

Nematrian Website Pages on Solvency II

[Nematrian website page: [SolvencyIIIntro](#), © Nematrian 2015]

Solvency II (also known as 'Solvency 2') is a new regulatory framework for EU insurers coming into force on 1 January 2016. It derives from [Directive 2009/138/EC](#) ('Solvency II') as amended by [Directive 2014/51/EU](#) ('Omnibus II') [a recast version of the Solvency II as at Nov 2014 is available [here](#)]. It replaces 14 existing directives (commonly referred to as 'Solvency I'). According to the European Commission, it introduces a "modern, harmonised framework for the taking-up of business and supervision of insurance and reinsurance undertakings in the Union". It is a maximum harmonising regime, with three pillars:

Pillar 1: Harmonised valuation and risk-based capital requirements

Pillar 2: Harmonised governance and risk management requirements

Pillar 3: Harmonised supervisory reporting and public disclosure

A high-level overview of the broad structure of the Solvency II regulatory framework is available [here](#).

Solvency II introduces a new Solvency Capital Requirement ('SCR') and a new Minimum Capital Requirement ('MCR') which insurers will need to satisfy if they are not to be subject to regulatory intervention. Insurers who believe that the 'standard formula' SCR is inappropriate for them can seek authorisation from the regulator to use an 'internal model' instead of the standard formula.

Solvency II also introduces a wide range of additional governance requirements (e.g. the requirement for an Own Risk and Solvency Assessment or 'ORSA'). Guidance on many of these requirements has been issued by EIOPA (the EU-wide grouping of insurance regulators).

Nematrian has provided consultancy services to insurers to help them implement Solvency II and to asset managers to help them help their insurance company clients, see [case studies](#). The Nematrian function library contains some tools that can help insurers with their planning, see [Nematrian Solvency II Tools](#). If you are looking for further help then please [contact us](#).

Throughout these pages, DA refers to the EU Commission Delegated Regulation, see [here](#), which is based on 76 empowerments in the Solvency II Directive.

Version dated 7 December 2015

Functions in the Nematrian Function Library relevant to Solvency II

[\[SolvencyIITools\]](#)

The Nematrian [function library](#) includes some online tools that can help insurers implement Solvency II more effectively.

Solvency II involves an overhaul in how EU insurers are regulated and a significant increase in the sophistication of regulatory capital computations. The regulators have sought to consult extensively with the industry, to minimise the likelihood that the resulting regulatory frameworks fail to pass the test of time. This consultation process has in some cases resulted in parameters used within the proposed regulatory capital computations changing over time, particularly some parameters used within the computation of the 'standard formula' SCR.

The Nematrian online tools bear this in mind and also bear in mind the possibility that some parameters may change after Solvency II goes live. For example [DA](#) Recital 150 indicates that:

“In order to ensure that the standard formula continues to meet the requirements set out in paragraphs 2 and 3 of Article 101 of Directive 2009/138/EC on an ongoing basis, the Commission will review the methods, assumptions and standard parameters used when calculating the Solvency Capital Requirement with the standard formula, in particular the methods, assumptions and standard parameters used in the market risk module as set out in Title I Chapter V Section 6, including a review of the standard parameters for fixed-income securities and long-term infrastructure, the standard parameters for premium and reserve risk set out in Annex II, the standard parameters for mortality risk, as well as the subset of standard parameters that may be replaced by undertaking-specific parameters referred to in Article 218 and the standardised methods to calculate these parameters referred to in Article 220. This review should make use of the experience gained by insurance and insurance undertakings during the transitional period and the first years of application of these delegated acts, and be performed before December 2018.”

[Note, at the time of writing a change has already been proposed in relation to some types of infrastructure investments]

Some of the Nematrian tools provide online access to factors relevant to the computation of standard formula SCR stress tests. As the factors have changed during the consultation process (and may change further in the future) many of these tools include a parameter *StressName* which allows historic factors to be identified as well as current ones. Please refer to the EIOPA website and those of any national regulator to which your company is subject before drawing any conclusions based on results derived from using any Nematrian online tools. In particular, please update your analyses to reflect any changes in guidance or practice since those available via the online tools.

Solvency II aims to be ‘market consistent’. This, in the main, means that it aims to value assets and liabilities using market valuations on markets that are deep, liquid and transparent. Where these are not available, then if possible the valuations are based on assumptions consistent with currently observable market prices of comparable instruments that are traded on such markets. For further background on this term, see [Market Consistency](#). The standard formula SCR is, in the main, calculated by stressing the insurer’s balance sheet away from these ‘market consistent’ assumptions in a way that aims to cater for 1 in 200 year events.

Please bear in mind that if you use any of the Nematrian online tools and services then you will be deemed to have agreed to the Nematrian [License Agreement](#). In particular please note the limitations on Nematrian’s liability, if any, that apply because of this License Agreement if you make use of these tools.

Links to Nematrian webpages covering these standard formula SCR elements

- [Market risk](#)
- [Counterparty default risk](#)
- [Life underwriting risk](#)

- [Correlations](#) between the above (and with Heath and Non-Life risk)

The overall capital position of a EU insurer, using the standard formula SCR also depends on the magnitude of its technical (and other) provisions and of its available capital base. Part of the technical provisions in turn depend on the SCR (and how it is expected to evolve in the future) via the [Risk Margin](#).

Version dated 7 December 2015

Solvency II Standard Formula SCR: Market Risk Module

[Nematrian website page: [SolvencyII_Mkt](#), © Nematrian 2015]

At the time of writing, the Market Risk component of the [Solvency II](#) standard formula Solvency Capital Requirement involved the application of stresses in the following areas, combined using a correlation-based approach as follows, see [DA](#) Articles 164 - 188.

Links to Nematrian webpages covering these standard formula SCR elements

- [Interest rate risk](#)
- [Equity risk](#)
- [Currency risk](#)
- [Property risk](#)
- [Spread risk](#)
- [Concentration risk](#)

- [Correlations](#)

Version dated 7 December 2015

Interest Rate Risk Sub-module

[[SolvencyII_MktInt](#)]

According to the Solvency II [Delegated Act](#) Articles 165 - 167, the market interest rate risk component of the standard formula SCR is to be calculated by reference to the largest balance sheet change arising from 1 of 2 scenarios, one involving interest rate rising in a specified way and one involving interest rates falling in a specified way, subject to a minimum of zero.

The proposed *intUp* and *intDn* shocks have changed during the consultation process and are term dependent, see:

- [MnSolvencyII_SCRSFTermStructureStressFactors](#) (returns an array of stress factors varying by term, as well as the terms to which each factor applies)
- [MnSolvencyII_SCRSFTermStructureStressedRate](#) (applies the stress factor applicable to a given term, and includes any minima and maxima involved).

Stress Set Names recognised by the website are given in [MnSolvencyII_SCRSFStressSetNames](#).

Part way through the consultation period it was proposed that there should also be stresses applied to interest rate volatility but these were not carried through to the final Solvency II [Delegated Act](#).

Version dated 7 December 2015

Equity Risk Sub-module

[[SolvencyII_MktEquity](#)]

The equity risk sub-module of the market risk module of the standard formula SCR has evolved significantly through time. Currently it is specified in the Solvency II [Delegated Act](#) Articles 168 – 173 and has the following features:

- (a) Equities are split between Type 1 equities and Type 2 equities. Loosely speaking Type 1 equities refer to equities listed in regulated markets in developed economies whilst Type 2 equities consist of equities listed in other countries (or other assets treated as within the scope of the equity risk sub-module). Contributions from the two different types are combined using a correlation based approach;
- (b) In the main, the stress applied to Type 1 equities is a market decline of 39% plus or minus a symmetric adjustment as specified in [DA](#) Article 172 and in Article 106 of the [Solvency II Directive \(2009\)](#), see below. For Type 2 equities the corresponding decline is 49% plus or minus the symmetric adjustment. However, for some equities a lower 22% decline is applicable;
- (c) A lower (22%) transitional equity stress applies in the first few years of Solvency II for some equities, and was introduced by the [Omnibus II Directive](#)

Symmetric adjustment

The symmetric adjustment is specified in [DA](#) Article 172 and is referred to in Article 106 of the [Solvency II Directive \(2009\)](#). It depends on the current level of a specified index compared to its weighted average level of the last 36 months, subject to a lower limit of -10% and an upper limit of +10%. The adjustment at any given time is published by EIOPA.

Equity volatility stress

Equity market implied volatility can be important for some types of insurance contract. CEIOPS (EIOPA's predecessor) proposed including such a stress but this was not carried through to the final [Delegated Act](#).

Version dated 7 December 2015

Currency Risk Sub-module

[\[SolvencyII_MktCurrency\]](#)

The currency sub-module of the market risk is specified in [DA](#) Article 188. In most instances it involves an instantaneous adverse currency move of 25% although there are exceptions for currencies that are deemed to be pegged to each other.

Version dated 7 December 2015

Property Risk Sub-module

[\[SolvencyII_MktProperty\]](#)

This sub-module is covered in [DA](#) Article 174 and involves an instantaneous market value decline of 25%.

Spread Risk Sub-module

[\[SolvencyII_MktSpread\]](#)

This sub-module is covered in [DA](#) Articles 175 - 181 and covers:

- bonds and loans
- securitisation positions
- credit derivatives, such as credit default swaps, total return swaps and credit linked notes

For bonds and loans, the computation depends on a combination of the duration and the credit quality assigned to the bond, see [DA](#) Article 176.

For securitisations, the computation is split between Type 1 and Type 2 securitisations (Type 1 securitisations generally being ones that meet specified criteria including ones relating to credit quality, listing, documentation etc. and Type 2 being all others). Exactly how securitisations should be split between these two types and what contribution to capital requirements that they then generate is set out in [DA](#) Articles 177 and 178.

The computation for credit derivatives is set out in [DA](#) Article 179.

Overrides are applied to some specific types of spread-sensitive asset such as covered bonds and bonds or loans to central governments, see [DA](#) Article 180.

The spread risk component went through several iterations during the Solvency II consultation process and set out below are some of the elements of these iterations.

QIS4 (Quantitative Impact Study 4)

In QIS4 it involved the following, according to CP70:

Capital charge calculated by multiplying the market value of the bond or structured credit product bond with its modified duration and a function F (for bonds) or G (for structured credit products) based on rating class of bond or structured credit product, the modified duration being subject to a floor and sometimes a cap as follows:

Rating class	F(rating)	G(rating)	Duration floor	Duration cap for corporate bonds	Duration cap for structured credit products
AAA	0.25%	2.13%	1	-	-
AA	0.25%	2.55%	1	-	-
A	1.03%	2.91%	1	-	-
BBB	1.25%	4.11%	1	-	-
BB	3.39%	8.42%	1	8	5
B	5.60%	13.35%	1	6	4
CCC or lower	11.20%	29.71%	1	4	2.5
Unrated	2.00%	100.00%	1	4	1

For credit derivatives, the QIS4 capital charge was determined as the change in the value of the derivative (i.e. as the decrease in the asset or increase in the liability) that would occur following whichever was the more onerous of a widening of credit spreads by 300% or a narrowing by 75%.

CP70

CP70 proposed a change to this which involved factors dependent on rating and maturity buckets as follows (no longer then multiplied by the duration):

F(rating, maturity)	AAA	AA	A	BBB	BB or lower	Unrated
0-2.9 years	3.4%	4.5%	6.8%	7.7%	14.0%	8.0%
3-4.9 years	5.4%	7.1%	11.5%	14.6%	27.0%	15.0%
5-6.9 years	7.9%	10.3%	16.5%	20.1%	38.5%	21.5%
7-9.9 years	8.5%	13.5%	21.5%	25.9%	49.0%	27.5%
10+ years	11.5%	19.1%	24.0%	27.5%	52.0%	30.0%

G(rating, tenure)	AAA	AA	A	BBB	BB	B	CCC or lower
0-1.9 years	0.8%	1.9%	4.3%	7.8%	19.8%	41.1%	64.7%
2-3.9 years	1.6%	3.1%	8.1%	15.9%	34.5%	59.7%	82.9%
4-5.9 years	2.3%	5.4%	11.6%	22.1%	43.4%	67.8%	88.4%
6-7.9 years	3.5%	7.4%	14.3%	27.5%	50.8%	73.6%	90.3%
8+ years	4.7%	9.7%	17.4%	32.9%	56.6%	76.7%	91.9%

Recovery rates were taken into account (for structured credit) using a function R as follows, overlaid on which was a methodology to capture the impact of the waterfall structure of the product (the attachment and detachment points of the relevant tranche):

R(rating)	AAA	AA	A	BBB	BB	B	CCC or lower
Recovery rate	50%	45%	40%	35%	30%	25%	20%

When calculating the spread charge for structured products, a cap of 100% and a floor of 10% of market value was also applied.

For credit derivatives, the CP70 capital charge was determined as the change in the value of the derivative (i.e. as the decrease in the asset or increase in the liability) that would occur following whichever was the more onerous of a widening of credit spreads by 600% or a narrowing by 75%.

CEIOPS (2010)

In its finalised Level 2 advice, CEIOPS reverted to a somewhat simpler approach for corporate bonds more akin to that used in QIS4 (in which the stress involved a factor multiplied by the modified duration), but now involving both up and down movements:

F	F(up,rating)	F(down,rating)	Duration floor	Duration cap
AAA	1.0%	-0.4%	1	-
AA	1.5%	-1.0%	1	-

A	2.6%	-1.7%	1	-
BBB	4.5%	-3.0%	1	-
BB	8.4%	-6.3%	1	8
B or lower	16.2%	-8.6%	1	6
Unrated	5.0%	-3.3%	1	4

G and R were adjusted to include, amongst other elements, an unrated bucket, with similar but not identical calibrations used for G:

G(rating, tenure)	AAA	AA	A	BBB	BB	B	CCC or lower	Unrated
0-1.9 years	0.8%	1.6%	4.7%	8.1%	20.9%	41.5%	65.9%	9.7%
2-3.9 years	1.6%	3.1%	8.1%	14.7%	34.1%	59.7%	83.3%	17.6%
4-5.9 years	2.3%	5.4%	10.9%	20.2%	43.0%	68.2%	88.4%	24.2%
6-7.9 years	3.5%	7.4%	14.0%	25.2%	50.4%	73.3%	90.7%	30.2%
8+ years	4.7%	9.7%	17.1%	30.2%	56.2%	77.1%	91.9%	36.2%

R(rating)	AAA	AA	A	BBB	BB	B	CCC or lower	Unrated
Recovery rate	50%	45%	40%	35%	30%	25%	20%	35%

If the originator of the structured credit product did not comply with the 5% net retention foreseen in the CRD (Directive 2006/48/EC) then it was proposed that the capital charge for the product be set to 100% regardless of the seniority of the position.

For credit derivatives, including credit default swaps (CDS), total return swaps (TRS) and credit linked notes (CLN), it was proposed that the charge be determined (if the (re)insurance undertaking did not hold underlying instruments with immaterial basis risk or where the credit derivative is not part of the undertaking's risk mitigation policy) as the change in the value of the derivative (i.e. as the decrease in the asset or increase in the liability) that would occur following whichever was the more onerous of a widening of credit spreads by 600% or a narrowing by 75%

A somewhat different approach was mandated for exposures secured by real estate (i.e. 'property' in UK English parlance), see sections 3.206 onwards of [CEIOPS \(2010\)](#).

Solvency II Delegated Act

Further changes were made to some of these formulae in the [Delegated Act](#). Readers are advised to refer to it for further details.

Version dated 7 December 2015

Concentration Risk Sub-module

[\[SolvencyII_MktConcentration\]](#)

The computation for this sub-module is specified in [DA](#) Articles 182 – 187 and loosely speaking involves the following approach:

- (a) Calculate E_i = exposure at default to counterparty i

- (b) Calculate *Assets*= amount of total assets to which concentration risk sub-module applies
- (c) Determine *rating_i* = credit quality step applied to counterparty *i*
- (d) Calculate ‘excess’ exposure to that counterparty, *XS_i*, using the following formula, where the specified concentration threshold, *CT_i*, varies according to the credit quality step:

$$XS_i = \max(0, E_i - CT_i \cdot Assets)$$

- (e) Calculate risk concentration charge, per name as follows, where *g_i* is rating dependent as below:

$$Conc_i = Assets_{xl} * XS_i * g_i + \Delta Liab_{future\ profits}$$

- (f) Calculate the overall capital requirement as:

$$SCR_{conc} = \sqrt{\sum_i Conc_i^2}$$

Some overrides apply to specified types of assets, see [DA](#) Article 187.

The approach went through a significant number of iterations as Solvency II developed, much like the [spread risk](#) sub-module.

For example in [CEIOPS \(2010\)](#) the approach proposed involved:

$$Conc_i = Assets_{xl} * XS_i * g_i + \Delta Liab_{future\ profits}$$

Here *CT* and *g_i* were:

Rating	CT	g*
AAA, AA	3%	0.12
A	3%	0.21
BBB	1.5%	0.27
BB or lower, or unrated	1.5%	0.73

Similar but not identical parameters were used for QIS4. The ones finally adopted in the [Delegated Act](#) are similar to those shown above, except that they refer to credit quality steps rather than credit ratings.

In the above, $\Delta Liab_{future\ profits}$ (called $\Delta Liab_{ul}$ in CP47 Final Advice) was the impact on the undertaking’s liabilities (for policies where the policyholders bear the investment risk) of a change in the value of the assets of the issuer attracting a concentration risk charge by $XS_i * g_i$ (subject to a minimum of nil).

Aggregate exposures across different names were then to be combined assuming a correlation of 0.25 between names, so:

$$Mkt_{conc_financial} = \sqrt{\sum_i Conc_i^2 + \sum_{i,j,i \neq j} 0.25 * Conc_i * Conc_j}$$

However, by the time the [Delegated Act](#) was adopted, the correlation between (unrelated) names had in effect been reduced to zero.

Version dated 7 December 2015

Market Risk Module – Correlations

[\[SolvencyII MktCorrelations\]](#)

In the standard formula SCR computation individual sub-component capital charges (or individual component charges) are typically aggregated using a correlation coefficient based approach. This involves calculating the overall charge using a formula along the lines, where $Charge_i$ is the capital charge for a given component element:

$$Aggregated\ charge = \sqrt{\sum_{i,j} \rho_{i,j} Charge_i Charge_j}$$

In the case of the market risk module, the correlations proposed changed as the consultation process developed. For example, the Level 2 guidance from CEIOPS (EIOPA's predecessor) introduced different correlations between interest rate risk and some of the other subcomponents included in the market risk module depending on whether the interest rate risk that applied involved a fall in interest rates or a rise in interest rates. The justification was that there was stronger support for a positive correlation (with falls in equity values, falls in property values or spread movements) in the case of falling interest rates than in the case of rising interest rates. This approach has been retained in the correlations specified in [DA](#) Article 164.

The Nematrian website makes available the following tools to help manipulate these correlations:

- (a) [MnSolvencyII_SCRSFStressSetNames](#). Indicates acceptable stress set names (e.g. "DA" for the correlations contained in the [Delegated Act](#)).
- (b) [MnSolvencyII_SCRSFMktStressNames](#). Indicates acceptable stress names for a given *StressSetName*. For DA this includes an 'interest rate (down)' and an 'interest rate (up)' rather than merely 'interest rate'.
- (c) [MnSolvencyII_SCRSFMktCorrs](#). Provides an array containing the correlation matrix. If there are n different stress names then is an array with n^2 terms, ordered consistently with the ordering of the stress names given in (b).
- (d) [MnSolvencyII_SCRSFCombineStresses](#). Combines different stresses using the correlation matrix and stress names as above. Works for other sub-modules as well as the market risk module. For e.g. DA one or other of the 'interest rate (down)' and 'interest rate (up)' stresses needs to be zero.

Version dated 7 December 2015

Solvency II Standard Formula SCR: Counterparty Default Risk Module

[Nematrian website page: [SolvencyII_Counterparty](#), © Nematrian 2015]

The counterparty default risk component of the [Solvency II](#) standard formula Solvency Capital Requirement (SCR) covers the following risk exposures, see in the Solvency II [Delegated Act](#):

- Risk-mitigating contracts, such as reinsurance arrangements, securitisations and derivatives;
- Receivables from intermediaries; and
- Any other credit exposures which are not covered in the market risk [spread risk sub-module](#) including e.g. (this list does not aim to be exhaustive):
 - Policyholder debtors
 - Cash at bank
 - Deposits with ceding institutions
 - Capital, initial funds, letters of credit (and any other called up but unpaid commitments)
 - Guarantees, letters of credit, letters of comfort etc. provided by the undertaking as well as any other commitments which the undertaking has provided and which depend on the credit standing of a counterparty

Credit risk transferred via credit derivatives is typically covered by the [spread risk sub-module](#) rather than this module.

The methodologies proposed involved subdividing these exposures between two classes. [Type 1](#) aims to cover exposures primarily of the sort that might well not be diversified and where the counterparty is likely to be rated (e.g. reinsurance arrangements), whilst [Type 2](#) aims to cover exposures primarily of the sort that are usually diversified and where the counterparty is likely to be unrated (e.g. receivables from intermediaries or policyholder debtors).

Links to Nematrian webpages covering these standard formula SCR elements

- [Counterparty risk for Type 1 exposures](#)
- [Counterparty risk for Type 2 exposures](#)
- [Counterparty loss-given-default assumptions](#)

- [Correlations](#)

Version dated 7 December 2015

Counterparty Default Risk Module – Type 1 Risk

[[SolvencyII_CounterpartyType1](#)]

The final Solvency II [Delegated Act](#), like the earlier CEIOPS Level 2 guidance, subdivides counterparty exposures into two types. Type 1 aims to cover exposures primarily of the sort that might well not be diversified and where the counterparty is likely to be rated (e.g. reinsurance arrangements). It involves a formula along the following lines:

$$SCR_{def,1} = \min \left(\sum_i LGD_i, q\sqrt{V} \right)$$

where:

LGD_i = loss-given-default for type 1 exposure of counterparty i

$q = 3$ or 5 depending on how big $\sigma = \sqrt{V}$ is in relation to $\sum_i LGD_i$ (based on the earlier CEIOPS Level 2 guidance the 3 seems to assume a lognormal distribution)

V = deemed variance of the loss distribution of the type 1 exposures, calculated as below

V is in effect calculated as follows (although the formulae specified in the [Delegated Act](#) less clearly brings this out than the formulae in the earlier CEIOPS Level 2 guidance), subdividing exposures by rating class, where j and k run through each rating class and u_{jk} , v_j and w_j are parameters which depend on rating classes.

$$V = \sum_j \sum_k u_{jk} y_j y_k + \sum_j v_j z_j - \left(\sum_j w_j y_j \right)^2$$

where the y_j and z_j are to be calculated summing over all independent counterparties i in rating class j :

$$y_j = \sum_i LGD_i$$

$$z_j = \sum_i (LGD_i)^2$$

As with the [Type 2](#) exposures, the impact of possible recoveries should be taken into account when assessing exposures, see e.g. [loss-given-default adjustments](#).

7 December 2015

Counterparty Default Risk Module – Type 2 Risks

[\[SolvencyII CounterpartyType2\]](#)

The final Solvency II [Delegated Act](#) subdivides counterparty exposures into two types. Type 2 aims to cover exposures primarily of the sort which are usually diversified and where the counterparty is likely to be unrated (e.g. receivables from intermediaries or policyholder debtors). It involves a formula along the following lines:

$$SCR_{def,2} = x \cdot E + y \cdot E_{past-due}$$

where:

x = risk factor for type 2 exposures

E = sum of the values of type 2 exposures, except for receivables from intermediaries which have been due for more than T months

y = risk factor for past-due receivables from intermediaries

$E_{past-due}$ = sum of values of receivables from intermediaries which have been due for more than T months

As with the [Type 1](#) exposures, the impact of possible recoveries should be taken into account when assessing exposures, see [loss-given-default adjustments](#).

Version dated 7 December 2015

Counterparty Default Risk Module – Loss Given Default

[\[SolvencyII CounterpartyLGD\]](#)

The final Solvency II [Delegated Act](#) includes an adjustment to counterparty exposures to reflect the partial recovery that often arises when a counterparty defaults. The precise adjustment mandated by the Delegated Act is reasonably complicated and readers are advised to refer to the [Delegated Act](#) for more details. The original [CEIOPS \(2009\)](#) advice indicated that the adjustment should:

- Approximate loss given default, weighted by probability of default
- Take account of possible default events during the whole run-off period of the recoverable
- Be based on current, reliable and credible information, sources for which might include credit spreads, rating judgements, information on the supervisory solvency assessment, financial reporting etc.
- Where possible use point-in-time estimates
- Take account of the fact that cumulative probability typically increases with time horizon of assessment
- Reflect the impact of risk mitigating instruments as well as any other risk connected with them
- Be calculated separately for each business line and counterparty, to help with identification of risk concentrations
- If no reliable estimate of recovery rate is available then the adjustment should be no higher than 50%.

Version dated 7 December 2015

Counterparty Default Risk Module – Correlations

[\[SolvencyII CounterpartyCorrelations\]](#)

The final Solvency II [Delegated Act](#) includes the following diversification computation when aggregating [Type 1](#) and [Type 2](#) exposures to derive the overall capital requirement for counterparty default risk, SCR_{def} :

$$SCR_{def} = \sqrt{SCR_{def,1}^2 + 2 \times 0.75 \cdot SCR_{def,1}SCR_{def,2} + SCR_{def,2}^2}$$

This formula is effectively the same as proposed in [CEIOPS \(2010\)](#).

Version dated 7 December 2015

Solvency II Standard Formula SCR: Life Underwriting Risk Module

[Nematrian website page: [SolvencyII_Life](#), © Nematrian 2015]

At the time of writing, the Life Underwriting Risk component of the [Solvency II](#) standard formula Solvency Capital Requirement involved the application of stresses in the following areas, combined using a correlation-based approach.

Links to Nematrian webpages covering these standard formula SCR elements

- [Mortality risk](#)
- [Longevity risk](#)
- [Disability-morbidity risk](#)
- [Life expense risk](#)
- [Revision risk](#)
- [Lapse risk](#)
- [Life catastrophe risk](#)

- [Correlations](#)

Version dated 7 December 2015

Mortality Risk Sub-module

[\[SolvencyII_LifeMortality\]](#)

In Solvency II [Delegated Act](#) this is based on the impact of applying a permanent increase in mortality rates of 15% for policies where this would increase technical provisions without the risk margin (grouping together all policies in respect of the same insured person).

Some of the earliest iterations of the standard formula used a different factor, e.g. QIS4 used 10%.

Version dated 7 December 2015

Longevity Risk Sub-module

[\[SolvencyII_LifeLongevity\]](#)

In Solvency II [Delegated Act](#) this is based on the impact of applying a permanent improvement in mortality rates of 20% for policies where this would increase technical provisions without the risk margin. Earlier iterations of the standard formula had a different improvement factor.

Version dated 7 December 2015

Disability-Morbidity Risk Sub-module

[\[SolvencyII_LifeDisability\]](#)

The standard formula SCR set out in the Solvency II [Delegated Act](#) involves a capital requirement for morbidity/disability risk that is based on the change in net asset value (assets minus liabilities) arising from the combination of:

- (a) An increase of $x_1\%$ in morbidity/disability inception rates for the first year followed by an increase of $x_2\%$ for all subsequent years;
- (b) A permanent decrease of $y\%$ in morbidity/disability recovery rates.

The calibrations used (which differ from those used in QIS4 and those set out in earlier proposed Level 2 guidance) are:

$$\begin{aligned}x_1 &= 35 \\x_2 &= 25 \\y &= 20\end{aligned}$$

Version dated 7 December 2015

Expense Risk Sub-module

[\[SolvencyII LifeExpense\]](#)

The stress originally recommended by CEIOPS and finally adopted in the Solvency II [Delegated Act](#) (see Article 140) involves:

- An increase in 10% in the amount of expenses included in the technical provisions; and
- An increase of 1 percentage point to the future expense inflation rate

Version dated 7 December 2015

Revision Risk Sub-module

[\[SolvencyII LifeRevision\]](#)

According to original CEIOPS guidance, 'revision risk' is intended to capture the risk of adverse variation of an annuity's amount, as a result of an unanticipated revision of the claims process. CEIOPS (EIOPA's predecessor) envisaged that this risk would only be applied to:

- Annuities arising from non-life claims (including accident insurance, but excluding workers compensation) where the amount of the annuity may be revised during the year; and
- Benefits that can be approximated by a life annuity arising from non-life claims (including accident insurance, but excluding workers compensation) where the amount of the annuity may be revised during the next year).

The calibration in the final Solvency II [Delegated Act](#) does not appear to have changed since early iterations of the SCR (e.g. QIS4). It involves calculating the capital charge assuming an increase in 3% in the annual amount payable for annuities exposed to revision risk.

Version dated 7 December 2015

Lapse Risk Sub-module

[\[SolvencyII LifeLapse\]](#)

Whilst some shortcomings were identified in the approach proposed in QIS4 in the subsequent consultation process, no practical way of improving on the basic approach proposed there was identified. The approach finally adopted in the Solvency II [Delegated Act](#) remains based on the maximum of three stresses:

- A permanent increase of lapse rates
- A permanent decrease of lapse rates; and
- A mass lapse event

The stresses are:

Lapse down

Reduction of 50% in option exercise rates (suitably defined) for all policies for which exercise of option would increase technical provisions without the risk margin. Shock not to change the rate to which the reduction is apply to by more than 20 percentage points in absolute terms.

Lapse up

Increase of 50% in assumed option take-up rates in all future years for which exercise of option would increase technical provisions without the risk margin. The shocked rate should not exceed 100%.

Mass Lapse

Discontinuance of 70% of non-retail policies (suitably defined) and 40% of retail policies (suitably defined) for which discontinuance would result in an increase technical provisions without the risk margin. The corresponding percentages were different in earlier iterations of the standard formula.

Version dated 7 December 2015

Catastrophe Risk Sub-module

[\[SolvencyII LifeCatastrophe\]](#)

[CEIOPS \(2010\)](#) perceived life catastrophe risk as stemming from extreme or irregular events whose effects are not sufficiently captured in the other life underwriting risk sub-modules. It cited as examples a pandemic event or a nuclear explosion.

The test it proposed involved an absolute 1.5 per mille increase in mortality rates over the following 12 months. This is in effect the same test as was finally adopted in the Solvency II [Delegated Act](#) although it is worded slightly differently there.

Version dated 7 December 2015

Life Underwriting Risk Module – Correlations

[[SolvencyII_MktConcentration](#)]

In the standard formula SCR computation individual sub-component capital charges (or individual component charges) are typically aggregated using a correlation coefficient based approach. This involves calculating the overall charge using a formula along the lines, where $Charge_i$ is the capital charge for a given component element:

$$Aggregated\ charge = \sqrt{\sum_{i,j} \rho_{i,j} Charge_i Charge_j}$$

In the case of the life risk module, the correlations proposed have changed as the consultation process has developed, with different ones proposed in QIS4, CP74 and in the final Level 2 guidance developed in response to feedback on CP74. The ones eventually implemented in the Solvency II [Delegated Act](#) appear in effect to be the same as those in CP74, but reordered.

The Nematrian website makes available the following tools to help manipulate these correlations:

- (a) [MnSolvencyII_SCRSFStressSetNames](#). Indicates acceptable stress set names (e.g. “DA” for the correlations contained in the [Delegated Act](#)).
- (b) [MnSolvencyII_SCRSFLifeStressNames](#). Indicates acceptable stress names for a given *StressSetName*, e.g. ‘mortality’ and ‘longevity’.
- (c) [MnSolvencyII_SCRSFLifeCorrs](#). Provides an array containing the correlation matrix. If there are n different stress names then is an array with n^2 terms, ordered consistently with the ordering of the stress names given in (b).
- (d) [MnSolvencyII_SCRSFCombineStresses](#). Combines different stresses using the correlation matrix and stress names as above. Works for other sub-modules as well as the life risk module.

Version dated 7 December 2015

Solvency II Standard Formula SCR: Correlations

[Nematrian website page: [SolvencyII_Correlations](#), © Nematrian 2015]

In the standard formula SCR computation individual sub-component capital charges (or individual component charges) are typically aggregated using a correlation coefficient based approach. This involves calculating the overall charge using a formula along the lines, where $Charge_i$ is the capital charge for a given component element:

$$Aggregated\ charge = \sqrt{\sum_{i,j} \rho_{i,j} Charge_i Charge_j}$$

The correlations proposed changed as the consultation process developed, with different ones proposed in QIS4, [CP74](#), in the final Level 2 guidance developed in response to feedback on CP74 and in the final Solvency II [Delegated Act](#).

The Nematrian website makes available the following tools to help manipulate these correlations:

- (a) [MnSolvencyII_SCRSFStressSetNames](#). Indicates acceptable stress set names (e.g. “DA” for the correlations contained in the final Solvency II [Delegated Act](#)).
- (b) [MnSolvencyII_SCRSFOverallStressNames](#). Indicates acceptable stress names for a given *StressSetName*, e.g. ‘market’ and ‘life’.
- (c) [MnSolvencyII_SCRSFOverallCorrs](#). Provides an array containing the correlation matrix. If there are n different stress names then is an array with n^2 terms, ordered consistently with the ordering of the stress names given in (b).
- (d) [MnSolvencyII_SCRSFCombineStresses](#). Combines different stresses using the correlation matrix and stress names as above. Works for sub-modules as well as the overall computation of the ‘Basic’ SCR.

Version dated 7 December 2015

Solvency II Risk Margin

[Nematrian website page: [SolvencyII_RiskMargin](#), © Nematrian 2015]

The [Solvency II Directive](#) (as recast) (Article 77) indicates that the *“value of technical provisions shall be equal to the sum of a best estimate and a risk margin”*.

The Directive indicates that the *“best estimate shall correspond to the probability-weighted average of future cash-flows, taking account of the time value of money (expected present value of future cash-flows), using the relevant risk-free interest rate term structure”*.

The Directive also indicates that the *“risk margin shall be such as to ensure that the value of the technical provisions is equivalent to the amount that insurance and reinsurance undertakings would be expected to require in order to take over and meet the reinsurance and reinsurance obligations”*.

If the future cash flows associated with the reinsurance obligations can be replicated reliably using financial instruments for which a reliable market value is observable then Article 77.4 indicates that the value of technical provisions shall be determined on the basis of the market value of those financial instruments. This might, for example, apply to unit liabilities of funds invested in readily marketable investments.

However, where this is not possible, the best estimate and risk margin need to be calculated separately, and Article 77.5 indicates that *“the risk margin shall be calculated by determining the cost of providing an amount of eligible own funds equal to the solvency Capital Requirement necessary to support the insurance and reinsurance obligations over the lifetime thereof”*. This article also mandates that the rate used for this purpose (the ‘Cost-of-Capital rate’) shall be the same for all insurance and reinsurance undertakings and shall be reviewed periodically.

A higher Cost-of-Capital rate increases the size of the risk margin and the size of the overall technical provisions. It therefore reduces the calculated solvency position of the undertaking. Not surprisingly, the choice of Cost-of-Capital rate has thus been the subject of discussions between the regulators and the industry, but so far it has remained unchanged at 6% pa, see [DA](#) Article 39.

Version dated 7 December 2015