CEIOPS-PI-08/06

Quantitative Impact Study 2

Technical Specification

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Section 1

Purpose

1.1 This paper sets out technical specifications for CEIOPS' second Quantitative Impact Study (QIS2). The exercise is intended to deliver a quantitative estimate of the overall impact of the new solvency system.

1.2 QIS2 concerns:

- valuation assumptions for assets and liabilities;
- the solvency capital requirement (SCR) calculated by way of a standard formula;
- the SCR calculated by way of an insurer's internal model; and
- the minimum capital requirement (MCR).

1.3 The technical specification should not be understood as a closed CEIOPS proposal about the future Solvency II regime, nor should it limit the future room for manoeuvre to follow other approaches or re-open alternatives previously discussed. The specifications can be regarded only as an initial and tentative step towards the 'final' SCR, MCR and valuation standards. The inclusion or exclusion of particular modelling approaches is for QIS2 purposes only.

No aspect of this paper constitutes formal technical advice to the European Commission

Additional information requests

1.4 The technical specification should be read in conjunction with the paper *QIS2 Additional Information Requests*. These requests are not essential for CEIOPS to test different modelling approaches, but will give CEIOPS a better understanding of the main risk drivers faced by insurers. In turn, this will allow CEIOPS to assess whether its proposals strike the right balance between risk sensitivity and complexity.

Prioritisation

1.5 CEIOPS recognises that the complexity of the QIS2 exercise may result in considerable use of time and expertise by the participants. Partly, this is because of the multiplicity of approaches being tested. The exercise attempts to reflect the different options laid out in CEIOPS' *Answers to the Second Wave of Calls for Advice.* It also takes into account discussions with stakeholders following the submission of those answers, including their own proposals for the Solvency II project.

1.6 Testing an approach helps CEIOPS to understand its suitability, including any practical implications. To enable CEIOPS to make informed policy choices, it is important that the results of different approaches can be compared. Participants should therefore attempt to complete as much of the exercise as possible, even where they disagree with the validity of particular proposals. The results of testing should help to illustrate any perceived shortcomings.

1.7 However, CEIOPS is equally concerned that a broad range of insurers can take part in QIS2, including smaller undertakings. As a general principle, the inability to submit particular estimates or to respond to particular questions should not preclude an insurer's participation in the exercise. Clearly, QIS2 should be attempted on a 'best efforts' basis.

1.8 For insurers trying to determine where to focus their efforts, the following order of prioritisation is suggested:

- any modelling treatment or valuation approach denoted as a 'placeholder' should be attempted first;
- other modelling treatments and valuation approaches should be attempted second; then
- finally, any additional information requests

National supervisors may also provide guidance on priority areas, or suggest suitable approaches to overcome practical difficulties with the exercise that might be encountered in the local market.

Calibration approach

1.9 The parameters used in the MCR and SCR reflect an initial, tentative calibration. Prior to collecting data from the exercise and other sources, CEIOPS cannot make assertions about the appropriateness of this calibration. The 'target' standard is TailVaR at an equivalent level of prudence to VaR 99.5%. A broad assumption has been made that TailVaR 99% would meet this objective, and this is reflected in certain SCR parameters.

1.10 CEIOPS recognises that a coherent approach will be needed to ensure capital requirements are calibrated appropriately. For example, within the standard formula, each risk module will need to be calibrated to a consistent prudential standard. The aggregation process will then need to ensure that the overall SCR charge is calibrated to the same standard (e.g. with appropriate adjustments for cross-risk diversification effects). Such an approach to calibration would also facilitate the use of partial internal models for the SCR.

Next steps

1.11 CEIOPS intends to issue high-level results from the exercise and a post-QIS2 CP in late October 2006. The CP will provide further technical advice on Pillar 1. The aim is to support the European Commission as it prepares a draft of the Framework Directive and the accompanying 'impact assessment.'

1.12 Given QIS2 as a whole reflects only an initial and very tentative calibration, the advice following the exercise is likely to focus on the structure of Pillar 1 requirements (e.g. the risk drivers that need to be addressed) rather than closed proposals for valuation standards, the SCR standard formula and the MCR. Further QIS exercises will be necessary to ensure that the approaches under consideration meet the prudential objectives set out in CEIOPS' previous technical advice to the Commission.

1.13 Before the October CP, CEIOPS looks forward to continued cooperation with stakeholder groups on how the proposals tested under QIS2 might be further refined.

CEIOPS would like to thank all participants in advance for their constructive contribution to the Solvency II project.

Section 2

Valuation assumptions: standard approach

2.1 This section concerns placeholder valuation requirements for:

- assets
- technical provisions
- other liabilities

These estimates form basis for the MCR and the standard SCR calculations.

2.2 Supplementary information is required on technical provisions.

2.3 Estimates produced for the first Quantitative Impact Study (QIS1) may be re-used to the extent that they are in line with the requirements of this section. Participants should clearly state whether they are using year-end 2004 or year-end 2005 data and use the same reference reporting date consistently through the exercise (e.g. in the MCR and SCR calculations).

Assets

2.4 Assets should be valued at their market value, taking account of any bid-offer spread. In cases where there is no readily-available market value, alternative approaches may be adopted, but these should still be consistent with any relevant market information. For tradable assets, this should be an estimate of the realisable value.

Technical provisions: placeholder requirements

2.5 The approach can be summarised as:

- market-consistent values for risks where hedges are readily available (e.g. financial risks)
- best estimate + risk margin approach to the 75th percentile for other risks (e.g. some insurance risks)

Where participants are unsure of the distinction between hedgeable and non-hedgeable risks, or where market-consistent values cannot be derived, the best estimate + risk margin approach should be followed.

2.6 Technical provisions should be shown both gross and net of reinsurance.

Segmentation

2.7 Values for non-life insurance should be indicated in each of the lines of business defined in Article 63 of the *Council Directive on the annual accounts and consolidated accounts of insurance undertakings* (91/674/EEC), namely:

- Accident and health
- Motor, third-party liability
- Motor, other classes
- Marine, aviation and transport
- Fire and other property damage
- Third-party liability
- Credit and suretyship
- Legal expenses
- Assistance
- Miscellaneous non-life insurance
- Reinsurance[1]

2.8 For life business, the following general segmentation should be used:

- Contracts with profit participation clauses
- Contracts where the policyholder bears the investment risk
- Other contracts without profit participation clauses (excluding health)
- Reinsurance

2.9 Amounts for health contracts with features similar to life business should be disclosed separately.

2.10 The segments / lines of business described above are not necessarily mutually exclusive. Business should therefore be allocated according to its predominant characteristic.

2.11 Additionally, overall estimates for life, health and non-life technical provisions should be provided. The summation approach may include some allowance for diversification benefits, provided that sound actuarial techniques are used and potential regulatory restrictions are taken into account (for example, requirements to treat customers fairly).

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[1] In the case of facultative reinsurance cover, business may be allocated to the other segments if this is more reflective of how an insurer's accounting systems operate in practice.

Hedgeable risks

2.12 Financial guarantees and options should be considered on a market-consistent basis. Technical provisions for financial guarantees and options should be derived using risk-neutral discount rates applying at the balance sheet date. An allowance for the time value of hedgeable guarantees and options should also be considered,[2] which brings in a range of potential future levels of interest rate.

Best estimate

2.13 This should be separately disclosed. The expected present value of future cashflows should be used. In principle, the estimate should be based on policy-by-policy data, but reasonable actuarial methods and approximations may be used.

2.14 The expected cashflows should be based on actuarial assumptions that are deemed to be realistic for the book of business in question i.e. each element sampled from a distribution believed to be reasonable and realistic having regard to all the available information. Assumptions should be made based on a participant's experience for the probability distributions for each risk factor, but taking into consideration market or industry data where own experience is limited or not sufficiently credible.

2.15 Cashflow projections should reflect expected demographic, legal, medical, technological, social or economic developments. For example, a foreseeable trend in life expectancy should be taken into account.

2.16 Cashflows should be discounted at the risk-neutral discount rate applicable for the relevant duration. Participants will be supplied with data on the term structure of interest rate for different EEA currencies, together with the US Dollar, Japanese Yen and Swiss Franc. Where the given rate structure provides no data for a duration, the interest rate should be interpolated or extrapolated in a suitable fashion.

2.17 Appropriate assumptions for future inflation should be built into the cashflow projections. Care should be taken to identify the type of inflation to which particular cashflows are exposed. For some cashflows, the link may be to consumer prices, but there are other links such as salary inflation, which tends to exceed consumer price inflation.

2.18 The realistic valuation of assets and liabilities means that all potential future cashflows that would be incurred in meeting liabilities to policyholders need to be identified and valued. The present value of contract loadings and the present value of expected expenses should be recognised explicitly in the cashflow projection. Any shortfall would need to be recognised as an additional liability.

- Expenses that will have to be incurred in the future to service an insurance contract are cashflows for which a provision should be calculated. Participants should select assumptions with respect to

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2 Time value is given by option value – (exercise price of the option) – current value of the underlying security

future expenses arising from commitments made on, or prior to, the valuation date.

- All future administrative costs, including investment management, commissions, claims expenses and overheads should be considered. Expense assumptions should include an allowance for future cost escalation. This should have regard to the types of cost involved. The allowance for inflation should be consistent with the economic assumptions made. For disability income and other similar types of business, claims expenses may be a significant factor.

- Expenses related to future deposits or premiums should usually be taken into consideration.

- Participants should consider their own analysis of expenses, future plans and relevant market data. But this should not include economies of scale where these have not yet been realised.

2.19 Taxation payments required to meet policyholder liabilities should be allowed for on the basis that currently applies. In cases where changes to taxation requirements have been agreed (but not yet implemented), the pending adjustments should be reflected in the calculations.

2.20 In certain reassurances, the timing of recoveries and the time of direct payments might markedly diverge, and this should be taken into account when valuing the technical provisions (e.g. when discounting cashflows). Nevertheless, in calculating technical provisions net of reinsurance, participants should assume that the reinsurer will not default.

2.21 In certain classes of business, non-reinsurance recoveries may be material, their timing markedly diverging from that of direct payments. Nevertheless, participants may assume for this QIS that their counterparts will not default.

2.22 No reduction in liabilities should be made on account of the creditworthiness of the undertaking itself.

Life business

2.23 Relevant risk factors should include at least the following:

- Mortality rates
- Morbidity rates
- Longevity
- Lapse rates
- Option take-up rates
- Expense assumptions

2.24 Mortality, longevity and morbidity assumptions should be assessed separately for different risk groups. Where a participant assumes correlation of risks between different risk groups, the assumptions made and the rationale should be disclosed. Assumptions on the volatility of mortality, longevity and morbidity experience should also be disclosed.

2.25 It is important to consider policyholder options to change the terms of the contract. Cashflow projections should take account of the proportion of policyholders that are expected to take up options. This may depend on financial conditions at the time the option crystallises, which will affect the value of the option. Non-financial conditions should also be considered – for example, deterioration in health could be expected to have an impact on take-up rates of guaranteed insurability options.

2.26 Participants may use credible and relevant discontinuance experience. Where a discretionary surrender value is paid on discontinuance, the estimates should allow for the payment the insurer would reasonably make in the scenario under consideration.

2.27 Future management actions should be reflected in the projected cashflows. The assumptions used should reflect the actions that management would reasonably expect to carry out in the circumstances of each scenario, such as changes in asset allocation, changes in bonus rates or product changes, or the way in which a market value adjustment is applied. Allowance should be made for the time taken to implement actions.

2.28 In considering the reasonableness of projected management actions, participants should consider their obligations to policyholders, whether through policy wordings, marketing literature or other statements that give rise to policyholder expectations of how management will run the business.

2.29 Technical provisions should generally include amounts in respect of guaranteed, statutory and discretionary benefits. Assumptions for these should follow the general principles for management actions.

- Participants may take into consideration recent bonus rates, especially where their policy is to smooth changes in bonus rates.

- Where participants differentiate their bonuses between policy types or risk groups, this should be reflected in the assumptions on future bonus rates.

- Where material to the results, participants should take into consideration the expected apportionment between annual and final bonuses.

- Participants should also take into consideration any constraints arising from legal restrictions or profit-sharing clauses in policy conditions. Undertakings should assume that, in applying such clauses, the approach to calculating profits for profit-sharing purposes will not change from that which applies currently.

2.30 For profit-sharing contracts, the following amounts should be disclosed separately:

- total technical provisions

- the amount of technical provisions relating to guaranteed and statutory benefits

- the amount of technical provisions relating to discretionary benefits

2.31 Where discretionary future bonuses may be used to cover 'general' losses, the 'placeholder' valuation of technical provisions may be restricted to guaranteed benefits. 'General' means the amounts are not restricted to covering losses in respect of specific groups of policyholders.

2.32 The same cashflow projection approach should be used for unit and index-linked business. Participants should also assume that unit-linked funds perform on a market-consistent basis. All cashflows arising from the product should be considered, including expenses, death benefits and charges receivable by the insurer. Where participants have the right to increase charges, assumptions on increased charging should be consistent with the general principles for management actions.

Non-life business

2.33 The technical provisions to be tested comprise:

- the provision for claims outstanding

- premium provisions (unearned premium provision, provision for unexpired risks)

2.34 The valuation of the provision for claims outstanding and the premium provisions should generally be carried out separately. However, if such a separate treatment is not practical (for example, where business is written on an underwriting year basis), and a split between covered but not incurred (CBNI) and incurred but not settled (IBNS) claims would be artificial, participants may value these provisions together.

2.35 Participants should generally determine a single value for premium provisions comprising both the provision for unearned premiums and any provision for unexpired risks. If this is not practical, a separate treatment is also acceptable.

2.36 Participants should use statistical methods compatible with current actuarial 'best practice' and should take into account all factors that might have a material impact on the expected future claims experience.. Typically, this will require the use of claims data on both an occurrence year and a development year basis (run-off triangles).

2.37 Cashflow estimates should take account of amounts arising from salvage and subrogation rights (i.e. estimates should be net of recoveries).

75^{th} percentile

2.38 The required risk margin on non-hedgeable risks is the difference between the expected value and the value needed to achieve a given, overall, entity-wide level of confidence, including uncertainty over the assumed distributions.

2.39 Participants may calculate the risk margin using sound actuarial techniques – for example, by stochastically simulating the variation in cashflows (based on random variation in the risk factors) to determine an appropriate distribution. The approach to calculating the 75th percentile should generally reflect the same considerations that apply when calculating the best estimate.

Estimates of the standard deviation

2.40 For consistency with the Commission's *Framework for Consultation,* participants should separately estimate half a standard deviation of the assume distribution for each of the lines of business / segments described above.

Technical provisions: additional requirements

Discounting

2.41 For non-life business, participants should provide an estimate of the change in technical provisions that would arise from using a discount rate of 0%.

Surrender risk

2.42 Participants should also disclose the total of surrender values payable if all contracts were to be immediately surrendered.

Other liabilities

2.43 The total of liabilities other than technical provisions should be disclosed according to local valuation practices.

Section 3

Valuation assumptions: cost of capital approach

Participants are invited to complete this section of QIS2 at their discretion.

3.1 Following discussions within CEIOPS and EIOPC on a standard for technical provisions, it is anticipated that the Commission will issue the following clarification to the *Amended Framework for Consultation*:

"The risk margin covers the risks linked to the future liability cash flows over their whole time horizon. Two possible ways to calculate the risk margin should be considered as working hypotheses. It can be calculated as the difference between the 75th percentile of the underlying probability distribution until run-off and the best estimate… Alternatively, the risk margin can be calculated based on the cost of providing SCR capital to support the business-in-force until run-off. Further quantitative impact information should be collected to assess the merits of the two methods."[3]

3.2 To enable an assessment of the two methods, participants are strongly encouraged to provide estimates of technical provisions according to a 'cost of capital approach.' Estimates provided under this approach are supplementary information – to facilitate a comparison, they are requested in addition to the valuation of technical provisions required under section 2.

Benchmark Cost of Capital Approach

3.3 CEIOPS understands that one practical implementation of a 'cost of capital' approach is the *Swiss Solvency Test* (SST). To ensure that broadly comparable estimates are collected, CEIOPS requests that the approach is first analysed using fixed assumptions which follow the SST, including

- Required capital is given by the regulatory standard (i.e. the placeholder SCR under the standard formula[4])
- The pre-tax market cost of capital is set at 6% above the risk-free rate.

3.4 Given these assumptions, the SST provides two broad methods for calculating the risk margin:

- A simplified approach whereby the regulatory capital requirement at time 0 is applied to the full run-off period, assuming the relationship

[3] EIOPC (2006) – *Draft Amended Framework for Consultation on Solvency II*, Annex to MARKT/2511/06-EN. The final document will be made available on the Commission's website.

[4] To facilitate comparison of the results, the following fixed values should be used in the *CorrSCR* correlation matrix: MH should be replaced with 0.75, M with 0.5, ML with 0.25 and L with 0

between the regulatory capital requirement and technical provisions remains constant throughout that period; and

- A more sophisticated approach whereby regulatory capital requirements are calculated for each period, based on projections of assets, liabilities and risks.

Participants should clearly indicate which of these two approaches have been used for QIS2.

3.5 Detailed instructions on the Swiss Solvency Test can be found accompanying the QIS2 spreadsheets.[5]

Alternative cost of capital approach

3.6 As a final step, participants that have completed the benchmark cost of capital approach may also provide cost of capital estimates using their own assumptions. These assumptions should be contrasted with the assumptions underlying the SST.

3.7 One example of an alternative cost of capital approach is given in the *Working Document on Cost of Capital* prepared by the Comité Européen des Assurances (CEA).[6]

Segmentation

3.8 To the extent possible, estimates under 'cost of capital' approaches should follow the same segmentation described in 2.6-2.9. This will help CEIOPS to draw comparisons between the 'cost of capital' and percentile approaches. Aggregate estimates may also be provided, reflecting a participant's assumptions on diversification effects between different segments.

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5 Available from www.ceiops.org

6 Available from www.cea.assur.org

The inclusion of this specific paper as an example should not be understood as an endorsement from CEIOPS.

Section 4

Eligible elements to cover the capital requirements

4.1 Section 2 described the valuation basis for assets and liabilities in QIS2. This should also form the basis for determining eligible capital in the exercise.

Available capital

4.2 The rules for calculating the amount available capital are the same as under Solvency I, with the exception of the following adjustments:

- hidden reserves / deficits arising from differences between the statutory-accounting values of assets and their value according to section 2, to the extent that such differences are not already reflected in the Solvency I available capital;
- hidden reserves / deficits arising from differences between the statutory-accounting valuation of technical provisions and their valuation according to section 2, to the extent that such differences are not already reflected in the Solvency I available capital (In non-life insurance, this comprises the equalisation provision); and

Both the aggregate value of asset-side adjustments and the aggregate value of liability-side adjustments should be disclosed separately.

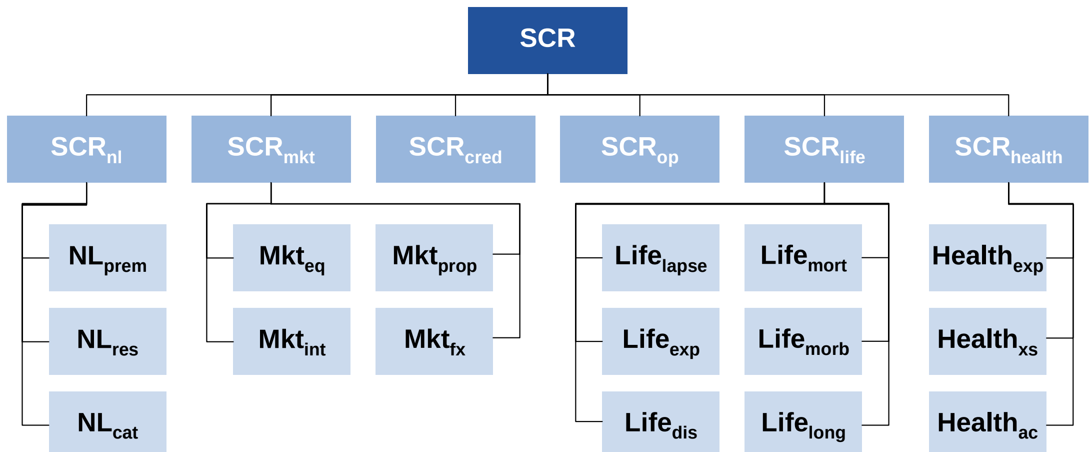
4.3 In those cases in life insurance business where provisions for discretionary future bonuses can absorb losses only under certain limited circumstances (for e.g. due to restrictions by national laws or management rules), these unguaranteed amounts should generally not be recognised as available capital, but as a risk mitigant for the SCR by way of a "k factor." This is described further in section 5.

4.4 Where discretionary future bonuses can be used to cover 'general' losses, these amounts may be excluded from the 'placeholder' valuation of technical provisions and treated instead as part of available capital. 'General' means the amounts are not restricted to covering losses in respect of specific groups of policyholders. Participants should disclose the effect on their level of available capital arising from the inclusion of such amounts.

Section 5

Solvency Capital Requirement: the standard formula

5.1 The standard formula calculation is divided into modules, following the risk classification set out in CEIOPS' answer to Call for Advice No. 10.



5.2 Participants may be requested to test a number of different modelling approaches for the same risk. Generally, this means a relatively simple, 'robust' approach and a more sophisticated, 'risk-sensitive' approach. Applying these different approaches will enable CEIOPS to form a view on the most appropriate treatments and, in particular, the right balance between risk-sensitivity and complexity.

5.3 In each module, the results of a single approach are singled out to serve as a 'placeholder' risk capital charge. This enables the construction of an overall 'placeholder SCR' charge for comparative purposes.

5.4 The parameters and assumptions used reflect only an initial and very tentative calibration. Parameters and shocks have been selected with the aim of approximating for 1/200 year events. However, the focus for this exercise is on methodological / design issues. CEIOPS recognises that further calibration work will be required at a later stage in the Solvency II project to fully reflect the prudential objectives set out in the answer to Call for Advice No. 10.

General approach to risk mitigation

5.5 A broad assumption is made that the effect of risk mitigation techniques should be given full recognition in reducing the relevant risk capital charges. However, the risk of risk mitigation failure should be addressed through an explicit charge for counterparty risk (as part of credit risk). Implicitly, the operational risk charge also addresses the risk of risk mitigation failure.

5.6 No additional criteria apply for hedging instruments.

5.7 The ‘placeholder’ valuation for technical provisions set out in section 2 generally includes amounts in the provisions relating to future discretionary profit sharing. In life insurance, such amounts may have significant risk absorption abilities. This is reflected in the calculations by following a three-step approach as follows:

- In a first step, capital charges for the individual modules are calculated *before* allowing for the risk mitigating effects of future profit sharing. This implies that, for these calculations, the valuation of technical provisions is restricted to guaranteed and statutory benefits, whenever this valuation is used under the factor-based and scenario-based treatments set out below.

- In a second step, the capital requirements for each of the major risk modules are aggregated by applying a correlation matrix, thus allowing for diversification effects across those risk modules.

- In a third step, an offset to the overall capital requirement obtained in step 2 equal to a certain proportion of the amount in technical provisions relating to future discretionary benefits is included to derive the final SCR value. The determination of this proportion will need to reflect the degree to which future discretionary benefits may be used to absorb risk (see below).

Different approaches to technical provisions

5.8 The requirements of this section are based on the standard valuation assumptions set out in section 2. Whenever an SCR modelling approach requires part of the technical provisions valuation as an input, this should be valued according to section 2.

5.9 In <u>addition</u> to the SCR based on the standard valuation assumptions, participants may (on an optional basis) calculate the SCR based on the cost of capital approach. Such an SCR is necessary as an input for the cost of capital calculation following the SST assumptions. Whenever in this context an SCR modelling approach requires part of the technical provisions valuation as an input, the best estimate (or an approximation of the best estimate) should be used.

Overall SCR calculation

5.10 The SCR is the Solvency Capital Requirement.

Data Requirements

5.11 The following input information is required:

BSCR	=	Basic Solvency Capital Requirement
RPS	=	Reduction for profit sharing
NL_PL	=	For non-life insurance, expected profit or loss arising from next year's business

Output

5.12 The placeholder capital charge for the SCR includes an allowance for the risk absorption ability of future profit sharing, and – for non-life insurance – the expected profit or loss from next year's business, so that:

$$SCR = BSCR - RPS - NL\_PL$$

5.13 Where non-life business is profitable, the assumption of continued new business might reduce the SCR. Therefore, CEIOPS may also need to consider the effect of omitting SCR_{nl} and *NL_PL* from the placeholder formula.

RPS Reduction for profit-sharing

Data requirements

5.14 The following input information is required:

$TP_{benefits}$	=	total amount in the placeholder valuation of technical provisions relating to future discretionary benefits
k	=	risk-absorbing proportion of $TP_{benefits}$

Approaches to test

5.15 The factor k ranges between 0 and 1 and is intended to reflect the extent to which future discretionary profit sharing may be used to absorb future losses under adverse circumstances. Generally, this will depend on a range of aspects, including

- the extent to which legal or statutory restrictions impede the use of future discretionary benefits to absorb losses;
- the nature of agreed management actions in adverse circumstances;
- the degree of policyholder expectations on future profit sharing; and
- the extent to which cross subsidy would be allowed across policies or across different funds.

5.16 The factor k should be set by the participating undertakings using their own assumptions, taking into account any aspect that has a material impact on the degree to which amounts in technical provisions relating to discretionary benefits may be used to cover losses under adverse circumstances. National supervisors may provide additional guidance, taking into account the legal environment and general practices in their markets.

5.17 In some cases, life insurance undertakings have a complex fund structure consisting of a number of non-profit and with-profit funds. Typically, to each fund a separately managed pool of assets and liabilities is associated. Profit sharing rules may be different in the different funds, restricting or disallowing a sharing of profits and risks across funds. In such cases, undertakings should set the factor k such that it is consistent with the structure of funds in their portfolio.

5.18 In cases where amounts relating to future discretionary benefits are excluded from the 'placeholder' valuation of technical provisions and treated instead as part of available capital, the factor k needs to be set to zero to avoid a double-counting of such amounts both as available capital and as a risk mitigant under the SCR calculation.

Output

5.19 The reduction of the overall capital charge with respect to future profit sharing is defined as $RPS = k \bullet TP_{benefits}$

NL_PL expected profit or loss

5.20 For non-life insurance business, the determination of the overall capital charge also takes into account the expected profit or loss NL_PL arising from next year's business.

Data requirements

5.21 The following input information is required:

P_{lob}	=	estimate of the net earned premium in the forthcoming year in each of the LOBs
$P_{lob,y}$	=	earned net premiums in each of the LOBs and for historic years *y* (to the extent available, not more than 5 years)
$CR_{lob,y}$	=	net combined ratios in each of the LOBs and for historic years *y* (to the extent available, not more than 5 years)
PCO	=	the net provision for claims outstanding for the overall business
PCO_{lob}	=	the net provision for claims outstanding in each of the LOB's

5.22 In each of the LOBs, the estimate P_{lob} of the net earned premium in the forthcoming year should be determined as:

- the undertaking's estimate of the net earned premium volume for the forthcoming year, in cases where the undertaking estimates that this will exceed previous year's net earned premiums by more than 5%; and
- in other cases, 105% of the previous year's net earned premiums

5.23 The combined ratio $CR_{lob,y}$ is the ratio for year y of expenses and incurred claims in a given LOB over earned premiums, determined at the end of year y. The earned premiums should exclude prior year adjustments, the expenses should be those attributable to the premiums earned other than claims expenses, and incurred claims should exclude the run-off result, that is they should be the total for losses occurring in year y of the claims paid (including claims expenses) during the year and the provisions established at the end of the year. Alternatively, if it is more practicable, participants may calculate the combined ratio as the sum of the expense ratio and the claims ratio, where the expense ratio is the ratio of expenses (other than claims expenses) to written premiums and the expenses are those attributable to the written premiums.

Approaches to test

5.24 Under this approach, the expected profit or loss arising from next year's premiums NL_PL_{prem} is defined as

$$NL\_PL_{prem} = (100\% - \mu) \bullet P$$

where

μ = the estimate of the expected value of the combined ratio for the overall non-life business

and where P is defined as follows:

$$P = \sum_{lob} P_{lob}$$

5.25 The estimate μ is set as

$$\mu = \frac{\sum_{lob} \mu_{lob} \bullet P_{lob}}{P}$$

where

μ_{lob} = company-specific estimate of the expected value of the combined ratio in the individual LOBs

and μ_{lob} is defined as the premium-weighted average of historic combined ratios:

$$\mu_{lob} = \frac{\sum_{y} P_{lob,y} \bullet CR_{lob,y}}{\sum_{y} P_{lob,y}}$$

Here, the summation should run over at least 3, but not more than 5 years. In the case where less than 3 years of historic data are available, μ_{lob} is set as 100%.

5.26 The expected surplus or deficit NL_PL_{res} arising from next year's run-off result is defined as

$$NL\_PL_{res} = \mu \bullet PCO$$

where

μ = the estimate of the expected value of the (relative) run-off result for the overall business in the forthcoming year

and μ is defined as

$$\mu = \frac{\sum_{lob} \mu_{lob} \bullet PCO_{lob}}{PCO},$$

where

μ_{lob} = the estimate of the expected value of the (relative) run-off result in the forthcoming year in each of the LOB's

5.27 The estimate μ_{lob} is defined as follows:

$$\mu_{lob} = \alpha \bullet \frac{RM_{lob}}{PCO_{lob}}$$

where

α	=	the proportion of the claims provision PCO_{lob} that is expected to be paid out in the forthcoming year
RM_{lob}	=	the risk margin in the claims provision PCO_{lob}

5.28 The parameter α in the previous paragraph may be approximated by

$$\alpha = \frac{1}{D}$$

where D is the mean duration of the claims provision PCO_{lob}, but where the firm can make a more accurate estimate it should attempt to do so.

Output

5.29 The expected profit or loss NL_PL arising from next year's business may be determined as:

$$NL\_PL = NL\_PL_{prem} + NL\_PL_{res}$$

Alternatively, the expected profit or loss NL_PL arising from next year's business may also be determined by following the approach set out for the determination of NL_PL_{prem}, but where instead of combined ratios excluding the run-off result "full" combined ratios including the run-off result are used.

Basic SCR calculation

5.30 *BSCR* is the Basic Solvency Capital Requirement before any adjustments for profit sharing or the expected profit or loss arising from next year's business.

Data requirements

5.31 The following input information is required:

SCR_{mkt} = the placeholder capital charge for market risk

SCR_{life} = the placeholder capital charge for life underwriting risk

SCR_{health} = the placeholder capital charge for health underwriting risk

SCR_{nl} = the placeholder capital charge for non-life underwriting risk

SCR_{cred} = the placeholder capital charge for credit risk

SCR_{op} = the placeholder capital charge for operational risk

Approaches to test

5.32 The capital charges for the main risk modules should be combined using a correlation matrix as follows:

$$SCR_1 = \sqrt{\sum_{r \times c} CorrSCR^{r \times c} \bullet SCR_r \bullet SCR_c}$$

where

$CorrSCR^{rxc}$ = the cells of the correlation matrix *CorrSCR*

SCR_r, SCR_c = capital charges for individual SCR risks according to the rows and columns of correlation matrix CorrSCR, where for non-life underwriting risk SCR_{nl} is substituted by $SCR_{nl,vol}$

5.33 Participants should complete the cells of the correlation matrix *CorrSCR* using their own assumptions, particularly where these can be evidenced by analysis based on real data observed in stressed conditions. Broadly, the following relationships might be expected:

CorrSCR=	SCR_{mkt}	SCR_{cred}	SCR_{life}	SCR_{health}	SCR_{nl}	SCR_{op}
SCR_{mkt}	1					
SCR_{cred}	MH	1				
SCR_{life}	ML	ML	1			
SCR_{health}	ML	ML	ML	1		
SCR_{nl}	ML	M	L	L	1	
SCR_{op}	M	ML	ML	ML	M	1

where L indicates low correlation; ML, medium-low correlation; M, medium correlation; MH, medium-high correlation; and H indicates high correlation.

5.34 Capital charges for the main risk modules should also be combined assuming full independence:

$$SCR_2 = \sqrt{SCR_{Mkt}^2 + SCR_{cred}^2 + SCR_{life}^2 + SCR_{health}^2 + SCR_{nl}^2 + SCR_{op}^2}$$

5.35 Capital charges should also be combined assuming no diversification effects between the main risk modules:

$$SCR_3 = SCR_{Mkt} + SCR_{cred} + SCR_{life} + SCR_{health} + SCR_{nl} + SCR_{op}$$

Output

5.36 The placeholder capital charge for the Basic SCR is given by the results of applying the correlation matrix.

$BSCR = SCR_1$

SCR_{mkt} market risk module

5.37 Market risk arises from the level or volatility of market prices of financial instruments. Exposure to market risk is measured by the impact of movements in the level of financial variables such as stock prices, interest rates, real estate prices and exchange rates.

Data requirements

5.38 The following input information is required:

Mkt_{int} = the placeholder capital charge for interest rate risk

Mkt_{eq} = the placeholder capital charge for equity risk

Mkt_{prop} = the placeholder capital charge for property risk

Mkt_{fx} = the placeholder capital charge for currency risk

Approaches to test

5.39 The capital charges for the sub-risks should be combined using a correlation matrix as follows:

$$SCR_{mkt} = \sqrt{\sum_{r \times c} CorrMkt^{r \times c} \bullet Mkt_r \bullet Mkt_c}$$

where

SCR_{mkt} = the placeholder capital charge for market risk

$CorrMkt^{rxc}$ = the cells of the correlation matrix *CorrMkt*

Mkt_r, Mkt_c = capital charges for individual market sub-risks according to the rows and columns of correlation matrix *CorrMkt*

and the correlation matrix *CorrMkt* is defined as:[7]

CorrMkt=	Mkt_{int}	Mkt_{eq}	Mkt_{prop}	Mkt_{fx}
Mkt_{int}	1			
Mkt_{eq}	0.75	1		
Mkt_{prop}	0.75	1	1	
Mkt_{fx}	0.25	0.25	0.25	1

[7] The correlation matrix does not reflect *average* correlations between sub-risks, but reflects correlations at the confidence level for determining the SCR. It considers only multiples of 25%.

Output

5.40 The placeholder capital charge for the market risk is given by the results of applying the correlation matrix.

Mkt_{int} interest rate risk

5.41 Interest rate risk exists for all assets and liabilities of which the value is sensitive to changes in the term structure of interest rates or interest rate volatility and which are not allocated to policies where the policyholders bear the investment risk. In any event, these are fixed-income investments, insurance liabilities, and financing instruments (loan capital) and interest-rate derivatives. The value of assets and liabilities sensitive to interest rate changes can be determined using the (prescribed) term structure of interest rates ('zero rates'). This term structure can, of course, change over the period of a year.

Data requirements

5.42 The following input information is required:

NAV	=	the net value of assets minus liabilities
TP	=	total technical provisions not allocated to policies for which the policyholders bear the investment risk
MV_{FI}	=	The net market value of interest-rate dependent assets and financing instruments not allocated to policies where the policyholders bear the investment risk
$D^{gen}{}_{FI}$	=	the generalized duration of interest-rate dependent assets and financing instruments, defined below.
$D^{gen}{}_{TP}$	=	the generalized duration of the technical provisions
$r(t)$	=	the current annualized interest rate for maturity t; $d(t) = 1/(1+r(t))^t$ is the corresponding discount factor

Approaches to test

5.43 A factor-based approach as follows:

$$Mkt_{int\,1} = \max\begin{Bmatrix} 0 \\ MV_{FI} \bullet D^{gen}_{FI}(r, s^{up}) - TP \bullet D^{gen}_{TP}(r, s^{up}) \\ MV_{FI} \bullet D^{gen}_{FI}(r, s^{down}) - TP \bullet D^{gen}_{TP}(r, s^{down}) \end{Bmatrix}$$

The term structure $r(t)$ and the stresses $s^{up}(t)$ and $s^{down}(t)$ are prescribed. The formula looks quite general, but an important approximation enters the equation in the computation of the generalized duration, as shown below.

5.44 Given a cash flow $C=(C(1), C(2), \dots)$[8], the relative change in its market value subject to a small change of the term structure $r(t)$ can be approximated using the first-order Taylor approximation:

$$\frac{MV(C,r(1+s)) - MV(C,r)}{MV(C,r)} \approx -\frac{1}{MV(C,r)} \bullet \sum_t \frac{s(t) \bullet r(t)}{1+r(t)} \bullet t \bullet d(t) \bullet C(t)$$

$$=: D_C^{gen}(r,s)$$

So, using the generalized duration effectively restricts the calculation of the capital charge to a first order Taylor approximation. From its definition the generalized duration can take positive and negative values (unlike the modified duration, see below, that can only take positive values).

5.45 If the term structure $r(t)$ and the stress factor $s(t)$ are constant in t, then the right-hand side becomes srD_C^{mod}, given that the modified duration is defined as

$$D_C^{\mathrm{mod}} = -\frac{1}{MV(C)} \bullet \frac{1}{1+r} \bullet \sum_t t \bullet d(t) \bullet C(t).$$

5.46 Both the up stress $s^{up}(t)$ and the down stress $s^{down}(t)$ are constant over five maturity buckets:

Maturity t (years)	1-3	3-6	6-12	12-18	18+
relative change $s^{up}(t)$	0.75	0.5	0.4	0.35	0.3
relative change $s^{down}(t)$	-0.4	-0.35	-0.3	-0.25	-0.2

which allows approximating the generalized duration by pooling cash flows (or assets) in the five maturity buckets:

$$D_C^{gen}(r,s) \approx \sum_{b=1}^{5} r_b \bullet s_b \bullet D_b^{\mathrm{mod}} \bullet \frac{MV_b}{MV(C)}$$

r_b is the average interest rate for bucket b, s_b the stress for bucket b, D_b^{mod} the modified duration of the cash flow pooled in bucket b and MV_b the market value of the cash flow pooled in bucket b.

5.47 For those undertakings who cannot easily perform the separation into the five pools of cash flows, the following is to be considered an optional approximation:

$$D_C^{gen}(r,s) \approx r_b \bullet s_b \bullet D_C^{\mathrm{mod}}$$

where the chosen interest rate and stress depends on the bucket b, into which the duration of the cashflow C falls. (C stands for either assets or liabilities.)

5.48 Alternatively, those undertakings that cannot easily perform the separation into five pools of cash flows for the technical provisions, the subdivision could be based on the best estimates instead.

5.49 Participants should also test the change in net asset value that would occur given a pre-defined scenario:

$$Mkt_{\text{int}\,2} = \max\left\{\begin{array}{c} 0 \\ \Delta NAV \mid upwardshock \\ \Delta NAV \mid downwardshock \end{array}\right\}$$

where ΔNAV|*upwardshock* and ΔNAV|*downwardshock* are the changes in the net value of asset and liabilities due to re-valuing all interest rate sensitive instruments using altered term structures. The altered term structures can be derived by multiplying the current interest rate curve by $(1+s^{up})$ and $(1+s^{down})$ as above.

Output

5.50 The placeholder capital charge for interest rate risk is given by the results of the scenario-based approach, so that

$$Mkt_{\text{int}} = Mkt_{\text{int}\,2}$$

$\mathbf{Mkt_{eq}}$ equity risk

5.51 Equity risk arises from the level or volatility of market prices for equities. Exposure to equity risk refers to all assets and liabilities whose value is sensitive to changes in equity prices.

Data requirements

5.52 The following input information is required and has to be shown:

NAV	=	The net value of assets minus liabilities
eq	=	The market value of the overall equity exposure
eq_{link}	=	the market value of equity exposures where the policyholders bear the investment risk (e.g. linked business)

Approaches to test

5.53 A factor-based approach based on the net position in equities as follows:

$$Mkt_{eq1} = (\Delta eq \mid eqfall) - (\Delta eq_{link} \mid eqfall)$$

where *eqfall* is the immediate effect expected in the event of a 40% fall in all individual equities, also considering the effect on derivatives and short positions. [9] If participants wish to take account of the effect of short

9 The value of call options and short positions would then increase in a 40% market drop.

positions and derivatives, they should do so in the following way: the change in value should be calculated on the basis of the change in value of the underlying instrument. However, no consideration should be given to management actions or active trading strategies.

CEIOPS is undertaking further work on the calibration of this approach to ensure that it is consistent with a fall in equity benchmarks in line with the proposed calibration of the SCR (i.e. a 1/200 year event).

5.54 Participants should also test a scenario approach as follows:

$$Mkt_{eq2} = \Delta NAV \mid equity\ shock$$

where the *equity shock* is the immediate effect expected in the event of a 40% fall in equity benchmarks (e.g. Eurostoxx), taking account of all the participant's individual direct and indirect exposures to equity prices. The equity shock takes account of the specific investment policy including e.g. hedging arrangements, gearing etc.

Output

5.55 The placeholder capital charge for equity risk is given by the results of the factor-based approach, so that

$$Mkt_{eq} = Mkt_{eq1}$$

Mkt_{prop} property risk

5.56 Property risk arises from the level or volatility of market prices of property. For reasons of simplicity, QIS2 offers no distinction between direct and indirect real estate or between different types of real estate investment (offices, retail, residential etc).

5.57 For the purpose of QIS2, no differentiation is made between property investments which may have equity-type characteristics (e.g. freehold ownership of a property) and those with more bond-like characteristics (e.g. property rented for a fixed period at agreed rents). Undertakings are invited to comment as to whether such a distinction would be beneficial.

Data requirements

5.58 The following input information is required:

NAV = the net value of assets minus liabilities

prop = the market value of the overall property position not allocated to policies where the policyholders bear the investment risk

Approaches to test

5.59 A factor-based approach as follows:

$$Mkt_{prop1} = 0.2 \bullet prop$$

5.60 A scenario-based approach as follows:

$$Mkt_{prop2} = \Delta NAV \mid property\ shock$$

where the *property shock* is the immediate effect expected in the event of a 20% fall in real estate benchmarks, taking account of all the participant's individual direct and indirect exposures to property prices. The property shock takes account of the specific investment policy including e.g. hedging arrangements, gearing etc.

Output

5.61 The placeholder capital charge for property risk is given by the results of the factor-based approach, so that

$$Mkt_{prop} = Mkt_{prop1}$$

Mkt_{fx} currency risk

5.62 Currency risk arises from the level or volatility of currency exchange rates.

Data requirements

5.63 The following input information is required:

NAV = the net value of assets minus liabilities

Fx = the market value of the overall net foreign currency position

5.64 For each currency other than the local currency, the currency position is the difference in the technical provisions for liabilities in that currency and the assets in that currency.

Approaches to test

5.65 A factor-based approach as follows:

$$Mkt_{fx1} = 0.25 \bullet fx$$

5.66 A scenario-based approach as follows:

$$Mkt_{fx2} = \Delta NAV \mid fx\ shock$$

*w*here the fx shock is the immediate effect expected in the event of a 25% change (more onerous of a rise or fall) in value of all other currencies against the local currency in which the undertaking prepares its local regulatory accounts, taking account of all the participant's individual currency positions and its investment policy (e.g. hedging arrangements, gearing etc.).

Output

5.67 The placeholder capital charge for currency risk is given by the results of the factor-based approach, so that

$$Mkt_{fx} = Mkt_{fx1}$$

SCR_{cred} credit risk module

5.68 Credit risk is the risk of default and change in the credit quality of the issuers of securities, counterparties (including reinsurers and other recoveries) and intermediaries to whom an undertaking has an exposure. Exposures to counterparties should take account of the availability of risk mitigants, such as collateral (but see below).

Data requirements

5.69 The following input information is required:

$rating_i$ = the external rating of credit risk exposure i

$RDur_i$ = the effective duration[10] of credit risk exposure i, but with a minimum value of 1 year and a maximum value of 5 years

MV_i = the nominal size[11] of credit risk exposure i as determined by reference to market values (exposure at default)

5.70 In cases where there is no readily-available market value of a credit risk exposure i, alternative approaches may be adopted to determine MV_i (for example, in the case of insurance-related recoveries, the best estimate of the credit risk exposure), but these should still be consistent with any relevant market information.

5.71 For traded exposures, the term CSE_i can be provided by estimating the credit spread directly. For non-traded exposures, an equivalent to the credit spread may be

- inferred from the ratings; or
- inferred using the product of conservative estimates of the probability of default (PD) and the loss given default (LGD)

Approaches to test

5.72 A ratings-based approach as follows:

$$SCR_{cred1} = \sum_i g(rating_i) \bullet RDur_i \bullet MV_i$$

---

10 In the case of a reinsurance exposure, the duration of the exposure should be an estimate of the modified duration of the projected payments to the cedant under the terms of the reinsurance contract. In principle, this should be the modified duration of relevant cash flows in stressed conditions assumed to underlie the SCR. For the purposes of QIS2 it will be acceptable to have regard only to projected cash flows included in the determination of the change in technical provisions due to reinsurance. For yearly renewed re-insurance this means that the duration can be assumed to be 1 year.

11 In the case of a reinsurance exposure, the nominal size of the exposure should, in principle, be the value of the projected payments to the cedant under the terms of the reinsurance contract, in stressed conditions assumed to underlie the SCR. For the purpose of QIS2 it will be acceptable to assume the nominal size of the exposure is the difference between the value placed on technical provisions gross and net of reinsurance.

where the function g produces a risk weight according to the following table:

$rating_i$	CEIOPS rating bucket	g risk weight
AAA	I – Extremely strong	0.008%
AA	II – Very strong	0.056%
A	III – Strong	0.66%
BBB	IV – Adequate	1.312%
BB	V – Speculative	2.032%
B	VI – Very speculative	4.446%
CCC or lower	VII – Extremely speculative	6.95%
Unrated (except reinsurance)	VIII – unrated	1.6%

The ratings notation used by Standard & Poor's is given for illustrative purposes. In cases where several ratings are available for a given credit exposure, generally the most recent rating should be applied.

5.73 Exposures to reinsurance counterparties should take account of the availability of risk mitigants, such as collateral (but see below). Participants should consider the net exposure to the reinsurance. These should be treated as follows:

- where the reinsurer is rated, the risk weight function should be applied
- where the reinsurer is unrated but would be subject to the requirements of the Reinsurance Directive, including supervision by an EEA competent authority, the exposure should be assigned to bucket IV (BBB)
- in other cases, the exposure should be assigned to bucket VI

5.74 Where collateral and other risk mitigants are recognized as credit risk mitigants, other risks arising from those mitigants should be taken into account in determining the SCR. For example asset risks associated with collateral provided should be assessed in the same way as other assets.

Output

5.75 The placeholder capital charge for credit risk is given by the results of the simple formula, so that:

$$SCR_{cred} = SCR_{cred1}$$

SCR_{life} life underwriting risk module

5.76 This concerns specific risk arising from the underwriting of life insurance contracts, associated with both the perils covered and the processes followed in the conduct of the business.

5.77 Life underwriting risk is split into biometric risks (comprising mortality risk, longevity risk, morbidity and disability risk), lapse and expense risk.

Data requirements

5.78 The following input information is required:

$Life_{mort}$	=	the placeholder capital charge for mortality risk
$Life_{long}$	=	the placeholder capital charge for longevity risk
$Life_{morb}$	=	the placeholder capital charge for morbidity risk
$Life_{dis}$	=	the placeholder capital charge for disability risk
$Life_{lapse}$	=	the placeholder capital charge for lapse risk
$Life_{exp}$	=	the placeholder capital charge for expense risk

Approaches to test

5.79 The capital charges for the sub-risks should be combined using a correlation matrix as follows:

$$SCR_{life} = \sqrt{\sum_{r \times c} CorrLife^{r \times c} \bullet Life_r \bullet Life_c}$$

where

SCR_{life}	=	the placeholder capital charge for life underwriting risk
$CorrLife^{rxc}$	=	the cells of the correlation matrix *CorrLife*
$Life_r$, $Life_c$	=	capital charges for individual life underwriting sub-risks according to the rows and columns of correlation matrix *CorrLife*

and the correlation matrix *CorrLife* is defined as:

$CorrLife=$	$Life_{mort}$	$Life_{long}$	$Life_{morb}$	$Life_{dis}$	$Life_{lapse}$	$Life_{exp}$
$Life_{mort}$	1					
$Life_{long}$	0	1				
$Life_{morb}$	0.5	0	1			
$Life_{dis}$	0.25	0	1	1		
$Life_{lapse}$	0	0.5	0	0	1	
$Life_{exp}$	0.5	0.5	0.5	0.5	0.5	1

Output

5.80 The placeholder capital charge for the life underwriting risk is given by the results of applying the correlation matrix.

Life$_{mort}$ mortality risk

5.81 The treatment of mortality risk is split into the risk components volatility risk, uncertainty risk and CAT risk. Uncertainty risk comprises accumulation risk, trend risk and parameter risk, to the extent these are not already reflected in the valutaion of technical provisions.

Data requirements

5.82 The following input information is required for the class of insurance contracts contingent on mortality risk (i.e., where an increase in mortality rates leads to an increase in technical provisions):

Capital_at_Risk	=	the sum of the (net) capital at risk in the portfolio
q_x	=	the average probability of death
N	=	the number of insurance contracts
TP_{mort}	=	the sum of (net) technical provisions
TP_i	=	for each policy i: technical provision
$Death_i$	=	for each policy i: the amount payable on immediate death

5.83 The average probability of death q_x should be determined by the participating undertakings using sound actuarial methods and approximations. For example, q_x may be determined as the ratio of total actual claims paid and claims related expenses (in the most recent business year) over the sum of the capital at risk in the portfolio.

Approaches to test

5.84 A factor-based approach defined as follows:

$$Life_{mort1} = Life_{mort,vol1} + Life_{mort,trend1} + Life_{CAT}$$

where

$Life_{mort,\ vol1}$	=	the factor-based risk capital for volatility risk
$Life_{mort,\ trend1}$	=	the factor-based risk capital for trend/uncertainty risk
$Life_{CAT}$	=	the risk capital for mortality CAT risks

5.85 A scenario-based approach as follows:

$$Life_{mort2} = Life_{mort,vol2} + Life_{mort,trend2} + Life_{CAT}$$

where

$Life_{mort,\ vol2}$	=	the results of the mortality scenario for volatility risk
$Life_{mort,\ trend2}$	=	the results of the mortality scenario for trend/uncertainty risk

5.86 The life mortality scenario for volatility risk is defined as:

$$Life_{mort,vol2} = \sum_i \left(\Delta NAV \mid mortshock_{vol}\right)$$

where the subscript *i* denotes each policy where the payment of benefits (either lump sum or multiple payments) is contingent on death. The other terms represent

ΔNAV	=	The change in the net value of assets minus liabilities
$mortshock_{vol}$	=	a 10% increase in mortality rates for each age during the next business year

5.87 The life mortality scenario for trend/uncertainty risk is defined as:

$$Life_{mort,trend2} = \sum_i \left(\Delta NAV \mid mortshock_{trend}\right)$$

where the subscript *i* denotes each policy where the payment of benefits (either lump sum or multiple payments) is contingent on mortality risk. The other terms represent

ΔNAV	=	The change in the net value of assets minus liabilities
$mortshock_{trend}$	=	a (permanent) 20% increase in mortality rates for each age

5.88 The risk capital charge for volatility risk under the factor-based approach is defined as follows:

$$Life_{mort,vol1} = 2.58 \bullet \sigma_{mort} \bullet Capital\_at\_Risk$$

where

σ_{mort} = estimate of the standard deviation in the loss distribution for mortality risk

and this is estimated as:

$$\sigma_{mort} = \sqrt{\frac{q_x \bullet (1 - q_x)}{N}}$$

5.89 In the factor-based approach, the risk capital charge for uncertainty risk is defined as follows:

$$Life_{mort,trend1} = 0.002 \bullet TP_{mort}$$

5.90 The CAT risk charge for mortality risk is defined as follows:

$$Life_{mort,CAT} = \sum_i \left(0.003 \bullet \max \begin{Bmatrix} TP_i \\ Death_i \end{Bmatrix} \right)$$

where the subscript *i* denotes each policy where the payment of benefits (either lump sum or multiple payments) is contingent on mortality risk.

Output

5.91 The placeholder capital charge for mortality risk is given by the results of the factor-based formula, so that:

$$Life_{mort} = Life_{mort1}$$

$\text{Life}_{\text{long}}$ longevity risk

5.92 The treatment of longevity risk is split into the risk components volatility risk and uncertainty risk. Uncertainty risk comprises trend risk and parameter risk, to the extent these are not already reflected in the valuation of technical provisions.

Data requirements

5.93 The following input information is required for the class of insurance contracts contingent on longevity risk (i.e., where a decrease in mortality rates leads to an increase in technical provisions):

Potential_release = total of (net) technical provisions, net of any benefits payable on immediate death

q_x = the average probability of death

N = the number of insurance contracts

TP_{long} = the sum of (net) technical provisions

5.94 The average probability of death q_x should be determined by the participating undertakings using sound actuarial methods and approximations. For example, q_x may be determined as the ratio of the actual release of reserve for insurance contracts contingent on longevity risk (in the most recent business year) over total technical provisions (net of any benefits payable on immediate death) for those contracts.

Approaches to test

5.95 A factor-based approach defined as follows:

$$Life_{long1} = Life_{long,vol1} + Life_{long,trend1}$$

where

$Life_{long,\ vol1}$ = the factor-based risk capital for volatility risk

$Life_{long,\ trend1}$ = the factor-based risk capital for trend/uncertainty risk

5.96 A scenario-based approach as follows:

$$Life_{long2} = Life_{long,vol2} + Life_{long,trend2}$$

where

$Life_{long,\ vol2}$ = the results of the longevity scenario for volatility risk

$Life_{long,\ trend2}$ = the results of the longevity scenario for trend/uncertainty risk

5.97 The life longevity scenario for volatility risk is defined as:

$$Life_{long,vol2} = \sum_i \left(\Delta NAV \mid longevityshock_{vol} \right)$$

where the subscript *i* denotes each policy where the payment of benefits (either lump sum or multiple payments) is contingent on survival. The other terms represent

ΔNAV = The change in the net value of assets minus liabilities

$longevityshock_{vol}$ = a 10% decrease in mortality rates for each age during the next business year

5.98 The life longevity scenario for trend/uncertainty risk is defined as:

$$Life_{long,trend2} = \sum_i \left(\Delta NAV \mid longevityshock_{trend} \right)$$

where the subscript *i* denotes each policy where the payment of benefits (either lump sum or multiple payments) is contingent on survival. The other terms represent

ΔNAV = The change in the net value of assets minus liabilities

$longevityshock_{\text{trend}}$	=	a (permanent) 20% decrease in mortality rates for each age

5.99 The risk capital charge for volatility risk under the factor-based approach is defined as follows:

$$Life_{long,vol1} = 2.58 \bullet \sigma_{long} \bullet Potential\_release$$

where

σ_{long}	=	estimate of the standard deviation in the loss distribution for mortality risk

and this is estimated as:

$$\sigma_{long} = \sqrt{\frac{q_x \bullet (1 - q_x)}{N}}$$

5.100 In the factor-based approach, the risk capital charge for uncertainty risk is defined as follows:

$$Life_{long,trend1} = 0.005 \bullet TP_{long}\ Output$$

5.101 The placeholder capital charge for longevity risk is given by the results of the factor-based formula, so that:

$$Life_{long} = Life_{long1}$$

Life$_{\text{morb}}$ morbidity risk

5.102 The treatment of morbidity risk is split into the risk components volatility risk, uncertainty risk. and CAT risk. Uncertainty risk comprises accumulation risk, trend risk and parameter risk, to the extent these are not already reflected in the valutaion of technical provisions.

Data requirements

5.103 The following input information is required for the class of insurance contracts contingent on health status:

Capital_at_Risk	=	the sum of the (net) capital at risk
i_x	=	the average morbidity probability
N	=	the number of insurance contracts
TP_{morb}	=	the sum of (net) technical provisions
SA_i	=	for each policy *i*: where benefits are payable as a single lump sum, the sum assured. Otherwise, zero.
AB_i	=	for each policy *i*: where benefits are not payable as a single lump sum, the annualised amount of

benefit payable. Otherwise, zero.

Approaches to test

5.104 A factor-based approach defined as follows:

$$Life_{morb1} = Life_{morb,vol1} + Life_{morb,trend1} + Life_{morb,CAT}$$

where

$Life_{morb,\ vol1}$	=	the factor-based risk capital for volatility risk
$Life_{morb,\ trend1}$	=	the factor-based risk capital for trend/uncertainty risk
$Life_{morb,\ CAT}$	=	the risk capital for morbidity CAT risks

5.105 A scenario-based approach as follows:

$$Life_{morb2} = Life_{morb,vol2} + Life_{morb,trend2} + Life_{morb,CAT}$$

where

$Life_{morb,\ vol2}$	=	the results of the morbidity scenario for volatility risk
$Life_{morb,\ trend2}$	=	the results of the morbidity scenario for trend/uncertainty risk

5.106 The life morbidity scenario for volatility risk is defined as:

$$Life_{morb,vol2} = \sum_i \left(\Delta NAV \mid morbshock_{vol}\right)$$

where the subscript *i* denotes each policy where the payment of benefits (either lump sum or multiple payments) is contingent on health status. The other terms represent

ΔNAV	=	The change in the net value of assets minus liabilities
$morbshock_{vol}$	=	a 10% increase in morbidity rates for each age during the next business year

5.107 The life morbidity scenario for trend/uncertainty risk is defined as:

$$Life_{morb,trend2} = \sum_i \left(\Delta NAV \mid morbshock_{trend}\right)$$

where the subscript *i* denotes each policy where the payment of benefits (either lump sum or multiple payments) is contingent on health status. The other terms represent

ΔNAV	=	The change in the net value of assets minus liabilities
$morbshock_{trend}$	=	a (permanent) 25% increase in assumed rates of morbidity for each age (including probability of

remaining sick or disabled)

5.108 The risk capital charge for volatility risk under the factor-based approach is defined as follows:

$$Life_{morb,vol1} = 2.58 \bullet \sigma_{morb} \bullet Capital\_at\_Risk$$

where

σ_{morb} = estimate of the standard deviation in the loss distribution for mortality risk

and this is estimated as:

$$\sigma_{morb} = \sqrt{\frac{i_x \bullet (1 - i_x)}{N}}$$

5.109 In the factor-based approach, the risk capital charge for uncertainty risk is defined as follows:

$$Life_{morb,trend1} = 0.002 \bullet TP_{morb}$$

5.110 The CAT risk charge for morbidity risk is defined as:

$$Life_{morb,CAT} = \sum_i \left(0.001SA_i + 0.005AB_i\right)$$

where the subscript *i* denotes each policy where the payment of benefits (lump sum or multiple payment) is contingent on health status.

Output

5.111 The placeholder capital charge for morbidity risk is given by the results of the factor-based formula, so that:

$$Life_{morb} = Life_{morb1}$$

$Life_{dis}$ disabilty risk

5.112 The treatment of disability risk is split into the risk components volatility risk, uncertainty risk and CAT risk. Uncertainty risk comprises accumulation risk, trend risk and parameter risk, to the extent these are not already reflected in the valuation of technical provisions.

Data requirements

5.113 The following input information is required for the class of insurance contracts contingent on a definition of disability:

Capital_at_Risk = the sum of the (net) capital at risk

i_x = the average disability probability

N	=	the number of insurance contracts
TP_{dis}	=	the sum of (net) technical provisions
SA_i	=	for each policy *i*: where benefits are payable as a single lump sum, the sum assured. Otherwise, zero.
AB_i	=	for each policy *i*: where benefits are not payable as a single lump sum, the annualised amount of benefit payable. Otherwise, zero.

Approaches to test

5.114 A factor-based approach defined as follows:

$$Life_{dis1} = Life_{dis,vol1} + Life_{dis,trend1} + Life_{dis,CAT}$$

where

$Life_{dis,\ vol1}$	=	the factor-based risk capital for volatility risk
$Life_{dis,\ trend1}$	=	the factor-based risk capital for trend/uncertainty risk
$Life_{\ dis,\ CAT}$	=	the risk capital for disability CAT risks

5.115 A scenario-based approach as follows:

$$Life_{dis2} = Life_{dis,vol2} + Life_{dis,trend2} + Life_{dis,CAT}$$

where

$Life_{dis,\ vol2}$	=	the results of the disability scenario for volatility risk
$Life_{dis,\ trend2}$	=	the results of the disability scenario for trend/uncertainty risk

5.116 The life disability scenario for volatility risk is defined as:

$$Life_{morb,vol2} = \sum_i \left(\Delta NAV \mid disshock_{vol} \right)$$

where the subscript *i* denotes each policy where the payment of benefits (either lump sum or multiple payments) is contingent on a definition of disability. The other terms represent

ΔNAV	=	The change in the net value of assets minus liabilities
$disshock_{vol}$	=	a 10% increase in disability rates for each age during the next business year

5.117 The life disability scenario for trend/uncertainty risk is defined as:

$$Life_{dis,trend2} = \sum_i \left(\Delta NAV \mid disshock_{trend} \right)$$

where the subscript *i* denotes each policy where the payment of benefits (either lump sum or multiple payments) is contingent on a definition of disability. The other terms represent

ΔNAV	=	The change in the net value of assets minus liabilities
$disshock_{\text{trend}}$	=	a (permanent) 25% increase in assumed rates of disability for each age (including probability of remaining sick or disabled)

5.118 The risk capital charge for volatility risk under the factor-based approach is defined as follows:

$$Life_{dis,vol1} = 2.58 \bullet \sigma_{dis} \bullet Capital\_at\_Risk$$

where

σ_{dis}	=	estimate of the standard deviation in the loss distribution for disability risk

and this is estimated as:

$$\sigma_{dis} = \sqrt{\frac{i_x \bullet (1 - i_x)}{N}}$$

5.119 In the factor-based approach, the risk capital charge for uncertainty risk is defined as follows:

$$Life_{dis,trend1} = 0.002 \bullet TP_{dis}$$

5.120 The CAT risk charge for disability risk is defined as:

$$Life_{dis,CAT} = \sum_i \left(0.001SA_i + 0.005AB_i\right)$$

where the subscript *i* denotes each policy where the payment of benefits (lump sum or multiple payment) is contingent on a definition of disability.

Output

5.121 The placeholder capital charge for morbidity risk is given by the results of the factor-based formula, so that:

$$Life_{dis} = Life_{dis1}$$

$Life_{lapse}$ lapse risk

5.122 Lapse risk relates to an unanticipated (higher or lower) rate of policy lapses, terminations, changes to paid-up status (cessation of premium payment) and surrenders.

Data requirements

5.123 The following input information is required:

TP	=	technical provision
RB	=	total amount of claims against policyholders and insurance agents and Zillmer / agents' and other intermediaries' commission claw-back claims

Approaches to test

5.124 A factor-based approach as follows:

$$Life_{lapse1} = 0.005 \bullet TP + 0.1 \bullet RB$$

5.125 A scenario-based approach as follows:

$$Life_{lapse2} = \sum_{i} \left(\Delta NAV \mid lapseshock_i \right)$$

where *i* denotes each policy. The other terms represent

ΔNAV	=	the change in the net value of assets minus liabilities
lapseshock	=	the more adverse of a 50% increase or 50% decrease in assumed rates of lapsation at each duration, subject to a minimum change of 3% per annum[12]

Output

5.126 The placeholder capital charge for life lapse risk is given by the results of the factor-based formula, so that:

$$Life_{lapse} = Life_{lapse1}$$

$Life_{exp}$ expense risk

5.127 Expense risk arises from the variation in the expenses associated with the insurance contracts.

Data requirements

5.128 The following input information is required:

E_{fixed}	=	total annual amount of the fixed expenses of the undertaking

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12 This means that if an assumed lapsation rate is required to be reduced from a rate already below 3 % per annum, it should be reduced to zero

Approaches to test

5.129 A factor-based approach as follows:

$$Life_{\exp 1} = 0.1 \bullet E_{fixed}$$

5.130 A scenario-based approach as follows:

$$Life_{\exp 2} = \Delta NAV \mid \exp shock$$

where:

ΔNAV	=	the change in the net value of assets minus liabilities
expshock	=	all future expenses are higher than best estimate anticipations by 10% and the rate of expense inflation is 1.5% per annum higher than anticipated

Output

5.131 The placeholder capital charge for life expense risk is given by the results of the factor-based formula, so that:

$$Life_{\exp} = Life_{\exp 1}$$

SCR_{health} health underwriting risk module

5.132 This subsection sets out specifications for underwriting risk in health insurance that is practised on a similar technical basis to that of life assurance.[13]

5.133 Health underwriting risk is split into the three components: expense risk, excessive loss/mortality/cancellation risk and epidemic/accumulation risk.

Data requirements

5.134 The following input information is required:

$health_{exp}$	=	placeholder capital charge for health expense risk
$health_{xs}$	=	placeholder capital charge for health excessive loss / mortality / cancellation risk
$health_{ac}$	=	placeholder capital charge for health epidemic / accumulation risk
e_{hexp}	=	expected result in health expense risk
e_{hxs}	=	expected result in health excessive loss / mortality / cancellation risk

Approaches to test

5.135 The following aggregation formula:

$$SCR_{health} = \max\left\{\begin{array}{l} 0; \\ \sqrt{\begin{array}{l}(health_{\exp} + e_{h\exp})^2 + (health_{xs} + e_{hxs})^2 \\ + (health_{\exp} + e_{h\exp}) \bullet (health_{xs} + e_{hxs})\end{array}} + health_{ac} - \left(e_{h\exp} + e_{hxs}\right)\end{array}\right\}$$

(The correlation between the risks of fluctuations in expenses and in net risk is assumed to be 0.5)

Output

5.136 The placeholder capital charge for health risk is given by the results of the aggregation formula.

$Health_{exp}$ expense risk

5.137 Expense risk arises if the expenses anticipated in the pricing of a product are insufficient to cover the actual costs accruing in the accounting year. There are numerous possible causes of such a shortfall, therefore all cost items of private health insurers have to be taken into account. In order to

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[13] health insurance within the meaning of Article 16a (4) of the EU-directive 73/239/EEC (as amended by EU-directive 2002/13/EC)

ensure comparability among the financial years, all annual results will be related to the gross premiums earned in the specific financial year.

Data requirements

5.138 The following input information is required:

σ_{hexp}	=	the standard deviation of the expense result over the previous ten-year period
gp_{ay}	=	gross premium earned for the accounting year
μ_{hexp}	=	the mean value of the expense result in the last three financial years

Approaches to test

5.139 The following formula:

$$health_{\exp} = 2.58 \bullet \sigma_{\exp} \bullet gp_{ay} - e_{h\exp}$$

where

$$e_{h\exp} = \mu_{h\exp} \bullet gp_{ay}$$

Output

5.140 The following output information is provided:

$health_{exp}$	=	placeholder capital charge for health expense risk
e_{hexp}	=	expected result in health expense risk

Health$_{xs}$ excessive loss / mortality / cancellation risk

5.141 This covers:

- The excessive loss risk or per capita loss risk results if the actual per capita loss is greater than the loss assumed in the pricing of the product.
- The mortality risk exists if the actual funds from provisions for increasing age becoming available due to death are lower than those assumed in the pricing of the product.
- The cancellation risk exists if the actual funds from provisions for increasing age becoming available due to cancellations are lower than those assumed in the pricing of the product.

Data requirements

5.142 The following input information is required:

σ_{hxs}	=	the standard deviation of the $health_{xs}$ result over the previous ten-year period
gp_{ay}	=	gross premium earned for the accounting year
μ_{hxs}	=	the mean value of the $health_{xs}$ result in the last three financial years

Approaches to test

5.143 The following formula:

$$health_{xs} = 2.58 \bullet \sigma_{xs} \bullet gp_{ay} - e_{hxs}$$

where

$$e_{hxs} = \mu_{hxs} \bullet gp_{ay}$$

Output

5.144 The following output information is provided:

$health_{xs}$	=	placeholder capital charge for $health_{xs}$ risk
e_{hxs}	=	expected result in $health_{xs}$ risk

Health_{ac} epidemic/accumulation risk

Data requirements

5.145 The following input information is required:

$claims_{ay}$	=	claims expenditure for the accounting year
gp_{ay}	=	gross premium earned for the accounting year
mgp_{ay}	=	total gross premium earned for the accounting year in the health insurance market

Approaches to test

5.146 The following formula:

$$health_{ac} = claims_{ay} \bullet 0.01 \bullet \frac{gp_{ay}}{mgp_{ay}}$$

Output

5.147 The placeholder capital charge for epidemic/accumulation risk is given by the results of the formula.

SCR_{nl} non-life underwriting risk module

5.148 Underwriting risk is the specific insurance risk arising from insurance contracts. These risks are based on the technicalities of the insurance business: the insurance undertaking has to ensure future payment commitments, and the volume of such payments must be calculated in advance.

5.149 Non-life underwriting risk is split into the three components: reserve risk, premium risk and cat risk.

Data requirements

5.150 The following input information is required:

NL_{res} = the placeholder capital charge for reserve risk

NL_{prem} = the placeholder capital charge for premium risk

NL_{CAT} = the placeholder capital charge for CAT risk

Approaches to test

5.151 The capital charges for the sub-risks should be combined using a correlation matrix as follows:

$$SCR_{nl} = \sqrt{\sum_{rxc} CorrNL^{r \times c} \bullet NL_r \bullet NL_c}$$

where

SCR_{nl} = the placeholder capital charge for non-life underwriting risk

$CorrNL^{rxc}$ = the cells of the correlation matrix *CorrNL*

NL_r, NL_c = capital charges for the individual non-life underwriting sub-risks according to the rows and columns of correlation matrix CorrNL

and the correlation matrix *CorrNL* is defined as:

CorrNL=	NL_{res}	NL_{prem}	NL_{CAT}
NL_{res}	1		
NL_{prem}	0.5	1	
NL_{CAT}	0	0	1

Output

5.152 The placeholder capital charge for the non-life underwriting risk is given by the results of applying the correlation matrix.

NL_{prem} premium risk

5.153 Premium risk is understood to relate to future claims arising during and after the time horizon for the solvency assessment. Premium risk is present at the time the policy is issued, and before any insured events will have happened. The risk is that expenses plus the volume of incurred losses for these claims (comprising both amounts paid during the time horizon and provisions made at its end) is higher than the premiums received.

Data requirements

5.154 The following input information is required:

$CR_{lob,y}$	=	net combined ratios in each of the LOBs and for historic years y (to the extent available, not more than 15 years)
$P_{lob,y}$	=	earned net premiums in each of the LOBs and for historic years y (to the extent available, not more than 15 years)
P_{lob}	=	estimate of the net earned premium in the forthcoming year in each of the LOBs
$P_{lob,gross}$	=	estimate of the gross earned premium in the forthcoming year in each of the LOBs

where the segmentation in lines of businesses (LOBs) is defined as for the placeholder valuation of technical provisions in non-life insurance.

5.155 In each of the LOBs, the estimate P_{lob} of the net earned premium in the forthcoming year should be determined as set out further above. $P_{lob,gross}$ should be determined in the same way.

5.156 The combined ratios $CR_{lob,y}$ are defined as set out further above.

Approaches to test

5.157 A factor-based approach as follows:

$$NL_{prem1} = \rho(\sigma_M) \bullet P$$

and another more sophisticated factor based approach as follows:

$$NL_{prem2} = \rho(\sigma_U) \bullet P$$

where

P	=	estimate of net earned premium of the overall business in forthcoming year
σ_M	=	market-wide estimate of the standard deviation of the overall combined ratio
σ_U	=	undertaking-specific estimate of the standard deviation of

the overall combined ratio

$\rho(.)$ = function of the standard deviation

5.158 The estimate P of the volume of net earned premium for the overall non-life business in the forthcoming year is defined as follows:

$$P = \sum_{lob} P_{lob}$$

5.159 The estimates σ_M and σ_U are set as

$$\sigma_M = \sqrt{\frac{1}{P^2}\sum_{r,c} CorrLob\_Prem^{rxc} \bullet P_r \bullet P_c \bullet \sigma_{M,r} \bullet \sigma_{M,c}}$$

and

$$\sigma_U = \sqrt{\frac{1}{P^2}\sum_{r,c} CorrLob\_Prem^{rxc} \bullet P_r \bullet P_c \bullet \sigma_{U,r} \bullet \sigma_{U,c}}$$

where

$CorrLob\_Prem^{rxc}$ = the cells of the correlation matrix *CorrLob_Prem*

$\sigma_{M,r}$, $\sigma_{M,c}$ = market-wide estimates of the standard deviation of the combined ratio in the individual LOBs

$\sigma_{U,r}$, $\sigma_{U,c}$ = undertaking-specific estimates of the standard deviation of the combined ratio in the individual LOBs

and the correlation matrix *CorrLob_Prem* is defined as:

CorrLob_Prem=	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1: A & H	1										
2: M (3rd party)	0.25	1									
3: M (other)	0	0.5	1								
4: MAT	0	0	0.5	1							
5: Fire	0	0	0.5	0.25	1						
6: 3rd party liab	0.25	0	0	0	0	1					
7: credit	0	0	0	0	0	0.75	1				
8: legal exp.	0.5	0.25	0	0	0	0.5	0.75	1			
9: assistance	0	0	0.5	0.5	0.5	0	0	0	1		
10: misc.	0	0	0	0	0	0	0	0	0	1	
11: reinsurance	0	0	0.5	0.5	0.5	0.5	0	0	0	0	1

5.160 The market-wide estimates of the standard deviation of the combined ratio in the individual LOBs are defined as follows:

$$\sigma_{M,lob} = sf_{lob} \bullet f_{lob}$$

where

sf_{lob} = the size factor

f_{lob} = the volatility factor specific for the LOB

5.161 The volatility factor f_{lob} is defined as follows:

LOB =	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
f_{lob}	0.05	0.125	0.075	0.15	0.10	0.25	0.10	0.15	0.10	0.15	0.15

5.162 The size factor sf_{lob} is defined as follows (where *m* denotes millions of euro):

$$sf_{lob} = \begin{cases} 1 \quad if \quad P_{lob,gross} \geq 100\ m \\ \dfrac{10}{\sqrt{P_{lob,gross} \bullet 10^{-6}}} \quad if \quad 100\ m > P_{lob,gross} \geq 20\ m \\ \dfrac{10}{\sqrt{20}} \quad otherwise \end{cases}$$

5.163 The undertaking-specific estimates of the standard deviation of the combined ratio in the individual LOB's are defined as follows:

$$\sigma_{U,lob} = \sqrt{c_{lob} \bullet \sigma^2_{CR,lob} + (1 - c_{lob}) \bullet \sigma^2_{M,lob}}$$

where

c_{lob} = credibility factor for LOB

$\sigma_{CR,lob}$ = estimate of the standard deviation of the combined ratio in the individual LOBs on the basis of historic combined ratios of the undertaking

5.164 The credibility factor c_{lob} is defined as

$$\mathrm{c}_{\mathrm{lob}} = 0.2 \bullet \max \begin{Bmatrix} 0 \\ J_{lob} - 10 \end{Bmatrix}$$

where

J_{lob} = number of historic combined ratios for each LOB (to the extent available, not more than 15 years)

5.165 In case of J_{lob} > 10, the estimate $\sigma_{CR,lob}$ of the standard deviation of the combined ratio in the individual LOBs on the basis of historic combined ratios of the undertaking and is defined as

$$\sigma_{CR,lob} = \sqrt{\frac{1}{(J_{lob} - 1) \bullet P_{lob}} \bullet \sum_y P_{lob,y} \bullet (CR_{lob,y} - \mu_{lob})^2}\ ,$$

where

μ_{lob} = company-specific estimate of the expected value of the combined ratio in the individual LOBs

and μ_{lob} is defined as the premium-weighted average of historic combined ratios:

$$\mu_{lob} = \frac{\sum_y P_{lob,y} \bullet CR_{lob,y}}{\sum_y P_{lob,y}}$$

5.166 The function $\rho(x)$ is specified as

$$\rho(x) = \frac{0.99 - \Phi\left(N_{0.99} - \sqrt{log(x^2+1)}\right)}{0.01}$$

where

Φ = cumulative distribution function of the standard normal distribution

$N_{0.99}$ = 99% quantile of the standard normal distribution

Output

5.167 The placeholder capital charge for premium risk is given by the results of the first factor-based approach (based on a market-wide estimation of the standard deviation of the combined ratio), so that:

$$NL_{prem} = NL_{prem1}$$

5.168 For reinsurance undertakings, the placeholder capital charge for premium risk will probably not adequately reflect the risk profile of the undertaking. Therefore, for QIS 2 reinsurers should follow the more sophisticated factor-based approach as the placeholder approach, but the mechanic estimation of the standard deviation of the combined ratio in the individual LOBs on the basis of historic combined ratios of the undertaking should be replaced by estimates that are provided by the reinsurer.

NL_{res} reserve risk

5.169 Reserve risk stems from two sources: on the one hand, the absolute level of the technical provisions may be mis-estimated. On the other hand, because of the stochastic nature of future claim payouts, the actual claims will fluctuate around their statistical mean value.

Data requirements

5.170 The following input information is required:

PCO = the net provision for claims outstanding for the overall business

PCO_{lob} = the net provision for claims outstanding in each of the LOB's

$PCO_{lob,gross}$ = the gross provision for claims outstanding in each of the LOB's

where the segmentation in lines of businesses (LOBs) is defined as for the placeholder valuation of technical provisions in non-life insurance.

Approaches to test

5.171 A factor-based approach as follows:

$$NL_{res1} = \rho(\sigma) \bullet PCO$$

where

σ = market-wide estimate of the standard deviation of the run-off result of the forthcoming year

$\rho(.)$ = function of the standard deviation

5.172 The estimate σ is set as

$$\sigma = \sqrt{\frac{1}{PCO^2} \sum_{r,c} CorrLob\_Res^{rxc} \bullet PCO_r \bullet PCO_c \bullet \sigma_r \bullet \sigma_c}$$

where

$CorrLob\_Res^{rxc}$ = the cells of the correlation matrix *CorrLob_Res*

σ_r, σ_c = market-wide estimates of the standard deviation of the run-off result in the individual LOBs

and the correlation matrix *CorrLob_Res* is defined as:

CorrLob_Res=	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1: A & H	1										
2: M (3rd party)	0.25	1									
3: M (other)	0	0.5	1								
4: MAT	0	0	0.5	1							
5: Fire	0	0	0.5	0.25	1						
6: 3rd party liab	0.25	0	0	0	0	1					
7: credit	0	0	0	0	0	0.75	1				
8: legal exp.	0.5	0.25	0	0	0	0.5	0.75	1			
9: assistance	0	0	0.5	0.5	0.5	0	0	0	1		
10: misc.	0	0	0	0	0	0	0	0	0	1	

11: reinsurance	0	0	0.5	0.5	0.5	0.5	0	0	0	0	1

5.173 The market-wide estimates of the standard deviation of the run-off result in the individual LOB's are defined as follows:

$$\sigma_{lob} = sf_{lob} \bullet f_{lob}$$

where

sf_{lob} = the size factor

f_{lob} = the volatility factor specific for the LOB

5.174 The volatility factor f_{lob} is defined as follows:

LOB =	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
f_{lob}	0.15	0.15	0.075	0.15	0.10	0.20	0.10	0.10	0.20	0.20	0.20

5.175 The size factor sf_{lob} is defined as follows (where *m* denotes millions of euro):

$$sf_{lob} = \begin{cases} 1 \quad if \quad PCO_{lob,gross} \geq 100\ m \\ \dfrac{10}{\sqrt{PCO_{lob,gross} \bullet 10^{-6}}} \quad if \quad 100\ m > PCO_{lob,gross} \geq 20\ m \\ \dfrac{10}{\sqrt{20}} \quad otherwise \end{cases}$$

Output

5.176 The placeholder capital charge for reserve risk is given by the results of the factor-based approach, so that:

$$NL_{res} = NL_{res1}$$

5.177 For reinsurance undertakings, the placeholder capital charge for reserve risk will probably not adequately reflect the risk profile of the undertaking. Therefore, for the purposes of QIS2, reinsurers should be requested to provide their own estimates of the variables μ_{lob} (the expected value of the (relative) run-off result in the forthcoming year) and σ_{lob} (the standard deviation of the run-off result) in the individual LOBs to compute the risk capital charge according to the formulas set out above.

NL_{CAT} CAT risk

5.178 CAT risks stem from extreme or irregular events that are not sufficiently captured by the factor-based model for premium and reserve risk.

5.179 For QIS2, one or more severe Nat-CAT events are considered that are specified by the national regulator.

Data requirements

5.180 The following input information is required:

P_U	=	the sum of gross written premium in the LOBs affected by the CAT risks considered
f	=	the retention factor of the reinsurance programme of the undertaking (if applicable)
$X1$, $X2$	=	lower and upper bound of a CAT-XL layer in the reinsurance programme of the undertaking (if applicable)

Approaches to test

5.181 Either a 'market-loss' approach as follows:

$$NL_{CAT1} = \max(f \bullet MS \bullet ML - X_2;0) + \min(f \bullet MS \bullet ML;X_1)$$

where

MS	=	the market share of the undertaking
ML	=	the market loss

and the market loss is specified by the national regulator.

5.182 The market share MS is defined as

$$MS = \frac{P_U}{P_M}$$

where

P_M	=	the gross written premiums in the LOBs affected by the CAT risks considered for the entire market

5.183 For QIS2, the national regulator should have the freedom to modify the design of the 'market loss approach' if this seems necessary to adequately reflect the kind of Nat-CAT events that are relevant for the national market, as well as the characteristics of the typical reinsurance protection in the market. Generally, the modelling approaches should allow the participants to calculate a capital charge Nl_{CAT} consistent with a TailVaR risk measure, calibrated to a confidence level of 99.0%.

5.184 Alternatively, a scenario-based approach is tested as follows:

$$NL_{CAT2} = \Delta NAV \,|\, Nat - CAT\ events$$

5.185 The estimation of the change ΔNAV of the net asset value needs to take the particularities of the undertaking's business into account. In particular, the mitigation effects of the undertaking's reinsurance program should be taken into account. Also, the mitigating impact of any pool arrangements should be taken into consideration.

5.186 When assessing the mitigating effects of the reinsurance cover, the undertaking should take into account that, under stressed conditions, there might be an increased possibility of credit loss from reinsurance.

Output

5.187 The placeholder capital charge for CAT risk is given by the results of either the 'market-loss' approach or the scenario approach, depending on which was attempted by the participant.

5.188 For the purposes of QIS2, reinsurers should be requested to provide their own assessment for CAT-risk for the placeholder capital charge.

SCR_{op} operational risk module

5.189 Operational risk is the risk of loss arising from inadequate or failed internal processes, people, systems or from external events.

Data requirements

5.190 The following input information is required:

TP_{life}	=	Total life insurance technical provisions [14] (gross of reinsurance)
TP_{nl}	=	Total non-life insurance technical provisions (gross of reinsurance)
TP_h	=	Total health insurance technical provisions (gross of reinsurance)
$Earn_{life}$	=	Total earned life premium[15] (gross of reinsurance)
$Earn_h$	=	Total earned health insurance premium (gross of reinsurance)
$Earn_{nl}$	=	Total earned non-life premium (gross of reinsurance)

Approach to test

5.191 A simple, robust formula as follows:

$$Op_1 = \max\left\{ \begin{matrix} 0.06 \bullet Earn_{life} + 0.03 \bullet Earn_{nl} + 0.03 \bullet Earn_h, \\ 0.006 \bullet TP_{life} + 0.03 \bullet TP_{nl} + 0.003 \bullet TP_h \end{matrix} \right\}$$

[14] In the case of linked business with no policyholder guarantees, this may be reduced to one-tenth of the technical provisions

[15] In the case of linked business with no policyholder guarantees, this may be reduced to one-tenth of the earned life premium

Output

5.192 The placeholder capital charge for operational risk is given by the results of the simple formula, so that:

$$SCR_{Op} = Op_1$$

Section 6

Solvency Capital Requirement: internal models

Participants are invited to complete this section of QIS2 at their discretion.

6.1 To the extent possible, estimates of required capital produced by internal models should be given for each of the risk modules described in section 5. This is supplementary information - it is requested in addition to the results of the different modelling approaches tested in section 5.

6.2 CEIOPS recognises that, in practice, it may be difficult to disaggregate the output from models to the level of granularity suggested in section 5, especially where participants follow an internal risk classification that differs from the one used in this exercise. However, internal estimates for capital in the main risk categories (SCR_{mkt}, SCR_{life}, SCR_{health}, SCR_{nl}, SCR_{cred}, SCR_{op}) and the overall *SCR* would be especially welcome.

6.3 Partial internal model estimates would also be welcome – particularly in areas such as interest rate risk and equity risk where VaR approaches may be more familiar (drawing on practice in the banking sector).

6.4 While participants are invited to consider the overall SCR design criteria set out in CEIOPS' previous technical advice to the European Commission, estimates may still be provided if different criteria have been used to calibrate the model. In particular, CEIOPS recognises that the valuation basis for internal model estimates submitted in this exercise may differ from the requirements set out in section 2 of this specification (on which the standard formula is based).

6.5 CEIOPS expects that internal model estimates submitted for QIS2 will be of greatest use in assessing the *design* of the standard formula modelling treatments, rather than refining its *calibration*. Participants are encouraged to comment on reasons for material differences between their internal model estimates and the results of the standard formula modelling treatments, especially where they suspect the latter fail to reflect the true drivers of risk.

Section 7

Minimum Capital Requirement

7.1 In this section, participants are requested to

- Calculate a transitional MCR based on Solvency I
- Calculate a post-transition MCR based on the SCR standard formula
- Provide information on the additional expenses that would be incurred in run-off

7.2 According to the Commission's *Framework for Consultation*, the MCR should be subject to an absolute minimum floor expressed in Euros. This might be similar to the minimum guarantee fund in the present Life and Non-Life Directives. However, this aspect is not addressed explicitly in QIS2.

Transitional MCR based on Solvency I

7.3 CEIOPS' advice on Call for Advice No. 9 suggests that a formula based on the Solvency I requirements should be used to calculate the MCR for a set transitional period. However, this will need to reflect the Solvency II methodology for valuing technical provisions.

7.4 For non-life business, an assumption is made that changes to the valuation basis have a limited effect on the results of the formulaic Solvency I requirements.

7.5 For life business, the exercise adopts a shortcut whereby the calculations are performed on a gross of reinsurance basis.

Data requirements: life

7.6 The following input information is required from the Solvency I returns:

CTP_1 = Current mathematical provisions for non-linked life assurance

CTP_L = Current technical provisions for all linked assurance

CTP_{L1} = Current technical provisions for linked assurance, insofar as the insurer bears an investment risk

CTP_{L2} = Current technical provisions for linked assurance, insofar as the insurer bears no investment risk but the allocation to cover management expenses is fixed for a period exceeding 5 years

CCR_1 = Current capital at risk for non-linked life assurance, other than temporary assurance on death of a maximum term of 5 years

CCR_2	=	Current capital at risk for temporary assurance on death of a maximum term of 3 years
CCR_3	=	Current capital at risk for temporary assurance on death of a term more than 3 years but not more than 5 years
CCR_L	=	Current capital at risk for linked assurance insofar as the insurer covers a death risk
CRC_{sup}	=	Solvency I required capital for supplementary insurance
CRC_{health}	=	Solvency I required capital for permanent health insurance not subject to cancellation
CE_{L3}	=	Last year's net administrative expenses pertaining to linked assurance, insofar as the insurer bears no investment risk and the allocation to cover management expenses is not fixed for a period exceeding 5 years

7.7 The following inputs are required using the placeholder valuation requirements in section 2 of this specification:

TP_1	=	technical provisions for non-linked life assurance
TP_L	=	technical provisions for linked life assurance
TP_{health}	=	technical provisions for permanent health insurance
TP_{red}	=	technical provisions for capital redemption operations
A_{ton}	=	market-consistent value of tontine assets

Approaches to test: life

7.8 Participants should calculate the results of the following formula:

$$\begin{aligned} TMCR_{life} = 0.5 \bullet (&0.04 \bullet TP_1 + 0.003 \bullet CR_1 + 0.001 \bullet CR_2 + 0.0015 \bullet CR_3 \\ &+ CRC_{sup} + 0.04 \bullet TP_{health} + CRC_{health} + 0.04 \bullet TP_{red} + 0.01 \bullet A_{ton} \\ &+ 0.04 \bullet TP_{L1} + 0.01 \bullet TP_{L2} + 0.25 \bullet CE_{L3} + 0.003 \bullet CR_L) \end{aligned}$$

where

$$CR_1 = CCR_1 \bullet \left(1 + \frac{(CTP_1 - TP_1)}{(CCR_1 + CCR_2 + CCR_3)}\right)$$

$$CR_2 = CCR_2 \bullet \left(1 + \frac{(CTP_1 - TP_1)}{(CCR_1 + CCR_2 + CCR_3)}\right)$$

$$CR_3 = CCR_3 \bullet \left(1 + \frac{(CTP_1 - TP_1)}{(CCR_1 + CCR_2 + CCR_3)}\right)$$

$$TP_{L1} = CTP_{L1} \bullet \left(1 + \frac{(TP_L - CTP_L)}{CTP_L}\right)$$

$$TP_{L2} = CTP_{L2} \bullet \left(1 + \frac{(TP_L - CTP_L)}{CTP_L}\right)$$

$$CR_L = CCR_L + CTP_L - TP_L$$

Data requirements: non-life

7.9 Participants should calculate CRC_{nl}, the current capital required under Solvency I for their non-life business.

Approaches to test: non-life

7.10 A simple factor is applied to the Solvency I requirement, so that

$$TMCR_{nl} = 0.5 \bullet CRC_{nl}$$

Output

7.11 The values of $TMCR_{life}$ and $TMCR_{nl}$ should be disclosed separately.

7.12 As alternative results,

$TMCR_{life2} = 2 \bullet TMCR_{life}$ and

$TMCR_{nl2} = 2 \bullet TMCR_{nl}$

should be disclosed.

Post-transition MCR

7.13 In its answer to Call for Advice No. 9, CEIOPS gave the following working hypothesis for the MCR:

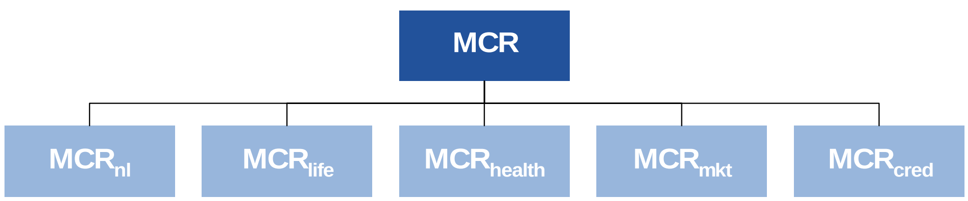
CEIOPS will develop a simple factor-based formula for the MCR by simplifying the SCR, possibly by retaining its most significant items, by using a more straightforward technique for aggregation and by calibrating the factors to a lower level of confidence.

7.14 For a placeholder calculation of the MCR, CEIOPS wishes to test

- the results of the relatively simple, 'robust' modelling approaches for the SCR, reduced by applying fixed factors; and
- the placeholder correlation assumptions used in the SCR

This means many of the outputs from section 5 of this specification are re-used for the MCR.

7.15 The MCR calculation is divided into components as follows:



For the purposes of QIS2, operational risk does not feature explicitly in the calculation of the MCR.

7.16 The capital charges for the main risk components should be combined using a correlation matrix as follows:

$$MCR_1 = \sqrt{\sum_{r\times c} CorrMCR^{r\times c} \bullet MCR_r \bullet MCR_c}$$

where

MCR	=	the overall MCR calculation
$CorrMCR^{rxc}$	=	the cells of the correlation matrix *CorrMCR*
MCR_r, MCR_c	=	capital charges for individual MCR risks according to the rows and columns of correlation matrix *CorrMCR*

and the correlation matrix *CorrMCR* is defined as:

CorrMCR=	MCR_{mkt}	MCR_{cred}	MCR_{life}	MCR_{health}	MCR_{nl}
MCR_{mkt}	1				
MCR_{cred}	0.75	1			
MCR_{life}	0.25	0.25	1		
MCR_{health}	0.25	0.25	0	1	
MCR_{nl}	0.25	0.5	0	0	1

7.17 Capital charges for the main risk components should also be combined assuming full independence:

$$MCR_2 = \sqrt{MCR_{Mkt}^2 + MCR_{cred}^2 + MCR_{life}^2 + MCR_{health}^2 + MCR_{nl}^2}$$

7.18 Capital charges should also be combined assuming no diversification effects between the main risk modules:

$$MCR_3 = MCR_{Mkt} + MCR_{cred} + MCR_{life} + MCR_{health} + MCR_{nl}$$

7.19 The placeholder capital charge for the MCR is given by the results of applying the correlation matrix, so that:

$$MCR = MCR_1$$

MCR_{mkt} market risk component

7.20 The capital charges for the sub-risks should be combined using a correlation matrix as follows:

$$MCR_{mkt} = \sqrt{\sum_{r \times c} CorrMMkt^{r \times c} \bullet MMkt_r \bullet MMkt_c}$$

where

MCR_{mkt} = the placeholder capital charge for market risk

$CorrMMkt^{rxc}$ = the cells of the correlation matrix *CorrMMkt*

$MMkt_r$, $MMkt_c$ = capital charges for individual market sub-risks according to the rows and columns of correlation matrix *CorrMMkt*

and the correlation matrix *CorrMMkt* is defined as:

CorrMMkt=	$MMkt_{int}$	$MMkt_{eq}$	$MMkt_{prop}$	$MMkt_{fx}$
$MMkt_{int}$	1			
$MMkt_{eq}$	0.75	1		
$MMkt_{prop}$	0.75	1	1	
$MMkt_{fx}$	0.25	0.25	0.25	1

7.21 For interest rate risk ($MMkt_{int}$), the MCR uses the factor-based approach under the SCR (Mkt_{int1}). However, a different shock is applied, so that

Maturity t (years)	1-3	3-6	6-12	12-18	18+
relative change $s^{up}(t)$	0.3	0.25	0.2	0.15	0.15
relative change $s^{down}(t)$	-0.25	-0.20	-0.15	-0.1	-0.1

additionally, the following approximation (see section 5) should be used in all cases:

$$D_C^{gen}(r,s) \approx r_b \bullet s_b \bullet D_C^{\mathrm{mod}}$$

7.22 The MCR charges for equity, property and currency risk are each calculated by applying a fixed factor to the 'simple' treatments used under section 5:

$$MMkt_{eq} = 0.5 \bullet Mkt_{eq1}$$

$$MMkt_{prop} = 0.5 \bullet Mkt_{prop1}$$

$$MMkt_{fx} = 0.5 \bullet Mkt_{fx1}$$

MCR_{cred} credit risk component

7.23 The ratings-based approach under section 5 should be used with application of a fixed factor, so that:

$$MCR_{cred} = 0.5 \bullet SCR_{cred1}$$

MCR_{life} life underwriting risk component

7.24 The MCR charge for life underwriting risk is given by applying a fixed factor to the 'simple' treatment used under section 5:

$$MCR_{life-bio} = 0.5 \bullet Life_{bio1}$$

$$MCR_{life-lapse} = 0.5 \bullet Life_{lapse1}$$

$$MCR_{life-\exp} = 0.5 \bullet Life_{\exp 1}$$

7.25 The overall MCR charge MCR_{life} for life underwriting risk is calculated from the sub-risk charges in the same way as in the SCR.

MCR_{health} health underwriting risk component

7.26 The MCR charge for health underwriting risk is given by applying a fixed factor to the 'simple' treatment used under section 5:

$$MCR_{health} = 0.5 \bullet SCR_{health}$$

MCR_{nl} non-life underwriting risk component

7.27 The calculation should follow the same structure as the SCR calculation, except for the following changes.

7.28 In each of the LOBs, the estimate P_{lob} of the net earned premium in the forthcoming year should be determined as the previous year's net earned premiums (cf. section 5).

7.29 In the premium and reserve sub-risk modules, the function $\rho(x)$ should be re-specified as

$$\rho(x) = \frac{1 - \Phi\left(N_{0.9} - \sqrt{\log(x^2 + 1)}\right)}{0.1}$$

where

Φ	=	cumulative distribution function of the standard normal distribution
$N_{0.9}$	=	90% quantile of the standard normal distribution

7.30 In the CAT sub-risk module, the market loss parameter referred to in section 5 should generally be consistent with a TailVaR risk measure calibrated to a confidence level of 90%.