SST standard model for reinsurance captives (StandCap)

Model description

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I. General information

Unless otherwise stated in this model description, the *Wegleitung für die Erarbeitung des SST-Berichtes*\(^1\) is valid for reinsurance captives when preparing the SST report.

This graph illustrates the various companies involved in a reinsurance captive agreement:

From a risk perspective, common reinsurance captives differ from standard reinsurance companies as follows:

- Reinsurance contracts are usually known by the reinsurance captive at the beginning of the year.
- There is a strong connection between the reinsurance captive and its parent (industrial conglomerate); detailed information about the ground losses are available to the reinsurance captive.
- Participation in a cash pool is likely for a reinsurance captive.

Generally, the SST standard model for reinsurance captives (StandCap) is based on the technical concept of the SST standard model for Swiss general insurers described in the *Technical document on the Swiss Solvency Test*. This document has, however, been adapted to deal with the different risk situation of common reinsurance captives. Owing to the special risk situation of reinsurance captives and their parent companies, which are the only insured parties, StandCap has been kept as simple as possible.

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\(^{1}\) Documents cited in this model description are available at [www.finma.ch > Supervision > Insurers > Cross-sectoral tools > Swiss Solvency Test (SST)].
I.1 Limitations of StandCap

StandCap is based on a number of assumptions that expose limitations when using the model. Apart from the specific limitations described in the corresponding sections, the following general limitations also hold:

I.1.1 Independence of market and insurance risks

StandCap assumes that market risks and insurance risks are independent. However, special combinations of assets and reinsured risks may violate this assumption, for instance:

- Nat cat portfolios and cat bonds.
- Reinsurance of credit insurance business and assets in corresponding areas.

I.1.2 Reinsured life risks

StandCap is not suitable for reinsured life risks.

I.2 Changes to the SST 2016

Compared to the SST 2016, modelling of insurance risk has been adjusted to take into account the currency of each line of business (see section III.2.2.1).

The conditions under which the market risk model can be used have been stated using a quantitative requirement (see section V.2.3.2). In addition, market risk from insurance liabilities is automatically entered in the Excel template and does not need to be computed by the company itself.

The model for the market value margin has been adjusted to consistently take into account the development of the current year and prior year business.

I.3 Short introduction to the SST concept and the captive model

I.3.1 Solvency

This section provides a short technical introduction to the SST.

In accordance with the Insurance Supervision Ordinance (ISO; SR 961.011), Article 47 para. 1, the risk-bearing capital ("RBC") has to cover the target capital ("TC").

The RBC is by definition (see Arts. 47-49 ISO) the core capital plus additional capital, where the core capital can be roughly defined as the market-consistent value of assets minus the discounted best estimate of insurance liabilities. More information about determining RBC can be found in the Tech-
In accordance with Article 41 para.1 ISO, the TC is the amount of the risk-bearing capital $RBC_0$ that has to be available at the beginning of the year such that the expected shortfall of the risk-bearing capital $RBC_1$ at the end of the year is greater than or equal to the market value margin (MVM), where the latter is the cost of capital of the risk-bearing capital needed for the run-off of the insurance liabilities after the end of the year. Currently, the threshold $\alpha$, which must be used for the computation of the expected shortfall, is set to $\alpha = 1\%$.

Change in RBC over one year $\Delta RBC$ is given by:

$$\Delta RBC = RBC_1 - RBC_0$$

Following the calculations set out in the Technical document on the Swiss Solvency Test, the TC is calculated by:

$$TC = -ES_\alpha(\Delta RBC) + MVM,$$

(1)

Up to a linearization error, the change in risk bearing capital $\Delta RBC$ can be split into:

$$\Delta RBC = -X^C - X^M - X^I - X^S + e^M + e^I,$$

(2)

where

- $-X^C$ is the change in RBC caused by credit risks (CR);
- $-X^M$ is the change in RBC caused by market risks (MR);
- $-X^I$ is the change in RBC caused by insurance risks (IR);
- $-X^S$ is the change in RBC caused by risks not modelled in the CR, MR or IR;
- $e^M$ is the expected financial result and
- $e^I$ is the expected technical result.

The insurance risk $X^I$ can be decomposed further into current year risk $X^{CY}$ and previous year risk $X^{PY}$, i.e. $X^I = X^{CY} + X^{PY}$.

I.3.2 Currency

StandCap distinguishes between two currencies:
• The currency used for SST computations (StandCap currency).
• The currency used in the SST template to report monetary amounts (reporting currency).

The StandCap currency is specified by an implicit relation defined in section V.2.3.2. Section III.2.2.1 explains the link between the currency in which payments are made and the StandCap currency.

The reporting currency has no impact on the solvency calculation since it is only used for reporting purposes. The reporting currency is either CHF, EUR, USD or JPY.

I.3.3 Credit risk

In StandCap, the influence of credit risk on changes in RBC is estimated by a simplified version of the Basel III approach (see section II; Excel sheet Credit risk). Alternatively, the more sophisticated Basel III approach to the SST standard model for Swiss general insurers may be used.

I.3.4 Market risk

The influence of market risk on changes in RBC is considered without the expected financial result $e^M$. Mathematically, this means $E(X^M) = 0$. In StandCap, $X^M$ is modelled by a simplified version of the delta-normal model of the SST standard model for Swiss general insurers (see section V; Excel sheet Market risk). Alternatively, the full delta-normal model may be used. Moreover, if Swiss francs are not the functional currency for the SST, or if there is material risk stemming from derivatives, the full delta-normal model has to be used.

I.3.5 Current year insurance risk

As for market risk, the influence of CY insurance risk on changes in RBC is considered without the expected technical result $e^I$. The description of how $X^{CY}$ is modelled within StandCap is detailed in section III (Excel sheet CY_Insurance risk). Alternatively, an adaptation of the SST standard model for Swiss general insurers may be used.

I.3.6 Previous year insurance risk

Since claim reserves are on a best estimate basis, the previous year (PY) insurance risk $X^{PY}$ already is a centred random variable. Therefore, no expected result for the PY insurance risk must be considered. In StandCap, $X^{PY}$ is modelled by a simplified version of the SST standard model for Swiss general insurers (see section IV; Excel sheet PY_Insurance risk). Alternatively, an adapted version of the SST standard model for Swiss general insurers may be used.

I.3.7 Scenarios

Risks not modelled previously are considered within the random variable $X^S$, which is modelled by a scenario approach (see section VI; Excel sheet Scenarios).
I.3.8 Market-value margin

For the MVM, StandCap uses a simplified version of the SST standard model for Swiss general insurers (see section VII; Excel sheet Payment pattern and MVM). Alternatively, an adaptation of the SST standard model for Swiss general insurers may be used.

I.3.9 Aggregation

For the aggregation of the individual risk components, StandCap assumes that the random variables $X^{CY}$ and $X^{PY}$ are comonotonic and that $X^I$, $X^M$ and $X^S$ are independent random variables. Finally, the credit risk is assumed to be comonotonic to the sum $X^I + X^M + X^S$. For more details, see section IX (Excel sheet Target capital).

If both $X^{CY}$ and $X^{PY}$ are modelled by an adapted version of the SST standard model for Swiss general insurers, the corresponding aggregation within this standard model may be used instead of the assumption of comonotonicity.

I.4 General remarks on using the Excel template

The following colour convention is used in the template, except for the Fundamental_Data sheet:

- Values which have to be provided or computed by the company;
- Values which are computed automatically in the template;
- Values entered by FINMA for illustration purposes.

The template consists of the following Excel sheets:

- Model description provides the model description on the SST standard model for reinsurance captives, including information about completing the Excel template.
- Change log lists the changes in the template.

Model used contains the following switches which define the model used:

- Simplified credit risk module for reinsurance captives has been used:
  Yes, if the simplified credit risk module has been used (see section III; Excel sheet Credit risk), the credit risk is calculated in the Excel sheet Credit risk.
  No, if the Basel III approach has been used, the credit risk is calculated in the Excel sheets Credit_Risk (Basel III) and Credit_Risk_Info (Basel III).
- Simplified market risk module for reinsurance captives has been used:
  Yes, if the simplified market risk module has been used (see section V; Excel sheet Market risk), the market risk is calculated in the Market risk Excel sheet.
No, if the delta-normal model has been used, the market risk is calculated in the Sensitivitäten Delta_Market and Market_Risk (Delta Normal) Excel sheets.

- Simplified CY insurance risk module for reinsurance captives has been used:
  Yes, if the CY insurance risk module defined in section III (Excel sheet CY_Insurance risk) has been used.
  No, if an adapted version of the SST standard model for Swiss general insurers has been used. This switch has no effect on the calculations in the Excel template.

- Simplified PY insurance risk module for reinsurance captives has been used:
  Yes, if the PY insurance risk module defined in section IV (Excel sheet PY_Insurance risk) has been used.
  No, if an adapted version of the SST standard model for Swiss general insurers has been used. This switch has no effect on the calculations in the Excel template.

- Simplified aggregation of PY insurance risk has been used:
  Yes, if the PY insurance risk has been aggregated as a constant; see section IX (Excel sheet Target capital).
  No, if the PY insurance risk has been stochastically modelled with the aggregation of CY insurance risk and market risk.
  This switch has no effect on the calculations in the Excel template.

Claims history contains information about the number of normal claims used to estimate the corresponding claim frequency and information about large claims.

Fundamental_Data: provides a standardized overview of SST key figures; see Wegleitung für die Erarbeitung des SST-Berichtes. Figures marked with NA are optional for reinsurance captives.

Credit risk contains the simplified credit risk module for reinsurance captives; see section II.

Market risk contains the simplified market risk module for reinsurance captives; see section V.

CY_insurance risk contains information about the CY insurance risk; see section III.

PY_insurance risk contains the PY insurance risk module for reinsurance captives; see section IV.

Technical result contains the calculation of the expected technical result; see section VIII.2.

Payment pattern and MVM contains the payment pattern for CY and PY reserves used to calculate discount factors. Moreover, the simplified MVM module for reinsurance captives is implemented in this sheet; see section □.

Scenarios contains information about various scenarios and their aggregation; see section VI.

Target capital contains the aggregation of risk modules to compute target capital; see section IX.
Credit_Risk (Basel III) and Credit_Risk_Info (Basel III): These sheets contain the Basel III approach to credit risk; see Wegleitung für die Erarbeitung des SST-Berichtes and Wegleitung zum SST-Kreditrisiko-Standardmodell.

Sensitivitäten Delta_Market and Market_Risk (Delta Normal): These sheets contain the Basel III approach to credit risk; see Wegleitung für die Erarbeitung des SST-Berichtes and Wegleitung zum SST-Marktrisiko-Standardmodell.

II. Credit risk

StandCap uses a simplified version of the Basel III approach. Alternatively, the more sophisticated Basel III approach to the SST standard model for Swiss general insurers may be used.

II.1 Limitations

The simplified version can only be used if the credit risk situation is not too complex.

II.2 Model description

The credit risk $X^C$ model is based on a simplification of the Basel III approach. Therefore, $X^C$ is modelled as a deterministic random variable whose value is obtained by a factor model. This model is based on eight categories grouped into two groups:

- Exposure other than retrocession
  - Total of positions rated > "A"
  - Total of positions rated "BBB" … "A"
  - Total of positions rated < "BBB"
  - Total of unrated positions

- Receivables from retrocession
  - Total of positions rated > "A"
  - Total of positions rated "BBB" … "A"
  - Total of positions rated < "BBB"
  - Total of unrated positions

Total exposure to each category has to be computed. Then the value of the credit risk $X^C$ is defined as a weighted sum of the exposures, where the weights are predefined by FINMA.
II.3 Implementation in the Excel template

To determine which balance sheet positions carry credit risk, see Wegleitung zum SST-Kreditrisiko-Standardmodell.

The simplified credit risk module for reinsurance captives is implemented in the Credit risk Excel sheet.

Where the Basel III approach is used, the calculations are made in the Credit_Risk (Basel III) Excel sheet, whereas the Credit_Risk_Info (Basel III) Excel sheet defines the rating classes. For detailed information, see Wegleitung zum SST-Kreditrisiko-Standardmodell and Wegleitung für die Erarbeitung des SST-Berichtes.

II.3.1 Credit risk Excel sheet

- Credit risk calculation block:
  - Exposure column: total credit risk exposure for each category.
  - Comments column: comments on special terms may be stated.
- Counterparty concentration risks block:
  - Exposure column: volume of the corresponding counterparty risk concentration. For concentration risk with volume within the range of 10% to 25% of the RBC, the total of all such concentration risks should be entered, whereas for concentration risks greater than 25% of the RBC, each standalone concentration risk has to be provided.
  - Comments column: short comments about the concentration risk.

III. Current year insurance risk

StandCap for current year (CY) insurance risk is based on a stochastic model of the ground-up losses. These losses must be simulated, and the contract conditions and the retrocession structure has to be applied to each simulation. This leads to an empirical distribution of the losses borne by the reinsurance captives which can be used to calculate the corresponding expected shortfall.

A computation gross of retrocession may also be used, in which case the expected technical result must also be computed on a gross basis.

III.1 Limitations

The model has some limitations, for which some work arounds are presented in section X.1.
III.1.1 Detailed claims data

In general, StandCap assumes that data for each individual claim are obtainable. Such data are evident for large claims. Regarding normal claims, observations of the number of claims and the aggregate claims amount per accident year may be enough; see section X.1.1 for details.

III.1.2 Independence of claims

Independence of all claims is a general assumption of StandCap. This assumption may be violated by

- special insured risks such as nat cat;
- too many portfolios or too many claims per year and per portfolio.

For detailed information, see section X.1.2.

III.1.3 Dissociation of coverage periods

StandCap assumes that all claims can be modelled ground-up on an accident-year basis. Moreover, it is assumed that the coverage period of the underlying insurance contracts (coverage on an accident-year base) coincides with a single calendar year. If this is not the case, conservative adjustments may be acceptable; see section X.1.3.

III.2 Model description

III.2.1 Insurance cash flows

The balance sheet at time 1 contains all active reinsurance contracts underwritten up to time 1, together with the corresponding passive reinsurance contracts.

Active and passive reinsurance contracts generate cash flows. Typically, a claim will induce an outgoing cash flow from the active reinsurance and an ingoing cash flow from the passive reinsurance. As a simplification, we consider only the net cash flows. This means that we assume that for each cash flow stemming from the active reinsurance, the corresponding cash flow from the passive reinsurance will occur at the same time.

The net insurance cash flow occurring at time t is denoted by \( Y_t \) and has a positive sign. As a simplification, the cash flows are assumed to occur only at year end. This means that we consider the vector \( \langle Y_1, Y_2, ... \rangle \) of cash flows, occurring at time \( t = 1, 2, ... \).

\(^2\) Depending on the cover, any or both cash flows may be equal to zero.
III.2.1.1 Coverage period

Each contract has a coverage period, which is split into the earned and unearned part:

- coverage period up to time 0 ("earned part")
- coverage period after time 0 ("unearned part").

Each loss payment corresponds either to the earned part or the unearned part of some contract. This induces the following decomposition of the cash-flows:

\[ Y_t = Y_t^{PF} + Y_t^{CY} \]

The following terminology is used for the cash flows:

- \( Y_t^{CY} \) are the losses stemming from the unearned part ("current year loss")
- \( Y_t^{PF} \) are the losses from the earned part ("previous year loss").

III.2.1.2 Outstanding losses

As a convention, we assume that the insurance losses are paid shortly after time 1. Thus, the outstanding current year losses at time 1 are given by

\[ Y^{CY} = \sum_{t=1}^{\infty} Y_t^{CY} \]

III.2.1.3 Line of business

The model assumes that each reinsurance contract belongs to a line of business ("current year LOB"). By abuse of notation, we will use the term LOB instead of "current year LOB".

The current year losses \( Y_t^{CY} \) can be split accordingly:

\[ Y_t^{CY} = \sum_{\ell \in \text{LOB}} Y_{t,\ell}^{CY} \]

III.2.2 Current year insurance risk for one LOB

We consider the insurance risk of a given LOB \( \ell \). By abuse of notation, dependence with respect to \( \ell \) will be omitted.
III.2.2.1 Currency consideration

The losses \( Y_t^{CV} \) (in StandCap currency) will be paid in a given currency ("payment currency"). The payment currency depends on the LOB and is either CHF, EUR, USD or JPY. The exchange rate fluctuation between the payment currency and the StandCap currency impacts the losses \( Y_t^{CV} \).

To model the insurance risk accurately, the exchange rate fluctuation needs to be removed from \( Y_t^{CV} \). This is done by defining the random variable \( \tilde{Y}_t^{CV} \) through the following relation

\[
\tilde{Y}_t^{CV} = \frac{E_t}{E_t} \cdot Y_t^{CV},
\]

where \( E_t \) denotes the exchange rate between the payment currency and the StandCap currency at time \( t \).

The outstanding losses \( \tilde{Y}^{CV} \) at time 1 is defined correspondingly by

\[
\tilde{Y}^{CV} = \sum_{t=1}^{\infty} \tilde{Y}_t^{CV}
\]

III.2.2.2 Valuation of liabilities

To derive the best estimate of the insurance liability, we define \( r_t^{(s)} \) as the interest rate for risk-free zero-coupon bond for the StandCap currency with maturity \( t \) seen from time \( s \). Similarly, the interest rate for the payment currency is denoted by \( \tilde{r}_t^{(s)} \).

The best estimate of the insurance liability \( L_t^{CV} \) at time 1 is given by:

\[
L_1^{CV} = \sum_{t=1}^{\infty} \mathbb{E}(Y_t^{CV} | \mathcal{F}_1) \frac{1}{(1 + r_t^{(1)})^{t-1}}
\]

We obtain the following expression via the interest rate parity:

\[
L_t^{CV} = \frac{E_t}{E_0} \sum_{t=1}^{\infty} \mathbb{E}(\tilde{Y}_t^{CV} | \mathcal{F}_1) \frac{1}{(1 + \tilde{r}_t^{(1)})^{t-1}}
\]

III.2.2.3 Stochastic discount factor

We define the current year payment pattern seen from time 1 in the payment currency by

\[
\alpha_t = \frac{\mathbb{E}(\tilde{Y}_t^{CV} | \mathcal{F}_1)}{\mathbb{E}(\tilde{Y}^{CV} | \mathcal{F}_1)}
\]
As an approximation, we assume that the payment patterns remain the same as those seen from time 0, that is:

\[ \alpha_t = \frac{\mathbb{E}(\hat{f}^{CV}_t)}{\mathbb{E}(\hat{Y}^{CV})} \]

The discount factor \( D^{CV} \) for the current year losses is given by the following expression, which only depends on market risk drivers:

\[ D^{CV} = \frac{E_1}{E_0} \sum_{t=1}^{\infty} \frac{\alpha_t}{(1 + \hat{r}_t^{(0)})^{t-1}} \]

To simplify the notation, it is useful to consider the expected discount factor \( d^{CV} = \mathbb{E}(D^{CV}) \), which is approximated by

\[ d^{CV} = \sum_{t=1}^{\infty} \frac{\alpha_t}{(1 + \hat{r}_t^{(0)})^t} \]

III.2.2.4 Current year insurance risk

Using the discount factor, the liabilities are then given by the following product:

\[ L^{CV}_1 = \mathbb{E}(\hat{Y}^{CV} | F_1) \cdot D^{CV} \]

The first factor depends only on insurance risk drivers and the second one only on market risk drivers. Assuming the independency between these two risk drivers, the linearization formula\(^3\) yields

\[ L^{CV}_1 = \left( \mathbb{E}(\hat{Y}^{CV} | F_1) - \mathbb{E}(\hat{Y}^{CV}) \right) d^{CV} + \mathbb{E}(\hat{Y}^{CV})(D^{CV} - d^{CV}) + \mathbb{E}(L^{CV}_1). \]

The first term is the insurance risk \( X^{CV}_t \) for the LOB \( \ell \), that is:

\[ \left( \mathbb{E}(\hat{Y}^{CV} | F_1) - \mathbb{E}(\hat{Y}^{CV}) \right) d^{CV} \]

As a simplification, the current year insurance risk is modelled to ultimate, that is:

\[ X^{CV}_t = \left( \hat{Y}^{CV} - \mathbb{E}(\hat{Y}^{CV}) \right) d^{CV} \]

\(^3\) For \( X, Y \) the following linearization is used \( XY = \mathbb{E}(X)(Y - \mathbb{E}(Y)) + \mathbb{E}(Y)(X - \mathbb{E}(X)) + \mathbb{E}(X)\mathbb{E}(Y) \).
III.2.3 Current year insurance risk

The current year insurance risk $X^{CY}$ is given by summing up the insurance risk of all LOB:

$$X^{CY} = \sum_{\ell \in \text{LOB}} X^{CY}_\ell$$

The LOB is assumed to be independent, meaning that the random variables $X^{CY}_\ell$ are mutually independent.

III.3 Model parametrisation

When modelling the CY insurance risk $X^{CY}$, the first step is to split the CY portfolio into homogeneous parts, which are called lines of business or LOBs. StandCap differs depending on the following two types of LOBs:

- LOBs for which individual claims can be modelled from ground-up; see section III.3.1.
- LOBs for which the corresponding insurance risk is modelled conservatively based on a maximal possible loss; see section III.3.2.

In general, the parameters used to derive the insurance risk $X^{CY}_\ell$ for each LOB $\ell$ will depend on the $\ell$; however, to enhance readability, no additional indices are used.

III.3.1 Ground-up modelling

Here the CY insurance risk $X^{CY}_\ell$ of a LOB $\ell$ is modelled based on the ground-up losses of the mother company.

The ground-up losses consist of losses corresponding to normal claims and those corresponding to large claims, both modelled by a frequency-severity approach:

- Normal claims are assumed to have a Poisson-distributed frequency $N^n$ and a Gamma-distributed severity $Y^n$.
- Large claims are assumed to have a Poisson-distributed frequency $N^l$ and a Pareto-distributed severity $Y^l$.
- All random variables $N^n, Y^n_1, Y^n_2, ..., N^l, Y^l_1, Y^l_2, ...$ are independent.

The undiscounted net losses $\bar{Y}^{CY}$ of the reinsurance captive are obtained by applying the reinsurance and retrocession structures to the ground-up losses using simulations. These structures can be modelled by an aggregation function (see appendix X.2 for examples) $f: \mathbb{R}^n \rightarrow \mathbb{R}$ with

$$\bar{Y}^{CY} = f(N^n, Y^n_1, Y^n_2, ..., N^l, Y^l_1, Y^l_2, ...).$$

Finally, the insurance risk $X^{CY}_\ell$ is obtained by
\[ X_{\ell}^{CY} = \left( \bar{Y}^{CY} - \mathbb{E}(\bar{Y}^{CY}) \right) d^{CY}, \]

where \( d^{CY} \) is the discount factor for the LOB \( \ell \).

StandCap for CY insurance risk is based on the following parameters which must be estimated:

- frequency of normal claims \( \mathbb{E}(N^n) \) and of large claims \( \mathbb{E}(N^l) \);
- the mean \( \mathbb{E}(Y^n_i) \) and standard deviation \( sd(Y^n_i) \) of normal claims;
- the large loss threshold \( x_0 \) and the Pareto shape \( \alpha \) of the large losses.

The parameters can be estimated in the following way:

- The frequency \( \mathbb{E}(N^n) \) of normal claims is given by the average number of historical normal claims frequencies. The same applies mutatis mutandis to the large claims frequency \( \mathbb{E}(N^l) \).
- The expected normal claim severity \( \mathbb{E}(Y^n_i) \) is given by the average of historical normal claims. The corresponding standard deviation \( sd(Y^n_i) \) is obtained in a similar way.
- The large loss threshold \( x_0 \) and Pareto shape \( \alpha \) must be obtained based on data and using actuarial expert judgement.

Historical data used for the estimation of parameters must be adjusted such that they are comparable over time. For instance, incurred losses should be adjusted according to the corresponding inflation.

### III.3.2 Maximal possible loss modelling

For a given LOB \( \ell \) with maximal possible loss \( M \), it is assumed that the loss amount \( M \) is almost surely reached. As a simplification, no discounting effect is taken into account.

The insurance risk is given by the maximum possible loss \( M \) reduced by the expected loss \( L \) of the LOB:

\[ X_{\ell}^{CY} = M - L. \]

### III.4 Implementation in the Excel template

The template for the CY insurance risk is split into two Excel sheets. The sheet Clalms history is for recording Normal claims and Large claims for information purposes only. The CY_Insurance risk sheet shows SST calculations for LOBs modelled from ground-up and evaluated by the reinsurance captive, for instance by simulations.
III.4.1  **Claims history Excel sheet**

- **Normal claims**
  - Column *Name of LOB*: name of the LOB. Generally, this coincides with the list of LOB in the *CY_Insurance risk* Excel sheet.
  - Column *Main geographic regions*: most relevant geographic region.
  - Column *Observation period*: observation period of claim numbers.
  - Columns *Years*: number of normal claims made during the corresponding calendar year.
  - Column *Chosen frequency*: frequency selected for the ground-up model.

- **Large claims**
  - Column *Date*: occurrence date of the large loss.
  - Column *Name of LOB*: name of the LOB.
  - Columns *Incurred amount, Paid amount*: total incurred loss and total paid amount up to the SST date.
  - Column *Geographical region*: region where the loss occurred.
  - Column *Comments*: additional information about the large loss may be provided here.

III.4.2  **CY_Insurance risk Excel sheet**

- **CY insurance risk** block:
  - Row *CY insurance risk from the ground-up model*: total CY insurance risk of all LOBs modelled from ground-up.

- **LOB description** block:
  - Column *Name of LOB*: name of the LOB.
  - Column *Currency*: Currency in which payments are made for this LOB (nonetheless amounts are reported in reporting currency within the template).
  - Column *Type of LOB*: which modelling approach has been used, ground-up or maximum possible loss.
  - *Comments* column: for comments on the insured risks of the LOB.
  - Columns *Aggregation function (gross and net)*: a short description of the aggregation function together with a reference to a detailed description including formula in the SST Report.
  - Column *Comments about the aggregation method*: Comments on the aggregation function, for instance on the retrocession structure.

- **Parameters** block:
- Column *Maximum possible loss*: the maximum possible loss $M$ (for maximum possible loss model only).
- Column *Expected loss*: the expected loss $L$ (for maximum possible loss model only).
- Column *Normal claims frequency*: expected number of normal claims $\mathbb{E}(N^n)$ (for ground-up model only).
- Column *Normal claims mean*: expected normal claim severity $\mathbb{E}(Y^n_i)$ (for ground-up model only).
- Column *Normal claims standard deviation*: standard deviation of normal claim severity $sd(Y^n_i)$ (for ground-up model only).
- Column *Large claims frequency*: expected number of large claims $\mathbb{E}(N^l)$ (for ground-up model only).
- Column *Large claims threshold*: threshold $x_0$ for large claims (for ground-up model only).
- Column *Large claims Pareto shape*: Pareto shape $\alpha$ for large claims (for ground-up model only).
- Column *Additional parameters*: additional parameters for the aggregation function should be provided here, for example annual aggregate limits and each and every loss limits. Column labels should be adapted accordingly.

**IV. Previous year insurance risk**

StandCap for PY insurance risk is a conservative simplification of the SST standard model for Swiss general insurers. Alternatively, an adapted version of the SST standard model for Swiss general insurers could be used; see section 4.4 of the Technical document on the Swiss Solvency Test, Wegleitung für die Erarbeitung des SST-Berichtes, as well as the corresponding Excel template for the SST standard model for Swiss general insurers.

In general, the PY insurance risk is computed net of retrocession. However, a more conservative gross of retrocession modelling is allowed.

**IV.1 Limitations**

The PY insurance risk does not dominate the target capital.

**IV.2 Model description**

**IV.2.1 Line of business**

The previous year insurance risk is modelled with a granularity of line of business ("prior year LOB"). The granularity of the prior year LOB may differ from the granularity of the current year LOB.
When no confusion is possible, we will only speak of “LOB”.

The previous year losses $Y_{t}^{PV}$ can be split accordingly:

$$Y_{t}^{PV} = \sum_{\ell \in \text{LOB}} Y_{t,\ell}^{PV}$$

IV.2.2 Previous year insurance risk of one LOB

We provide the expression of the previous year insurance risk $X_{t}^{PV}$ for a given LOB $\ell$. By abuse of notation, we will drop the index $\ell$.

Similarly to section III.2.2 we obtain the following payment pattern in the payment currency:

$$\beta_{t} = \frac{\mathbb{E}(\tilde{Y}_{t}^{PV})}{\mathbb{E}(\tilde{Y}^{PV})}$$

This induces the discount factor

$$d^{PV} = \sum_{t=1}^{\infty} \frac{\beta_{t}}{(1 + r^{(0)} t)^{t}}$$

The prior year insurance risk $X_{t}^{PV}$ is modelled on a one-year view; it satisfies

$$X_{t}^{PV} = \left(\mathbb{E}(\tilde{Y}^{PV}|\mathcal{F}_{t}) - \mathbb{E}(\tilde{Y}^{PV})\right) d^{PV}$$

The random variable $\mathbb{E}(\tilde{Y}^{PV}|\mathcal{F}_{t})$ of the given LOB is modelled by a log-normal distribution with mean $\mathbb{E}(\tilde{Y}^{PV})$. Since the mean is prescribed, the log-normal distribution is entirely specified by its coefficient of variation $CV$.

IV.2.3 Previous year insurance risk

The previous year insurance risk $X^{PV}$ is given by summing the insurance risk of all LOB:

$$X^{PV} = \sum_{\ell \in \text{LOB}} X_{t,\ell}^{PV}$$

The LOBs are assumed to be comonotonic. This implies the following relation:

$$-ES_a(-X^{PV}) = \sum_{\ell \in \text{LOB}} -ES_a(-X_{t,\ell}^{PV}).$$
IV.3 Model parametrisation

By abuse of notation, we again drop the dependency of the LOB \( \ell \).
Each LOB is parameterized by a coefficient of variation \( CV \). For each LOB, two approaches are possible.

IV.3.1 Default value

The default value for the \( CV \) is set to 10\%. This approximately corresponds to

\[
-ES_a(-X^{PY}) \approx 0.3 \cdot R,
\]

where \( R = \mathbb{E}(\tilde{Y}^{PY})d^{PY} \) is the discounted reserves.

IV.3.2 Estimation by the company

Alternatively, \( CV \) can be estimated by the Merz-Wüthrich approach; see Modelling The Claims Development Result For Solvency Purposes\(^4\), or its generalisation for Linear Stochastic Reserving Methods\(^5\). In both alternative cases, an additional model uncertainty of 5\% must be used, i.e.

\[
CV = \sqrt{(CV_{estimated})^2 + 0.05^2}.
\]

IV.4 Implementation in the Excel template

IV.4.1 Excel sheet PY_Insurance risk

- Column Name of LOB: name of the LOB.
- Column Currency: Currency in which payments are made for this LOB (nonetheless amounts are reported in reporting currency within the template).

- Columns Gross and Net undiscounted reserves: gross and net undiscounted reserves.
- Column Coefficient of variation: coefficient of variation \( CV_\ell \) of the reserves. The default value of 10\% may be overwritten by company-specific estimated coefficient of variation, in which case a model uncertainty must be included (only relevant if the simplified PY insurance risk module for reinsurance captives has been used).

\(^4\) https://www.casact.org/pubs/forum/08fforum/21Merz_Wuetrich.pdf
\(^5\) http://sourceforge.net/projects/lsrmtools/files/LSRM.pdf/download
V. Market risk

StandCap uses a simplified approach to model market risk. Alternatively, the delta-normal model of the SST standard model for Swiss general insurers may be used; see Wegleitung zum SST-Marktrisiko-Standardmodell.

The simplified approach for the market risk model is based on the delta-normal, where the number of risk factors is reduced. Furthermore, the volatility parameters and correlation matrix are predefined by FINMA.

V.1 Limitations

The market risk model can only be used in the case of a simple investment structure. In particular, this means that

- risks related to derivatives are not material;
- the condition related to foreign exchange risk as stated in section V.2.3.2 is satisfied.

V.2 Model description

V.2.1 Exposure to market risk drivers

The risk bearing capital at year end \( RBC_1 \) is decomposed into

\[
RBC_1 = A_1 - L_1^I - L_1^N
\]

where:

- \( A_1 \) is the market value of the assets
- \( L_1^I = L_1^{CY} + L_1^{PY} \) is the best estimate of the insurance liabilities at time 1, decomposed in liabilities from losses unearned at time 0 (CY) and losses earned at time 0 (PY).
- \( L_1^N \) is the market value of non-insurance liabilities

Please note that we have assumed that without loss of generality the loss payment \( Y_1 \) is made shortly after time 1 (see section III.2.1). This implies that at time 1, the assets \( A_1 \) have not been reduced by the loss payment \( Y_1 \).

The model requires that the assets \( A_1 \) and the non-insurance liabilities \( L_1^N \) have only exposure with respect to market risk drivers. Under this requirement, the exposure \( X \) to market risk drivers is given by

\[
X = A_1 - (\mathbb{E}(Y^{CY})D^{CY} - \mathbb{E}(Y^{PY})D^{PY}) - L_1^N.
\]
The market risk $X^M$ is the deviation from the expected exposure:

$$X^M = X - \mathbb{E}(X).$$

### V.2.2 Market risk

The state of the market risk drivers at the end of the year is represented by the vector $Z = (Z_1, \ldots, Z_n)$ ("risk factors"). The risk factors are assumed to be centered, that is $\mathbb{E}(Z) = 0$, where $0 = (0, \ldots, 0)$.

The exposure $X$ is assumed to depend on the risk factors $Z$ through a functional dependency. This means that the following relation holds for some $f: \mathbb{R}^n \to \mathbb{R}$

$$X = f(Z).$$

Under the approximation $\mathbb{E}(X) = f(0)$, we can apply a Taylor development around $0$. This provides the following expression for the market risk:

$$X^M = f(Z) - f(0) = \delta \cdot Z$$

The vector $\delta = (\delta_1, \ldots, \delta_n)$ is given by $\delta = \nabla f(0)$ and represents the sensitivity of the RBC with respect to each risk factor.

Each risk driver belongs to one of the following risk category:

- Interest rate risk
- Shares risk
- Exchange rate risk
- Participation risk

As we will see in section V.2.3.2, the exchange rate risk is not taken into account in the market risk model for captives.

The following instruments are modelled:

- Cash
  - Cash
- Fixed-maturity instruments
  - Instruments with maturity at time $(0,1]$  
  - Instruments with maturity at time $(1,2]$ 
  - Instruments with maturity at time $(2,4]$ 
  - Instruments with maturity at time $(4,6]$ 
  - Instruments with maturity at time strictly larger than 6
V.2.3 Exchange rate considerations

V.2.3.1 Change of currency

Consider a currency basket whose exchange rate between the StandCap currency and the currency basket at time \( t \) is denoted by \( E_t \). We require that \( E_0 = 1 \) and use the approximation \( \mathbb{E}(E_1) = E_0 \).

When the RBC is expressed in the currency basket, the one-year change in RBC is given by

\[
\Delta \tilde{RBC} = RBC_1 E_1 - RBC_0 E_0
\]

From the linearization formula, we obtain the following decomposition of \( \Delta \tilde{RBC} \)

\[
\Delta \tilde{RBC} = -X^C - \tilde{X}^M - X^l - X^S + e^M + e^I
\]

where the market risk component \( \tilde{X}^M \) is given by \( \tilde{X}^M = X^M + \mathbb{E}(X)(E_1 - 1) \).

This implies that changing the StandCap currency has no impact on the risk modules from (2) except for the market risk.

V.2.3.2 Foreign exchange risk

Denote by \( I \subset \{1, \ldots, n\} \) the set of indices corresponding to FX risk factors.

Define the vector \( \delta^I = (\delta^I_1, \ldots, \delta^I_n) \) is by

\[
\delta^I_i = \begin{cases} \delta_i & i \in I \\ 0 & \text{otherwise} \end{cases}
\]

This provides the following decomposition of the sensitivities \( \delta \) with respect to the foreign exchange risk and the remaining risk factors:

\[
\delta = \delta^I + (\delta - \delta^I)
\]
The market risk is decomposed accordingly into the foreign exchange risk and the remaining market risk components:

\[ X^M = \delta^I \cdot Z + (\delta - \delta^I) \cdot Z \]

Assume that the following conditions are satisfied:

- \( \delta_i \geq 0 \) for each \( i \in I \)
- \( \sum_{i \in I} \delta_i \leq \mathbb{E}(X) \)

In order to check whether these conditions are satisfied, the company is to use the following approximation; check that this is satisfied for the balance sheet at time 0, whereby each liability can be covered by an asset with the same currency.

In this case, we consider the currency basket which is given at time 0 by:

- a proportion \( \frac{\delta_i}{\mathbb{E}(X)} \) of the \( i \)-th currency for each \( i \in I \)
- a proportion \( 1 - \frac{\sum_{i \in I} \delta_i}{\mathbb{E}(X)} \) of the StandCap currency.

By construction of the currency basket, a Taylor approximation provides the following expression:

\[ \mathbb{E}(X)(E_1 - 1) = -\delta^I \cdot Z \]

Using this currency basket, the market risk \( \tilde{X}^M \) satisfies \( \tilde{X}^M = (\delta - \delta^I) \cdot Z \), which implies that no exposure to foreign exchange risk will remain.

In StandCap, this currency basket is used as the StandCap currency, thus the foreign exchange risk is not taken into account.

### V.2.4 Market risk decomposition

The market risk is split into the following components:

- market risk from the assets;
- market risk from the non-insurance liabilities;
- market risk from the insurance liabilities.

The consideration of each component is described below.

#### V.2.4.1 Market risk of the assets

The market risk of the assets is given by \( A_1 - \mathbb{E}(A_1) \).
The assets consist of cash, fixed maturity instruments, shares and other assets.

At time 0 the assets $A_0$ are split into two categories:

- invested assets;
- non-invested assets and cash-equivalent.

The following assumptions are made concerning the investment strategy over the year:

- The asset allocation of the invested assets remains unchanged during the year, meaning that no portfolio rebalancing occurs.
- The premium received during the year are invested in cash and belong to the category non-invested assets and cash-equivalent.

The invested assets seen from time 1 consist of the same financial instruments as when seen from time 0, up to the bonds. When seen from time 1, the maturity of the bonds will appear one year shorter. Accordingly, a one-year bond (seen from time 0) will consist of cash at time 1.

Since non-invested assets bear no market risk, the market risk only stems from the invested assets. Furthermore, the asset allocation of the invested assets at time 1 is the same as that at time 0. Thus, the market risk of the assets is derived from the asset allocation at time 0.

V.2.4.2 Market risk of the non-insurance liabilities

The market risk of the non-insurance liabilities is given by $L_1^N - \mathbb{E}(L_0^N)$.

Non-insurance liabilities are replicated by cash and fixed-maturity instruments.

At time 0, the non-insurance liabilities are split into:

- non-insurance liabilities replicated by fixed-maturity instruments;
- non-insurance liabilities replicated by cash.

Mutatis mutandis, the replication of non-insurance liabilities satisfy the same conditions as the assets. By a similar argument, the market risk of the insurance liabilities is derived from the liability structure at time 0.

V.2.4.3 Market risk from the insurance liabilities

The market risk of the insurance liabilities is given by

$$\mathbb{E}(Y^{CY})(D^{CY} - d^{CY}) + \mathbb{E}(Y^{FY})(D^{FY} - d^{FY})$$
From the formulas for the discount factor in section III.2.2.3, the insurance liabilities are replicated by fixed-term instruments, using the payment pattern of the CY and PY losses.

V.3 Implementation in the Excel template

Each asset and non-insurance liability must be allocated to its financial instrument or split accordingly if necessary. The allocation provides a volume for each financial instrument, based on which the sensitivities are computed.

Note that the last instrument “other assets” is aggregated in the same way as the “participation” risk factor in the delta-normal model of the SST standard model for Swiss general insurers.

The market risk decomposition requires that:

- The sum of the asset exposure has to be equal to $A_0$
- The sum of the non-insurance liability exposure has to be equal to $L_0^N$

The split of the insurance liabilities is computed in Excel.

V.3.1 Market risk Excel sheet

- **Assets column**: market value of assets for each corresponding risk factor on an aggregate basis, except for **other assets**, which should be presented in more detail.
- **Liabilities column**: discounted best estimate of liabilities.

*Comments column*: comments on the allocation used; in particular, comments on **other assets**.

VI. Scenarios

A scenario approach is used to take into account risks which are not sufficiently modelled in other modules.

VI.1 Model description

Scenarios, indexed by $i = 1, \ldots, n$, are defined by events with occurrence probability $p_i$ and corresponding loss $c_i$, where $c_i < 0$ denotes a loss and $c_i > 0$ denotes a gain. In a given year, the model assumes that one scenario at the most can occur, thus the scenarios are mutually exclusive and $\sum_{i=1}^{n} p_i \leq 1$.

Denote by $I$ the random variable representing the index of the scenario (if any) occurring during a given year. This implies $\mathbb{P}(I = i) = p_i$. The total loss induced by scenarios is then given by the random variable $X^S$ defined by
\[ X^S = - \sum_{i=1}^{n} c_i \cdot 1_{\{i=i\}}. \]

For the time being, there are no mandatory scenarios that have to be aggregated to the target capital. Mathematically, this is achieved by setting \( p_i \) to zero for all scenarios. However, the impact \( c_i \) of the following scenarios must be computed:

- Pandemic; see *Wegleitung betreffend Szenarien und Stresstests im SST*, section III.4.2.
- Industrial accident; see *Wegleitung betreffend Szenarien und Stresstests im SST*, section III.3.5.
- Concentration scenarios:
  In line with FINMA practice, a counterparty represents a risk concentration whenever the market value of the corresponding positions exceed 25% of the RBC. For each counterparty subject to a risk concentration, a scenario must be defined. The loss \( c_i \) is given by 80% of the market value of the corresponding positions.

The company can define company-specific scenarios in order to model specific risks that are not appropriately captured by StandCap.

### VI.2 Implementation in the Excel template

**VI.2.1 Scenarios Excel sheet**

- Column *Occurrence probability*: occurrence probability of the scenario. This value is set to zero if a scenario has not to be aggregated.
- Column *Impact on the RBC*: change in RBC due to the occurrence of the scenario which is typically a negative value.

### VII. Market value margin

#### VII.1 Limitations

StandCap may not be applicable if in a run-off situation:

- market risks or credit risks are not negligible;
- the reserve portfolio is not stable over the time.
VII.2 Model description

To compute the market value margin (MVM), the model makes the assumption that the CY business is earned at time 1. This assumption means that for each contrast, the coverage period ends before or at time 1.

This assumption implies that the insurance risk for each future year \( T = 2,3, \ldots \) consists only of reserve risk.

In the sequel the random variables and the parameters will depend on a LOB \( \ell \). By abuse of notation, we will drop the index \( \ell \) when the meaning is clear from the context.

VII.2.1 MVM contribution from PY business

Consider a given LOB from the PY business. Using the same notations as section IV.2 and III.2, the outstanding losses at time \( T \) seen from time 0 are given by:

\[
\mathbb{E}(Y^{PY}) \sum_{t=T}^{\infty} \frac{\beta_t}{\left( 1 + \frac{\bar{r}_t^{(0)}}{\hat{E}} \right)^t}
\]

The insurance risk is modelled in the same way as for the previous year insurance risk, with the same coefficient of variation \( CV \).

VII.2.2 MVM contribution from CY business

Consider a LOB from the CY business. Similarly, the outstanding losses at time \( T \) seen from time 0 are given by

\[
\mathbb{E}(Y^{CY}) \sum_{t=T}^{\infty} \frac{\alpha_t}{\left( 1 + \frac{\bar{r}_t^{(0)}}{\hat{E}} \right)^t}
\]

By assumption, these outstanding losses refer to earned business for \( T = 2,3, \ldots \). The insurance risk related to this business is modelled as a previous year insurance risk.

The coefficient of variation for each LOB has to be specified. When a current year LOB corresponds to a previous year LOB, then the coefficient of variation from the previous year LOB can be used.
VII.3 Implementation in the Excel template

VII.3.1 Excel sheet Payment pattern and MVM

- Block CY payment pattern:
  - Columns Years: incremental payment pattern for CY business.
- Block PY payment pattern:
  - Columns Years: incremental payment pattern for claim reserves of PY business.
- Block Exchange rates:
  - Row Company-specific currency: If a company-specific currency is used, then the name of this currency and the corresponding exchange rate are required.

VIII. Expected technical and financial result

VIII.1 Expected financial result

The expected financial result $e^M$ is set to zero if the simplified delta-normal model described in section V (Excel sheet Market risk) is used. However, if the expected financial result $r^M$ is negative, it should be taken into account.

VIII.2 Expected technical result

The expected technical result $e^I$ must be based on a best estimate for the CY business. It is defined by the net premiums $P$, reduced by the sum of the net expected discounted losses $L$ and the costs $C$:

$$e^I = P - L - C.$$ 

In cases where the CY insurance risk is modelled on a gross basis, gross premiums and gross losses must be used.

Since the focus of the model of the CY insurance risk $X^{CY}$ is to quantify the loss uncertainty, the expectation $E(X^{CY})$ may differ from the expected technical result $e^I$.

VIII.3 Implementation in the Excel template

There is no separate Excel sheet for the expected financial result. It has to be entered in the Target capital Excel sheet; see section IX.
VIII.3.1 Excel sheet *Technical result*

- Columns *Gross and Net premiums*: gross and net premiums must be provided.
- Column *Costs*: costs must be provided.
- Columns *Gross and Net undiscounted expected losses*: gross and net undiscounted expected losses.

IX. Aggregation

IX.1 Model description

The model is based on the following assumptions:

- The terms $X^{CY}$ and $X^{PY}$ are comonotonic.
- The terms $X^M$, $X^I$ and $X^S$ are independent.

Based on the above assumptions, the target capital is defined by

$$TC := -ES_a(-X^C - X^M - X^I - X^S) + e^M + e^I + MV M.$$  

Since the credit risk $X^C$ is modelled by a deterministic random variable, this is equivalent to

$$TC = -ES_a(-X^M - X^I - X^S) + X^C + e^M + e^I + MV M.$$  

If the PY insurance risk is calculated without simulations, the following simplified approach is also allowed:

$$TC := -ES_a(-X^M - X^{CY^I} - X^S) - ES_a(-X^{PY}) + X^C + e^M + e^I + MV M.$$  

In general, an approach based on numerical simulations must be used to calculate the first expected shortfall of the last equation.

IX.2 Implementation in the Excel template

Scenario aggregation, if any, could also be done with the scenario aggregation template for Swiss general insurers.

IX.2.1 Excel sheet *Target capital*

- Row *CY insurance risk*: the CY insurance risk $-ES_a(-X^{CY})$ (only relevant if the simplified CY insurance risk module for reinsurance captives has been used).
• Row **PY insurance risk**: the PY insurance risk $-ES_a(-X_{PY})$ (only relevant if the simplified PY insurance risk module for reinsurance captives has been used).

• Row **Market and insurance risk**: the market and insurance risk $-ES_a(-X_M - X_I)$ has to be computed by the reinsurance captive, for instance by simulations. The simplified approximation $-ES_a(-X_M - X_{PY}) - ES_a(-X_{PY})$ may be used in the case of simplified aggregation of PY insurance risks.

• Row **Expected financial result**: the expected financial result $e^M$ (only relevant if the delta-normal model for market risk has been used or if $e^M$ is negative).

• Row **Target capital**: target capital $TC$ (only relevant if at least one scenario has been aggregated to the target capital).

**X. Appendix**

**X.1  Works around for some limitations**

Most of the limitations can always be dealt with by using an adapted version of the SST-standard model for Swiss general insurers; see section 4.4 of the *Technical document on the Swiss Solvency Test*. Other cases of workarounds are presented in this section.

**X.1.1  Only aggregate data on the incurred losses of normal claims**

It can happen that historical normal losses are only available on an yearly aggregate basis together with the number of normal claims. This means that only the historical realisations of the random variables $Y_n = \sum_{i=1}^{N_n} Y_i^n$ and $N^n$ are available. In this case, the following procedure must be applied:

- The expected number of claims $\mathbb{E}(N^n)$ together with the mean $\mathbb{E}(Y^n)$ and standard deviation $sd(Y^n)$ of the aggregate claim amount are estimated.
- The mean $\mathbb{E}(Y_i^n)$ and the standard deviation $sd(Y_i^n)$ of the single loss are derived by using the following formulas:

$$\mathbb{E}(Y^n) = \mathbb{E}(N^n) \cdot \mathbb{E}(Y_i^n) \quad \text{and} \quad Var(Y^n) = \mathbb{E}(N^n) \cdot Var(Y_i^n) + \mathbb{E}(Y_i^n)^2 \cdot Var(N^n).$$

**X.1.2  Over-dispersion or too many claims**

Claim frequencies are assumed to be Poisson distributed. In case of over-dispersion, or if there are too many claims, this assumption may be violated and the frequency must be modelled by a negative binomial distribution instead of a Poisson distribution. In this case, the variance $Var(N^n)$ or $Var(N^I)$ must also be estimated ($N^n$ and $N^I$ are introduced in Section III.3.1).
If there are several portfolios with too many claims, dependence between the portfolios may be of importance and can no longer be ignored. In this case, an adapted version of the SST standard model for Swiss general insurers must be used for the whole CY insurance risk.

X.1.3 Contracts affecting several calendar years

Although the following description refers to inward reinsurance business, it applies analogously to retrocessions. Additionally, it is assumed that the direct insurance contracts covered are on an occurrence basis (i.e. accident-year point of view). Other attachment bases of direct insurance contracts covered can be dealt with analogously.

StandCap assumes that all claims can be modelled ground-up on an accident-year base. Moreover, it is assumed that the coverage period of all contracts (coverage on an accident-year base) coincides with a single calendar year. If this is not the case, the following transformations (or a combination of them) could be applied:

**Scaling of the claims frequency:** If a contract covers six months only (or two years), it could be modelled as a contract covering one year, but with half (double) of the original claims frequency.

**Splitting of contracts:** A contract covering two years could be split into two independent contracts of which each concerns only one year. In particular, this method must be used if the premium of the underlying contract is already partly earned (based on an accident-year view).

In general, such scaling or splitting should be risk-based, but in most cases a pro rata temporis approach may be a good approximation.

The two transformations described may not be applicable in case of non-linear contract conditions such as aggregate limits or deductibles. In such cases, FINMA will accept prudent splits of those conditions. For instance, an aggregate deductible may be reduced by a prudent estimation of the total incurred loss of all claims already known.

Finally, if contracts are split such that at the end of the CY there is still some unearned and not modelled business left, the simplified approach to the MVM may no longer be appropriate.

X.1.4 Scenario approach

If a limitation StandCap is not connected to a major risk, a company-specific scenario may be aggregated to the target capital; see section VI (Excel sheet Scenarios) to model this risk.

X.2 Example of aggregation functions

To illustrate the concept of aggregation functions, some examples of common types of simple reinsurance structures together with the corresponding aggregation function are presented in this section. By combing these examples, more complex reinsurance structures can be modelled.
Annual aggregate limit (AAL)
In the case of an annual aggregate limit $AAL$, the insurance losses $X$ can be obtained by:

$$X = \min \left( \sum_{i=1}^{N^n} Y^n_i + \sum_{i=1}^{N^l} Y^l_i, AAL \right).$$

Each and every loss limit (EEL)
In the case of an each and every loss limit $EEL$, the insurance losses $X$ can be obtained by:

$$X = \sum_{i=1}^{N^n} \min(Y^n_i, EEL) + \sum_{i=1}^{N^l} \min(Y^l_i, EEL).$$

Annual aggregate deductible (AAD)
In the case of an annual aggregate deductible $AAD$, the insurance losses $X$ can be obtained by:

$$X = \max \left( \sum_{i=1}^{N^n} Y^n_i + \sum_{i=1}^{N^l} Y^l_i - AAD, 0 \right).$$

Each and every loss deductible (EED)
In the case of an each and every loss deductible $EED$, the insurance losses $X$ can be obtained by:

$$X = \sum_{i=1}^{N^n} \max(Y^n_i - EED, 0) + \sum_{i=1}^{N^l} \max(Y^l_i - EEL, 0).$$

Quota share
In the case of a quota share $p \in (0,1)$, the insurance losses $X$ can be obtained by:

$$X = p \cdot \left( \sum_{i=1}^{N^n} Y^n_i + \sum_{i=1}^{N^l} Y^l_i \right).$$