CCS Calculator

Discount Factor Method

User Guide & Calculation Formulae

English

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1 November 2026

This documentation describes the Cross-Currency Swap Calculator with discount-factor-based risk assessment. The calculator implements the DF method, in which discount factors serve as risk factors. This provides a more intuitive and mathematically elegant alternative to the classical rate-based method.

The documentation on this website was developed with the support of the AI Claude (Anthropic).

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Abstract

This documentation describes the Cross-Currency Swap Calculator with discount-factor-based risk assessment. The calculator implements the DF method, in which discount factors serve as risk factors. This provides a more intuitive and mathematically elegant alternative to the classical rate-based method. The calculator contains built-in EUR/USD sample data (251 trading days) from which discount factors, the covariance matrix and Value at Risk can be computed directly.

1 Overview

1.1 What is a Cross-Currency Swap?

A Cross-Currency Swap (CCS) is a financial derivative in which two parties exchange cash flows denominated in different currencies. Typically both interest payments and principal amounts are exchanged.

Key features:

- Exchange of interest payments in two currencies
- Exchange of principal amounts at inception and at maturity
- Fixed exchange rate for the principal exchange
- Both legs pay fixed interest rates

1.2 The Discount Factor Method

Core idea: The risk factors are the discount factors themselves, not the zero rates. Their daily changes are measured as logarithmic returns.

Advantages:

- Sensitivity = discounted cash flow (direct interpretation)
- No chain rule through the yield curve required
- Mathematically more elegant
- Ideal for teaching purposes

Comparison with the rate-based method:

Aspect	DF Method	Rate Method
Risk factor	$\ln DF(t)$	$r(t)$
Sensitivity	$\Delta = CF \times DF$	$\delta = \frac{\partial PV}{\partial r}$
Interpretation	Cash flow value	Rate sensitivity
Covariance	$\mathrm{Cov}(\ln DF, \ln DF)$	$\mathrm{Cov}(r, r)$

2 User Guide

The calculator has four tabs: **Swap Details**, **Market Data (DFs)**, **Data** and **Risk Metrics**. Quickest start: in the **Data** tab click **"Load sample data"**, then **"Calculate Swap"** in the **Swap Details** tab and **"Calculate Risk"** in the **Risk Metrics** tab.

2.1 Tab 1: Swap Details

2.1.1 Input Parameters

Notional amounts:

- **EUR Notional:** Principal amount in EUR (default 10,000,000)
- **USD Notional:** Principal amount in USD (default 11,000,000)

Interest rates (fixed rates):

- **EUR Fixed Rate:** Fixed rate for the EUR leg (default 0.035 = 3.5%)
- **USD Fixed Rate:** Fixed rate for the USD leg (default 0.045 = 4.5%)

FX rate (EUR per 1 USD):

- Price of 1 USD in EUR, e.g. 0.909091 means 1 USD = 0.909091 EUR (equivalent to 1.10 USD per EUR)
- Default: 0.909091
- When sample or curve data are loaded, the FX rate of the last row is used and the USD notional is set to the market-consistent value $N_{USD} = N_{EUR}/FX$, rounded to 1,000

Term structure:

- **Number of payments:** Minimum 1, default 5, recommended 1–10
- **Payment frequency:**
  - 0.25 = Quarterly
  - 0.5 = Semi-annual
  - 1.0 = Annual (default)

Pay leg:

- **EUR:** We pay EUR, receive USD (default)
- **USD:** We pay USD, receive EUR

2.1.2 Running a Calculation

1. Enter parameters (optionally load sample data first, Tab 3)
2. Click button **"Calculate Swap"**
3. Results appear:
   - Result (EUR Leg PV, USD Leg PV in EUR, Net PV, USD Leg PV in USD)
   - EUR leg cash flows (table)
   - USD leg cash flows (table)
4. Optional: **"Export CSV"** to export cash flows

2.1.3 Interpreting the Results

EUR Leg PV: Present value of all EUR payments

$$PV_{EUR} = \sum_{i=1}^{n} CF_{EUR}(t_i) \times DF_{EUR}(t_i) \tag{1}$$

USD Leg PV: Present value of all USD payments (in USD and converted to EUR)

$$PV_{USD} = \sum_{i=1}^{n} CF_{USD}(t_i) \times DF_{USD}(t_i), \qquad PV_{USD}^{EUR} = PV_{USD} \times FX \tag{2}$$

Net PV: Net present value in EUR

$$\text{Net PV} = \begin{cases} PV_{USD}^{EUR} - PV_{EUR} & \text{if Pay Leg = EUR} \\ PV_{EUR} - PV_{USD}^{EUR} & \text{if Pay Leg = USD} \end{cases} \tag{3}$$

2.2 Tab 2: Market Data (DFs)

2.2.1 Source of the Discount Factors

For each payment date $t_i = i \times \Delta t$ one EUR and one USD discount factor is required:

- DF EUR 1.00Y, DF EUR 2.00Y, DF EUR 3.00Y, ...
- DF USD 1.00Y, DF USD 2.00Y, DF USD 3.00Y, ...

The fields are filled automatically:

- **Without loaded data:** from a simple template curve $r_{EUR}(t) = 3.5\% + 0.2\% \times (t-1)$ and $r_{USD}(t) = 4.5\% + 0.2\% \times (t-1)$
- **With sample or curve data:** from the yield curves of the last data row (Section 3.2)

The values can be overwritten manually. Manual changes apply until the number of payments or the frequency is changed.

2.2.2 Deriving DFs from Zero Rates

From continuously compounded zero rates $r(t)$:

$$DF(t) = e^{-r(t) \times t} \tag{4}$$

Example:

$$r_{EUR}(1) = 2.9\% = 0.029 \tag{5}$$

$$DF_{EUR}(1) = e^{-0.029 \times 1} = 0.971439674 \tag{6}$$

2.2.3 Key Properties

- $0 < DF(t) < 1$ for positive rates
- Monotonically decreasing: $DF(t_1) > DF(t_2)$ for $t_1 < t_2$
- $DF(0) = 1$ (today)

2.3 Tab 3: Data

This tab provides the covariance matrix for the risk calculation. There are three sources; the one used last applies. As long as no data are loaded, the calculator uses a simple default matrix (variances 9×10^{-6}, covariances 5×10^{-6}).

2.3.1 Sample Data EUR/USD (251 days)

The calculator contains realistic synthetic data from 14 Nov 2025 to 30 Oct 2026:

- **EUR swap curve** (zero-coupon, continuous) with tenors 3M, 6M, 1Y, 2Y, 3Y, 5Y, 7Y, 10Y
- **USD yield curve** (zero-coupon, continuous) with the same tenors
- **FX rate** EUR per 1 USD

Buttons:

- **"Load sample data"**: takes the curves and FX rate of the last row, sets the USD notional to the market-consistent value and calculates DFs and the covariance matrix
- **"As CSV"**: saves the data as `CCS_Sample_Data_EUR_USD_251.csv` (template for your own data)

For every day the discount factors at the payment dates are derived from the curves, then their daily log returns and the covariance matrix. If the number of payments or the frequency is changed, the calculator recalculates DFs and matrix automatically.

2.3.2 Uploading Historical Data

Your own CSV file can be loaded via the file input. The calculator recognises two formats.

Format 1 – yield curves (recommended):

```
Datum,EUR_0.25Y,...,EUR_10Y,USD_0.25Y,...,USD_10Y,FX_EURUSD
2025-11-14,1.9710,...,2.6712,3.9200,...,4.0800,0.863558
...
2026-10-30,2.5916,...,3.2451,3.5500,...,3.9800,0.896138
```

- Tenors with `M` (months) or `Y` (years), e.g. `EUR_3M` or `EUR_0.25Y`
- Rates as continuously compounded zero rates in percent
- FX as the price of 1 USD in EUR
- At least 30 complete rows, 251 recommended
- The tenors need not match the payment dates; values are interpolated

Format 2 – discount factors directly:

```
EUR_DF_1Y,...,EUR_DF_5Y,USD_DF_1Y,...,USD_DF_5Y,FX_EURUSD
0.971157,...,0.857474,0.966088,...,0.835270,0.896138
...
```

- One EUR and one USD DF column per payment date, FX last
- Number of columns $= 2n + 1$ (where n = number of payments)

- At least 2 data rows, 100–250 recommended

Applies to both formats:

- **Location:** The file must be stored locally on your computer (or a drive connected to it). Download online files first.
- **Privacy:** The file is processed only in your browser and is not uploaded.
- **Rows:** one trading day per row, in ascending chronological order; the last row provides the current values.
- **Separator:** comma or semicolon; with semicolon a decimal comma is allowed (e.g. German Excel export). Encoding UTF-8.

Logarithmic returns are calculated from the time series:

$$R_{t,i} = \ln\left(\frac{X_{t,i}}{X_{t-1,i}}\right), \qquad X \in \{DF_{EUR}, DF_{USD}, FX\} \tag{7}$$

The covariance matrix is estimated from them (Section 3.4.2).

2.3.3 Generating Synthetic Data

Button: "Generate Synthetic Data"
Generates correlated time series of the current discount factors and the FX rate:

- 250 days (1 trading year)
- Volatility: 1% p.a. for all factors
- Correlation: 0.3 for all pairs (Cholesky decomposition)
- Fixed random seed: the same series, and therefore the same VaR, on every click

Synthetic data are for illustration only; the sample data provide realistic values.

2.4 Tab 4: Risk Metrics

2.4.1 Running the Risk Calculation

Prerequisites:

- Swap parameters set (Tab 1)
- Covariance matrix available (Tab 3 or default matrix)

Button: "Calculate Risk"
Computes:

1. DF sensitivities (deltas) and FX delta
2. Portfolio variance (1-day)
3. Portfolio volatility (1-day)
4. Value at Risk (VaR 95% and 99%, 1-day)

2.4.2 Interpreting the Results

DF sensitivities (deltas): For each payment date t_i

$$\Delta_i = CF(t_i) \times DF(t_i) = \text{discounted cash flow (in EUR)} \tag{8}$$

FX delta: Sum of the USD present values in EUR

$$\Delta_{FX} = \sum_{i=1}^{n} \Delta_{USD,i} \tag{9}$$

It gives the change in value in EUR per unit log return of the FX rate. Rule of thumb: if the USD falls by 1%, the present value changes by about $-0.01 \times \Delta_{FX}$.

Signs:

- Negative: We pay this currency → loss when the DF rises
- Positive: We receive this currency → gain when the DF rises

Portfolio variance (1-day):

$$\sigma_P^2 = \boldsymbol{\Delta}^\top \boldsymbol{\Sigma} \boldsymbol{\Delta} \tag{10}$$

where:

- $\boldsymbol{\Delta}$ = vector of all sensitivities (EUR deltas, USD deltas, FX delta)
- $\boldsymbol{\Sigma}$ = covariance matrix of the daily log returns

Portfolio volatility (1-day):

$$\sigma_P = \sqrt{\sigma_P^2} \tag{11}$$

Value at Risk (1-day):

$$VaR_\alpha = z_\alpha \times \sigma_P \tag{12}$$

where:

- $z_{0.95} = 1.645$ (95% confidence)
- $z_{0.99} = 2.326$ (99% confidence)

For a horizon of h days, multiply the 1-day VaR by $\sqrt{h}$ (Section 3.4.4).

2.4.3 Covariance Matrix Display

The covariance matrix is displayed in tabular form (first 6×6 entries):

- Rows/columns: EUR DFs, USD DFs, FX
- Values in scientific notation (e.g. 9.00×10^{-6})
- Diagonal: variances
- Off-diagonal: covariances

2.4.4 CSV Export

Button: "Export CSV"

Exports:

1. DF sensitivities (all tenors) and FX delta
2. Value at Risk metrics
3. **Complete covariance matrix**

3 Calculation Formulae

3.1 Swap Valuation

3.1.1 Cash Flow Calculation

EUR leg:

$$CF_{EUR}(t_i) = N_{EUR} \times r_{fix,EUR} \times \Delta t + \mathbb{1}_{i=n} \times N_{EUR} \tag{13}$$

$$= \text{interest payment} + \text{principal (final payment only)} \tag{14}$$

USD leg:

$$CF_{USD}(t_i) = N_{USD} \times r_{fix,USD} \times \Delta t + \mathbb{1}_{i=n} \times N_{USD} \tag{15}$$

where:

- N = notional (principal amount)
- r_{fix} = fixed rate
- Δt = payment frequency in years
- $\mathbb{1}_{i=n}$ = indicator (1 for the last payment, otherwise 0)

3.1.2 Present Value Calculation

EUR leg:

$$PV_{EUR} = \sum_{i=1}^{n} CF_{EUR}(t_i) \times DF_{EUR}(t_i) \tag{16}$$

USD leg (in EUR):

$$PV_{USD}^{EUR} = \left[\sum_{i=1}^{n} CF_{USD}(t_i) \times DF_{USD}(t_i) \right] \times FX \tag{17}$$

with FX = EUR per 1 USD.

Net present value:

$$\text{Net PV} = PV_{receive} - PV_{pay} \tag{18}$$

3.2 Discount Factors from Yield Curves

When curve data are loaded, the zero rate $r(t)$ for each day and each payment date t is determined from the curve points $T_1 < \cdots < T_m$:

- $t = T_k$: curve value
- $T_k < t < T_{k+1}$: linear interpolation

$$r(t) = r_k + (r_{k+1} - r_k) \frac{t - T_k}{T_{k+1} - T_k} \tag{19}$$

- $t > T_m$: flat, $r(t) = r_m$
- $t < T_1$: linear in the discount factor between $DF(0) = 1$ and $DF(T_1)$

Then $DF(t) = e^{-r(t)\,t}$. The DFs of the last row are the current market data (Tab 2).

3.3 Sensitivities

3.3.1 Definition

As the covariance matrix is estimated from log returns, the matching sensitivity is the derivative of the present value with respect to the logarithm of the risk factor:

$$\Delta_i = \frac{\partial PV}{\partial \ln DF_i} = DF_i \times \frac{\partial PV}{\partial DF_i} \tag{20}$$

3.3.2 DF Sensitivities

For a single cash flow at t_i, $\partial(CF_i \cdot DF_i)/\partial DF_i = CF_i$, therefore:

$$\boxed{\Delta_i = CF(t_i) \times DF_i = \text{discounted cash flow}} \tag{21}$$

Accounting for direction (Pay EUR):

$$\Delta_{EUR,i} = -CF_{EUR}(t_i) \times DF_{EUR}(t_i) \quad \text{(negative)} \tag{22}$$
$$\Delta_{USD,i} = +CF_{USD}(t_i) \times DF_{USD}(t_i) \times FX \quad \text{(positive)} \tag{23}$$

Accounting for direction (Pay USD):

$$\Delta_{EUR,i} = +CF_{EUR}(t_i) \times DF_{EUR}(t_i) \quad \text{(positive)} \tag{24}$$
$$\Delta_{USD,i} = -CF_{USD}(t_i) \times DF_{USD}(t_i) \times FX \quad \text{(negative)} \tag{25}$$

3.3.3 FX Sensitivity

The present value depends linearly on the FX rate via $PV_{USD}^{EUR} = FX \times PV_{USD}$. For log returns of the rate:

$$\Delta_{FX} = \frac{\partial PV}{\partial \ln FX} = FX \times \frac{\partial PV}{\partial FX} = \pm PV_{USD}^{EUR} \tag{26}$$

and therefore

$$\boxed{\Delta_{FX} = \sum_{i=1}^{n} \Delta_{USD,i}} \tag{27}$$

Note: Earlier versions additionally divided this sum by FX. That yields the sensitivity in USD and does not match the log returns of the covariance matrix; for $FX < 1$ the FX risk was overstated as a result.

3.4 Risk Calculation

3.4.1 Delta Vector

$$\boldsymbol{\Delta} = [\Delta_{EUR,1}, \ldots, \Delta_{EUR,n},\ \Delta_{USD,1}, \ldots, \Delta_{USD,n},\ \Delta_{FX}]^\top \tag{28}$$

Dimension: $(2n+1) \times 1$

3.4.2 Covariance Matrix

From T daily log returns $R_{t,i}$ (sample covariance):

$$\Sigma_{ij} = \frac{1}{T-1} \sum_{t=1}^{T} \left(R_{t,i} - \bar{R}_i\right)\left(R_{t,j} - \bar{R}_j\right) \tag{29}$$

$$\mathbf{\Sigma} = \begin{bmatrix} \sigma^2_{EUR,1} & \cdots & \sigma_{EUR,1,USD,1} & \cdots & \sigma_{EUR,1,FX} \\ \vdots & \ddots & \vdots & & \vdots \\ \sigma_{USD,1,EUR,1} & \cdots & \sigma^2_{USD,1} & \cdots & \sigma_{USD,1,FX} \\ \vdots & & \vdots & \ddots & \vdots \\ \sigma_{FX,EUR,1} & \cdots & \sigma_{FX,USD,1} & \cdots & \sigma^2_{FX} \end{bmatrix} \tag{30}$$

Dimension: $(2n+1) \times (2n+1)$

3.4.3 Portfolio Variance

$$\boxed{\sigma^2_P = \mathbf{\Delta}^\top \mathbf{\Sigma} \mathbf{\Delta} = \sum_{i=1}^{2n+1} \sum_{j=1}^{2n+1} \Delta_i \Sigma_{ij} \Delta_j} \tag{31}$$

3.4.4 Value at Risk

1-day VaR:

$$\boxed{VaR^{1d}_\alpha = z_\alpha \times \sqrt{\sigma^2_P}} \tag{32}$$

h-day VaR (square-root-of-time rule):

$$VaR^h_\alpha = VaR^{1d}_\alpha \times \sqrt{h} \tag{33}$$

Confidence levels:

Confidence	z-score
90%	1.282
95%	1.645
99%	2.326
99.9%	3.090

The calculator uses 95% and 99%.

4 Worked Example 1: Book Example (1 Year)

The book example shows every calculation step by hand with a given covariance matrix (3×3).

4.1 Given Parameters

- EUR Notional: 1,000,000
- USD Notional: 1,190,476.19
- Fixed Rate EUR: 4% (0.04)
- Fixed Rate USD: 5% (0.05)
- FX rate: 0.84 EUR per 1 USD
- Payments: 1, Frequency: 1 (annual)
- Pay Leg: EUR
- DF EUR 1Y: 0.971439674
- DF USD 1Y: 0.966183575

4.2 Step 1: Cash Flows

EUR leg:

$$CF_{EUR}(1) = 1{,}000{,}000 \times 0.04 \times 1 + 1{,}000{,}000 \tag{34}$$
$$= 40{,}000 + 1{,}000{,}000 = 1{,}040{,}000 \text{ EUR} \tag{35}$$

USD leg:

$$CF_{USD}(1) = 1{,}190{,}476.19 \times 0.05 \times 1 + 1{,}190{,}476.19 \tag{36}$$
$$= 59{,}523.81 + 1{,}190{,}476.19 = 1{,}250{,}000 \text{ USD} \tag{37}$$

4.3 Step 2: Present Values

EUR leg:

$$PV_{EUR} = 1{,}040{,}000 \times 0.971439674 \tag{38}$$
$$= 1{,}010{,}297.26 \text{ EUR} \tag{39}$$

USD leg (in EUR):

$$PV_{USD}^{EUR} = 1{,}250{,}000 \times 0.966183575 \times 0.84 \tag{40}$$
$$= 1{,}207{,}729.47 \times 0.84 \tag{41}$$
$$= 1{,}014{,}492.75 \text{ EUR} \tag{42}$$

Net PV:

$$\text{Net PV} = PV_{USD}^{EUR} - PV_{EUR} \tag{43}$$
$$= 1{,}014{,}492.75 - 1{,}010{,}297.26 \tag{44}$$
$$= 4{,}195.49 \text{ EUR} \tag{45}$$

4.4 Step 3: Sensitivities

Since we pay EUR (Pay EUR):

EUR delta:

$$\Delta_{EUR} = -CF_{EUR}(1) \times DF_{EUR}(1) \tag{46}$$
$$= -1{,}040{,}000 \times 0.971439674 \tag{47}$$
$$= -1{,}010{,}297.26 \text{ EUR} \tag{48}$$

USD delta:

$$\Delta_{USD} = +CF_{USD}(1) \times DF_{USD}(1) \times FX \tag{49}$$
$$= +1{,}250{,}000 \times 0.966183575 \times 0.84 \tag{50}$$
$$= +1{,}014{,}492.75 \text{ EUR} \tag{51}$$

FX delta:

$$\Delta_{FX} = \Delta_{USD} = 1{,}014{,}492.75 \text{ EUR} \tag{52}$$

4.5 Step 4: VaR Calculation

Covariance matrix (from book):

$$\boldsymbol{\Sigma} = \begin{bmatrix} 9\times10^{-6} & 5\times10^{-6} & 3\times10^{-6} \\ 5\times10^{-6} & 9\times10^{-6} & 3\times10^{-6} \\ 3\times10^{-6} & 3\times10^{-6} & 1\times10^{-5} \end{bmatrix} \tag{53}$$

Delta vector:

$$\boldsymbol{\Delta} = \begin{bmatrix} -1{,}010{,}297.26 \\ 1{,}014{,}492.75 \\ 1{,}014{,}492.75 \end{bmatrix} \tag{54}$$

Portfolio variance:

$$\sigma_P^2 = \boldsymbol{\Delta}^\top \boldsymbol{\Sigma} \boldsymbol{\Delta} \tag{55}$$

$$\approx 18{,}517{,}166 \tag{56}$$

Portfolio volatility:

$$\sigma_P = \sqrt{18{,}517{,}166} \tag{57}$$

$$= 4{,}303.16 \text{ EUR} \tag{58}$$

Value at Risk (1-day):

$$VaR^{1d}_{95\%} = 1.645 \times 4{,}303.16 = 7{,}078.69 \text{ EUR} \tag{59}$$

$$VaR^{1d}_{99\%} = 2.326 \times 4{,}303.16 = 10{,}009.14 \text{ EUR} \tag{60}$$

Scaling to 10 days:

$$VaR^{10d}_{99\%} = 2.326 \times 4{,}303.16 \times \sqrt{10} = 31{,}651.69 \text{ EUR} \tag{61}$$

5 Worked Example 2: Built-in Sample Data (5 Years)

This example can be reproduced directly in the calculator: **Data** tab → **"Load sample data"**, all other inputs at their defaults.

5.1 Parameters

- EUR Notional: 10,000,000; Fixed Rate EUR: 3.5%
- USD Notional: 11,159,000 (market-consistent: 10,000,000/0.896138, rounded); Fixed Rate USD: 4.5%
- FX rate: 0.896138 EUR per 1 USD (30 Oct 2026)
- 5 payments, annual; Pay Leg: EUR
- Covariance matrix: 11×11, from 250 daily log returns

Curves on 30 Oct 2026 (zero-coupon, continuous, %):

	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y
EUR (swap)	2.5916	2.7609	2.9267	3.0352	3.0246	3.0753	3.1377	3.2451
USD	3.5500	3.5000	3.4500	3.4000	3.4500	3.6000	3.7800	3.9800

The 4Y rate is interpolated linearly between 3Y and 5Y.

5.2 Cash Flows, Discount Factors and Present Values

t	DF_{EUR}	DF_{USD}	CF_{EUR}	CF_{USD}	PV_{EUR}	PV_{USD}^{EUR}
1	0.971157	0.966088	350,000	502,155	339,905.00	434,739.92
2	0.941102	0.934260	350,000	502,155	329,385.62	420,417.38
3	0.913257	0.901676	350,000	502,155	319,639.93	405,754.37
4	0.885150	0.868489	350,000	502,155	309,802.55	390,820.34
5	0.857474	0.835270	10,350,000	11,661,155	8,874,850.76	8,728,577.15
Σ					10,173,583.86	10,380,309.17

$$PV_{USD} = 11{,}583{,}382.43 \text{ USD} \tag{62}$$

$$\text{Net PV} = 10{,}380{,}309.17 - 10{,}173{,}583.86 = 206{,}725.31 \text{ EUR} \tag{63}$$

The English calculator reads the DFs from the input fields rounded to six decimals; its Net PV therefore differs by a few euros (about 206,717 EUR).

5.3 Sensitivities

The EUR deltas are the negative EUR present values in the table, the USD deltas the USD present values in EUR. The FX delta is their sum:

$$\Delta_{FX} = 10{,}380{,}309.17 \text{ EUR} \tag{64}$$

5.4 Value at Risk

Metric	**Value**
Portfolio variance (1d)	2.3288×10^9
Portfolio volatility (1d)	48,257.66 EUR
VaR 95% (1d)	79,383.85 EUR
VaR 99% (1d)	112,247.32 EUR
VaR 99% (10d)	354,957.20 EUR

Interpretation: With the rate deltas alone the 99% VaR (1d) would be 58,470 EUR, with the FX delta alone 97,278 EUR. FX risk dominates: the daily volatility of the FX rate in the sample data is 0.40%, that of the 5-year DF 0.22% (EUR) and 0.28% (USD).

6 Frequently Asked Questions

6.1 Why do the deltas have different signs?

The signs of the sensitivities reflect our position:

- **Negative:** We pay this currency → higher DFs are bad for us
- **Positive:** We receive this currency → higher DFs are good for us

6.2 How do I interpret the covariance matrix?

- **Diagonal:** Variances of the daily log returns of the individual risk factors
- **Off-diagonal:** Covariances between risk factors
- **Positive covariance:** Risk factors move together
- **Negative covariance:** Risk factors move in opposite directions

6.3 Why is the FX delta so large?

The FX delta is the sum of all USD present values in EUR, including the principal at maturity. It is therefore as large as the entire USD leg, whereas each rate delta covers only one payment date. In addition, FX rates usually fluctuate more than discount factors. FX risk therefore generally dominates the VaR of a CCS.

6.4 Are the synthetic data the same every time?

Yes. The random number generator uses a fixed seed, so identical inputs always produce the same series and the same VaR. Use the sample data or your own data for realistic values.

6.5 Difference from zero-rate-based methods?

DF method:

- Risk factors = discount factors (log returns)
- Sensitivity = discounted cash flow
- Direct interpretation

Rate method:

- Risk factors = zero rates
- Sensitivity via chain rule: $\delta_i = \frac{\partial PV}{\partial DF_i} \times \frac{\partial DF_i}{\partial r_i} = -t_i \times CF_i \times DF_i$
- Market standard, better data availability

With a correct transformation of the covariance matrices both methods are approximately equivalent, since $\Delta \ln DF(t) = -t \times \Delta r(t)$.

7 Troubleshooting

7.1 CSV Upload Does Not Work

Problem: "Expected X columns, found Y" (format 2)
Solution:

- Check: number of columns $= 2n + 1$
- For 1 payment: 3 columns; for 5 payments: 11 columns
- Or use format 1 (yield curves); the number of columns is then independent of the number of payments

Problem: "only X complete rows" (format 1)
Solution: At least 30 rows without empty or non-numeric values; 251 recommended.
Problem: File is not recognised as yield curves
Solution:

- Check the header: columns `EUR_<tenor>`, `USD_<tenor>` and a column starting with `FX`
- Tenor with `M` or `Y`, e.g. `EUR_6M`, `USD_10Y`
- Save the sample data via "As CSV" and use it as a template

Problem: Parsing error
Solution:

- With comma as separator: use a decimal point
- With semicolon as separator: a decimal comma is allowed
- No thousands separators or spaces within numbers

7.2 Discount Factors Not Monotonically Decreasing

Problem: $DF(1Y) < DF(2Y)$
Solution:

- Discount factors must decrease monotonically for positive rates
- Check: have you perhaps entered rates instead of DFs?
- Conversion: $DF(t) = e^{-r(t)\times t}$

7.3 VaR Values Are Unrealistic

Problem: VaR too high or too low
Solution:

- Check which covariance matrix is active (default, synthetic, sample or your own data)
- Enter the FX rate as EUR per 1 USD (not USD per EUR)
- Choose a USD notional consistent with the FX rate
- Historical data: use more data points

8 Appendix

8.1 Mathematical Notation

Symbol	Meaning
N	Notional (principal amount)
r_{fix}	Fixed rate
$r(t)$	Zero rate (continuous) for maturity t
$DF(t)$	Discount factor at time t
$CF(t)$	Cash flow at time t
FX	FX rate, EUR per 1 USD
PV	Present value
$R_{t,i}$	Log return of factor i on day t
Δ	Sensitivity (delta)
$\mathbf{\Sigma}$	Covariance matrix
σ_P^2	Portfolio variance
σ_P	Portfolio volatility
VaR_α	Value at Risk at confidence level α
z_α	z-score for confidence level α
h	Time horizon in days

8.2 Technical Specifications

Browser compatibility:

- Chrome/Edge, Firefox, Safari: fully supported
- All calculations run locally in the browser; no data are transmitted

Files:

- Calculator: approx. 70 KB (HTML, sample data built in)
- Sample data as CSV: approx. 33 KB (251 rows, 17 data columns)

Limits:

- Max. payments: 30 (input field), recommended 1–20
- Yield-curve CSV: at least 30 rows, 251 recommended
- DF CSV: at least 2 rows, 100–250 recommended