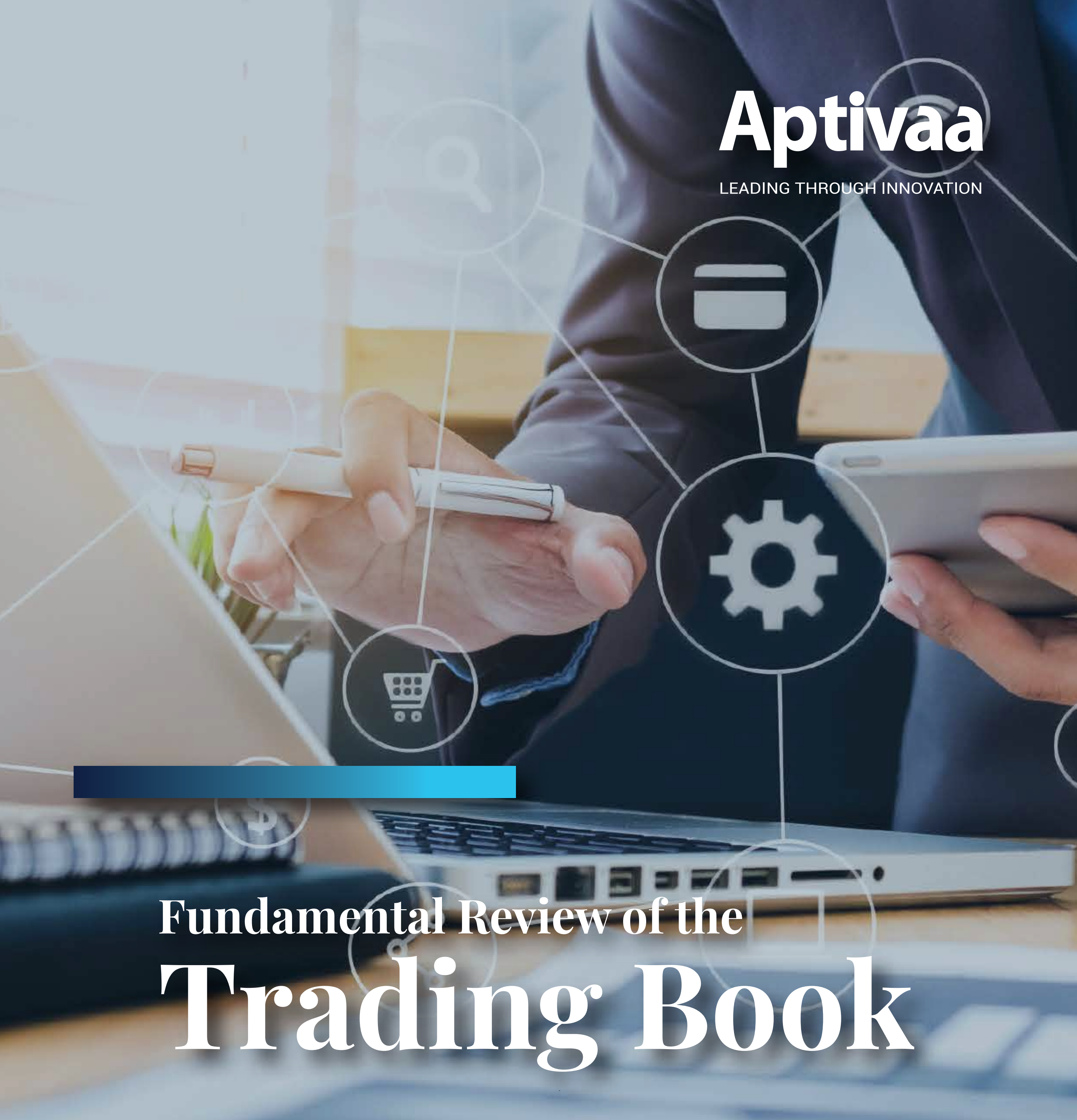


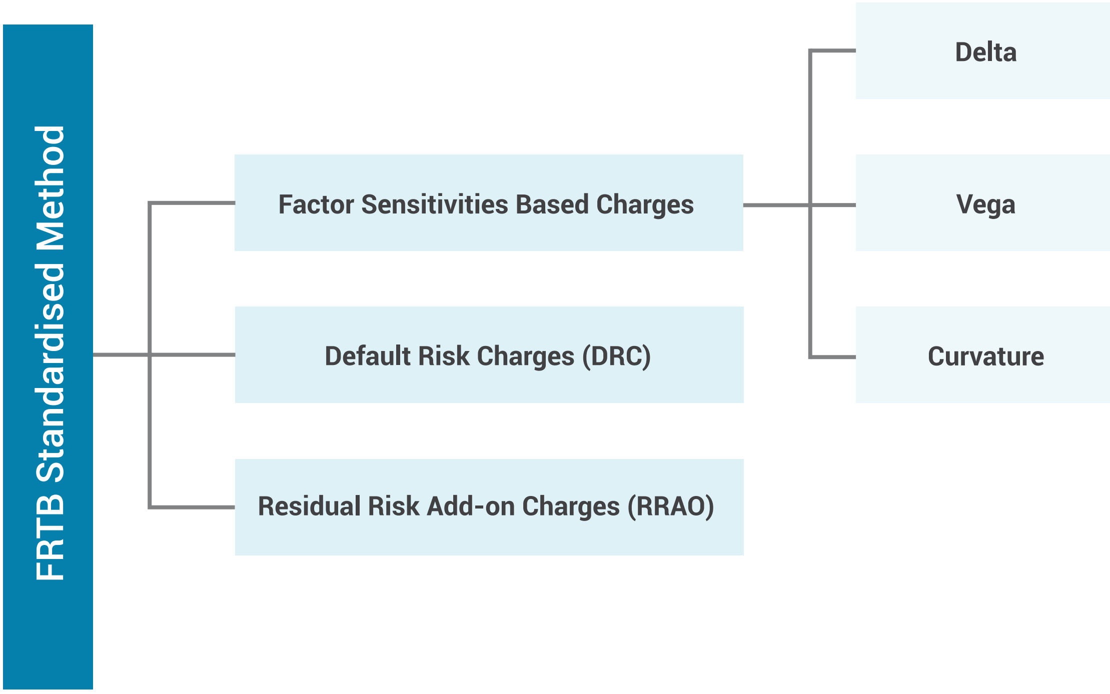
Aptivaa

LEADING THROUGH INNOVATION

Fundamental Review of the Trading Book

Standardised Approach – Stepwise Calculation Method

The standardised approach (SA) market risk capital charge calculation method is to come into effect from 2023 onwards. The calculation of market risk capital charge using the standardised method consists of determining a capital charge per risk class using the Sensitivities Based Approach (SBA) and aggregating them to determine the overall capital charge for market risk. To this are added the charge for the risk of default, as well as the additional charge for the residual risk to arrive at the minimum capital requirement as per the standardised approach.



A. Sensitivity Based Market Risk Capital Charge Calculation

The Factors Sensitivity based approach entails the introduction of the following calculation parameters:

Risk Indicators

Delta

Corresponds to the sensitivity of the value of a position to a variation of one basis point in the risk factor analyzed.

E.g.: The General Interest Rate RISK (GIRR) Delta Charge at Currency Level –

IRDL = $[pv(r(t) + 0.0001, cs(t)) - pv(r(t), cs(t))]/0.0001$

Where PV =present value of the trade

IRDL =Interest rate delta by bumping the relevant rate curve r(t) by 1bps, and keeping credit spread [cs] constant

Vega

Is the product of the vega and the implied volatility of the option; knowing that the vega itself represents the sensitivity of the option price to the implied volatility. In times of market stress, volatility increases significantly for most asset classes. Consequently, market participants buy options in order to hedge their portfolios, so that the price of options and their volatility also increase, which again impacts the value of the assets.

E.g.: The GIRR Vega Charge at Currency Level –

For each tenor (k)

$IRVG_k = Vega_k ImpliedVol_k$

Vega is price of 1 bps shock in Vol curve using BS Equation

Curvature

Consists of applying a significant change (a "shock") upwards and downwards to each risk factor, and retaining the most significant variation of the market value of the instrument, deduction made of the Delta. To calculate curvature risk charge (CVR) –

- Shift all curves up and down in parallel by a prescribed amount and revalue positions
- Subtract the delta gain / loss for the same shifts to arrive at a pure curvature gain / loss per factor for the up and down shift
- Aggregate the up-shift and down-shift CVRs to bucket level using the formula overleaf
- Select the highest loss for the up or down shift by bucket
- Aggregate the bucket charges up to risk class level

While the delta reflects the sensitivity to small variations in risk factors, the curvature seeks to capture the effect of a large variation (a "shock") of this same risk factor

E.g.: CVR+/CVR- is calculated as –

$$CVR_k^- = -\sum_i \left[PV_i\left(\chi_k^{RW(Curvature)^-}\right) - PV(\chi_k) - RW_k^{Curvature}.FS_{ik}\right]$$

$$CVR_k^+ = -\sum_i \left[PV_i\left(\chi_k^{RW(Curvature)^+}\right) - PV(\chi_k) + RW_k^{Curvature}.FS_{ik}\right]$$

where

- i is an instrument subject to curvature risks associated with risk factor k
- x_k is the current level of k
- $PV_i(x_k)$ is the price i at current level of k
- $PV_i\ (x_k^{RW(Curvature)+/-})$ denote the price of i after x_k is shifted (ie "shocked") upward and downward respectively
- $RW^{Curvature}$ is the risk weight for k
- FS_{ik} is the delta sensitivity of i with respect to the delta risk factor that corresponds to k

Other Parameters

Risk Classes

- General Interest Rate Risk (GIRR)
- Equity Risk
- Commodity Risk
- Foreign Exchange Risk
- Credit Spread Risk (CSR) - Risk non-related to securitization (non-SEC)
- CSR - Risk related to securitization within the Correlation Trading Portfolio (CTP)
- CSR - Risk related to securitization outside the Correlation Trading Portfolio (SEC)

Other Parameters

Risk Factors

Generally, a risk factor is an observable or measurable market data that is likely to influence the valuation and therefore the profit or loss generated by a financial instrument.

Risk Factors for the Delta calculation –

GIRR	Credit Risk	Equities	Commodities	Foreign Exchange
Risk factors are determined by rate curves, and identified for a predefined set of points (3M, 6M, 1Y, 2Y, 3Y etc.) or vertices	Credit spread curves (of bonds or CDS) for a predefined set of points	Share prices and repo rates	Commodity prices according to the different maturities of the contracts negotiated (spot, 3M, 6M, etc.)	Exchange rate of the currency in which the portfolio instruments are traded in relation to the bank's accounting currency

Risk Factors for calculation of Vega and Curvature –

Vega	Curvature
The risk factors are the implied volatilities of the options having an underlying Delta risk factor (interest rate options for interest rate risk, equity options, etc.)	The risk factors are modelled on the risk factors used in to calculate the Delta

Risk Buckets and Weights

A bucket is defined as a set of instruments of the same risk class sharing the same characteristics and therefore the same "risk profile". This does not correspond to the usual meaning in the trading room, but in this context, buckets correspond to time intervals, as below:

- Interest rates: buckets correspond to the different currencies
- Credit (non-SEC and CTP): buckets correspond to a two-level classification of credit risk, by quality (investment grade, high- yield & non-rated) on the one hand and by economic sector (sovereign, finance, etc.) on the other hand.
- Exchange rate: currency pairs
- Credit (non-SEC): buckets also correspond to a two-level classification, with credit quality at the first level and a securitization "sector" at the second level: RMBS, CMBS, ABS, CLO.
- Equities: buckets correspond to a 3-level classification of the assets: market cap (large / small), economy (emerging, advanced) and finally economic sector (retail goods services, telecom and industry).
- Commodities: buckets correspond, quite logically, to categories of raw materials (energy, metals, agriculture).

The buckets are the same for the 3 risk indicators (Delta, Vega and Curvature). However, each bucket has its own risk weights for each indicator. The product of the sensitivity calculated for a given risk factor and of the weighting corresponding to the risk bucket, or weighted sensitivity, gives a capital charge that could be called "elementary" (for a risk indicator, a risk factor, a risk bucket).

Correlation Parameters

To compute the overall capital charge for a class and a risk indicator, the weighted sensitivities must be aggregated. This is not done by simply summing them up, as both portfolio diversification and the propensity of risk factors to fluctuate simultaneously must be taken into account. This is where correlation parameters come into play. There are two categories corresponding to the two levels of aggregation –

"Intra-Bucket" correlation parameters are used to aggregate sensitivities within the same risk bucket in a first step.	"Inter-Bucket" correlation parameters are used to aggregate sensitivities across buckets in order to obtain the overall sensitivity for the risk class.

The definition of correlation parameters varies in complexity.

FRTB – SBA Capital Charge Bucketing and Aggregation Logic

Risk factors are identified and a Risk Factors model is specified

Factor Sensitivities (FS) are multiplied by prescribed Risk Weights (RWs) to calculate weighted sensitivities

Correlation/ diversification effects are aggregated to calculate Aggregated Sensitivities

Calculation is repeated for 3 correlation scenarios

Identify Risk Factors

- The first step is to identify, for all instruments held in the trading portfolio, the risk factors that apply and which risk buckets they belong to.
- The next step is to calculate net sensitivities by risk factor for the instruments in the portfolio. The term "net" is important, meaning that we calculate the arithmetic sum of all Delta (respectively all Vega and Curvatures) calculated on a given risk factor in the trading portfolio.
- As a result, sensitivities in opposite directions for a given risk factor compensate each other, which makes sense from the risk point of view: a position sensitive to a risk factor in one direction can be hedged by another position that varies in the opposite direction. In other words, within the same risk class and for the same indicator, the portfolio's diversification effect is fully exploited to achieve capital charge "savings" when exposed to market risk.

Calculate Weighted Sensitivities

Each net sensitivity is then assigned the risk weight provided in the documentation for the relevant risk factor and risk bucket to give the weighted sensitivity.

For example, Risk Weighted Factors Sensitivities for GIRR Delta charge at currency level for each Tenor [k] will be calculated as

$$WFS_k = FS_k.RW_k$$

$$\text{where } FS_k = \frac{[\text{Factor k PV01}]}{0.0001}$$

We can think of dividing PV01 by 0.0001 as converting a sensitivity into a 'Notional-Equivalent' to which a % Risk Weight is applied. Or we can think of the % RW divided by 0.001 as a bps scenario that is applied to a PV01.

Aggregate Sensitivities

a) By Bucket

Weighted sensitivities by risk bucket must then be aggregated. For Delta and Vega, the formula for calculating the capital charge for bucket b is as follows:

$$K_b = \sqrt{\sum_k WS_k^2 + \sum_k \sum_{k \neq l} \rho_{kl} WS_k WS_l}$$

Where:

- P_{kl} is the correlation parameter between risk factors k and l
- WS_k and WS_l are weighted sensitivities

b) By Risk Class

The aggregation by risk class is done in a similar way using the results of the previous step and the correlation parameters between buckets within the same risk class:

$$\text{Delta} = \sqrt{\sum_b K_k^2 + \sum_b \sum_{c \neq b} \gamma_{bc} S_b S_c}$$

Where:

- $S_b = \sum WS_k$ for all risk factors within bucket b (correspondingly for S_c).
- y_{bc} is the correlation parameter between buckets b and c

Risk Weight [RW] & Bucketing Logic [BL]

Risk Class	Buckets	Risk Weight [RW]	Aggregation Logic
GIRR	Any individual currency	RW are given by vertex for zero curves, Inflation CCS basis risk	Correlation parameter by same bucket and : • Same vertex & different curve • Different vertex & same curve • Different vertex & different curve • Inflation Curve & Yield Curve • Parameters for aggregating between different buckets as well
FX	Any currency pair	A unique RW	Uniform correlation parameters
CSR [Non-SEC, SEC, CTP]	16 Buckets: • Credit quality • Sector	RWs are given	• Correlation parameter between two risk factor sensitivities within the same buckets. • Correlation matrix for aggregating between different buckets • Other buckets
Equity	13 Buckets: • Market cap • Economy • Sector	RW are given for both Spot Prices & Repo Rates	Correlation parameter [except for "Other" sector bucket] by same bucket and: • Same Equity Issuer • Different Market Cap / Economies • Different Equity Issuer Parameter for aggregating between different buckets as well.
Commodity	11 Buckets: • Commodity Features	RWs are given	Correlation parameter by same bucket and: • Different Underlying Commodity • Different delivery location parameters for aggregating between different buckets as well

Scenarios

This dual aggregation process must be carried out 3 times per risk class and indicator, with three different correlation scenarios: low, medium and high. For each indicator, the correlation scenario with the highest end result (Delta + Vega + Curvature, for all risk classes) will be retained.

Using 3 scenarios makes it possible to take into account the fact that in times of market stress, correlations between risk factors may increase or decrease.

Scenario	Multiplier
Low	0.75
Medium	1
High	1.25
For each – Delta, Vega and Curvature	

Capital Charge for Market Risk is the largest of scenario related capital charges

The total capital charge is equal to the sum of Delta, Vega and Curvature charges. The three capital charges are calculated for each of the three correlation scenarios, and the highest one is retained as the capital charge for market risk.

B. Default Risk Capital Charge Calculation

The default risk capital (DRC) requirement is intended to capture jump-to-default (J2TD) risk that may not be captured by credit spread shocks under the sensitivities-based method. DRC requirements provide some limited hedging recognition and banking book like treatment.

- The default risk capital charge for non-securitization and securitization is independent from the other capital charges in the SA for market risk, in particular from the credit spread risk (CSR) capital charge.
- The capital for the correlation trading portfolio (CTP) includes the default risk for securitization exposures and for non-securitization hedges. There must be no diversification benefit between the DRC for non-securitization, DRC for securitization (non-CTP) and DRC for the securitization CTP.

- At national discretion, claims on sovereigns, public sector entities and multilateral development banks may be subject to a zero default risk weight.
- For traded non-securitization credit and equity derivatives, JTD amounts by individual constituent issuer legal entity should be determined by applying a look-through approach.

Net jump-to-default risk positions (Net JTD)

Exposures to the same obligator may be offset as follows:

- The gross JTD risk positions of long and short exposures to the same obligor may be offset where the short exposure has the same or lower seniority relative to the long exposure. For example, a short exposure in an equity may offset a long exposure in a bond, but a short exposure in a bond cannot offset a long exposure in the equity.
- For the purposes of determining whether a guaranteed bond is an exposure to the underlying obligor or an exposure to the guarantor, the credit risk mitigation requirements set out in paragraphs 189 and 190 of the Basel II framework apply.
- Exposures of different maturities that meet this offsetting criterion may be offset as follows:
    - Exposures with maturities longer than the capital horizon (one year) may be fully offset.
    - An exposure to an obligor comprising a mix of long and short exposures with a maturity less than the capital horizon (equal to one year) must be weighted by the ratio of the exposure's maturity relative to the capital horizon. For example, with the one-year capital horizon, a three-month short exposure would be weighted so that its benefit against long exposures of longer-than-one-year maturity would be reduced to one quarter of the exposure size.

Net jump-to-default risk positions (Net JTD)

The following step-by-step DRC Calculation approach must be followed for each risk class subject to default risk –

The gross J2TD risk of each exposure is computed separately

→ With respect to the same obligor the JTD amounts of long and short exposures are offset (where permissible) to produce net long and/or net short exposure amounts per distinct obligor

→ Net J2TD risk positions are then allocated to buckets

→ Within a bucket, a hedge benefit ratio is calculated using net long and short JTD risk positions. This acts as a discount factor that reduces the amount of net short positions to be netted against net long positions within a bucket

→ A prescribed risk weight is applied to the net positions which are then aggregated

→ Bucket level DRC requirements are aggregated as a simple sum across buckets to give the overall DRC requirement

Default risk weights are assigned to net J2TD by credit quality categories (i.e. rating bands) irrespective of the type of counterparty –

DRC Weight for Credit Non-SEC	
Credit Quality Category	Credit Quality Category
AAA	0.50%
AA	2%
A	3%
BBB	6%
BB	15%
B	30%
CCC	50%
Unrated	15%
Defaulted	100%

Debt Tier	LGD
Equity and non-senior debt instruments	100%
Non-Senior Debt	100%
Covered Bonds	25%
Senior debt instruments	75%

Default Risk Buckets
Corporate
Sovereigns
Government / Muni

C. Residual Risk Add-On (RRAO) Capital Charge Calculation

The Residual risk add-on (RRAO) is to be calculated for all instruments bearing residual risk separately in addition to other components of the capital requirement under the FRTB Standardised Approach.

Instruments subject to RRAO	**Exotic Underlying**	Instruments with an exotic underlying are trading book instruments with an underlying exposure that is not within the scope of delta, vega or curvature risk treatment in any risk class under the sensitivities-based method or default risk capital (DRC) requirements in the FRTB-SBA	
Instruments subject to RRAO	**Instruments bearing other residual risks**	Instruments subject to vega or curvature risk capital requirements in the trading book and with pay-offs that cannot be written or perfectly replicated as a finite linear combination of vanilla options with a single underlying equity price, commodity price, exchange rate, bond price, credit default swap price or interest rate swap	Instruments which fall under the definition of the correlation trading portfolio (CTP), except for those instruments that are recognized in the market risk framework as eligible hedges of risks within the CTP
		A non-exhaustive list of risk types and instruments that may fall within the criteria include: • Gap risk: risk of a significant change in vega parameters in options due to small movements in the underlying (e.g. barrier options, Asian options and digital options). • Correlation risk: risk of a change in the correlation parameter to determine the value of an instrument with multiple underlying (e.g. basket options, best-of-options, spread options, basis options, Bermudan options, etc.) • Behavioral risk: risk of a change in exercise outcomes motivated by social factors.	
Instruments not subject to RRAO	Instruments used in transactions where a transaction exactly matches with a third-party transaction	Any instrument that is listed and/or eligible for central clearing	When an instrument is subject to certain risk specified in the market risk framework (e.g. smile risk, correlation risk, etc.) this by itself will not cause the instrument to be subject to the risk add-on

The regulatory risk weights for RRAO Instrument types are:

Instruments Types	Risk Weight
Exotic Underlying	1%
Other Residual Risk	0.1%

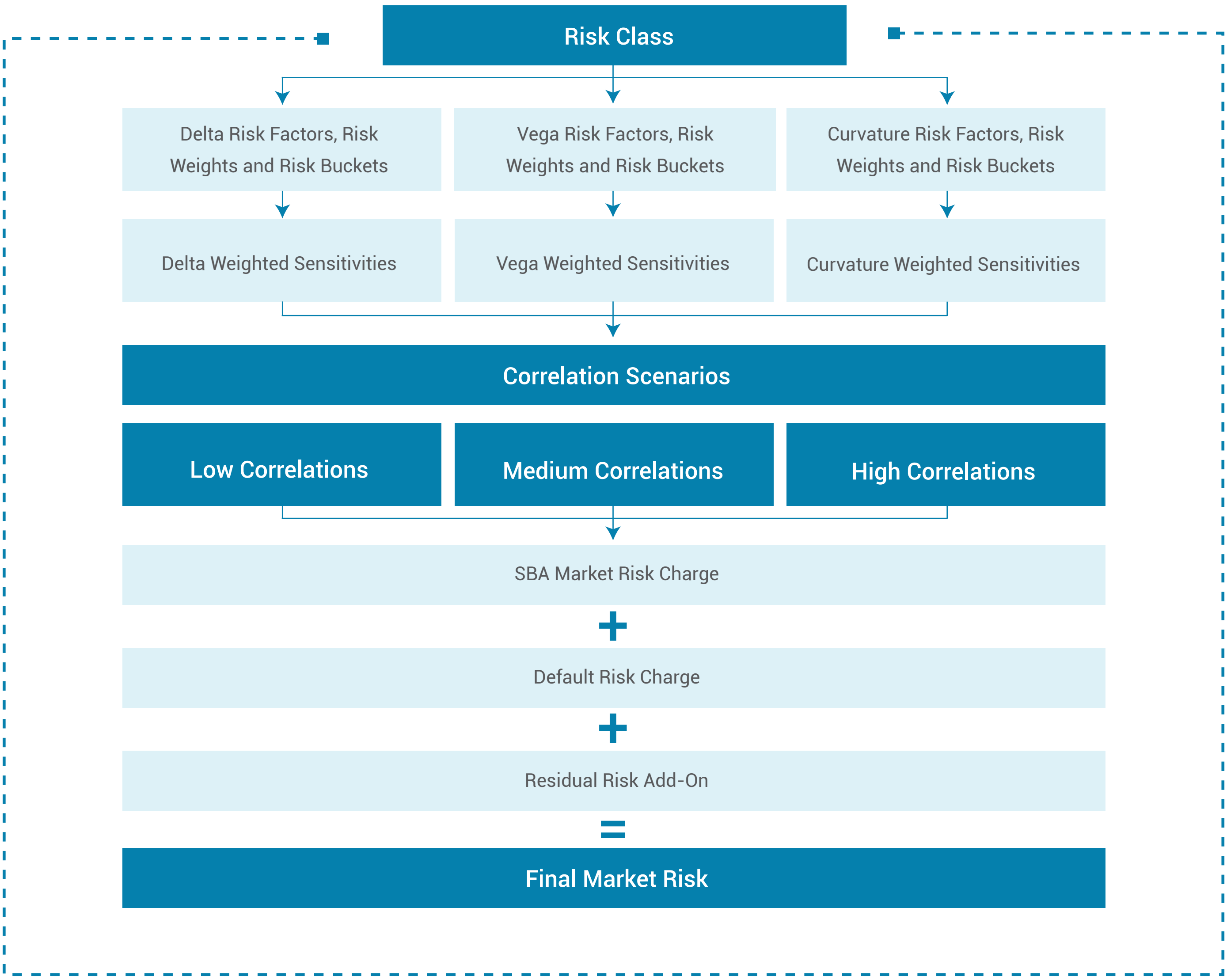
RRAO Calculation

RRAO is calculated as the simple sum of gross notional amounts of the instruments bearing residual risks, multiplied by a risk weight.

$$RARO_{CapitalCharge} = \text{Gross Notional Amount} * \text{Risk Weight}$$

Conclusion

The institutions are faced with a multitude of adjustments and calibrations in their methodology of capital charge computation for market risk, however the Standarised Approach provides a credible alternative for trading desks to operate under a capital regime that is conservative, but not totally punitive. There is a complexity to factor for the banks considering to adopt the Standardised Approach capital charge calculation and looking to leverage their existing sensitivity-based VaR model, due to the difference between the existing sensitivity calculations and the prescribed FRTB formula. Unless it can be shown that the discrepancies between the 2 sets of formulae are minor, some analytical duplication might have to be undertaken, with a set of calculations for FRTB and another set for internal risk management.



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