingent on mortality risk i.e. where the amount currently payable on death exceeds the technical provisions held and, as a result, an increase in mortality rates leads to an increase in the technical provisions.

3.25. The calculation of the capital requirement for mortality risk shall be a scenario based stress.

3.26. The capital requirement shall be calculated as the change in net asset value (assets minus liabilities) following a permanent increase in mortality rates of 15%.

3.27. Where (re)insurance obligations provide benefits both in case of death and survival and the death and survival benefits are contingent on the life of the same insured person(s), these obligations should not be unbundled. For these contracts the mortality scenario should be applied fully allowing for the netting effect provided by the 'natural' hedge between the death benefits component and the survival benefits component (note that a floor of zero applies at the level of contract if the net result of the scenario is favourable to the (re)insurer).

5.3 Level 2 Implementing Measures (Draft – 31 October 2011)

The draft Level 2 implementing measures contain no differences from QIS 5.

5.4 Other relevant jurisdictions (e.g. OSFI, APRA)

The **Australian** approach to capital requirements for mortality risk is as follows:

LPS 3.04 (Capital Adequacy Standards) requires life insurers to recalculate their liabilities using stressed assumptions, and to hold the difference between best estimate liabilities and stressed liabilities as a capital requirement. The stresses are expressed in the form of minima, as well as "high" estimates – there is nothing to prevent an insurer from using something above the "high" figure, but it gives insurers a sense of what APRA believes is a reasonable range of stresses.

For mortality risk, the minimum margin to be applied is 10%, while the high estimate is 40%

The capital requirements of the **Canadian** regulator (OSFI) are contained in the OSFI's Minimum Continuing Capital and Surplus Requirements (MCCSR) guidelines. The capital requirements are calculated as the sum of component capital requirements that are generally determined using factor-based methods. The MCCSR specifies capital requirements for the following risk categories:

- asset-default risk;
- mortality, morbidity and lapse risks;
- changes in interest rate environment risk;
- segregated funds risk (risk of loss arising from guarantees embedded in segregated funds); and
- foreign exchange risk.

5.5 Mapping of differences between above approaches (Level 2 and 3)

Both CEIOPS and APRA make allowance for an immediate shock to mortality, with the CEIOPS shock somewhat higher than the minimum APRA shock. The Canadian approach is not directly comparable to Solvency II or APRA.

6. ASSESSMENT OF AVAILABLE APPROACHES GIVEN THE SOUTH AFRICAN CONTEXT

6.1 Discussion of inherent advantages and disadvantages of each approach

From available international guidance it appears that the preferred approach for assessing mortality risk is to apply a percentage shock (increase) to mortality rates for all future periods. The main difference between the various jurisdictions relates to the size of the shock applied.

The initial Solvency II calibration for mortality risk was specified in the European QIS2 technical specifications as a 20% permanent increase in mortality rates applied to each age. Having regard to a study published by Watson Wyatt in 2004 about the 99.5% confidence level sensitivities UK insurers proposed to make for their ICAS submissions, CEIOPS conceded that the mortality risk calibration was too onerous and should be revised down to 10% for QIS3. This remained unchanged for QIS4. Further analysis of mortality stress parameters provided by firms using internal models indicated that the QIS3 calibration was relatively low. Based on a sample of 21 internal models a median stress of 22% was obtained, with an inter quartile range of 13% to 29%. This was significantly higher than the 10% stress applied in the standard formula at the time and CEIOPS therefore increased the sensitivity to a permanent increase of 15% for QIS5. This has not changed subsequently.

From the above it would appear that the process for calibrating the Solvency II mortality sub-module was not driven by a rigorous and robust statistical process, but rather by industry views and “best” practices at various points in time.

For the South African market there are currently no strong arguments or statistical evidence to justify a different calibration to that used in QIS5. Efforts to calibrate the sub-module for the South African context are complicated by a significant lack of complete and reliable local data as communicated by the CSI committee (especially when compared to data available in Europe).

In light of the above, it is proposed that SAM adopts the QIS5 mortality risk calibration, as any move away from this would be highly subjective.

6.2 Impact of the approaches on EU 3rd country equivalence

As long as the shock is calibrated to a 1 in 200 year event over 12 months for local conditions, third country equivalence would not be affected.

6.3 Comparison of the approaches with the prevailing legislative framework

Currently, South African life insurers are required to add compulsory margins (7.5% increase for life assurance products and 7.5% decrease for annuities) to all best estimate mortality rates, which results in higher reserves for all future time periods.

In addition, insurers are required to hold risk capital in respect of mortality fluctuation risk which is calibrated at a 95% confidence level. Together with the compulsory margins this should provide a level of protection that exceeds a 95% confidence level, but it is unclear what the exact level of protection actually is and how it compares to a 99.5% confidence level.

The capital requirement is quantified as follows:

i (ci) Mortality $\frac{45p}{\sqrt{n}}$;

Where:

n = number of lives assured in the category (net of lives fully reinsured); and
p = annual risk premium on the valuation basis or expected strain (net of reinsurance).

One feature of the above approach, which is not present in the Solvency II approach, is that the size of the insurance book is taken into account in the overall capital requirement (to allow for the benefit of diversification of larger portfolios). Larger insurers with a greater number of lives assured will therefore hold less capital relative to the size of their book, compared to smaller insurers with fewer lives (see next section).

6.4 SA QIS1 and SA QIS2 feedback

The mortality stress applied for SA QIS1 was based on the Solvency II QIS5 calibration – i.e. a permanent increase of 15% in mortality rates for all ages.

Mortality risk in QIS1 was the 2nd largest component of Life underwriting risk (after lapse risk), comprising 30% of undiversified Life SCR. For QIS2 this reduced to 19%.

The following consistent comments were received following the SA QIS1 and QIS2 exercises on the proposed methodology:

- A concern was raised with a part of the definition which requires that a floor of zero be applied at the level of the contract if the net result of the scenario is favourable to the (re)insurer. It was argued that such treatment would imply selective mortality, which is considered highly improbable. In practice, insurers are also unlikely to perform experience investigations and set assumptions at the level of the policy. It was therefore proposed that the requirement of a floor of zero be applied at product type level, rather than at the level of the contract.

- A comment was also raised that the methodology does not allow for the mortality stress to vary with the number of lives assured (as mentioned in 6.3 above) and as such ignores potential diversification effects within the block of business.

The above issues were addressed as follows:

- The first comment was discussed by the task group and it was agreed that the arguments were reasonable. It was decided to make an adjustment to the mortality risk definition for SA QIS2 – i.e. a floor of zero will apply at product type level (e.g. pure risk products, universal life products, immediate annuities, pure endowments, endowment assurance, etc.) and not at the level of the contract.

- The second comment was not resolved in time for the SA QIS2 exercise and the same issue was mentioned again in the SA QIS2 feedback.

  Sources of mortality risk

  Mortality risk can be defined as the risk of loss incurred by an insurer as a result of changes in the level, trend or volatility of mortality rates. Given this definition mortality risk can arise as a result of:

  - Mortality parameter risk – The true level/trend of mortality rates of a group of policyholders is underestimated.
  - Mortality fluctuation risk - Mortality rates in a given year are higher than expected due to random fluctuation, even though the long term mortality assumption is correct.
  - Mortality catastrophe risk - A once-off mortality catastrophe event that results in a "worst case" mortality scenario in a given year.

  It should be noted that fluctuation risk can be a lot more significant than either of the parameter or catastrophe risks for smaller insurers with few lives assured. This situation is quickly reversed however as the number of lives assured increases and the variability around the mortality best estimate assumptions reduces. For larger books of business mortality parameter and catastrophe risks should be much more significant than fluctuation risk.

  Mortality risk under current SAP104

  The current CAR assessment (as specified in SAP104) allows for mortality fluctuation risk and this is approximately calibrated at a 95% confidence level. Furthermore, the compulsory margins applied to the mortality best estimate assumptions (i.e. 7.5% increase for life insurance products) can be seen as an allowance for mortality parameter risk. When combined the above should produce a level of protection that exceeds a 95% confidence level (although it is not clear what confidence level is actually achieved or how it compares to a 99.5% confidence level). SAP104 defines no additional capital requirements in respect of parameter risk or mortality catastrophe risk.

  In the above, the number of lives assured only affects the size of the mortality fluctuation risk relative to the size of the insurer. The number of lives has no effect on the "allowance" for parameter risk (through the compulsory margins). For large insurers the majority of the allowance for mortality risk is therefore in respect of margin (i.e. parameter risk) and the remainder will be in respect of the capital requirement for fluctuation risk. For smaller insurers mortality fluctuation CAR should represent a much larger proportion of the overall mortality risk allowance.

  Mortality risk under SAM standard formula

  The SA QIS2 technical specifications allow for a "worst case" mortality scenario in the Mortality catastrophe SCR sub-module (Life CAT). It is also thought that the parameter and fluctuation risks may both be covered within the mortality SCR sub-module calibration, as discussed in past Solvency II calibration papers (esp. QIS3 calibration paper).

  In either of the above sub-modules the number of lives assured does not affect the size of the SCRs. This will not have a noticeable impact on large insurers where the majority of mortality risk will be in respect of parameter risk and the risk of a mortality

catastrophe event. However, since mortality fluctuation risk is not allowed for explicitly (as it is in the SAP104 mortality CAR formula) it is likely that overall mortality risk will be understated for smaller insurers. This seems to be confirmed by quantitative data from the SA QIS2 exercise.

Conclusions

While the current SA QIS2 allowance for mortality risk (through the mortality risk SCR and Mortality CAT risk SCR sub-modules) seems to be appropriate in respect of large insurance companies with large books of business, it tends to understate the extent of mortality fluctuation risk (and hence overall mortality risk) for smaller insurers with fewer lives.

Both the mortality catastrophe risk and mortality fluctuation risk are similar in that they represent changes in mortality experience over the following year. Parameter risk on the other hand relates to changes in mortality assumptions which can affect all future time periods and it can occur in addition to the other two risks.

As such it is recommended that the impact of the mortality fluctuation risk for smaller insurers is considered further in the mortality catastrophe risk SCR sub-module (Discussion Document 62).

6.5 SA QIS3 feedback

The calibration of the mortality risk sub-module remained unchanged from QIS2 at 15%.

The QIS3 industry feedback raised no new concerns with the calibration.

6.6 Conclusions on preferred approach

The Solvency II approach is preferred for comparability across companies and consistency with the way other sub-modules are treated.

The QIS5 calibration of the Mortality SCR sub-module is considered suitable for SAM purposes – i.e. a permanent 15% increase in mortality rates for all ages. Following feedback from the QIS1 exercise an adjustment will be made to the sub-module to allow for the application of the zero floor at a product type level instead of at the level of the contract.

7. RECOMMENDATION

Mortality risk ($Life_{mort}$)

Description

1. Mortality risk is the risk of loss, or of adverse change in the value of (re)insurance liabilities, resulting from changes in the level, trend, or volatility of mortality rates. Mortality risk is associated with (re)insurance obligations (such as term assurance or endowment policies) where a (re)insurer guarantees to make a single or recurring series of payments in the event of the death of the policyholder during the policy term.

2. It is applicable for (re)insurance obligations contingent on mortality risk i.e. where an increase in mortality rates leads to an increase in the technical provisions. This is to be considered at product type level (e.g. pure risk products, universal life policies, immediate annuities, pure endowments, endowment assurance, etc.).

   It is also applicable for (re)insurance obligations contingent on disability / morbidity risk and pursued on similar technical basis to that of life insurance, since mortality risk relates to the general mortality probabilities used in the calculation of the technical provisions. Even if the morbidity product does not insure death risk, there may be a significant mortality risk because the valuation includes profit at inception: if the policyholder dies early he/she will not pay future premiums and the profit of the insurer will be lower than allowed for in the technical provisions.

3. The capital requirement should be calculated as the change in value of Basic Own Funds (where Basic Own Funds (BOF) is the excess of assets over liabilities, valued in accordance with SAM rules, plus subordinated liabilities, less any exclusions from Own Funds) following a permanent increase in mortality rates.

4. Impairments should be made to the risk mitigating effect of risk mitigating contracts, as specified in [Reference to Impairment of risk mitigating contracts within the Market risk module].

5. Where (re)insurance obligations provide benefits both in case of death and survival and the death and survival benefits are contingent on the life of the same insured person, these obligations do not need to be unbundled. For these contracts the mortality scenario can be applied fully allowing for the netting effect provided by the 'natural' hedge between the death benefits component and the survival benefits component.

6. The type and extent of management actions assumed in SCR stress scenarios, and the way in which dynamic assumptions should respond to these stresses, will vary depending on whether the stress is assumed to be company-specific or industry-wide.

7. Ranges of whether the scenario is caused by company-specific vs. industry-wide events to be used are (25:75) to (75:25) per cent. Companies should select the mix which results in the highest capital requirement (lowest allowance for management action).

Input

8. No specific input data is required for this module.

Output

9. The module delivers the following output:

   $Life_{mort}$ = Capital requirement for mortality risk

Calculation

10. The capital requirement for mortality risk is defined as the result of a mortality scenario defined as follows:

$$Life_{mort} = (\Delta BOF | mortshock)$$

where

ΔBOF	=	The change in the value of Basic Own Funds (BOF)
$mortshock$	=	A permanent 15% increase in mortality rates (including the best estimate assumptions for HIV/AIDS extra mortality) for each age and each policy where the payment of benefits (either lump sum or multiple payments) is contingent on mortality risk. Insurers are also required to apply this stress to policies where the payment of benefits is not contingent on mortality risk, as per paragraph *[Reference to relevant secondary legislation related to SA QIS3 specification paragraphs SCR.7.2.2]*

11. The result of the scenario should be determined under the condition that the value of future discretionary benefits can change and that the insurer is able to vary its assumptions in future bonus rates in response to the shock being tested. The resulting capital requirement is $Life_{mort}$.

12. Furthermore, for business with an original contract boundary of less than one year, the result of the scenario should be set subject to a minimum of the result as calculated using the simplification below, regardless of whether the simplification conditions are met or not.

Simplification

13. The simplification may be used provided the following conditions are met:
    - The simplification is proportionate to the nature, scale and complexity of the risks that the insurer faces; and
    - The standard calculation of the mortality risk sub-module is an undue burden for the insurer; or
    - In the case of Group or Grouped Individual business where the technical provisions are calculated at an aggregate level and are not based on individual policyholder cash flow projections.

14. The capital requirement for mortality risk according to the simplified calculation is as follows:

$$SCR_{mortality} = 0.15 * CAR * q * n * 1.1^{(\frac{n-1}{2})}$$

where,

CAR denotes the total positive capital at risk, meaning the sum, in relation to each product type (e.g. pure risk products, universal life policies, immediate annuities, pure endowments, endowment assurance, etc.), of the higher of zero and the difference between the following amounts (a) and (b):

a) The sum of:
    i. the amount that the insurance or reinsurance undertaking would currently pay (ignoring waiting periods) in the event of the death of the persons insured under the contract after deduction of the amounts recoverable from reinsurance contracts and special purpose vehicles; and
    ii. the expected present value of amounts not covered in the previous indent that the undertaking would pay in the future in the event of the immediate death of the persons insured under the contract after deduction of the amounts recoverable from reinsurance contracts and special purpose vehicles;

b) the best estimate of the corresponding obligations after deduction of the amounts recoverable form reinsurance contracts and special purpose vehicles;

c) q is the insurer-specific expected average death rate (including the best estimate assumption for HIV/AIDS extra mortality) over the next year (weighted by the sum assured), and
d) n is the modified duration of the liability cash-flows, subject to a minimum of 1.
e) the projected mortality increase ($1.1^{(\frac{n-1}{2})}$) is based on the assumption that the average mortality rate of the portfolio, due to age, increases over the period corresponding to the length of the duration with 10% per year.