Forward Swap VaR Calculator

User Manual with Worked Example

English

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Interface layout, time series file format, step-by-step operation, results and CSV export – with a complete worked example. Companion document: *Mathematical Foundations*.

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1 Purpose of the Calculator

The calculator values a **forward starting payer swap** (pay fixed, receive floating) and measures its interest rate risk. It provides

- the present value and the cash flow schedule,
- DV01, modified duration and convexity,
- a parametric Value at Risk based on a historical yield time series of at least 251 trading days,
- the covariance and correlation matrix of the risk factors (in the CSV export).

This manual refers to the English version of the calculator and quotes its labels exactly as they appear on screen.

1.1 Requirements

- A current web browser (Chrome, Edge, Firefox, Safari). The file is opened locally; no internet connection is required and no data is transmitted.
- A CSV file with the historical yield time series (Section 3) or one of the two built-in sample series (Section 3.3).
- The link ← **Back to risk management** at the bottom of the page points to the file `../risk-management_en.html`. It only works if the calculator sits in that folder structure.

2 Interface Layout

The page has two columns: all inputs on the left, results on the right. On narrow screens (below 1024 pixels wide) the two areas are stacked.

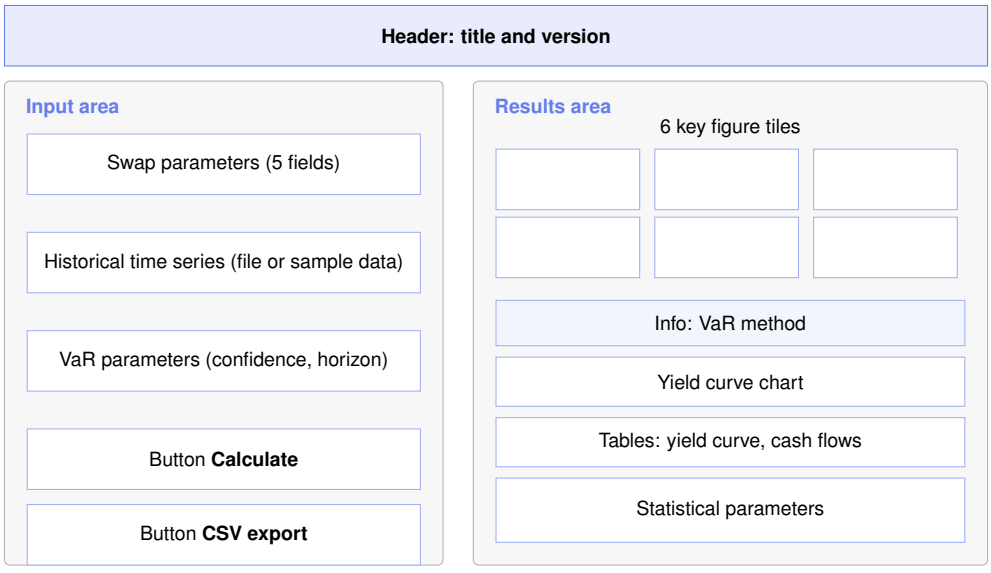


Figure 1: Schematic layout of the interface

2.1 Input fields

Field	Default	Meaning and input
Notional (EUR)	1000000	Notional N, with or without thousands separators (see note).
Fixed rate (% p.a.)	3.5	Fixed rate K in percent; comma or point as decimal separator.
Forward start (years)	2	Start T_0 of the swap from today, e.g. 1.5.
Tenor / term (years)	3	Term T from T_0. The swap ends at $T_0 + T$.
Payment frequency	Annually	*Annually*, *Semi-annually* or *Quarterly* ($f = 1, 2, 4$).
Time series file (251 days)	–	CSV file with at least 251 days (Section 3).
Sample data	Sample EUR yield curve	Alternatively a built-in time series (Section 3.3).
Confidence level (%)	99 %	95 %, 99 % or 99.9 %.
Time horizon (days)	1	Holding period h in trading days (integer ≥ 1).

Note: thousands separators

The notional can be entered with or without thousands separators, e.g. `1,000,000` or `1000000`. In the other fields a comma or a point is accepted as decimal separator.

Number of payments

The calculator creates $n = \lfloor T \cdot f \rfloor$ payments on the dates $T_0 + 1/f$, $T_0 + 2/f, \ldots$ An incomplete stub period (e.g. $T = 2.3$ with annual payments) is dropped.

3 The Time Series File

3.1 Format

- **Header row:** `Datum,1Y,2Y,3Y,4Y,5Y`. The column names after the date are maturities in years; the `Y` is stripped. Other or additional pillars are possible (e.g. `0.5Y,1Y,2Y,5Y,10Y`); they must be sorted in ascending order.
- **Data rows:** at least 251, in ascending chronological order (oldest first). All rows are used.
- **Rates** in percent, e.g. `2.5000` for 2.5 %. They are interpreted as continuously compounded zero rates.
- **Separator:** comma or semicolon.
- **Decimal separator:** point. A decimal comma is not possible, because the comma also acts as a column separator.
- Rows containing unreadable numbers are skipped.

Current yield curve

The **last row** of the file is the current yield curve. It is used to value the swap. There is no separate input for the curve.

3.2 Example

Excerpt from the example file `zinszeitreihe_beispiel.csv` (252 rows including header):

```
Datum,1Y,2Y,3Y,4Y,5Y
2025-10-14,1.3803,1.5882,1.6301,1.7438,1.8834
2025-10-15,1.4127,1.6226,1.6729,1.7860,1.9364
...
2026-09-28,2.1767,2.3175,2.4714,2.5919,2.6999
2026-09-29,2.2000,2.3500,2.5000,2.6200,2.7200
```

Note: exporting from Excel

With German (and many other European) regional settings, Excel saves CSV files with a semicolon and a decimal comma (`2,5000`). The semicolon is accepted, the decimal comma is not. Set the decimal separator to a point before exporting (File → Options → Advanced → clear "Use system separators") or fix the file afterwards with find and replace.

3.3 Built-in sample data

Below the **Load time series** button is the bar **... or use sample data**. It contains two time series in the format described above (251 days each, maturities 1Y to 5Y); **Sample EUR yield curve** is preselected:

Selection	Period	File name on download
Sample EUR yield curve	2025-10-14 – 2026-09-29	`zinszeitreihe_beispiel.csv`
Euro area interest rates	2023-12-18 – 2024-12-02	`euro_zone_zinssaetze_251_tage.csv`

- **Load** adopts the selected series immediately. No file needs to be selected.
- **As CSV** saves the series as a file, e.g. as a template for your own data.
- The period is shown next to the selection. After loading, the green status message names the source (file name or sample data).

4 Step-by-Step Operation

1. **Enter the swap parameters:** notional, fixed rate, forward start, tenor and payment frequency.
2. **Load a time series:** either choose the CSV under **Time series file (251 days)** and click **Load time series**, or pick a series in the bar **... or use sample data** and click **Load**.
3. **Check:** a green message shows the source, tenors, period, number of days and the current curve adopted. Below it the curve pillars appear; on the right, the curve chart and the yield curve table with discount factors.
4. **Choose the VaR parameters:** confidence level and time horizon.
5. Click **Calculate**. The results appear on the right.
6. Optionally click **CSV export (incl. matrices)** to save all results to a file.

After changing the swap or VaR parameters, clicking **Calculate** again is sufficient. After selecting a different file or sample series, **Load time series** or **Load** must be clicked first.

5 Results

5.1 Key figure tiles

Tile	Meaning
Present Value	Present value from the payer's perspective. Green if PV ≥ 0, red if PV < 0.
DV01	$-(\mathrm{PV}_{+1\mathrm{bp}} - \mathrm{PV})$: loss if all rates rise in parallel by 1 basis point. Usually negative for a payer swap (it gains when rates rise).
Modified duration (on notional)	$D = \mathrm{DV01} \cdot 10\,000 / N$. If all rates rise by 1 percentage point, the present value changes by about $-D$ % of the notional. Negative for a payer swap.
Convexity (on notional)	Second derivative with respect to a parallel shift, relative to the notional.
Value at Risk (99%)	VaR at the chosen confidence level and horizon (absolute value); the label shows the selected level, e.g. (99.9%).
Number of payments	$n = \lfloor T \cdot f \rfloor$.

5.2 Further displays

- **Info box VaR method:** number of observations, average volatility (square root of the mean variance of the DF log returns) and average correlation of adjacent payment dates.
- **Chart:** current yield curve against maturity.
- **Current yield curve**: pillars, rate and discount factor e^{-rt}.
- **Swap cashflow details**: for each payment the time, discount factor, forward rate, fixed, floating and net cash flow, and its present value. Amounts are shown without a currency symbol (unit € in the column header); negative amounts are red with a minus sign.
- **Statistical parameters**: the same figures as in the info box, shown as tiles.

Note on the significance of the VaR

The VaR captures both the fixed *and* the floating leg of the swap. The risk factors are the discount factors at the forward start and at the payment dates; the sensitivities are the full derivatives of the present value. The VaR is therefore comparable with the DV01 (in the example EUR 3,480.51 versus roughly EUR 2,950 from DV01 $\times$ rate volatility). Details: *Mathematical Foundations*, Sections 5.4 and 6.2.

6 CSV Export

The export creates the file `Forward_Swap_VaR_Historical_<timestamp>.csv` with a semicolon as separator. The section headings in the file are in English. It contains, in order:

1. swap parameters,
2. valuation (PV),
3. risk figures (DV01, duration and convexity on notional, VaR, confidence, horizon),
4. VaR methodology (observations, volatility, correlation),
5. yield curve,
6. cash flow details,
7. sensitivities w and covariance matrix of the risk factors, labelled with the maturity, e.g. `DF(t=2.00)` (8 decimal places),
8. correlation matrix (4 decimal places).

Notes on the export

- Numbers are written with a **decimal point**. In Excel with European regional settings, import the file via "Data → From Text/CSV" and choose the locale "English (United States)"; otherwise values are recognised as text or dates.
- Covariances are of the order of 10^{-6}. With 8 decimal places only two to three significant digits remain (e.g. `0.00000181`). This precision is not sufficient for exact recalculations.

7 Worked Example

The example uses the calculator's default values. As time series it uses the built-in series **Sample EUR yield curve**, identical to the file `zinszeitreihe_beispiel.csv`. The series is **synthetic** (simulated rate changes) so that the example is reproducible. All figures were computed with the calculator's program code and are shown rounded.

7.1 Inputs

Notional N	1,000,000 EUR	Payment frequency	annual ($f = 1$, $\delta = 1$)
Fixed rate K	3.50 %	Confidence level α	99 %
Forward start T_0	2 years	Time horizon h	1 day
Tenor T	3 years	Time series	2025-10-14 – 2026-09-29

The swap starts in two years and ends in five years ("2Y×3Y").

7.2 Step 1: Load the time series and current curve

The file contains 251 days. Figure 2 shows the history; the last row (2026-09-29) is the current curve.

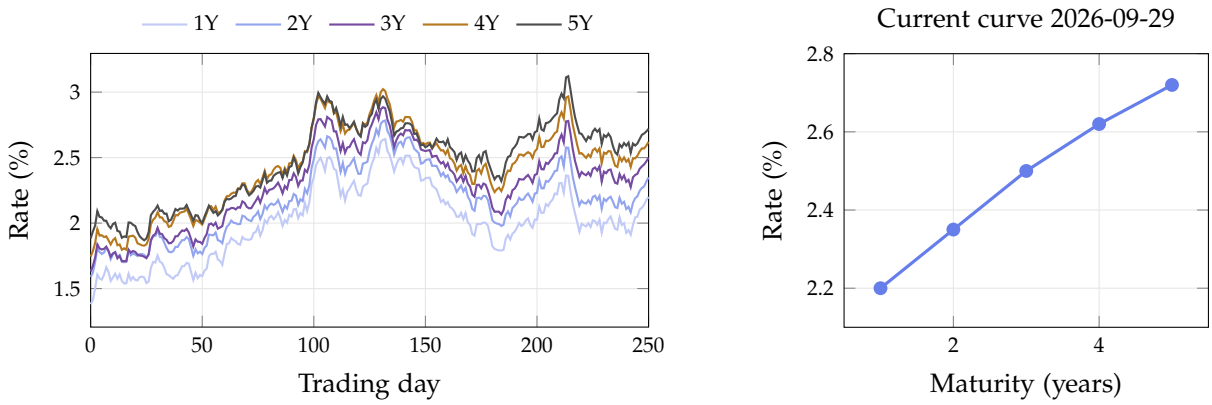


Figure 2: Historical rates (left) and current yield curve (right)

The discount factors of the current curve follow from $P(t) = e^{-rt}$:

Maturity t	Rate	$r \cdot t$	$P(t)$
1	2.20 %	0.0220	0.978240
2	2.35 %	0.0470	0.954087
3	2.50 %	0.0750	0.927743
4	2.62 %	0.1048	0.900505
5	2.72 %	0.1360	0.872843

7.3 Step 2: Payment schedule

$n = \lfloor 3 \cdot 1 \rfloor = 3$ payments on the dates $t_1 = 3,\ t_2 = 4,\ t_3 = 5$. The first accrual period starts at $t_0 = T_0 = 2$. Since all dates fall on pillars, no interpolation is needed.

7.4 Step 3: Forward rates

$$F_i = \frac{1}{\delta}\left(\frac{P(t_{i-1})}{P(t_i)} - 1\right)$$

$$F_1 = \frac{0.954087}{0.927743} - 1 = 2.8396\,\%,$$
$$F_2 = \frac{0.927743}{0.900505} - 1 = 3.0248\,\%,$$
$$F_3 = \frac{0.900505}{0.872843} - 1 = 3.1692\,\%.$$

All forward rates are below the fixed rate of 3.50 %. The payer therefore pays a net amount in every period.

7.5 Step 4: Cash flows and present value

Fixed cash flow: $N\,K\,\delta = 1{,}000{,}000 \cdot 0.035 = 35{,}000$ EUR. Floating cash flow: $N\,F_i\,\delta$.

Time	DF	Forward	Fixed CF	Floating CF	Net CF C_i	PV $C_i P(t_i)$
3	0.927743	2.8396 %	35,000.00	28,395.68	−6,604.32	−6,127.11
4	0.900505	3.0248 %	35,000.00	30,248.46	−4,751.54	−4,278.78
5	0.872843	3.1692 %	35,000.00	31,691.82	−3,308.18	−2,887.52
					Present value	**−13,293.41**

Check via the closed form.

$$\mathrm{PV}_{\mathrm{float}} = N\big(P(2) - P(5)\big) = 1{,}000{,}000 \cdot (0.954087 - 0.872843) = 81{,}244.77\ \mathrm{EUR},$$
$$\mathrm{PV}_{\mathrm{fix}} = NK\delta \sum P(t_i) = 35{,}000 \cdot 2.701091 = 94{,}538.18\ \mathrm{EUR},$$
$$\mathrm{PV} = 81{,}244.77 - 94{,}538.18 = -13{,}293.41\ \mathrm{EUR}. \quad \checkmark$$

The par swap rate is $S = 81{,}244.77 / (1{,}000{,}000 \cdot 2.701091) = 3.0079\,\%$. The agreed rate is about 49 basis points higher, hence the negative present value.

7.6 Step 5: DV01, duration, convexity

Revaluation with all rates shifted by ± 1 basis point:

$$\mathrm{PV}^{+} = -13{,}010.28\ \mathrm{EUR}, \qquad \mathrm{PV}^{-} = -13{,}576.74\ \mathrm{EUR}.$$

$$\begin{aligned}
\mathrm{DV01} &= -(\mathrm{PV}^{+} - \mathrm{PV}) = -(-13{,}010.28 + 13{,}293.41) = -283.13\,\mathrm{EUR},\\
D &= \frac{\mathrm{DV01} \cdot 10{,}000}{N} = \frac{-283.13 \cdot 10{,}000}{1{,}000{,}000} = -2.83,\\
\mathcal{C} &= \frac{\mathrm{PV}^{+} + \mathrm{PV}^{-} - 2\mathrm{PV}}{N \cdot 10^{-8}} = \frac{-0.19565}{1{,}000{,}000 \cdot 10^{-8}} = -19.56.
\end{aligned}$$

Interpretation: if all rates rise by 1 bp, the payer swap gains about 283 EUR. For a rise of 1 percentage point the duration implies about 2.83 % of the notional, i.e. roughly 28,300 EUR. The negative convexity slightly reduces this gain for large rate changes.

7.7 Step 6: DF time series and log returns

For each of the 251 days, the discount factors at $t = 2$ (forward start T_0) and $t = 3, 4, 5$ are computed from that day's curve, giving 250 daily log returns. For the last day (2026-09-28 → 2026-09-29), for example:

t_i	r on 09-28	r on 09-29	P on 09-28	P on 09-29	$x_i = \ln \frac{P_{09\text{-}29}}{P_{09\text{-}28}}$
2	2.3175 %	2.3500 %	0.954708	0.954087	−0.000650
3	2.4714 %	2.5000 %	0.928540	0.927743	−0.000858
4	2.5919 %	2.6200 %	0.901517	0.900505	−0.001124
5	2.6999 %	2.7200 %	0.873720	0.872843	−0.001005

Check: $x_i = -\Delta r \cdot t_i$, e.g. $-0.000286 \cdot 3 = -0.000858$.

7.8 Step 7: Covariance and correlation matrix

From the 250 log returns (sample covariance with denominator 249), order $t = 2, 3, 4, 5$:

$$\Sigma = 10^{-6} \cdot \begin{pmatrix} 0.841754 & 1.202812 & 1.545582 & 1.871956 \\ 1.202812 & 1.808508 & 2.365600 & 2.940823 \\ 1.545582 & 2.365600 & 3.268313 & 4.123158 \\ 1.871956 & 2.940823 & 4.123158 & 5.451721 \end{pmatrix},$$

$$\rho = \begin{pmatrix} 1 & 0.9749 & 0.9318 & 0.8738 \\ 0.9749 & 1 & 0.9730 & 0.9366 \\ 0.9318 & 0.9730 & 1 & 0.9768 \\ 0.8738 & 0.9366 & 0.9768 & 1 \end{pmatrix}.$$

Daily volatilities: $\sigma_0 = 0.0917\,\%$, $\sigma_1 = 0.1345\,\%$, $\sigma_2 = 0.1808\,\%$, $\sigma_3 = 0.2335\,\%$.

The summary figures in the info box refer to the payment dates $t = 3, 4, 5$ only:

$$\begin{aligned}
\bar{\sigma} &= \sqrt{(1.808508 + 3.268313 + 5.451721) \cdot 10^{-6}/3} = 0.1873\,\%,\\
\bar{\rho} &= (0.9730 + 0.9768)/2 = 0.9749.
\end{aligned}$$

7.9 Step 8: Sensitivities

The sensitivities are the full derivatives of the present value with respect to $\ln P(t_i)$ (*Mathematical Foundations*, Section 5.4). With $NK\delta = 35{,}000$ EUR:

$$\begin{aligned}
w_0 &= N\,P(2) = 1{,}000{,}000 \cdot 0.954087 = 954{,}087.40\,\mathrm{EUR},\\
w_1 &= -NK\delta\,P(3) = -35{,}000 \cdot 0.927743 = -32{,}471.02\,\mathrm{EUR},\\
w_2 &= -NK\delta\,P(4) = -35{,}000 \cdot 0.900505 = -31{,}517.66\,\mathrm{EUR},\\
w_3 &= -N(1 + K\delta)\,P(5) = -1{,}035{,}000 \cdot 0.872843 = -903{,}392.12\,\mathrm{EUR}.
\end{aligned}$$

Check: $\sum_i w_i = -13{,}293.41\,\mathrm{EUR} = \mathrm{PV}$.

7.10 Step 9: Portfolio variance and VaR

The portfolio variance $\sigma^2_{\text{PV}} = w^\top \Sigma w$ consists of 16 terms $w_i \Sigma_{ij} w_j$ (in EUR^2):

$i \backslash j$	0	1	2	3	Row sum
0	766,234.5	−37,263.3	−46,476.6	−1,613,466.8	−930,972.2
1	−37,263.3	1,906.8	2,421.0	86,266.3	53,330.8
2	−46,476.6	2,421.0	3,246.6	117,397.9	76,588.9
3	−1,613,466.8	86,266.3	117,397.9	4,449,244.2	3,039,441.7
				σ^2_{PV}	**2,238,389.16**

The large terms at T_0 and t_3 have opposite signs: the floating leg (start) and the fixed leg (end) partly offset each other.

$$\begin{aligned} \sigma_{\text{PV}} &= \sqrt{2{,}238{,}389.16} = 1{,}496.1247\,\text{EUR}, \\ z_{0.99} &= 2.326348, \\ \text{VaR}_{99\%,\,1\text{d}} &= 2.326348 \cdot 1{,}496.1247 \cdot \sqrt{1} = \mathbf{3{,}480.51}\,\text{EUR}. \end{aligned}$$

Other settings give, with the same σ_{PV}:

	95 %	99 %	99.9 %
Horizon 1 day	2,460.91 EUR	3,480.51 EUR	4,623.37 EUR
Horizon 10 days ($\times\sqrt{10}$)	7,782.07 EUR	11,006.33 EUR	14,620.39 EUR

7.11 Result in the calculator

Display in the calculator

Present Value	−€13,293.41	Value at Risk (99%)	€3,480.51
DV01	−€283.13	Number of payments	3
Modified duration (on notional)	−2.83	Observations	250
Convexity (on notional)	−19.56	Avg. volatility	0.1873%
		Avg. correlation	0.9749

The calculator shows amounts in US format (euro sign before the amount, comma as thousands separator) and negative values with a true minus sign.

For comparison: the simple DV01 approximation gives $2.33 \cdot 283.13\,\text{EUR} \cdot 4.48 \approx 2{,}950\,\text{EUR}$ (daily standard deviation of the 3Y rate: 4.48 bp), which is of the same order. Earlier versions of the calculator froze the net cash flows and reported only 52.18 EUR (*Mathematical Foundations*, Section 6.2).

8 Error Messages and Solutions

Message / symptom	Cause and solution
“Please select a time series file!”	No file selected. Select a file, then **Load time series**, or use the sample data.
“The time series file must contain at least 251 data rows!”	Fewer than 252 rows including header. Extend the time series.
“Not enough valid data rows found!”	Too many unreadable rows, usually due to a decimal comma or empty fields. Use a decimal point.
“Please load time series first!”	**Calculate** clicked before loading.
“Please calculate first!”	**CSV export** clicked before the calculation.
Average correlation “NaN”	Only one payment ($n = 1$); the figure is undefined in that case.
Wrong yield curve	Rows not sorted chronologically; the last row must be the most recent day.