

# Package ‘xVA’

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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 | <i>Calculates the Exposure-At-Default (EAD)</i> |
|-------------------|-------------------------------------------------|

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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)*

---

### 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)*

---

**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 |
|------------|---------------------------------------------|

**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> |
|--------|----------------------------------------------|

---

**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*

---

**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')

---

IS\_IG

*Checks if Credit rating is Investment Grade*

---

**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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LoadSupervisoryCVADData

*Supervisory Data Loading*

---

**Description**

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

**Usage**

```
LoadSupervisoryCVADData()
```

**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*


---

**Description**

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

**Usage**

```
xVACalculator(
    trades,
    CSA,
    collateral,
    sim_data,
    reg_data,
    credit_curve_P0,
    credit_curve_cpty,
    funding_curve,
    spot_rates,
    cpty_LGD,
    P0_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_P0 | 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*

---

**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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