

# Package: xVA (via r-universe)

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**Type** Package

**Title** Credit Risk Valuation Adjustments

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**Description** Calculates a number of valuation adjustments including CVA, DVA, FBA, FCA, MVA and KVA. A two-way margin agreement has been implemented. For the KVA calculation four regulatory frameworks are supported: CEM, (simplified) SA-CCR, OEM and IMM. The probability of default is implied through the credit spreads curve. The package supports an exposure calculation based on SA-CCR which includes several trade types and a simulated path which is currently available only for Interest Rate Swaps. The latest regulatory capital charge methodologies have been implementing including BA-CVA & SA-CVA.

**License** GPL-3

**Imports** methods, SACCR, Trading, data.table

**URL** <https://openriskcalculator.com/>

**Collate** 'CalcNGR.R' 'CalcPD.R' 'CalcSimulatedExposure.R' 'CalcVA.R' 'GenerateTimeGrid.R' 'calcDefCapital.R' 'calcEADRegulatory.R' 'calcEffectiveMaturity.R' 'calcKVA.R' 'xVACalculator.R' 'xVACalculatorExample.R' 'onLoad.R' 'IS\_ELIGIBLE\_CCY.R' 'IS\_IG.R' 'LoadSupervisoryCVADData.R' 'calcCVACapital.R'

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calcCVACapital	<i>Calculates the CVA Capital Charge</i>
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## Description

Calculates the CVA capital charge based on the standardized approach

## Usage

```
calcCVACapital(
  trades,
  EAD,
  reg_data,
  superv,
  effective_maturity,
  cva_sensitivities
)
```

**Arguments**

trades	The full list of the Trade Objects
EAD	Exposure-at-Default
reg_data	A list containing data related to the regulatory calculations
superv	A list containing supervisory data including correlations, risk weights etc
effective_maturity	The effective maturity of the trades of the netting set
cva_sensitivities	The effective maturity of the trades of the netting set

**Value**

The CVA capital charge of the trade set

**Author(s)**

Tasos Grivas <tasos@openriskcalculator.com>

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calcDefCapital	<i>Calculates the Default Capital Charge</i>
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**Description**

Calculates the default capital charge using the advanced IRB methodology and the stressed R

**Usage**

```
calcDefCapital(trades, EAD, reg_data, effective_maturity)
```

**Arguments**

trades	The full list of the Trade Objects
EAD	The Exposure-At-Default of the trades as per the selected regulatory framework
reg_data	A list containing data related to the regulatory calculations (for example the regulatory probability-of-default, the regulatory loss-given-default etc)
effective_maturity	The effective maturity of the trades of the netting set

**Value**

The default capital charge

**Author(s)**

Tasos Grivas <tasos@openriskcalculator.com>

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calcEADRegulatory      *Calculates the Exposure-At-Default (EAD)*

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### Description

Calculates the Exposure-At-Default (EAD) based on the given regulatory framework. It supports the CEM, IMM and (simplified) SA-CCR frameworks

### Usage

```
calcEADRegulatory(
  trades,
  framework,
  sa_ccr_simplified = "",
  CSA,
  collateral,
  EEE,
  time_points
)
```

### Arguments

trades	The full list of the Trade Objects
framework	Specifies the regulatory framework used in the calculations. It can take the values of 'IMM', 'CEM', 'SA-CCR'
sa_ccr_simplified	(Optional) Specifies whether the standard SACCR or its simplified version or the OEM will be implemented. It can take the values of "", 'simplified', 'OEM'
CSA	The margin agreement with the counterparty
collateral	The amount of collaterals currently exchanged with the counterparty
EEE	A vector containing the effective expected exposure against the counterparty
time_points	The timepoints that the analysis is performed on

### Value

The Exposure-At-Default

### Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

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calcEffectiveMaturity *Calculates the Effective Maturity*

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**Description**

Calculates the effective maturity based on the specified regulatory framework

**Usage**

```
calcEffectiveMaturity(trades, time_points, framework, simulated_exposure)
```

**Arguments**

trades	The full list of the Trade Objects
time_points	The timepoints that the analysis is performed on
framework	Specifies the regulatory framework used in the calculations. It can take the values of 'IMM', 'CEM', 'SA-CCR'
simulated_exposure	The exposure profile list containing the EE, EEE etc

**Value**

The effective maturity of the trade set

**Author(s)**

Tasos Grivas <tasos@openriskcalculator.com>

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calcKVA *Calculates the Capital Valuation Adjustment (KVA)*

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**Description**

Calculates the capital valuation adjustment by computing the default capital charge and the CVA capital charge and applying the required return-on-capital

**Usage**

```
calcKVA(  
  trades,  
  reg_data,  
  EAD,  
  effective_maturity,  
  ignore_def_charge = TRUE,  
  cva_capital_charge  
)
```

**Arguments**

trades	The full list of the Trade Objects
reg_data	A list containing data related to the regulatory calculations (for example the 'framework' member variable can be 'IMM','SACCR','CEM')
EAD	The Exposure-at-default calculated based on the prescribed framework as appearing in the 'reg_data'
effective_maturity	The effective maturity of the trades performed with a specific counterparty
ignore_def_charge	if set to true the default capital charge is set to zero
cva_capital_charge	The CVA Capital Charge linked to this portfolio

**Value**

The capital valuation adjustment (KVA)

**Author(s)**

Tasos Grivas <tasos@openriskcalculator.com>

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CalcNGR

*Calculates the Net/Gross ratio (NGR)*

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**Description**

Calculates the Net/Gross ratio used under the CEM regulatory framework

**Usage**

CalcNGR(MtM\_Vector)

**Arguments**

MtM_Vector	A vector containing the trades to be netted
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**Value**

The Net-Gross ratio (NGR)

**Author(s)**

Tasos Grivas <tasos@openriskcalculator.com>

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CalcPD	<i>Calculates the Probability of Default</i>
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**Description**

Calculates the probability of the default on specific time points by using the spread of the corresponding credit curve and the loss given default

**Usage**

```
CalcPD(spread, LGD, time_points)
```

**Arguments**

spread	The spread based on the credit curve
LGD	The loss-given-default
time_points	The timepoints that the analysis is performed on

**Value**

A vector containing the probability of default on the specified timepoints

**Author(s)**

Tasos Grivas <tasos@openriskcalculator.com>

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CalcSimulatedExposure	<i>Calculated the Simulated Exposure Profile</i>
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**Description**

Calculates the simulated exposure profile (EE, NEE, PFE, EEE) by use of the Hull-White model. Two sets of results are provided: one after taking into account the margining agreement and one assuming that there is no margining agreement present

**Usage**

```
CalcSimulatedExposure(  
  discount_factors,  
  time_points,  
  spot_curve,  
  CSA,  
  trades,  
  sim_data,  
  framework,  
  seed = NULL  
)
```

**Arguments**

discount_factors	The discount curve derived from the spot curve
time_points	The timepoints that the analysis is performed on
spot_curve	The curve derived from interpolating the market spot rates
CSA	The margin agreement
trades	The list of the trade objects
sim_data	A list containing simulation-related data (model parameters and number of simulation)
framework	regulatory framework can be 'IMM','SACCR','CEM'
seed	The seed for the simulations

**Value**

A list containing the exposure profile (both collateralized and uncollateralized)

**Author(s)**

Tasos Grivas <tasos@openriskcalculator.com>

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CalcVA

*Calculates the Valuation Adjustment*

---

**Description**

Calculates the Valuation Adjustment based on the exposure, the probability-of-default and the loss-given-default

**Usage**

CalcVA(exposure, discount\_factors, PD, LGD)

**Arguments**

exposure	A vector containing the exposure values on which the credit risk adjustment will be calculated
discount_factors	The Discount Curve
PD	The probability-of-Default
LGD	The Loss-Given-Default

**Value**

The Valuation Adjustment Value

**Author(s)**

Tasos Grivas <tasos@openriskcalculator.com>

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IS\_ELIGIBLE\_CCY      *Checks if specified currency is low risk*

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**Description**

Checks if the specified currency is eligible to receive reduced regulatory risk weights

**Usage**

IS\_ELIGIBLE\_CCY(ccy)

**Arguments**

ccy                      The currency to be checked

**Value**

TRUE if the currency is eligible to receive reduced regulatory risk weights

**Author(s)**

Tasos Grivas <tasos@openriskcalculator.com>

**References**

[https://www.bis.org/basel\\_framework/chapter/MAR/50.htm?inforce=20230101&published=20200708](https://www.bis.org/basel_framework/chapter/MAR/50.htm?inforce=20230101&published=20200708)

**Examples**

TRUE == IS\_ELIGIBLE\_CCY('EUR')

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IS\_IG

*Checks if Credit rating is Investment Grade*

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**Description**

Checks if the credit rating is investment grade or not (if not rating not recognised will be unrated)

**Usage**

```
IS_IG(credit_rating)
```

**Arguments**

credit\_rating The Credit Rating to be checked

**Value**

TRUE if Rating is Investment Grade

**Author(s)**

Tasos Grivas <tasos@openriskcalculator.com>

**References**

[https://en.wikipedia.org/wiki/Credit\\_rating](https://en.wikipedia.org/wiki/Credit_rating)

**Examples**

```
TRUE == IS_IG('AAA')
```

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LoadSupervisoryCVAData

*Supervisory Data Loading*

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**Description**

Loads the supervisory data (factors, correlation and option volatility) for each Asset Class and SubClass

**Usage**

```
LoadSupervisoryCVAData()
```

**Value**

A list with the required data

**Author(s)**

Tasos Grivas <tasos@openriskcalculator.com>

**References**

MAR50 - Credit Value Adjustment Framework [https://www.bis.org/basel\\_framework/chapter/MAR/50.htm?inforce=202301](https://www.bis.org/basel_framework/chapter/MAR/50.htm?inforce=202301)

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xVACalculator

*Calculates the xVA values*

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**Description**

Calculates the xVA values (CVA, DVA, FVA, FBA, MVA, KVA)

**Usage**

```
xVACalculator(
  trades,
  CSA,
  collateral,
  sim_data,
  reg_data,
  credit_curve_PO,
  credit_curve_cpty,
  funding_curve,
  spot_rates,
  cpty_LGD,
  PO_LGD,
  no_simulations
)
```

**Arguments**

trades	The full list of the Trade Objects
CSA	The margin agreement with the counterparty
collateral	The amount of collateral currently exchanged with the counterparty
sim_data	A list containing data related to the calculation of simulated exposures (for example the model parameters and the number of simulations)
reg_data	A list containing data related to the regulatory calculations (for example the 'ccr_framework' member variable can be 'IMM', 'SACCR', 'CEM')
credit_curve_PO	The credit curve of the processing organization

credit_curve_cpty	The credit curve of the processing organization
funding_curve	A curve containing the credit spread for the funding of the collateral
spot_rates	The spot rates curve
cpty_LGD	The loss-given-default of the counterparty
PO_LGD	The loss-given-default of the processing organization
no_simulations	if true, no simulated exposure will be generated and the regulatory framework should be SA-CCR

**Value**

A list containing the xVA values and the cva capital charge

**Author(s)**

Tasos Grivas <tasos@openriskcalculator.com>

**References**

Gregory J., The xVA Challenge, 2015, Wiley

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xVACalculatorExample *xVA calculation example*

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**Description**

Calculates the xVA values for a simple example containing two IR swaps.

**Usage**

```
xVACalculatorExample()
```

**Value**

A list with the values of various valuations' adjustments

**Author(s)**

Tasos Grivas <tasos@openriskcalculator.com>

**Examples**

```
## run the example

xVACalculatorExample()
```

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