CVA Technical Documentation

Introduction

This document contains the technical information required for the computation of the Credit Valuation Adjustment (CVA) and Debit Valuation Adjustment (DVA).

Purpose

This document provides detailed information for the CVA product including:

- Overview of the CVA Analytics.
- Technical specifications.
- Data model definition.
- Detailed descriptions of properties.
- Pricing mechanism.
- Use case examples.

It will be updated and reissued when appropriate to do so.

Document History

This document has been subject to the following iterations:

Issue	Date	Description
1.0	26 February 2024	Initial version

Overview of the CVA Analytics

Credit Valuation Adjustment (CVA) is the price that an investor would pay to hedge the counterparty credit risk of a derivative instrument. It reduces the mark to market value of an asset by the value of the CVA.

The CVA analytics describe how to get the Credit Valuation Adjustment (CVA) / Debt Valuation Adjustment (DVA) computation for each Credit Support Annex (CSA) / Netting set against a given counterparty.

It can be used to compute:

- Unilateral and bilateral **CVA** / **DVA** values for each deal of the same netting set.
- CVA Allocation for a portfolio.
- Expected positive and negative exposures.
- Potential positive and negative future exposures.
- Market values for each instrument.

For the computation a user set the Credit Support Annex (**CSA**) definition. This is a legal document that regulates credit support (collateral) for derivative transactions. It is one of four parts of a standard contract or master agreement developed by the International Swaps and Derivatives Association (ISDA). It defines the terms or rules under which collateral posted or transferred between swap counterparties to mitigate the credit risk arising from "in the money" derivative positions.

In QPS payload, the following features of CSA must be provided:

- a tag to identify the CSA,
- the reference (counterparty) entity.

To activate the collateral management, a user should set **useCollateral** property to 'true' in the CSAS definition (otherwise, it is 'false' by default).

In this case the following features also must be provided:

- the currency in which the collateral should be posted,
- the Minimum Transfer Amount (MTA) which corresponds to the minimum cash value that can be posted.
- the Initial Margin which is the initial collateral amount that is posted at the inception of the transaction,

- the Threshold Amount which is the minimum exposure from which the collateral begins to be posted,
- the Margining Call Frequency, which is the schedule on which the collateral should be posted.

Please note that collateral is only permitted is CASH. The margin period of risk stands for the time period from the most recent exchange of collateral covering a netting set with a defaulting counterparty until the financial instruments are closed out and the resulting market is re-hedged. It is usually fixed at two weeks by the CSA and should be taken into account by the pricing.

Other properties that must be specified by a user are:

- the type and definition of each instrument associated with the CSA,
- the reposting currency to express results of computations,
- an identifier of the contract owner in case of the Unilateral DVA and Bilateral DVA computation.

You should use market data assignments to apply the market data (curves and surfaces) to each counterparty.

- Assign credit curves.
- Override the recovery rates of counterparties.
- Assign Interest Rate curves.
- Override the CDS curve and Interest Rate curve points.

In addition, various pricing parameter can be used to control and adjust the calculation (for example, to define the date of the computation or set the number of simulation to be performed for CVA / DVA computation).

Instrument Pricing Analytics support CVA Analytics both for **a single product** and for **a portfolio** consisting of the same products (e.g., swaps), or **multi-asset portfolio** (swaps, caps, floors, FX options).

Technical Specifications

This section provides specification details that can be useful when constructing a pricing request.

Naming Convention

- Property names are designed in a **camelCase** convention.
- All input names, except fields requested, should begin with a lower-case letter (e.g., "instrumentType").
- The requested output fields must begin with a capital letter (e.g., "ValuationDate"), as they are case sensitive.

- Array names are pluralized to indicate that they contain multiple values (e.g., "pfePercentilesArray"). Names of objects, in turn, are singular (e.g., "instrumentDefinition").
- To indicate the currency a particular property is expressed, it is included in the property name (e.g., "BilateralCvaInReportCcy").

Importance of Properties

The are two categories of properties in the view of their importance for a pricing:

- **Mandatory**: a property must be specified in request. If not, the calculation is blocked, and an error message is returned indicating the reason why the input section is invalid.
- **Optional**: if an optional property is not included in request, either its default value is used, or the property is ignored for calculation (no default value applies).

Importance of properties together with the default behavior for optional parameters is provided in the documentation.

Request Structure

Please use **JSON format** to compose a request.

CVA Request

Input Name	Type	Description	Importance
csas	Array of objects	An array of the Credit Support Annex (**CSA**) definitions.	**Mandatory**
universe	Array of objects	An array of financial contract definitions that are used to calculate CVA.	**Mandatory**
fields	Array of strings	An array of fields that should be returned in response. If not set, the list of the predefined fields is returned (referred in descriptions as 'Returned by default').	Optional
pricingParameters	Dictionary	Parameters used to price CVA and applied to each instrument defined in the "universe". By default, override does not apply.	**Mandatory**

outputs	Array of strings	Defines what the API should return in the response, in addition to data. It is possible to request: • **Headers**: returns field headers on top of the output. A header contains the field name, type and possibly title and description. • **Data**: returns field values. • **Statuses**: returns status codes (0='not applicable', 1='specified by user', 2='from market data', 3='computed', 4='error') and descriptions. • **MarketData**: returns the market data used for computation. If not specified, "Header" and "Data" apply by default. Note that the "outputs" names are case-sensitive and if you specify them in the request, they must begin with an uppercase letter.	Optional
marketDataAssignments	Object	The section used to create a link between the instrument defined in the 'universe' / 'csas' sections and quotes/curves/rates/volSurfaces of the Market Data section which apply to this instrument. **Mandatory** to retrieve the specified market data for the instrument.	Optional

marketData	Object	The section used to override the market data that is pricing the financial instrument. The link between the asset and the market data to override must be managed by the Market Data Assignment.	Optional

Calculated Data

The calculated values of fields are returned in response in a tabular format.

- **"headers"** and **"data"** arrays contain the exact same number of columns. Each row is identified by its keys ("type" and "name").
- **"statuses"** has the same dimensions as data array.
- **"marketData"** section has its own format depending on the data returned (curves, volatility surfaces).

Error management

In case of error (the "status" table indicate where an error occurred by setting the value of a cell to 4), a user can retrieve details about it using two fields:

- **ErrorCode** is an integer uniquely associated to the error. Customers can rely on these error codes to trigger custom logic.
- **ErrorMessage** is a string that provides more details about the error, possibly including contextual information like "Swap data retrieval failed: invalid EUR ZC curve".

The **"ProcessingInformation"** field is used to return information about non-crucial issues, which do not block overall computations.

This field can also contain information about specific processing applied to the price the instrument.

The Credit Curve Assignment

There are several ways to define and assign credit curve in request that are described in detail below.

The credit curve assignment mechanism

- The 'marketData' section must contain credit curve definitions. Each credit curve definition must contain an **assignmentTag**.
- The 'marketDataAssignments' section establishes the link between the defined **assignmentTag** and **referenceEntity**.

- The 'csas' section (mandatory) lists several CSA definitions. Each CSA definition must have the 'referenceEntity' property whose value links the CSA to one of the market data assignments.

The credit curve assignment via reference entity

The CDS curve requires an entity, which can be passed to the 'referenceEntity' credit curve parameter. The type of the reference entity must be set in the 'referenceEntityType' parameter of the Market Data section.

Please note that if **referenceEntityType** is not set, the '**IssuerCode**' value is returned by default.

Example request

```
{
  "outputs": [
    "Data",
    "Statuses",
    "Headers",
    "MarketData"
  ],
  "fields": [
    "CsaTag",
    "BilateralCvaInReportCcy",
    "BilateralDvaInReportCcy",
    "UnilateralCvaInReportCcy",
    "UnilateralDvaInReportCcy",
    "MarketValueInReportCcyArray",
    "Allocations",
    "Exposure",
    "ErrorMessage"
  ],
  "csas": [
    {
      "csaTag": "RenaCsa",
      "referenceEntity": "RENA.PA",
      "counterpartyRecoveryRatePercent": 40
    }
  ],
  "universe": [
    {
      "csaTag": "RenaCsa",
      "portfolioName": "EurIrdPortfolio",
      "instrumentType": "CapFloor",
      "instrumentDefinition": {
        "notionalCcy": "EUR",
        "startDate": "2021-01-01",
        "tenor": "3Y",
        "buySell": "Sell",
        "indexName": "ESTR",
        "interestCalculationMethod": "Dcb_Actual_360",
        "notionalAmount": 10000000,
        "interestPaymentFrequency": "SemiAnnual",
```

```
        "capStrikePercent": 0.05
      }
    }
  ],
  "pricingParameters": {
    "valuationDate": "2022-02-15",
    "simulationCount": 1000,
    "selfAssignmentTag": "SelfTag",
    "selfRecoveryRatePercent": 40,
    "reportCcy": "EUR"
  },
  "marketDataAssignments": {
    "credit": {
      "defaultProbability": [
        {
          "key": {
            "referenceEntity": "RENA.PA"
          },
          "assignmentTag": "RenaCdsCurve"
        },
        {
          "key": {
            "referenceEntity": "BondCurve"
          },
          "assignmentTag": "SelfTag"
        }
      ]
    }
  },
  "marketData": {
    "creditCurves": [
      {
        "assignmentTag": "RenaCdsCurve",
        "curveDefinition": {
          "referenceEntity": "RENA.PA",
          "referenceEntityType": "Ticker"
        }
      },
      {
        "assignmentTag": "SelfTag",
        "curveDefinition": {
          "referenceEntity": "AIR.PA",
          "referenceEntityType": "Ticker"
        }
      }
    ]
  }
}
```

The credit curve assignment via credit curve type

The CDS curve can also be defined when the 'creditCurveType' property in the market data section is set to 'CdsIssuerCurve'.

Example request

```
{
  "outputs": [
    "Data",
    "Statuses",
    "Headers",
    "MarketData"
  ],
  "fields": [
    "CsaTag",
    "BilateralCvaInReportCcy",
    "BilateralDvaInReportCcy",
    "UnilateralCvaInReportCcy",
    "UnilateralDvaInReportCcy",
    "MarketValueInReportCcyArray",
    "Allocations",
    "Exposure",
    "ErrorMessage"
  ],
  "csas": [
    {
      "csaTag": "RenaCsa",
      "referenceEntity": "RENA.PA",
      "counterpartyRecoveryRatePercent": 40
    }
  ],
  "universe": [
    {
      "csaTag": "RenaCsa",
      "portfolioName": "EurIrdPortfolio",
      "instrumentType": "CapFloor",
      "instrumentDefinition": {
        "notionalCcy": "EUR",
        "startDate": "2021-01-01",
        "tenor": "3Y",
        "buySell": "Sell",
        "indexName": "ESTR",
        "interestCalculationMethod": "Dcb_Actual_360",
        "notionalAmount": 10000000,
        "interestPaymentFrequency": "SemiAnnual",
        "capStrikePercent": 0.05
      }
    }
  ],
  "pricingParameters": {
    "valuationDate": "2022-02-15",
    "simulationCount": 1000,
    "selfAssignmentTag": "SelfTag",
    "selfRecoveryRatePercent": 40,
    "reportCcy": "EUR"
  },
  "marketDataAssignments": {
    "credit": {
      "defaultProbability": [
        {
          "key": {
            "referenceEntity": "RENA.PA"
          },
```

```
          "assignmentTag": "RenaCdsCurve"
        },
        {
          "key": {
            "referenceEntity": "BondCurve"
          },
          "assignmentTag": "SelfTag"
        }
      ]
    }
  },
  "marketData": {
    "creditCurves": [
      {
        "assignmentTag": "RenaCdsCurve",
        "curveDefinition": {
          "referenceEntity": "RENA.PA",
          "creditCurveType": "CdsIssuerCurve"
        }
      },
      {
        "assignmentTag": "SelfTag",
        "curveDefinition": {
          "referenceEntity": "AIR.PA",
          "referenceEntityType": "Ticker"
        }
      }
    ]
  }
}
```

Override

CDS curve points and recovery rates

If you need to specify a certain recovery rate for a counterparty (the reference entity), or self-recovery rate, please use the 'recoveryRatePercent' property in the 'marketData' section.

You can also override curve points specifying spread(s) in basis points and tenor(s) to which override should be applied.

Example request

```
{
  "outputs": [
    "Data",
    "Statuses",
    "Headers",
    "MarketData"
  ],
  "fields": [
    "CsaTag",
    "MarketValueInReportCcyArray",
```

```
  "BilateralCvaInReportCcy",
  "UnilateralCvaInReportCcy",
  "BilateralDvaInReportCcy",
  "UnilateralDvaInReportCcy",
  "ReportCcy",
  "CollateralCcy",
  "Allocations",
  "Exposure",
  "PotentialFutureExposure",
  "ErrorMessage"
],
"csas": [
  {
    "csaTag": "RenaCsa",
    "thresholdAmountInCollateralCcy": 6000000,
    "initialMarginAmountInCollateralCcy": 4000000,
    "minimumTransferAmountInCollateralCcy": 1000000,
    "marginCallFrequency": "Annual",
    "useCollateral": true,
    "collateralCcy": "EUR",
    "referenceEntity": "Renault",
    "counterpartyRecoveryRatePercent": 40
  }
],
"universe": [
  {
    "csaTag": "RenaCsa",
    "portfolioName": "EurIrdPortfolio",
    "instrumentType": "CapFloor",
    "instrumentDefinition": {
      "notionalCcy": "EUR",
      "startDate": "2021-01-01",
      "tenor": "3Y",
      "buySell": "Sell",
      "indexName": "ESTR",
      "interestCalculationMethod": "Dcb_Actual_360",
      "notionalAmount": 10000000,
      "interestPaymentFrequency": "SemiAnnual",
      "capStrikePercent": 0.05
    }
  }
],
"pricingParameters": {
  "valuationDate": "2022-02-15",
  "simulationCount": 1000,
  "selfAssignmentTag": "SelfTag",
  "selfRecoveryRatePercent": 40,
  "reportCcy": "EUR"
},
"marketDataAssignments": {
  "credit": {
    "defaultProbability": [
      {
        "key": {
          "referenceEntity": "Renault"
        },
        "assignmentTag": "RenaCdsCurve"
```

```
        },
        {
          "key": {
            "referenceEntity": "BondCurve"
          },
          "assignmentTag": "SelfTag"
        }
      ]
    }
  },
  "marketData": {
    "creditCurves": [
      {
        "assignmentTag": "RenaCdsCurve",
        "curveDefinition": {
          "referenceEntity": "RENA.PA"
        },
        "curveParameters": {
          "recoveryRatePercent": 40.0
        },
        "points": [
          {
            "spreadBp": 50,
            "tenor": "5Y"
          },
          {
            "spreadBp": 60,
            "tenor": "7Y"
          },
          {
            "spreadBp": 70,
            "tenor": "10Y"
          }
        ]
      },
      {
        "assignmentTag": "SelfTag",
        "curveDefinition": {
          "referenceEntity": "AIR.PA"
        },
        "curveParameters": {
          "recoveryRatePercent": 40.0
        },
        "points": [
          {
            "spreadBp": 50,
            "tenor": "5Y"
          }
        ]
      }
    ]
  }
}
```

Interest Rate curve points

You can override curve points specifying rate percent and curve point with the start and end dates.

Example request

```
{
  "outputs": [
    "Data",
    "Statuses",
    "Headers",
    "MarketData"
  ],
  "fields": [
    "CsaTag",
    "DiscountCurveName",
    "DiscountCurveId",
    "MarketValueInReportCcyArray",
    "BilateralCvaInReportCcy",
    "UnilateralCvaInReportCcy",
    "BilateralDvaInReportCcy",
    "UnilateralDvaInReportCcy",
    "ReportCcy",
    "CollateralCcy",
    "ErrorMessage"
  ],
  "csas": [
    {
      "csaTag": "RenaCsa",
      "thresholdAmountInCollateralCcy": 6000000,
      "initialMarginAmountInCollateralCcy": 4000000,
      "minimumTransferAmountInCollateralCcy": 1000000,
      "marginCallFrequency": "Annual",
      "useCollateral": true,
      "collateralCcy": "EUR",
      "referenceEntity": "Renault",
      "counterpartyRecoveryRatePercent": 40
    }
  ],
  "universe": [
    {
      "csaTag": "RenaCsa",
      "portfolioName": "EurIrdPortfolio",
      "instrumentType": "CapFloor",
      "instrumentDefinition": {
        "notionalCcy": "EUR",
        "startDate": "2021-01-01",
        "tenor": "3Y",
        "buySell": "Sell",
        "indexName": "ESTR",
        "interestCalculationMethod": "Dcb_Actual_360",
        "notionalAmount": 10000000,
        "interestPaymentFrequency": "SemiAnnual",
        "capStrikePercent": 0.05
      }
    }
  ],
```

```
"pricingParameters": {
  "valuationDate": "2022-02-15",
  "simulationCount": 1000,
  "selfAssignmentTag": "SelfTag",
  "selfRecoveryRatePercent": 40,
  "reportCcy": "EUR"
},
"marketDataAssignments": {
  "credit": {
    "defaultProbability": [
      {
        "key": {
          "referenceEntity": "Renault"
        },
        "assignmentTag": "RenaCdsCurve"
      },
      {
        "key": {
          "referenceEntity": "BondCurve"
        },
        "assignmentTag": "SelfTag"
      }
    ]
  },
  "rates": {
    "discount": [
      {
        "key": {
          "currency": "EUR"
        },
        "assignmentTag": "SelfTag"
      }
    ]
  }
},
"marketData": {
  "creditCurves": [
    {
      "assignmentTag": "RenaCdsCurve",
      "curveDefinition": {
        "referenceEntity": "RENA.PA"
      },
      "curveParameters": {
        "recoveryRatePercent": 40.0
      },
      "points": [
        {
          "spreadBp": 50,
          "tenor": "5Y"
        },
        {
          "spreadBp": 60,
          "tenor": "7Y"
        },
        {
          "spreadBp": 70,
          "tenor": "10Y"
```

```
          }
        ]
      },
      {
        "assignmentTag": "SelfTag",
        "curveDefinition": {
          "referenceEntity": "AIR.PA"
        },
        "curveParameters": {
          "recoveryRatePercent": 40.0
        },
        "points": [
          {
            "spreadBp": 50,
            "tenor": "5Y"
          }
        ]
      }
    ],
    "interestRateCurves": [
      {
        "assignmentTag": "SelfTag",
        "curveDefinition": {
          "currency": "EUR",
          "discountingTenor": "OIS"
        },
        "points": [
          {
            "startDate": "2020-10-15",
            "endDate": "2020-10-15",
            "ratePercent": 2
          },
          {
            "startDate": "2020-10-15",
            "endDate": "2021-10-15",
            "ratePercent": 2
          },
          {
            "startDate": "2020-10-15",
            "endDate": "2040-10-15",
            "ratePercent": 2
          }
        ]
      }
    ]
  }
}
```

Calibration parameters

In CVA pricing the **Hull and White Model** calibration is used. Calibration involves finding values of parameters such that the model is able to reproduce (as close as possible) the prices of the "calibration instruments" observed in the market.

You can customize such parameters as the mean reversion, strike percent, the calibration period and frequency in the calibration parameters.

Example request


```
{
  "outputs": [
    "Headers",
    "Data",
    "MarketData"
  ],
  "fields": [
    "CsaTag",
    "BilateralCvaInReportCcy",
    "BilateralDvaInReportCcy",
    "UnilateralCvaInReportCcy",
    "UnilateralDvaInReportCcy",
    "MarketValueInReportCcyArray",
    "ErrorMessage"
  ],
  "csas": [
    {
      "csaTag": "totalCsa",
      "referenceEntity": "BA",
      "collateralCcy": "EUR",
      "counterpartyRecoveryRatePercent": 40,
      "initialMarginAmountInCollateralCcy": 10000,
      "minimumTransferAmountInCollateralCcy": 50000,
      "marginCallFrequency": "Annual",
      "thresholdAmountInCollateralCcy": 1000,
      "useCollateral": true
    },
    {
      "csaTag": "csaTag2",
      "referenceEntity": "RENA.PA",
      "collateralCcy": "EUR",
      "counterpartyRecoveryRatePercent": 40,
      "initialMarginAmountInCollateralCcy": 10000,
      "minimumTransferAmountInCollateralCcy": 50000,
      "marginCallFrequency": "Annual",
      "thresholdAmountInCollateralCcy": 1000,
      "useCollateral": true
    }
  ],
  "universe": [
    {
      "instrumentType": "Swap",
      "csaTag": "totalCsa",
      "instrumentDefinition": {
        "startDate": "2022-11-14",
        "endDate": "2027-11-15",
        "legs": [
          {
            "accruedCalculationMethod": "Dcb_Actual_360",
            "adjustInterestToPaymentDate": "Adjusted",
            "direction": "Paid",
```

```
        "interestCalculationMethod": "Dcb_Actual_360",
        "interestPaymentFrequency": "Annual",
        "interestType": "Fixed",
        "notionalAmount": 10000000,
        "fixedRatePercent": 2.45046500828386,
        "notionalCcy": "EUR",
        "paymentBusinessDayConvention": "ModifiedFollowing"
      },
      {
        "accruedCalculationMethod": "Dcb_Actual_360",
        "adjustInterestToPaymentDate": "Adjusted",
        "direction": "Received",
        "indexFixingLag": 0,
        "indexName": "ESTR",
        "indexResetType": "InArrears",
        "indexResetFrequency": "Everyday",
        "indexTenor": "ON",
        "interestCalculationMethod": "Dcb_Actual_360",
        "interestPaymentFrequency": "Annual",
        "interestType": "Float",
        "notionalAmount": 10000000,
        "notionalCcy": "EUR",
        "paymentBusinessDayConvention": "ModifiedFollowing"
      }
    ]
  },
  "pricingParameters": {
    "useLegsSigning": true
  }
},
{
  "instrumentType": "Swap",
  "csaTag": "totalCsa",
  "instrumentDefinition": {
    "startDate": "2022-11-14",
    "endDate": "2027-11-15",
    "legs": [
      {
        "accruedCalculationMethod": "Dcb_Actual_360",
        "adjustInterestToPaymentDate": "Adjusted",
        "direction": "Paid",
        "interestCalculationMethod": "Dcb_Actual_360",
        "interestPaymentFrequency": "Annual",
        "interestType": "Fixed",
        "notionalAmount": 10000000,
        "fixedRatePercent": 2.45046500828386,
        "notionalCcy": "EUR",
        "paymentBusinessDayConvention": "ModifiedFollowing"
      },
      {
        "accruedCalculationMethod": "Dcb_Actual_360",
        "adjustInterestToPaymentDate": "Adjusted",
        "direction": "Received",
        "indexFixingLag": 0,
        "indexName": "ESTR",
        "indexResetType": "InArrears",
        "indexResetFrequency": "Everyday",
```

```
            "indexTenor": "ON",
            "interestCalculationMethod": "Dcb_Actual_360",
            "interestPaymentFrequency": "Annual",
            "interestType": "Float",
            "notionalAmount": 10000000,
            "notionalCcy": "EUR",
            "paymentBusinessDayConvention": "ModifiedFollowing"
          }
        ]
      },
      "pricingParameters": {
        "useLegsSigning": true
      }
    },
    {
      "instrumentType": "Swap",
      "csaTag": "csaTag2",
      "instrumentDefinition": {
        "startDate": "2022-11-14",
        "endDate": "2027-11-15",
        "legs": [
          {
            "accruedCalculationMethod": "Dcb_Actual_360",
            "adjustInterestToPaymentDate": "Adjusted",
            "direction": "Paid",
            "interestCalculationMethod": "Dcb_Actual_360",
            "interestPaymentFrequency": "Annual",
            "interestType": "Fixed",
            "notionalAmount": 10000000,
            "fixedRatePercent": 2.45046500828386,
            "notionalCcy": "EUR",
            "paymentBusinessDayConvention": "ModifiedFollowing"
          },
          {
            "accruedCalculationMethod": "Dcb_Actual_360",
            "adjustInterestToPaymentDate": "Adjusted",
            "direction": "Received",
            "indexFixingLag": 0,
            "indexName": "ESTR",
            "indexResetType": "InArrears",
            "indexResetFrequency": "Everyday",
            "indexTenor": "ON",
            "interestCalculationMethod": "Dcb_Actual_360",
            "interestPaymentFrequency": "Annual",
            "interestType": "Float",
            "notionalAmount": 10000000,
            "notionalCcy": "EUR",
            "paymentBusinessDayConvention": "ModifiedFollowing"
          }
        ]
      },
      "pricingParameters": {
        "useLegsSigning": true
      }
    }
  ],
  "pricingParameters": {
```

```
  "valuationDate": "2022-11-10",
  "simulationCount": 400,
  "selfAssignmentTag": "SelfTag",
  "selfRecoveryRatePercent": 90,
  "reportCcy": "EUR",
  "calibrationParameters": [
    {
      "csaTag": "totalCsa",
      "currencies": {
        "EUR": {
          "meanReversionPercent": 3.0,
          "discretization": {
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