Adenza

Model Validation Report

Calypso FX American Option Using Trinomial Tree

Version 3.2

October 26, 2023

Report Summary

This document describes validation of the FX American Option using under FXOMarket Pricer.

References

[1] Justin London, *Modeling Derivatives in C++*, 2005.

Document History

Revision History

Version Number	Revision Date	Author	Summary of Changes
1.0	8/15/2017	Chang-Cheng Yang	Initial Draft
2.0	2/22/2019	Chang-Cheng Yang	Revised
3.0	9/15/2021	Chang-Cheng Yang	Adopted comments from German Miranda & others
3.1	10/31/2022	Chang-Cheng Yang	Reformatted
3.2	10/26/2023	Chang-Cheng Yang	Adopted comments from Fabien Le Floc'h on comparison with analytic solutions

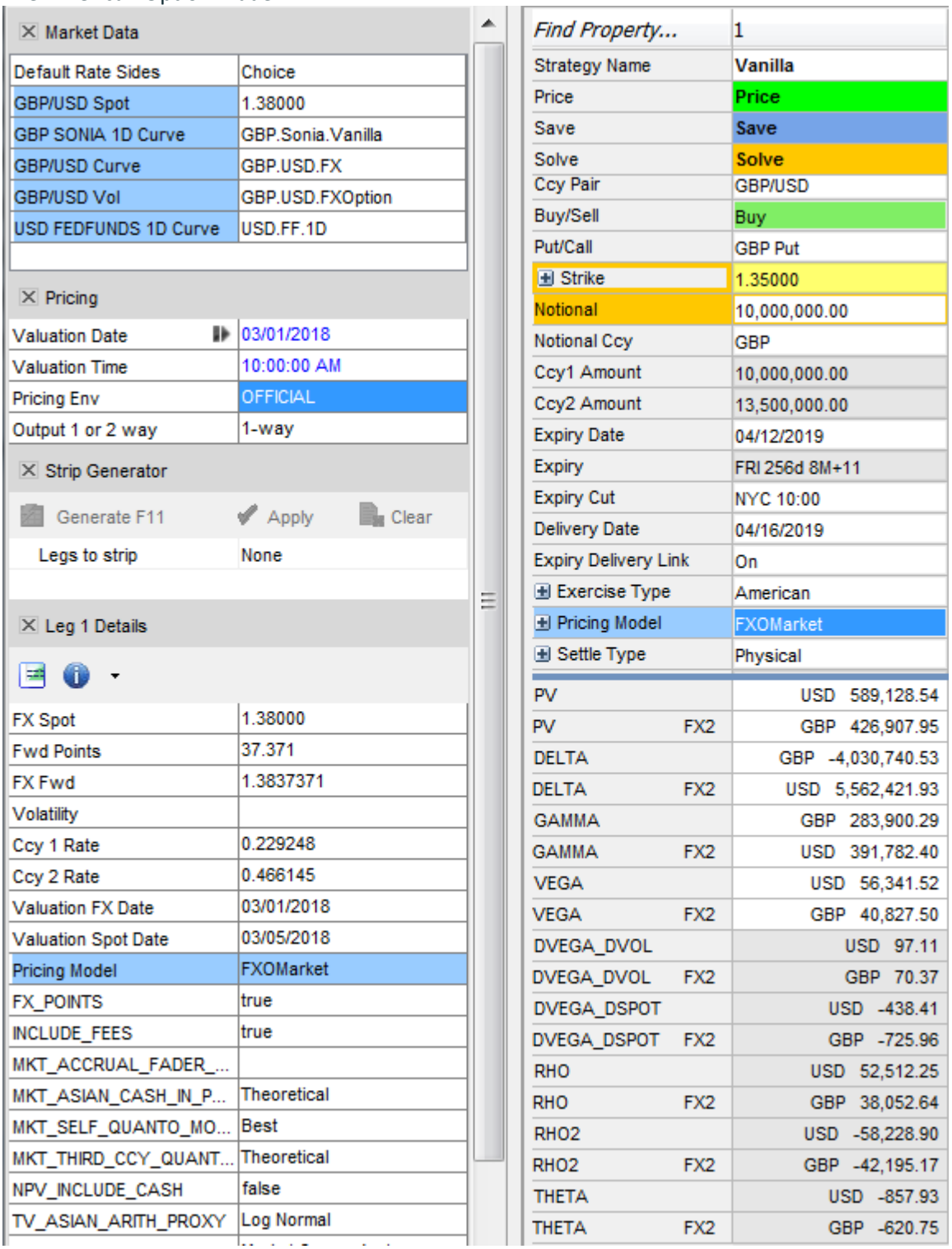
Distribution

Name	Title	Date	Version Number

Contents

Section 1. Sample Trades

The American Option Trade:



Market Data

Default Rate Sides	Choice
GBP/USD Spot	1.38000
GBP SONIA 1D Curve	GBP.Sonia.Vanilla
GBP/USD Curve	GBP.USD.FX
GBP/USD Vol	GBP.USD.FXOption
USD FEDFUNDS 1D Curve	USD.FF.1D

Pricing

Valuation Date	03/01/2018
Valuation Time	10:00:00 AM
Pricing Env	OFFICIAL
Output 1 or 2 way	1-way

Strip Generator

Generate F11 | Apply | Clear

Legs to strip	None

Leg 1 Details

FX Spot	1.38000
Fwd Points	37.371
FX Fwd	1.3837371
Volatility	
Ccy 1 Rate	0.229248
Ccy 2 Rate	0.466145
Valuation FX Date	03/01/2018
Valuation Spot Date	03/05/2018
Pricing Model	FXOMarket
FX_POINTS	true
INCLUDE_FEES	true
MKT_ACCRUAL_FADER_...	
MKT_ASIAN_CASH_IN_P...	Theoretical
MKT_SELF_QUANTO_MO...	Best
MKT_THIRD_CCY_QUANT...	Theoretical
NPV_INCLUDE_CASH	false
TV_ASIAN_ARITH_PROXY	Log Normal

Find Property...	1
Strategy Name	Vanilla
Price	Price
Save	Save
Solve	Solve
Ccy Pair	GBP/USD
Buy/Sell	Buy
Put/Call	GBP Put
Strike	1.35000
Notional	10,000,000.00
Notional Ccy	GBP
Ccy1 Amount	10,000,000.00
Ccy2 Amount	13,500,000.00
Expiry Date	04/12/2019
Expiry	FRI 256d 8M+11
Expiry Cut	NYC 10:00
Delivery Date	04/16/2019
Expiry Delivery Link	On
Exercise Type	American
Pricing Model	FXOMarket
Settle Type	Physical

PV		USD 589,128.54
PV	FX2	GBP 426,907.95
DELTA		GBP -4,030,740.53
DELTA	FX2	USD 5,562,421.93
GAMMA		GBP 283,900.29
GAMMA	FX2	USD 391,782.40
VEGA		USD 56,341.52
VEGA	FX2	GBP 40,827.50
DVEGA_DVOL		USD 97.11
DVEGA_DVOL	FX2	GBP 70.37
DVEGA_DSPOT		USD -438.41
DVEGA_DSPOT	FX2	GBP -725.96
RHO		USD 52,512.25
RHO	FX2	GBP 38,052.64
RHO2		USD -58,228.90
RHO2	FX2	GBP -42,195.17
THETA		USD -857.93
THETA	FX2	GBP -620.75

We perform a validation to tie out the PV/Delta/Gamma/Vega/Volga/Vanna/Rho/Rho2/Theta values.

Section 2. Analysis

2.1 The Trinomial Tree Construction

The method described here is similarly to Chapter 4 of [1].

The trinomial option pricing model, proposed by Phelim Boyle in 1986, is considered to be more accurate than the binomial model, and will compute the same results, but in fewer steps. The trinomial option pricing model differs from the binomial option pricing model in one key aspect by incorporating another possible value in one time period. Under the binomial option pricing model, it is assumed that the value of the underlying asset will either be greater than or less than, its current value.

The trinomial model, on the other hand, incorporates a third possible value, which incorporates a zero change in value over a time period. This assumption makes the trinomial model more relevant to real life situations, as it is possible that the value of an underlying asset may not change over a time period, such as a month or a year.

In our example, we first interpolate smile volatility from volatility surface on the expiry date time 12-April-2019 10:00:00 AM (Expiry Cut)

$$\sigma = \sigma_{Smile}(valDateTime, volSurfaceDateTime, tradeCutTime, spotFX, K, timeZone) \quad \text{(A)}$$

Using the above volatility, we determine the size of time grid from valuation date time 3/1/2018 10:00:00 AM to the expiry date time:

$$n = \max(100, 5000 * \sigma^2 T) \quad \text{(B)}$$

Note the convergence rate and stability are normally good at about 50 time-steps. In our example $n = 93$. And then the time-weighted variance together the size of time grid further determines the underlying variable exchange rate up/down move size:

$$u = e^{\sqrt{1.5*\sigma^2 T/n}}, \quad d = e^{-\sqrt{1.5*\sigma^2 T/n}} \quad \text{(C)}$$

Note that that constant value of 1.5 is suggested by (Kamrad and Ritchken 1991 quoted in [1]) which have shown that the value produces the best convergence rate.

Due to the feature of FX market where trading time is in second. For good accuracy, Calypso uses milli second as the unit – we divide the time to expiry from 1-Mar-2018 10:00:00 AM (Valuation Time) to 12-April-2019 10:00:00 AM (Expiry Cut) equally in n partitions in the unit of milli seconds: $\{t_i : i = 0, \cdots, n\}$ where

$t_0 = 1\ March\ 2018\ 10:00:00 AM$ in milli seconds

$t_n = 12\ April\ 2019\ 10:00:00 AM$ in milli seconds

$$t_i = t_0 + \frac{i}{n}(t_n - t_0),\ 0 < i < n$$

For each datetime point, t_i, where $i = 1, \cdots, n$ we interpolate the smile volatility from volatility surface:

$$\sigma_i = \sigma_{Smile}(valDateTime, volSurfaceDateTime, t_i, spotFX, K, timeZone) \quad \text{(D)}$$

We then determine the step time-weighted variance:

$$\Delta v_1 = \sigma_1^2 t_1$$
$$\Delta v_i = \sigma_i^2 t_i - \sigma_{i-1}^2 t_{i-1}, \quad i = 2, \cdots, n$$

At the valuation datetime $t_0 = \text{"1 } March \text{ 2018 10:00:00} AM\text{"}$, the FX rate S_0 (on valuation date) is calculated by

$$S_0 = spotFX * \frac{Df^Q(spotDate)}{Df^P(spotDate)} \quad \text{(E)}$$

For any datetime t_i, its FX rate is calculated by:

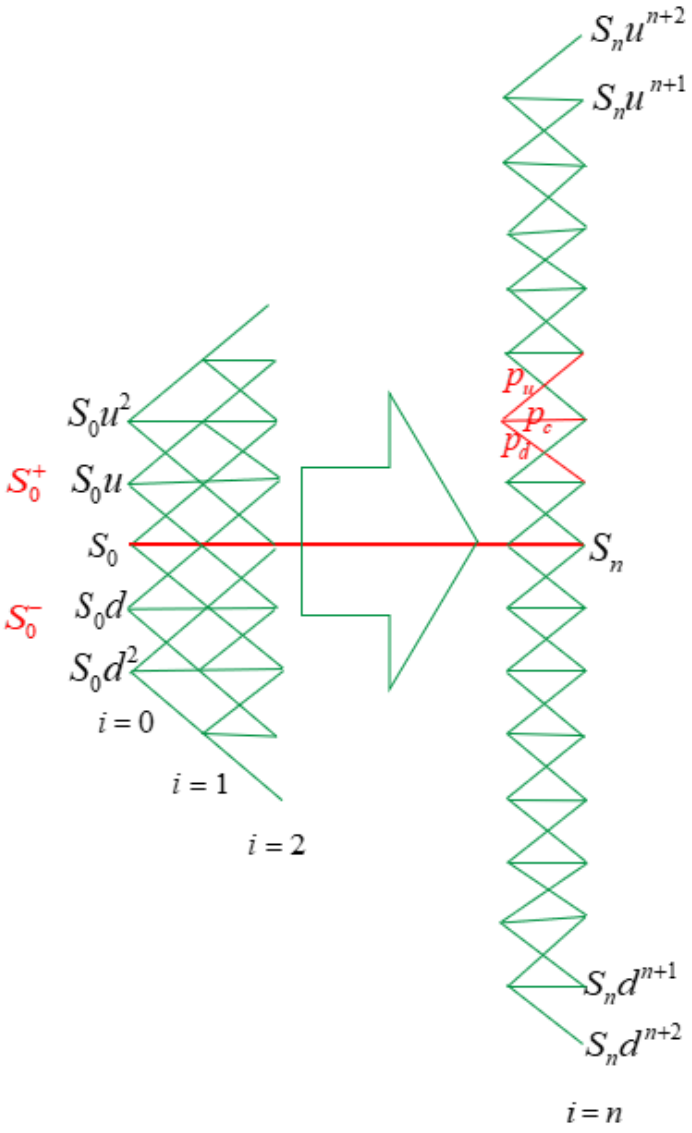
$$S_i = spotFX * \frac{Df^P(t_i)}{Df^P(spotDate)} * \frac{Df^Q(spotDate)}{Df^Q(t_i)} = S_0 * \frac{Df^P(t_i)}{Df^Q(t_i)} \quad \text{(F)}$$

We now build the trinomial tree start at $t_0 = \text{"1 } March \text{ 2018 10:00:00} AM\text{"}$ with five FX rate nodes:

$$\{S_{0,0}, S_{0,1}, S_{0,2}, S_{0,3}, S_{0,4}\} = \{S_0 d^2, S_0 d, S_0, S_0 u, S_0 u^2\}$$

At datetime t_i, it has $[2*(i+2)+1]$ FX rate nodes:

$$\{S_{i,j} = S_i u^j d^{i+2}, \quad j = 0, \cdots, 2*(i+2)\}$$



The FX rate move is assumed a martingale process:

$$dS = \sigma S dW$$

Or in a discretized expression

$$S_{i+1} = S_i e^{\varepsilon\sqrt{\sigma_{i+1}^2 t_{i+1} - \sigma_i^2 t_i}}$$

Note the first two moment functions:

$$E[S_{i+1}] = S_i$$
$$VAR[S_{i+1}] = S_i^2\left(e^{\sigma_{i+1}^2 t_{i+1} - \sigma_i^2 t_i} - 1\right)$$

When FX rates move by the time from t_i to t_{i+1}, the probabilities of FX rates move up, down, or keep the same on the trinomial tree should satisfy the following:

$$p_u + p_c + p_d = 1$$
$$p_u S_i u + p_c S_i + p_d S_i d = S_i$$
$$p_u (S_i u)^2 + p_c (S_i)^2 + p_d (S_i d)^2 - (S_i)^2 = S_i^2 \left(e^{\sigma_{i+1}^2 t_{i+1} - \sigma_i^2 t_i} - 1 \right) = S_i^2 \left(e^{\Delta v_i} - 1 \right)$$

The above equations have the following solutions:

$$p_u = \frac{e^{\Delta v_i} - 1}{(u-d)(u-1)}$$
$$p_c = 1 - p_u \frac{u-d}{1-d} \qquad \text{(G)}$$
$$p_d = p_u \frac{u-1}{1-d}$$

2.2 The Trinomial Tree Valuation

We start the valuation from the final time slice of the trinomial tree with present value of $[2*(n+2)+1]$ final payoffs:

$$f_{n,j} = Df^Q(T_n) \max\left(\phi(S_{n,j} - K), 0\right) \qquad \text{(H)}$$

where T_n is the payment date of t_n which is 16-April-2016 in our example.

Going backwards, assume we have the option values $\left\{ f_{i+1,j} : j = 0, \cdots, 2(i+1+2) \right\}$ on the datetime slice t_{i+1}, then the option values $\left\{ f_{i,j} : j = 0, \cdots, 2(i+2) \right\}$ are calculated by

$$f_{i,j} = \max\left[Df^Q(T_i) \max\left(\phi(S_{i,j} - K), 0\right), \; p_d f_{i+1,j} + p_c f_{i+1,j+1} + p_u f_{i+1,j+2} \right] \qquad \text{(I)}$$

where T_i is the payment date of t_i which is the spot settlement date of t_i .

Finally, the PV of the American Option is given by the 3 points quadratic curve interpolation of $\left\{ f_{0,1}, f_{0,2}, f_{0,3} \right\}$ on $\left\{ S_0 d, S_0, S_0 u \right\}$ at S_0:

$$American\ Option\ PV = QuadraticCurvature\left[S_0; \left\{ S_0 d, S_0, S_0 u \right\}, \left\{ f_{0,1}, f_{0,2}, f_{0,3} \right\} \right] \qquad \text{(J)}$$

Note that with any spot shift, S_0 is in the given points for interpolation so that the above equation can be simplified as

$$American\ Option\ PV(S_0) = f_{0,2} \qquad (J')$$

However, for Greeks valuation where the spot has been shifted so that equation (J) has to be used.

The slope b and curvature c are calculated as a curvature curve below:

$y = y_1 + b(x - x_1) + c(x - x_1)^2$, through the three points $(x_0, y_0), (x_1, y_1), (x_2, y_2)$

The coefficients slope b and curvature c can be derived as below:

$$y_0 = y_1 + b(x_0 - x_1) + c(x_0 - x_1)^2 \qquad y_2 = y_1 + b(x_2 - x_1) + c(x_2 - x_1)^2$$

For b: $\dfrac{y_0}{(x_0 - x_1)^2} = \dfrac{y_1}{(x_0 - x_1)^2} + \dfrac{b}{(x_0 - x_1)} + c$ $\qquad$ $\dfrac{y_2}{(x_2 - x_1)^2} = \dfrac{y_1}{(x_2 - x_1)^2} + \dfrac{b}{(x_2 - x_1)} + c$

$$\frac{y_2}{(x_2 - x_1)^2} - \frac{y_0}{(x_0 - x_1)^2} = \frac{y_1}{(x_2 - x_1)^2} - \frac{y_1}{(x_0 - x_1)^2} + \frac{b}{(x_2 - x_1)} - \frac{b}{(x_0 - x_1)}$$

$$\frac{b(x_2 - x_0)}{(x_2 - x_1)(x_0 - x_1)} = \frac{y_0}{(x_0 - x_1)^2} + \frac{y_1\left((x_0 - x_1)^2 - (x_2 - x_1)^2\right)}{(x_2 - x_1)^2(x_0 - x_1)^2} - \frac{y_2}{(x_2 - x_1)^2}$$

$$b = \frac{y_0(x_2 - x_1)}{(x_0 - x_1)(x_2 - x_0)} + \frac{y_1\left((x_0 - x_1)^2 - (x_2 - x_1)^2\right)}{(x_2 - x_1)(x_0 - x_1)(x_2 - x_0)} - \frac{y_2(x_0 - x_1)}{(x_2 - x_1)(x_2 - x_0)}$$
$$= -\frac{y_0(x_2 - x_1)}{(x_0 - x_1)(x_0 - x_2)} - \frac{y_1(x_0 + x_2 - 2x_1)}{(x_1 - x_2)(x_1 - x_0)} - \frac{y_2(x_0 - x_1)}{(x_2 - x_1)(x_2 - x_0)}$$

For c: $\dfrac{y_0}{(x_0 - x_1)} = \dfrac{y_1}{(x_0 - x_1)} + b + c(x_0 - x_1)$ $\qquad$ $\dfrac{y_2}{(x_2 - x_1)} = \dfrac{y_1}{(x_2 - x_1)} + b + c(x_2 - x_1)$

$$c(x_2 - x_0) = \frac{y_2}{(x_2 - x_1)} - \frac{y_1}{(x_2 - x_1)} + \frac{y_1}{(x_0 - x_1)} - \frac{y_0}{(x_0 - x_1)}$$

$$c = \frac{y_2}{(x_2 - x_1)(x_2 - x_0)} + \frac{y_1}{(x_1 - x_2)(x_1 - x_0)} + \frac{y_0}{(x_0 - x_1)(x_0 - x_2)}$$

2.3 Greeks

The basic FXO Greek framework please refer to Model Validation Notes “FX OPTION GREEKS”. This section we only describe

2.3.1 Delta and Gamma

For Delta and Gamma, the distribution of FX rate evolution unchanged, so that the payoff and discounting on each tree note are the same as in the original PV calculation, so that we get the same option values set $\{f_{0,0}, f_{0,1}, f_{0,2}, f_{0,3}, f_{0,4}\}$ on the valuation datetime t_0. However, the FX rates due to the shifting of $spotFX$ are different from the original S_0 on the valuation datetime t_0:

$$S_0^+ = spotFX^+ * \frac{Df^Q(spotDate)}{Df^P(spotDate)},\ S_0^- = spotFX^- * \frac{Df^Q(spotDate)}{Df^P(spotDate)}$$

Here we expect the changes of S_0 are in the range of $\{S_0 d, S_0, S_0 u\}$:

$$S_0 d \le S_0^-,\ S_0^+ \le S_0 u \qquad \text{(K)}$$

So that we can apply the quadratic curve interpolation in equation (J) to get shifted PV values:

$$PV\ Up = QuadraticCurvature\left[S_0^+;\ \{S_0 d, S_0, S_0 u\}, \{f_{0,1}, f_{0,2}, f_{0,3}\}\right]$$
$$PV\ Down = QuadraticCurvature\left[S_0^-;\ \{S_0 d, S_0, S_0 u\}, \{f_{0,1}, f_{0,2}, f_{0,3}\}\right]$$

2.3.2 Vega, Volga and Vanna

The volatility shift amount is 10bps and the spot FX shift amount is default value of 1bp

$$\sigma^{\pm} = \sigma \pm 10bp,\ S^{\pm} = S\left(1 \pm \frac{1bp}{2} + \frac{1}{2}\left(\frac{1bp}{2}\right)^2\right)$$

The distribution of FX rates evolution unchanged, but the forward step variances are changed due to equation (D):

$$\sigma_i^{\pm} = \sigma_i \pm 10bps \qquad \text{(C')}$$

2.3.3 Rho and Rho2

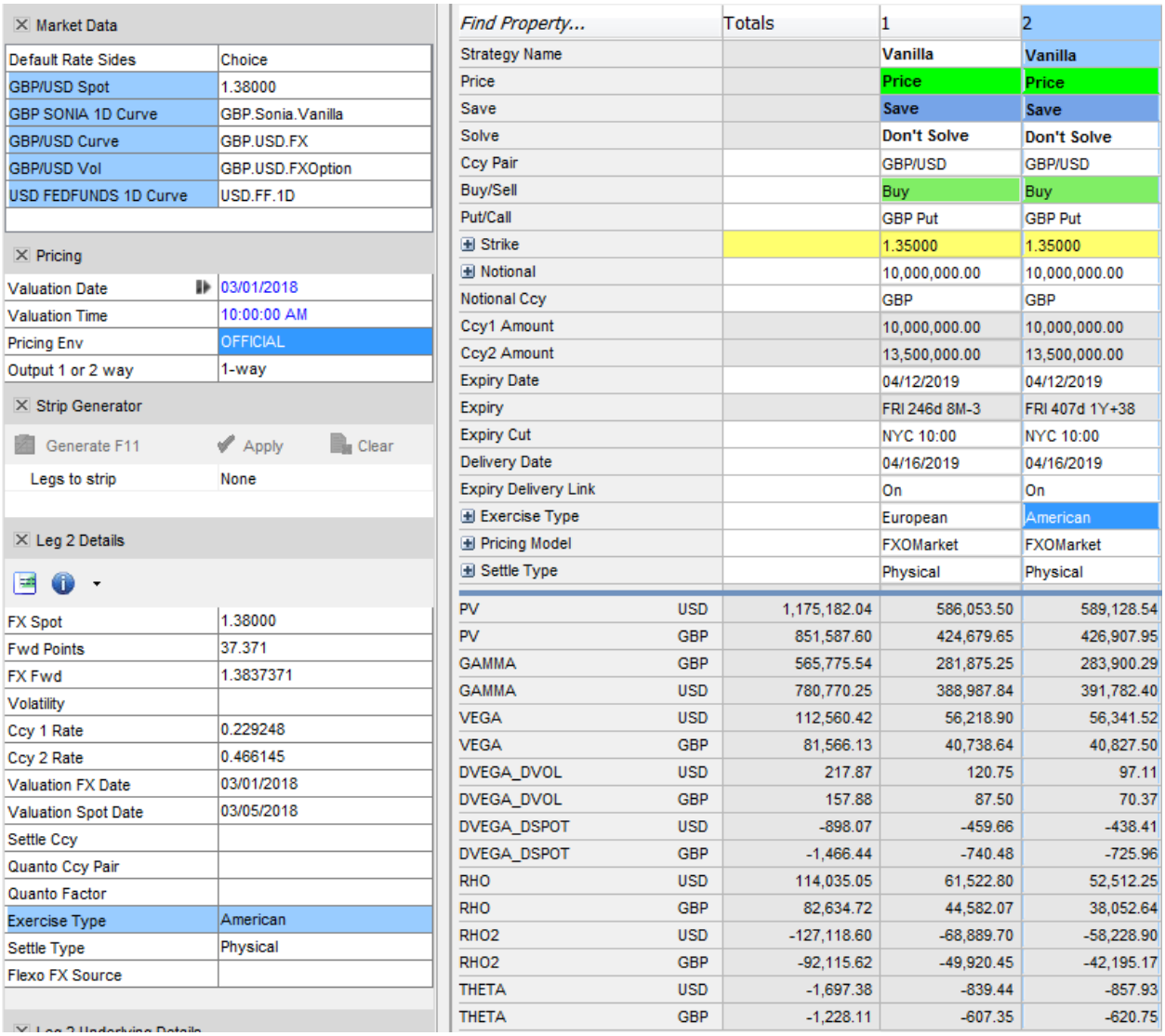
The primary/quoting rate shift amount is default value of 0.1bp. The distribution of FX rates evolution changes by the equation (F).

2.3.4 Theta

The valuation date is shifted one business date forward, the trinomial tree has to be rebuilt following Equation (A) to (J)

2.4 Comparison with European Option Measures

The American Option has slightly greater PV than European and Greeks should converge:



Market Data

Default Rate Sides	Choice
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GBP/USD Curve	GBP.USD.FX
GBP/USD Vol	GBP.USD.FXOption
USD FEDFUNDS 1D Curve	USD.FF.1D

Pricing

Valuation Date	03/01/2018
Valuation Time	10:00:00 AM
Pricing Env	OFFICIAL
Output 1 or 2 way	1-way

Strip Generator

Generate F11 | Apply | Clear

Legs to strip	None

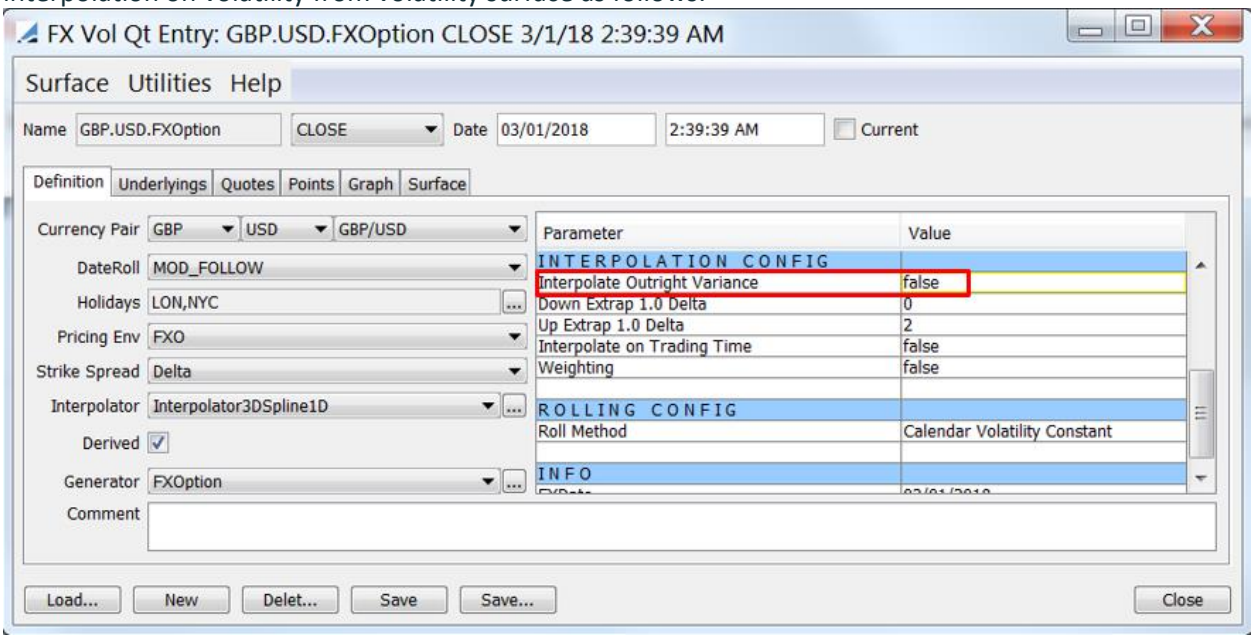
Leg 2 Details

FX Spot	1.38000
Fwd Points	37.371
FX Fwd	1.3837371
Volatility	
Ccy 1 Rate	0.229248
Ccy 2 Rate	0.466145
Valuation FX Date	03/01/2018
Valuation Spot Date	03/05/2018
Settle Ccy	
Quanto Ccy Pair	
Quanto Factor	
Exercise Type	American
Settle Type	Physical
Flexo FX Source	

Find Property...		Totals	1	2
Strategy Name			Vanilla	Vanilla
Price			Price	Price
Save			Save	Save
Solve			Don't Solve	Don't Solve
Ccy Pair			GBP/USD	GBP/USD
Buy/Sell			Buy	Buy
Put/Call			GBP Put	GBP Put
Strike			1.35000	1.35000
Notional			10,000,000.00	10,000,000.00
Notional Ccy			GBP	GBP
Ccy1 Amount			10,000,000.00	10,000,000.00
Ccy2 Amount			13,500,000.00	13,500,000.00
Expiry Date			04/12/2019	04/12/2019
Expiry			FRI 246d 8M-3	FRI 407d 1Y+38
Expiry Cut			NYC 10:00	NYC 10:00
Delivery Date			04/16/2019	04/16/2019
Expiry Delivery Link			On	On
Exercise Type			European	American
Pricing Model			FXOMarket	FXOMarket
Settle Type			Physical	Physical
PV	USD	1,175,182.04	586,053.50	589,128.54
PV	GBP	851,587.60	424,679.65	426,907.95
GAMMA	GBP	565,775.54	281,875.25	283,900.29
GAMMA	USD	780,770.25	388,987.84	391,782.40
VEGA	USD	112,560.42	56,218.90	56,341.52
VEGA	GBP	81,566.13	40,738.64	40,827.50
DVEGA_DVOL	USD	217.87	120.75	97.11
DVEGA_DVOL	GBP	157.88	87.50	70.37
DVEGA_DSPOT	USD	-898.07	-459.66	-438.41
DVEGA_DSPOT	GBP	-1,466.44	-740.48	-725.96
RHO	USD	114,035.05	61,522.80	52,512.25
RHO	GBP	82,634.72	44,582.07	38,052.64
RHO2	USD	-127,118.60	-68,889.70	-58,228.90
RHO2	GBP	-92,115.62	-49,920.45	-42,195.17
THETA	USD	-1,697.38	-839.44	-857.93
THETA	GBP	-1,228.11	-607.35	-620.75

2.5 Interpolation on Volatility Case

The test case used before have the interpolation on variance from volatility surface. If we change to interpolation on volatility from volatility surface as follows:



2.6 Comparison with Analytic Solutions

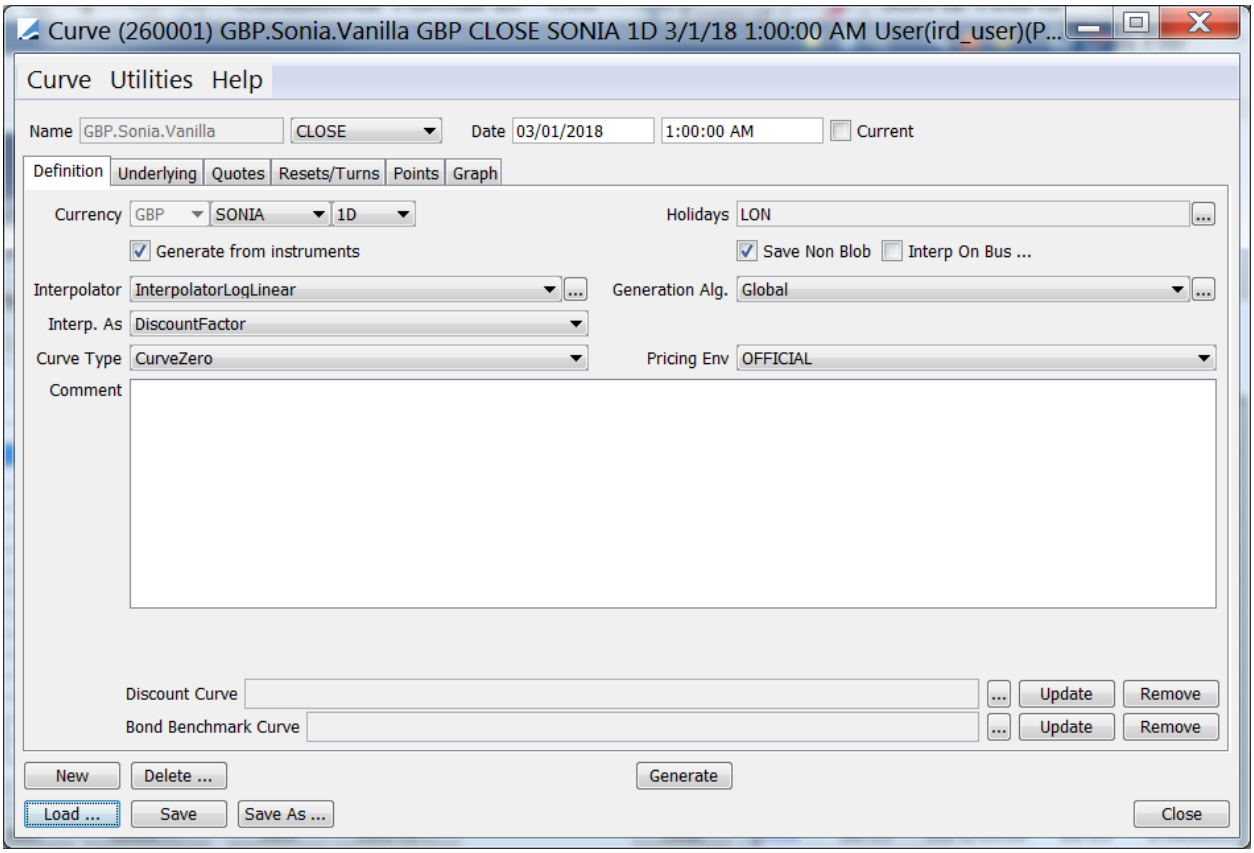
Comparing Analytic Solutions such as Barone-Adesi-Whaley approximation method, the trinomial method has the following advantages:

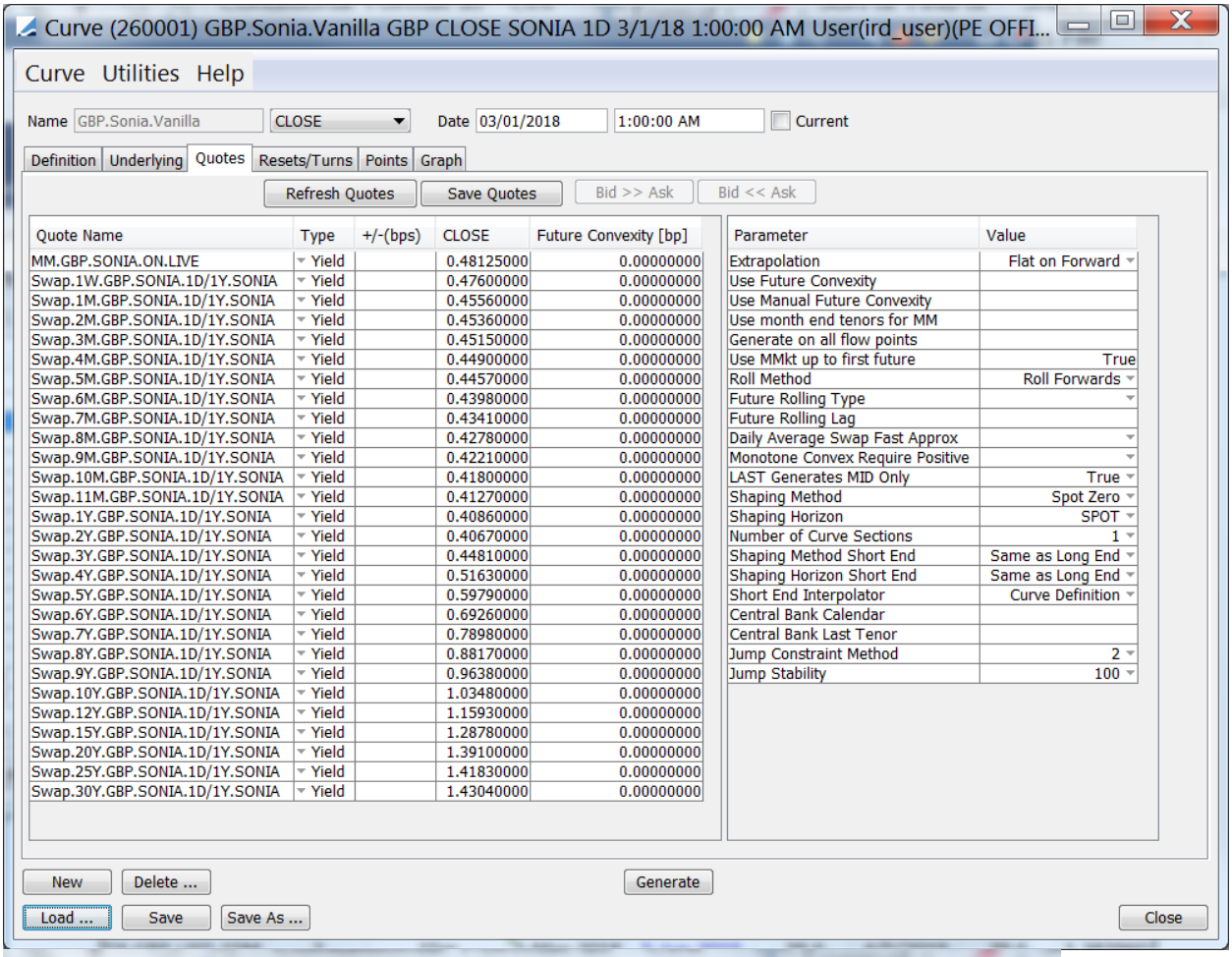
- The trinomial method takes into account term-structure of rates, which may impact the price of the American option significantly.
- The trinomial method takes into account term-structure of volatilities, which may impact the price of the American option significantly.
- Analytic solution is only an approximation. It is fast but does not take into account the above. Usually in analytic solution, the flat rates and volatility at expiry time are assumed so that may be not so accurate in various “edge” cases.

Trade-off of speed vs. accuracy. Speed of the trinomial tree method unlikely to be an issue however.

Section 3. Appendix A: Market Data Setup

3.1 The Primary Currency Discount Curve




Curve (260001) GBP.Sonia.Vanilla GBP CLOSE SONIA 1D 3/1/18 1:00:00 AM User(ird_user)(PE OFFI...
Curve Utilities Help
Name GBP.Sonia.Vanilla CLOSE Date 03/01/2018 1:00:00 AM Current
Definition Underlying Quotes Resets/Turns Points Graph
Refresh Quotes Save Quotes Bid >> Ask Bid << Ask
Quote Name Type +/-(bps) CLOSE Future Convexity [bp]
MM.GBP.SONIA.ON.LIVE Yield 0.48125000 0.00000000
Swap.1W.GBP.SONIA.1D/1Y.SONIA Yield 0.47600000 0.00000000
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Swap.7M.GBP.SONIA.1D/1Y.SONIA Yield 0.43410000 0.00000000
Swap.8M.GBP.SONIA.1D/1Y.SONIA Yield 0.42780000 0.00000000
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Swap.11M.GBP.SONIA.1D/1Y.SONIA Yield 0.41270000 0.00000000
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Swap.2Y.GBP.SONIA.1D/1Y.SONIA Yield 0.40670000 0.00000000
Swap.3Y.GBP.SONIA.1D/1Y.SONIA Yield 0.44810000 0.00000000
Swap.4Y.GBP.SONIA.1D/1Y.SONIA Yield 0.51630000 0.00000000
Swap.5Y.GBP.SONIA.1D/1Y.SONIA Yield 0.59790000 0.00000000
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Swap.7Y.GBP.SONIA.1D/1Y.SONIA Yield 0.78980000 0.00000000
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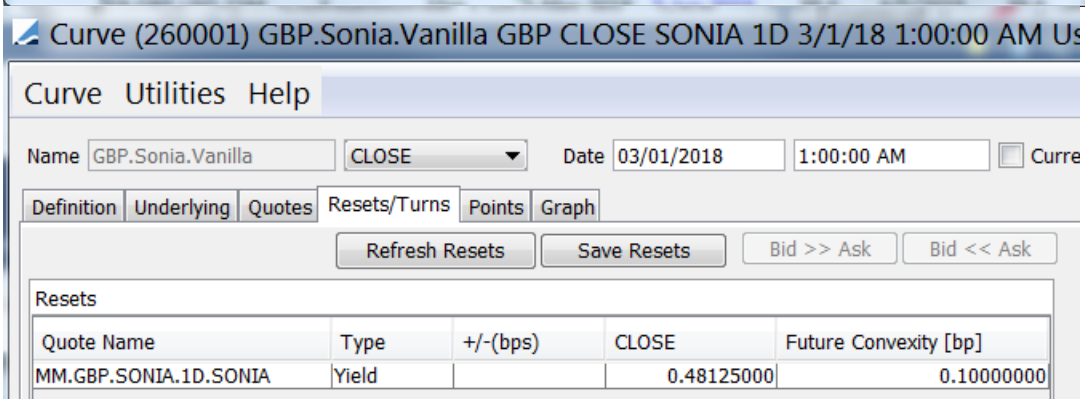
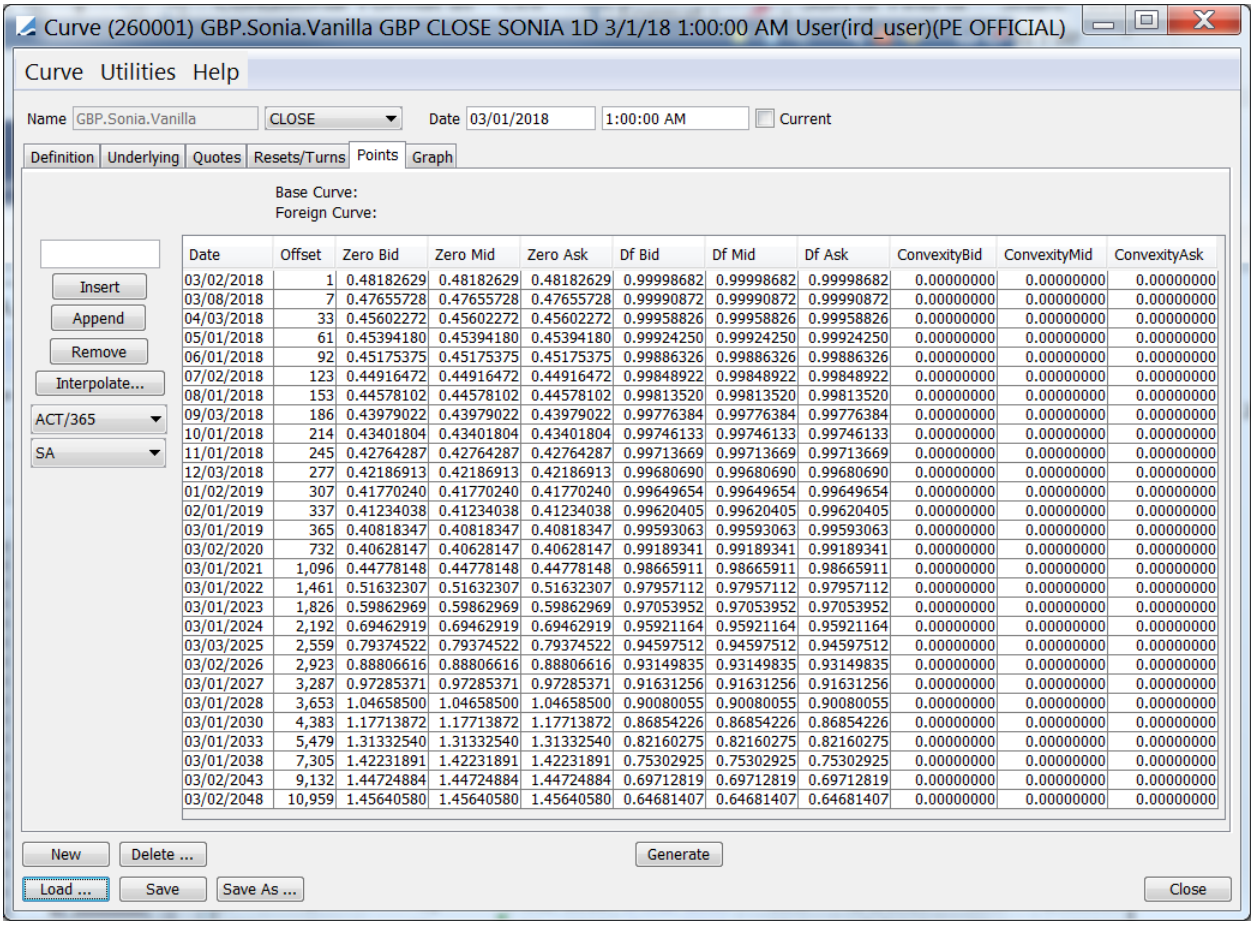
Parameter Value
Extrapolation Flat on Forward
Use Future Convexity
Use Manual Future Convexity
Use month end tenors for MM
Generate on all flow points
Use MMkt up to first future True
Roll Method Roll Forwards
Future Rolling Type
Future Rolling Lag
Daily Average Swap Fast Approx
Monotone Convex Require Positive
LAST Generates MID Only True
Shaping Method Spot Zero
Shaping Horizon SPOT
Number of Curve Sections 1
Shaping Method Short End Same as Long End
Shaping Horizon Short End Same as Long End
Short End Interpolator Curve Definition
Central Bank Calendar
Central Bank Last Tenor
Jump Constraint Method 2
Jump Stability 100
New Delete ... Generate
Load ... Save Save As ... Close


Curve (260001) GBP.Sonia.Vanilla GBP CLOSE SONIA 1D 3/1/18 1:00:00 AM Us
Curve Utilities Help
Name GBP.Sonia.Vanilla CLOSE Date 03/01/2018 1:00:00 AM Curre
Definition Underlying Quotes Resets/Turns Points Graph
Refresh Resets Save Resets Bid >> Ask Bid << Ask
Resets
Quote Name Type +/-(bps) CLOSE Future Convexity [bp]
MM.GBP.SONIA.1D.SONIA Yield 0.48125000 0.10000000



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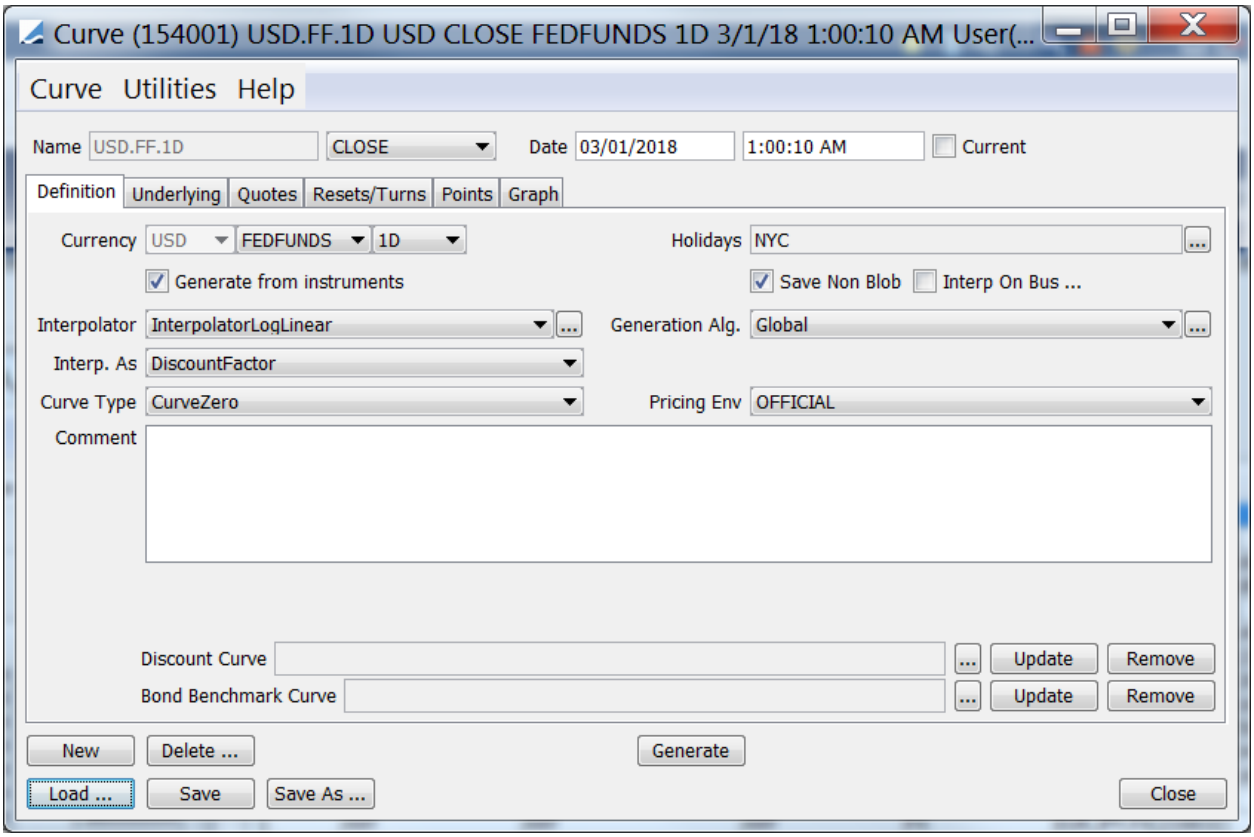
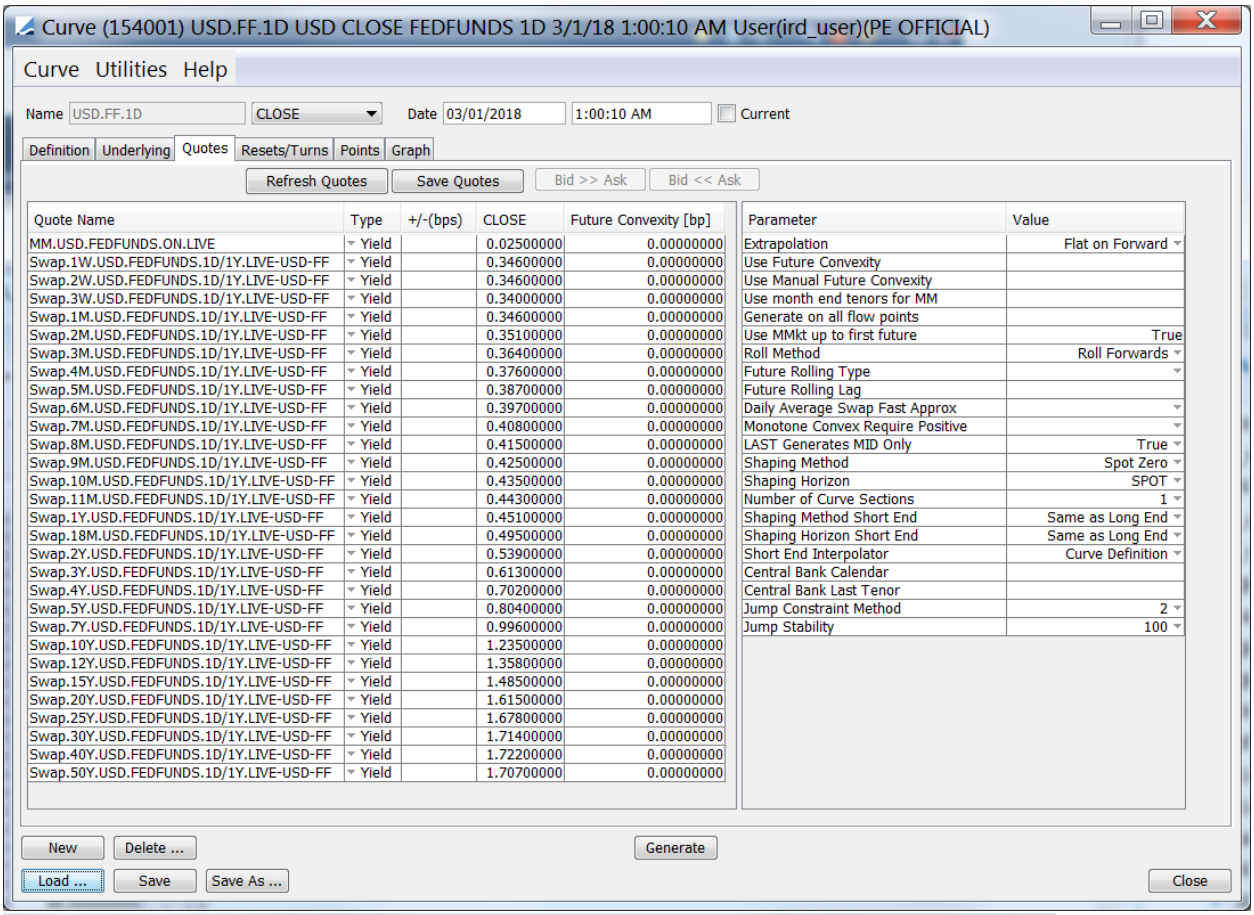
03/08/2018	7	0.47655728	0.47655728	0.47655728	0.99990872	0.99990872	0.99990872	0.00000000	0.00000000	0.00000000
04/03/2018	33	0.45602272	0.45602272	0.45602272	0.99958826	0.99958826	0.99958826	0.00000000	0.00000000	0.00000000
05/01/2018	61	0.45394180	0.45394180	0.45394180	0.99924250	0.99924250	0.99924250	0.00000000	0.00000000	0.00000000
06/01/2018	92	0.45175375	0.45175375	0.45175375	0.99886326	0.99886326	0.99886326	0.00000000	0.00000000	0.00000000
07/02/2018	123	0.44916472	0.44916472	0.44916472	0.99848922	0.99848922	0.99848922	0.00000000	0.00000000	0.00000000
08/01/2018	153	0.44578102	0.44578102	0.44578102	0.99813520	0.99813520	0.99813520	0.00000000	0.00000000	0.00000000
09/03/2018	186	0.43979022	0.43979022	0.43979022	0.99776384	0.99776384	0.99776384	0.00000000	0.00000000	0.00000000
10/01/2018	214	0.43401804	0.43401804	0.43401804	0.99746133	0.99746133	0.99746133	0.00000000	0.00000000	0.00000000
11/01/2018	245	0.42764287	0.42764287	0.42764287	0.99713669	0.99713669	0.99713669	0.00000000	0.00000000	0.00000000
12/03/2018	277	0.42186913	0.42186913	0.42186913	0.99680690	0.99680690	0.99680690	0.00000000	0.00000000	0.00000000
01/02/2019	307	0.41770240	0.41770240	0.41770240	0.99649654	0.99649654	0.99649654	0.00000000	0.00000000	0.00000000
02/01/2019	337	0.41234038	0.41234038	0.41234038	0.99620405	0.99620405	0.99620405	0.00000000	0.00000000	0.00000000
03/01/2019	365	0.40818347	0.40818347	0.40818347	0.99593063	0.99593063	0.99593063	0.00000000	0.00000000	0.00000000
03/02/2020	732	0.40628147	0.40628147	0.40628147	0.99189341	0.99189341	0.99189341	0.00000000	0.00000000	0.00000000
03/01/2021	1,096	0.44778148	0.44778148	0.44778148	0.98665911	0.98665911	0.98665911	0.00000000	0.00000000	0.00000000
03/01/2022	1,461	0.51632307	0.51632307	0.51632307	0.97957112	0.97957112	0.97957112	0.00000000	0.00000000	0.00000000
03/01/2023	1,826	0.59862969	0.59862969	0.59862969	0.97053952	0.97053952	0.97053952	0.00000000	0.00000000	0.00000000
03/01/2024	2,192	0.69462919	0.69462919	0.69462919	0.95921164	0.95921164	0.95921164	0.00000000	0.00000000	0.00000000
03/03/2025	2,559	0.79374522	0.79374522	0.79374522	0.94597512	0.94597512	0.94597512	0.00000000	0.00000000	0.00000000
03/02/2026	2,923	0.88806616	0.88806616	0.88806616	0.93149835	0.93149835	0.93149835	0.00000000	0.00000000	0.00000000
03/01/2027	3,287	0.97285371	0.97285371	0.97285371	0.91631256	0.91631256	0.91631256	0.00000000	0.00000000	0.00000000
03/01/2028	3,653	1.04658500	1.04658500	1.04658500	0.90080055	0.90080055	0.90080055	0.00000000	0.00000000	0.00000000
03/01/2030	4,383	1.17713872	1.17713872	1.17713872	0.86854226	0.86854226	0.86854226	0.00000000	0.00000000	0.00000000
03/01/2033	5,479	1.31332540	1.31332540	1.31332540	0.82160275	0.82160275	0.82160275	0.00000000	0.00000000	0.00000000
03/01/2038	7,305	1.42231891	1.42231891	1.42231891	0.75302925	0.75302925	0.75302925	0.00000000	0.00000000	0.00000000
03/02/2043	9,132	1.44724884	1.44724884	1.44724884	0.69712819	0.69712819	0.69712819	0.00000000	0.00000000	0.00000000
03/02/2048	10,959	1.45640580	1.45640580	1.45640580	0.64681407	0.64681407	0.64681407	0.00000000	0.00000000	0.00000000

3.2 The Quoting Currency Discounting Curve




Curve (154001) USD.FF.1D USD CLOSE FEDFUNDS 1D 3/1/18 1:00:10 AM User(ird_user)(PE OFFICIAL)
Curve Utilities Help
Name USD.FF.1D CLOSE Date 03/01/2018 1:00:10 AM Current
Definition Underlying Quotes Resets/Turns Points Graph
Refresh Quotes Save Quotes Bid >> Ask Bid << Ask
Quote Name Type +/-(bps) CLOSE Future Convexity [bp]
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Swap.2W.USD.FEDFUNDS.1D/1Y.LIVE-USD-FF Yield 0.34600000 0.00000000
Swap.3W.USD.FEDFUNDS.1D/1Y.LIVE-USD-FF Yield 0.34000000 0.00000000
Swap.1M.USD.FEDFUNDS.1D/1Y.LIVE-USD-FF Yield 0.34600000 0.00000000
Swap.2M.USD.FEDFUNDS.1D/1Y.LIVE-USD-FF Yield 0.35100000 0.00000000
Swap.3M.USD.FEDFUNDS.1D/1Y.LIVE-USD-FF Yield 0.36400000 0.00000000
Swap.4M.USD.FEDFUNDS.1D/1Y.LIVE-USD-FF Yield 0.37600000 0.00000000
Swap.5M.USD.FEDFUNDS.1D/1Y.LIVE-USD-FF Yield 0.38700000 0.00000000
Swap.6M.USD.FEDFUNDS.1D/1Y.LIVE-USD-FF Yield 0.39700000 0.00000000
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Swap.1Y.USD.FEDFUNDS.1D/1Y.LIVE-USD-FF Yield 0.45100000 0.00000000
Swap.18M.USD.FEDFUNDS.1D/1Y.LIVE-USD-FF Yield 0.49500000 0.00000000
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Swap.25Y.USD.FEDFUNDS.1D/1Y.LIVE-USD-FF Yield 1.67800000 0.00000000
Swap.30Y.USD.FEDFUNDS.1D/1Y.LIVE-USD-FF Yield 1.71400000 0.00000000
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Swap.50Y.USD.FEDFUNDS.1D/1Y.LIVE-USD-FF Yield 1.70700000 0.00000000
Parameter Value
Extrapolation Flat on Forward
Use Future Convexity
Use Manual Future Convexity
Use month end tenors for MM
Generate on all flow points
Use MMkt up to first future True
Roll Method Roll Forwards
Future Rolling Type
Future Rolling Lag
Daily Average Swap Fast Approx
Monotone Convex Require Positive
LAST Generates MID Only True
Shaping Method Spot Zero
Shaping Horizon SPOT
Number of Curve Sections 1
Shaping Method Short End Same as Long End
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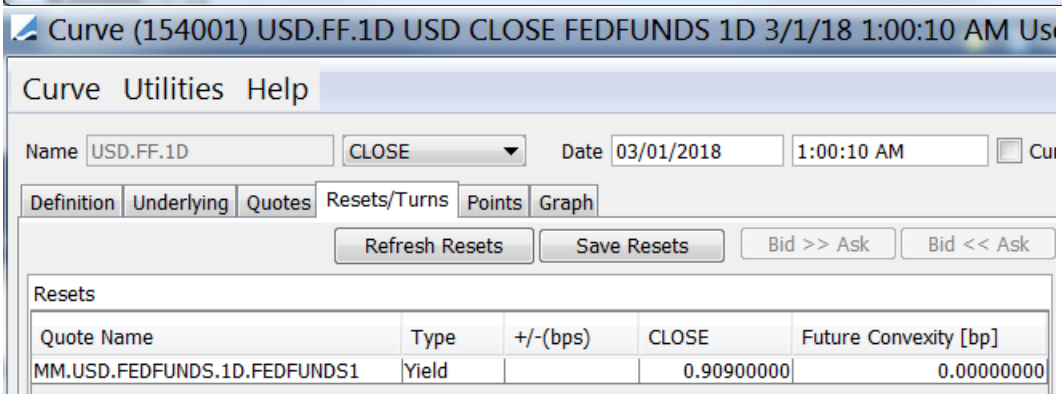
Short End Interpolator Curve Definition
Central Bank Calendar
Central Bank Last Tenor
Jump Constraint Method 2
Jump Stability 100
New Delete ... Generate
Load ... Save Save As ... Close


Curve (154001) USD.FF.1D USD CLOSE FEDFUNDS 1D 3/1/18 1:00:10 AM Us
Curve Utilities Help
Name USD.FF.1D CLOSE Date 03/01/2018 1:00:10 AM
Definition Underlying Quotes Resets/Turns Points Graph
Refresh Resets Save Resets Bid >> Ask Bid << Ask
Resets
Quote Name Type +/-(bps) CLOSE Future Convexity [bp]
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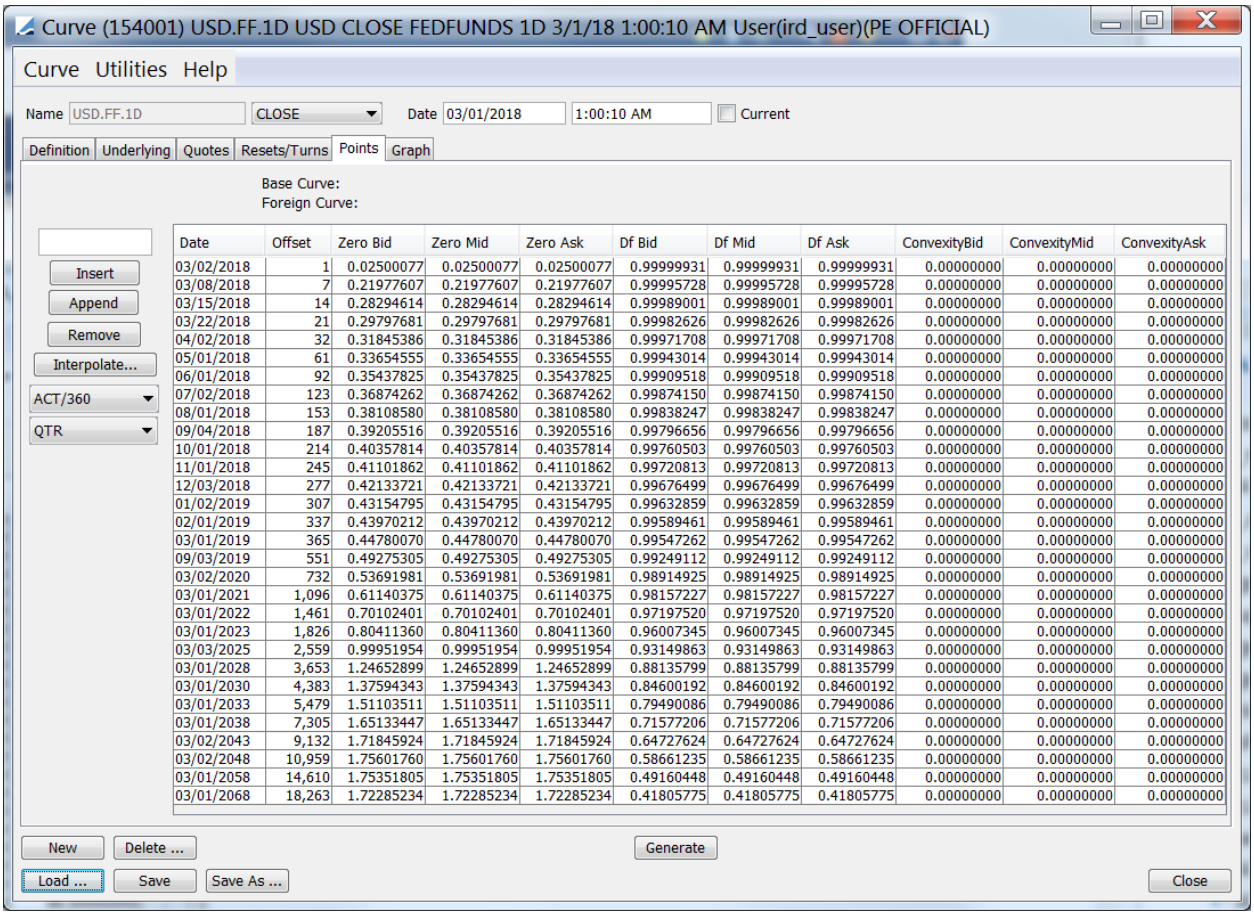
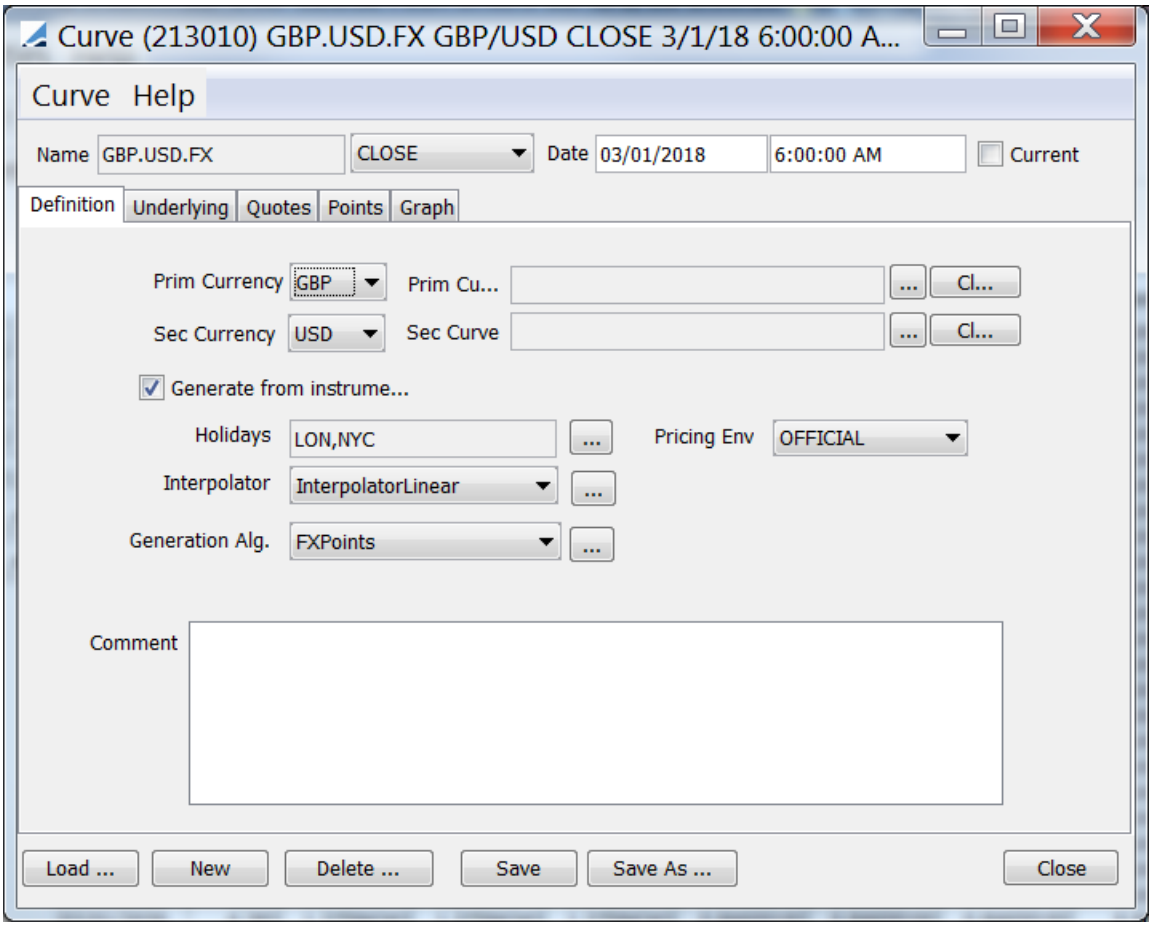
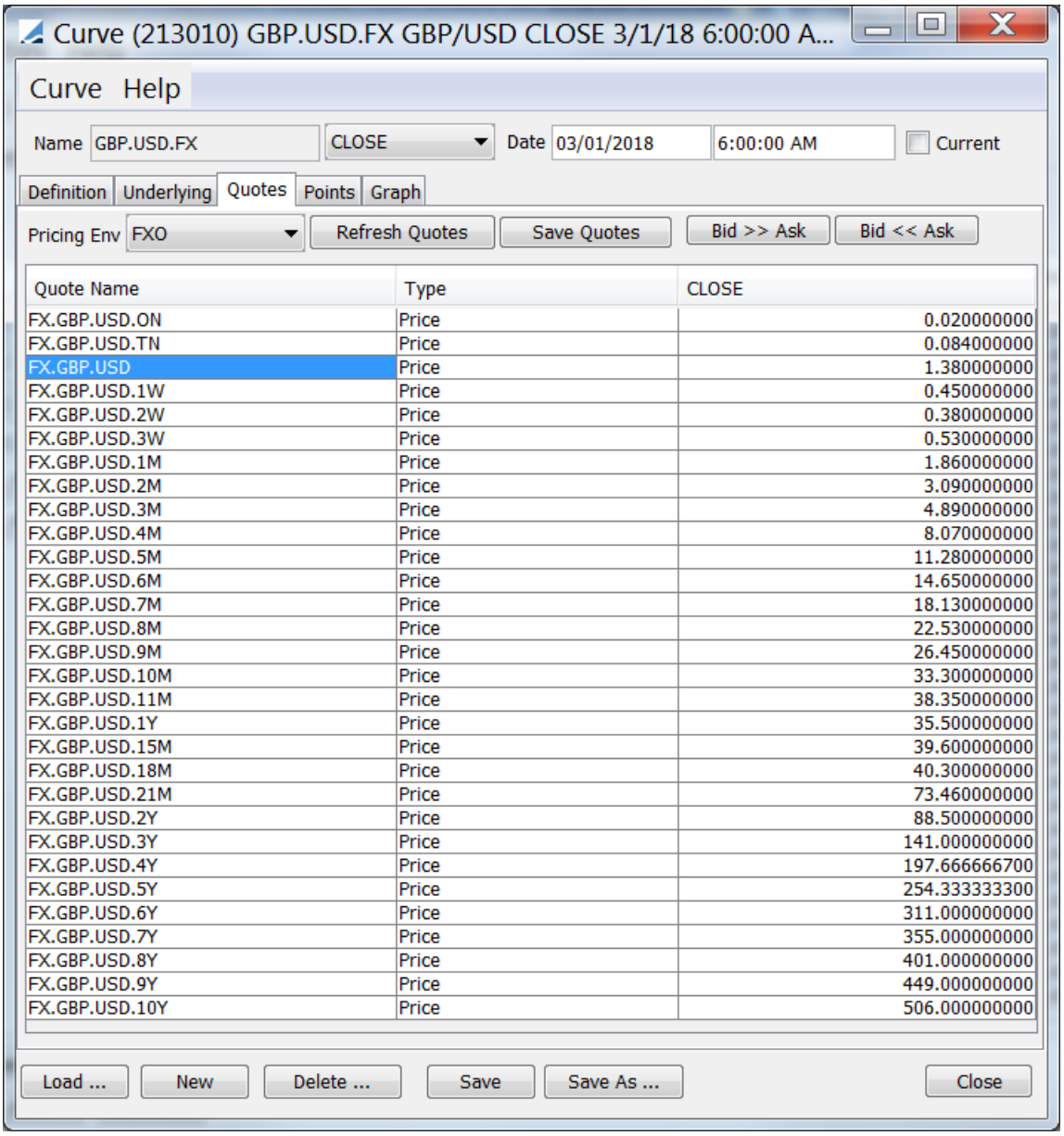


Date	Offset	Zero Bid	Zero Mid	Zero Ask	Df Bid	Df Mid	Df Ask	ConvexityBid	ConvexityMid	ConvexityAsk
03/02/2018	1	0.02500077	0.02500077	0.02500077	0.99999931	0.99999931	0.99999931	0.00000000	0.00000000	0.00000000
03/08/2018	7	0.21977607	0.21977607	0.21977607	0.99995728	0.99995728	0.99995728	0.00000000	0.00000000	0.00000000
03/15/2018	14	0.28294614	0.28294614	0.28294614	0.99989001	0.99989001	0.99989001	0.00000000	0.00000000	0.00000000
03/22/2018	21	0.29797681	0.29797681	0.29797681	0.99982626	0.99982626	0.99982626	0.00000000	0.00000000	0.00000000
04/02/2018	32	0.31845386	0.31845386	0.31845386	0.99971708	0.99971708	0.99971708	0.00000000	0.00000000	0.00000000
05/01/2018	61	0.33654555	0.33654555	0.33654555	0.99943014	0.99943014	0.99943014	0.00000000	0.00000000	0.00000000
06/01/2018	92	0.35437825	0.35437825	0.35437825	0.99909518	0.99909518	0.99909518	0.00000000	0.00000000	0.00000000
07/02/2018	123	0.36874262	0.36874262	0.36874262	0.99874150	0.99874150	0.99874150	0.00000000	0.00000000	0.00000000
08/01/2018	153	0.38108580	0.38108580	0.38108580	0.99838247	0.99838247	0.99838247	0.00000000	0.00000000	0.00000000
09/04/2018	187	0.39205516	0.39205516	0.39205516	0.99796656	0.99796656	0.99796656	0.00000000	0.00000000	0.00000000
10/01/2018	214	0.40357814	0.40357814	0.40357814	0.99760503	0.99760503	0.99760503	0.00000000	0.00000000	0.00000000
11/01/2018	245	0.41101862	0.41101862	0.41101862	0.99720813	0.99720813	0.99720813	0.00000000	0.00000000	0.00000000
12/03/2018	277	0.42133721	0.42133721	0.42133721	0.99676499	0.99676499	0.99676499	0.00000000	0.00000000	0.00000000
01/02/2019	307	0.43154795	0.43154795	0.43154795	0.99632859	0.99632859	0.99632859	0.00000000	0.00000000	0.00000000
02/01/2019	337	0.43970212	0.43970212	0.43970212	0.99589461	0.99589461	0.99589461	0.00000000	0.00000000	0.00000000
03/01/2019	365	0.44780070	0.44780070	0.44780070	0.99547262	0.99547262	0.99547262	0.00000000	0.00000000	0.00000000
09/03/2019	551	0.49275305	0.49275305	0.49275305	0.99249112	0.99249112	0.99249112	0.00000000	0.00000000	0.00000000
03/02/2020	732	0.53691981	0.53691981	0.53691981	0.98914925	0.98914925	0.98914925	0.00000000	0.00000000	0.00000000
03/01/2021	1,096	0.61140375	0.61140375	0.61140375	0.98157227	0.98157227	0.98157227	0.00000000	0.00000000	0.00000000
03/01/2022	1,461	0.70102401	0.70102401	0.70102401	0.97197520	0.97197520	0.97197520	0.00000000	0.00000000	0.00000000
03/01/2023	1,826	0.80411360	0.80411360	0.80411360	0.96007345	0.96007345	0.96007345	0.00000000	0.00000000	0.00000000
03/03/2025	2,559	0.99951954	0.99951954	0.99951954	0.93149863	0.93149863	0.93149863	0.00000000	0.00000000	0.00000000
03/01/2028	3,653	1.24652899	1.24652899	1.24652899	0.88135799	0.88135799	0.88135799	0.00000000	0.00000000	0.00000000
03/01/2030	4,383	1.37594343	1.37594343	1.37594343	0.84600192	0.84600192	0.84600192	0.00000000	0.00000000	0.00000000
03/01/2033	5,479	1.51103511	1.51103511	1.51103511	0.79490086	0.79490086	0.79490086	0.00000000	0.00000000	0.00000000
03/01/2038	7,305	1.65133447	1.65133447	1.65133447	0.71577206	0.71577206	0.71577206	0.00000000	0.00000000	0.00000000
03/02/2043	9,132	1.71845924	1.71845924	1.71845924	0.64727624	0.64727624	0.64727624	0.00000000	0.00000000	0.00000000
03/02/2048	10,959	1.75601760	1.75601760	1.75601760	0.58661235	0.58661235	0.58661235	0.00000000	0.00000000	0.00000000
03/01/2058	14,610	1.75351805	1.75351805	1.75351805	0.49160448	0.49160448	0.49160448	0.00000000	0.00000000	0.00000000
03/01/2068	18,263	1.72285234	1.72285234	1.72285234	0.41805775	0.41805775	0.41805775	0.00000000	0.00000000	0.00000000

3.3 The FX Curve

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Curve Help
Name GBP.USD.FX
CLOSE
Date 03/01/2018
6:00:00 AM
Current
Definition
Underlying
Quotes
Points
Graph
Pricing Env FXO
Refresh Quotes
Save Quotes
Bid >> Ask
Bid << Ask
Quote Name
Type
CLOSE
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FX.GBP.USD.TN Price 0.084000000
FX.GBP.USD Price 1.380000000
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FX.GBP.USD.15M Price 39.600000000
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FX.GBP.USD.21M Price 73.460000000
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FX.GBP.USD.8Y Price 401.000000000
FX.GBP.USD.9Y Price 449.000000000
FX.GBP.USD.10Y Price 506.000000000
Load ...
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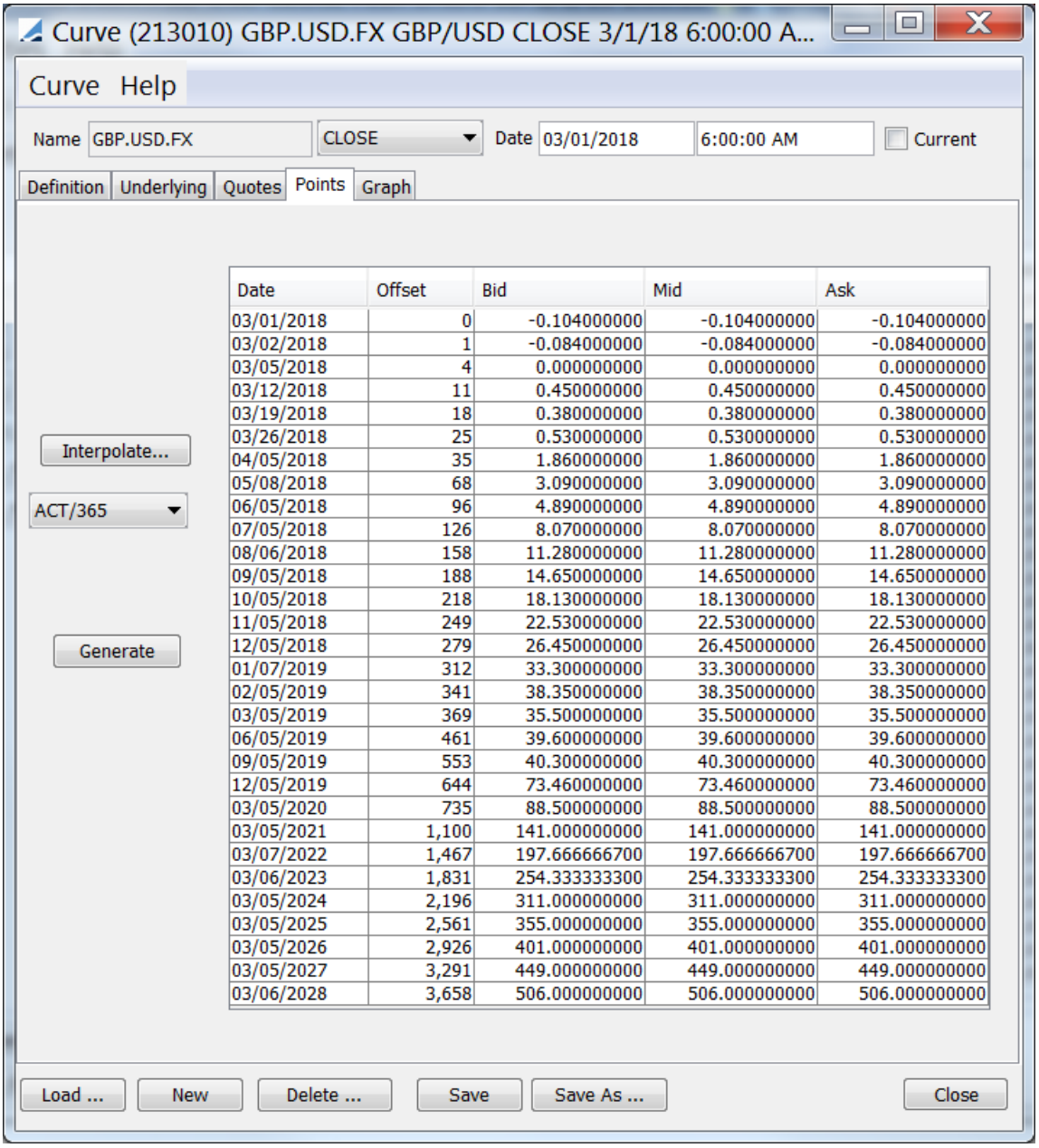
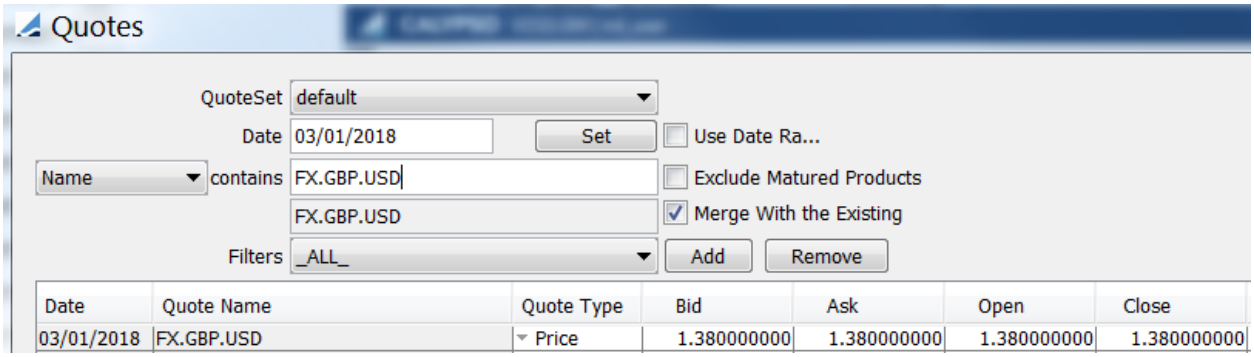
Save
Save As ...
Close

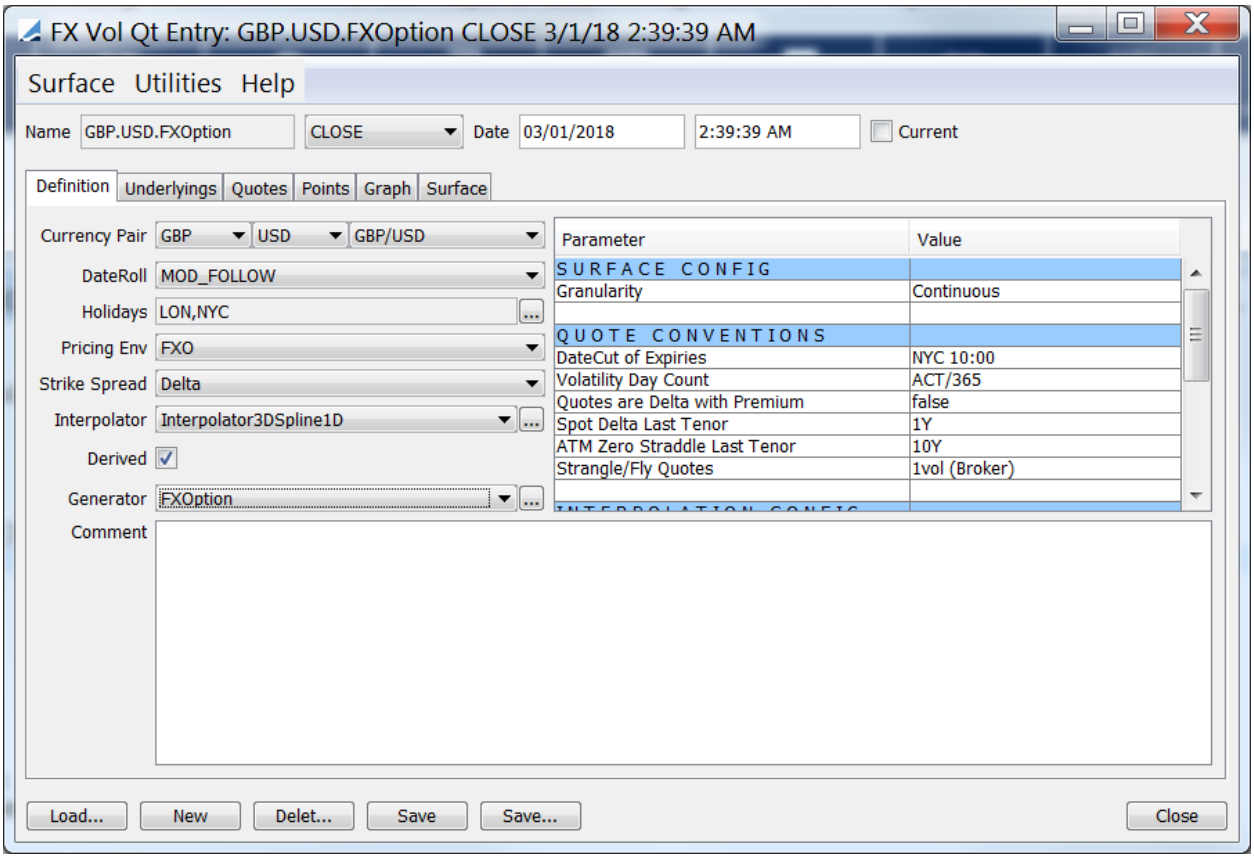


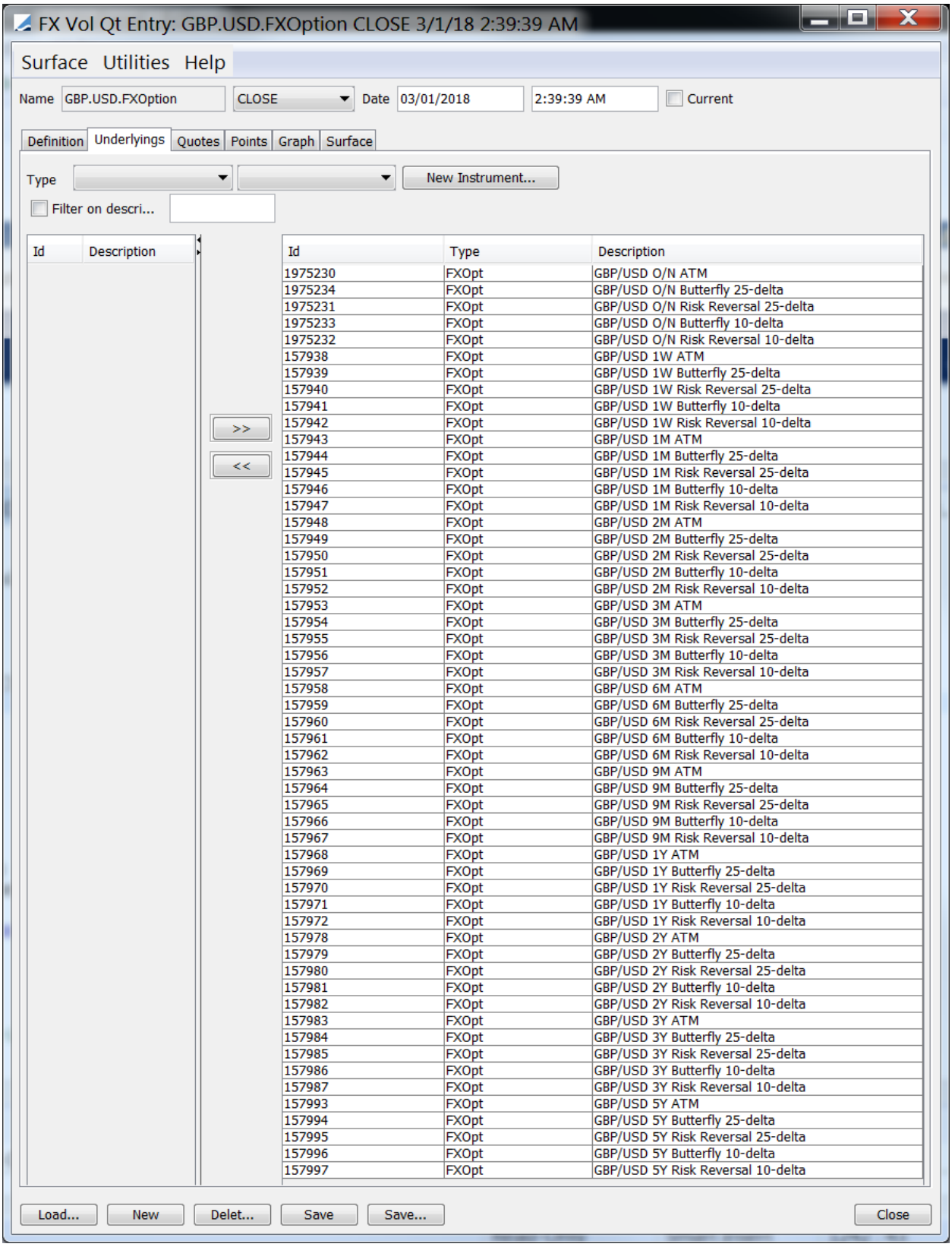
Date	Offset	Bid	Mid	Ask
03/01/2018	0	-0.104000000	-0.104000000	-0.104000000
03/02/2018	1	-0.084000000	-0.084000000	-0.084000000
03/05/2018	4	0.000000000	0.000000000	0.000000000
03/12/2018	11	0.450000000	0.450000000	0.450000000
03/19/2018	18	0.380000000	0.380000000	0.380000000
03/26/2018	25	0.530000000	0.530000000	0.530000000
04/05/2018	35	1.860000000	1.860000000	1.860000000
05/08/2018	68	3.090000000	3.090000000	3.090000000
06/05/2018	96	4.890000000	4.890000000	4.890000000
07/05/2018	126	8.070000000	8.070000000	8.070000000
08/06/2018	158	11.280000000	11.280000000	11.280000000
09/05/2018	188	14.650000000	14.650000000	14.650000000
10/05/2018	218	18.130000000	18.130000000	18.130000000
11/05/2018	249	22.530000000	22.530000000	22.530000000
12/05/2018	279	26.450000000	26.450000000	26.450000000
01/07/2019	312	33.300000000	33.300000000	33.300000000
02/05/2019	341	38.350000000	38.350000000	38.350000000
03/05/2019	369	35.500000000	35.500000000	35.500000000
06/05/2019	461	39.600000000	39.600000000	39.600000000
09/05/2019	553	40.300000000	40.300000000	40.300000000
12/05/2019	644	73.460000000	73.460000000	73.460000000
03/05/2020	735	88.500000000	88.500000000	88.500000000
03/05/2021	1,100	141.000000000	141.000000000	141.000000000
03/07/2022	1,467	197.666666700	197.666666700	197.666666700
03/06/2023	1,831	254.333333300	254.333333300	254.333333300
03/05/2024	2,196	311.000000000	311.000000000	311.000000000
03/05/2025	2,561	355.000000000	355.000000000	355.000000000
03/05/2026	2,926	401.000000000	401.000000000	401.000000000
03/05/2027	3,291	449.000000000	449.000000000	449.000000000
03/06/2028	3,658	506.000000000	506.000000000	506.000000000

3.4 Spot FX Quote



3.5 FX Option Volatility Surface




FX Vol Qt Entry: GBP.USD.FXOption CLOSE 3/1/18 2:39:39 AM
Surface Utilities Help
Name GBP.USD.FXOption
CLOSE
Date 03/01/2018
2:39:39 AM
Current
Definition Underlyings Quotes Points Graph Surface
Type
New Instrument...
Filter on descri...
Id Description
>>
<<
Id Type Description
1975230 FXOpt GBP/USD O/N ATM
1975234 FXOpt GBP/USD O/N Butterfly 25-delta
1975231 FXOpt GBP/USD O/N Risk Reversal 25-delta
1975233 FXOpt GBP/USD O/N Butterfly 10-delta
1975232 FXOpt GBP/USD O/N Risk Reversal 10-delta
157938 FXOpt GBP/USD 1W ATM
157939 FXOpt GBP/USD 1W Butterfly 25-delta
157940 FXOpt GBP/USD 1W Risk Reversal 25-delta
157941 FXOpt GBP/USD 1W Butterfly 10-delta
157942 FXOpt GBP/USD 1W Risk Reversal 10-delta
157943 FXOpt GBP/USD 1M ATM
157944 FXOpt GBP/USD 1M Butterfly 25-delta
157945 FXOpt GBP/USD 1M Risk Reversal 25-delta
157946 FXOpt GBP/USD 1M Butterfly 10-delta
157947 FXOpt GBP/USD 1M Risk Reversal 10-delta
157948 FXOpt GBP/USD 2M ATM
157949 FXOpt GBP/USD 2M Butterfly 25-delta
157950 FXOpt GBP/USD 2M Risk Reversal 25-delta
157951 FXOpt GBP/USD 2M Butterfly 10-delta
157952 FXOpt GBP/USD 2M Risk Reversal 10-delta
157953 FXOpt GBP/USD 3M ATM
157954 FXOpt GBP/USD 3M Butterfly 25-delta
157955 FXOpt GBP/USD 3M Risk Reversal 25-delta
157956 FXOpt GBP/USD 3M Butterfly 10-delta
157957 FXOpt GBP/USD 3M Risk Reversal 10-delta
157958 FXOpt GBP/USD 6M ATM
157959 FXOpt GBP/USD 6M Butterfly 25-delta
157960 FXOpt GBP/USD 6M Risk Reversal 25-delta
157961 FXOpt GBP/USD 6M Butterfly 10-delta
157962 FXOpt GBP/USD 6M Risk Reversal 10-delta
157963 FXOpt GBP/USD 9M ATM
157964 FXOpt GBP/USD 9M Butterfly 25-delta
157965 FXOpt GBP/USD 9M Risk Reversal 25-delta
157966 FXOpt GBP/USD 9M Butterfly 10-delta
157967 FXOpt GBP/USD 9M Risk Reversal 10-delta
157968 FXOpt GBP/USD 1Y ATM
157969 FXOpt GBP/USD 1Y Butterfly 25-delta
157970 FXOpt GBP/USD 1Y Risk Reversal 25-delta
157971 FXOpt GBP/USD 1Y Butterfly 10-delta
157972 FXOpt GBP/USD 1Y Risk Reversal 10-delta
157978 FXOpt GBP/USD 2Y ATM
157979 FXOpt GBP/USD 2Y Butterfly 25-delta
157980 FXOpt GBP/USD 2Y Risk Reversal 25-delta
157981 FXOpt GBP/USD 2Y Butterfly 10-delta
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157984 FXOpt GBP/USD 3Y Butterfly 25-delta
157985 FXOpt GBP/USD 3Y Risk Reversal 25-delta
157986 FXOpt GBP/USD 3Y Butterfly 10-delta
157987 FXOpt GBP/USD 3Y Risk Reversal 10-delta
157993 FXOpt GBP/USD 5Y ATM
157994 FXOpt GBP/USD 5Y Butterfly 25-delta
157995 FXOpt GBP/USD 5Y Risk Reversal 25-delta
157996 FXOpt GBP/USD 5Y Butterfly 10-delta
157997 FXOpt GBP/USD 5Y Risk Reversal 10-delta
Load...
New
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Save...
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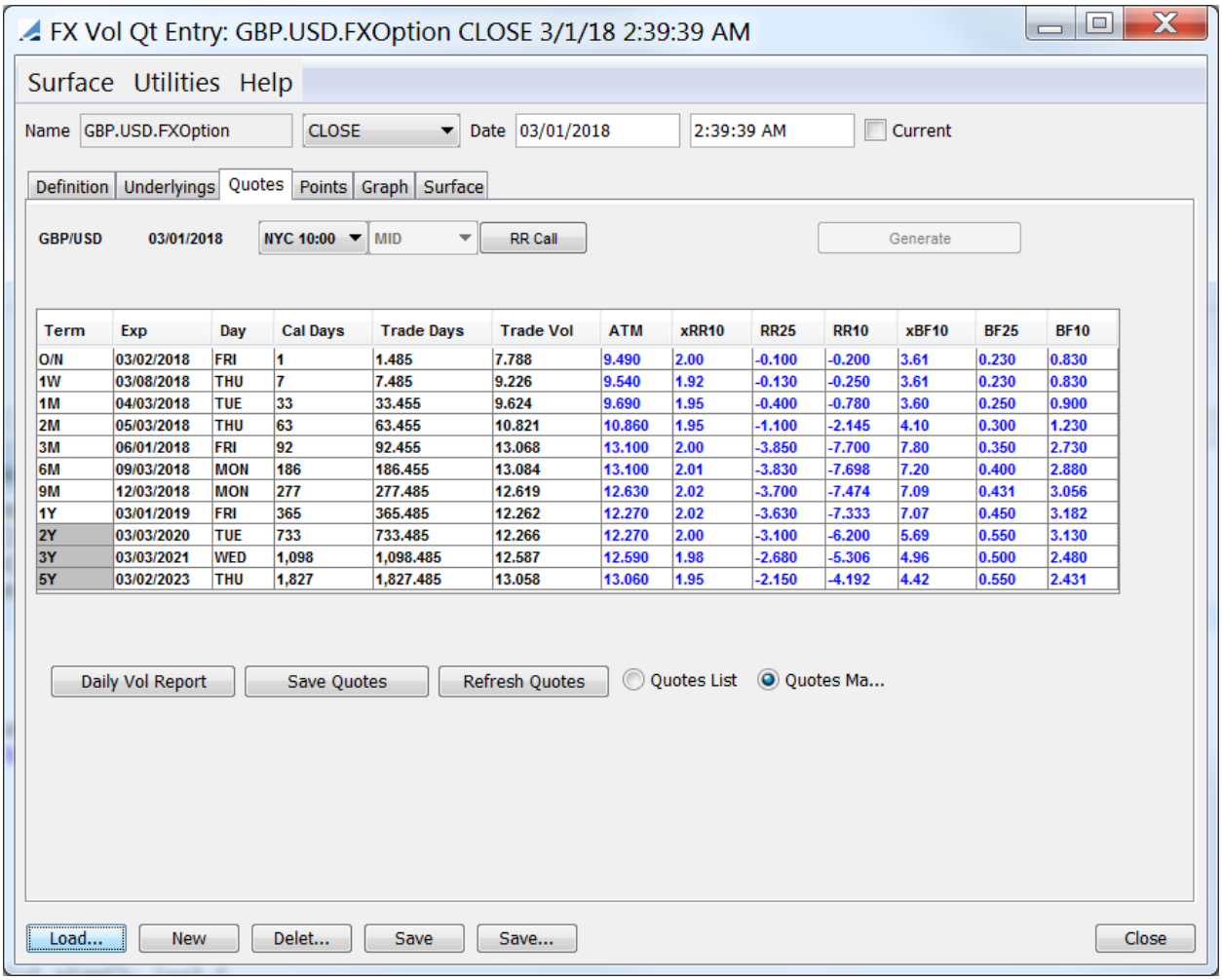
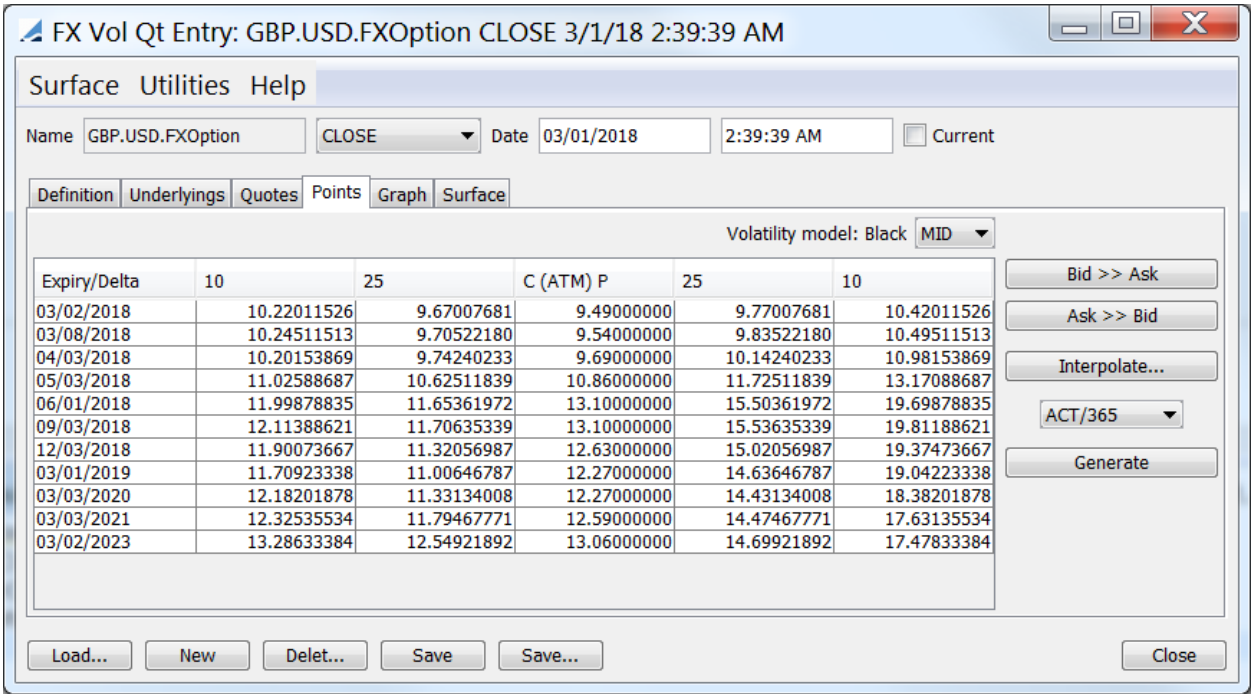


Term	Exp	Day	Cal Days	Trade Days	Trade Vol	ATM	xRR10	RR25	RR10	xBF10	BF25	BF10
O/N	03/02/2018	FRI	1	1.485	7.788	9.490	2.00	-0.100	-0.200	3.61	0.230	0.830
1W	03/08/2018	THU	7	7.485	9.226	9.540	1.92	-0.130	-0.250	3.61	0.230	0.830
1M	04/03/2018	TUE	33	33.455	9.624	9.690	1.95	-0.400	-0.780	3.60	0.250	0.900
2M	05/03/2018	THU	63	63.455	10.821	10.860	1.95	-1.100	-2.145	4.10	0.300	1.230
3M	06/01/2018	FRI	92	92.455	13.068	13.100	2.00	-3.850	-7.700	7.80	0.350	2.730
6M	09/03/2018	MON	186	186.455	13.084	13.100	2.01	-3.830	-7.698	7.20	0.400	2.880
9M	12/03/2018	MON	277	277.485	12.619	12.630	2.02	-3.700	-7.474	7.09	0.431	3.056
1Y	03/01/2019	FRI	365	365.485	12.262	12.270	2.02	-3.630	-7.333	7.07	0.450	3.182
2Y	03/03/2020	TUE	733	733.485	12.266	12.270	2.00	-3.100	-6.200	5.69	0.550	3.130
3Y	03/03/2021	WED	1,098	1,098.485	12.587	12.590	1.98	-2.680	-5.306	4.96	0.500	2.480
5Y	03/02/2023	THU	1,827	1,827.485	13.058	13.060	1.95	-2.150	-4.192	4.42	0.550	2.431



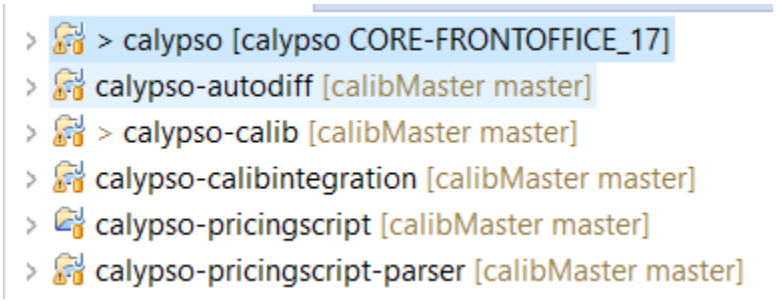
Expiry/Delta	10	25	C (ATM) P	25	10
03/02/2018	10.22011526	9.67007681	9.49000000	9.77007681	10.42011526
03/08/2018	10.24511513	9.70522180	9.54000000	9.83522180	10.49511513
04/03/2018	10.20153869	9.74240233	9.69000000	10.14240233	10.98153869
05/03/2018	11.02588687	10.62511839	10.86000000	11.72511839	13.17088687
06/01/2018	11.99878835	11.65361972	13.10000000	15.50361972	19.69878835
09/03/2018	12.11388621	11.70635339	13.10000000	15.53635339	19.81188621
12/03/2018	11.90073667	11.32056987	12.63000000	15.02056987	19.37473667
03/01/2019	11.70923338	11.00646787	12.27000000	14.63646787	19.04223338
03/03/2020	12.18201878	11.33134008	12.27000000	14.43134008	18.38201878
03/03/2021	12.32535534	11.79467771	12.59000000	14.47467771	17.63135534
03/02/2023	13.28633384	12.54921892	13.06000000	14.69921892	17.47833384

3.6 FX Option Pricing Parameters Setting

Product Type	Name	Value
FXOption	USE_FX_MID	false
FXOption	ROLL_VALUE_DT_B	true
FXOption	QuoteUsage	CLOSE
FXOption	INSTANCE_TYPE	CLOSE
FXOption	FX_POINTS	true
FXOption	USE_VOLATILITY_ADJ	false
FXOption	ZD_PRICING	true
FXOption	VV_REFERENCE_DELTA_TYPE	Market Concordant
FXOption	NPV_INCLUDE_COST	true
FXOption	VV_EXPIRY_BARRIER_MODEL	Market
FXOption	USE_RT_FX_FWD_PTS	false
FXOption	VV_SPARE_TERMINAL_ADJUSTMENT	true
FXOption	VV_WEIGHT_POLICY	Expected Life Fraction
FXOption	MKT_ASIAN_CASH_IN_PRIMARY_MODEL	Theoretical
FXOption	CURVE_USAGE	MID
FXOption	FXOPT_VEGA_DBL_SIDE	true
FXOption	INCLUDE_FEES	true
FXOption	USE_ATM_VOL	false
FXOption	VALUE_SETTLED_TRADE	false
FXOption	ROLL_ATM_VOL	false
FXOption	USE_BUY_SELL_CURVE_SIDE	false
FXOption	TV_USE_FLAT_TERM_STRUCTURE	false
FXOption	NPV_INCLUDE_CASH	false
FXOption	VV_WEIGHT_USE_SYMMETRIC_PROB	true
FXOption	VV_CONSISTENCY_ENFORCEMENT	Basic
FXOption	VV_TERMINAL_REF_MODEL	Market
FXOption	ADJUST_FOR_SPOT_MISMATCH	true
FXOption	VALUE_INTRADAY_OPTIONS	true
FXOption	VV_HEDGE_EXPIRY	Barrier End Date
FXOption	TV_ASIAN_ARITH_PROXY	Log Normal
FXOption	VV_HEDGE_POLICY	Synthetic
FXOption	TV_ATM_TYPE	Market Concordant
FXOption	RHO_SHIFT_UNDERLYINGS	false
FXOption	ADJUST_FX_RATE	true
FXOption	USE_DELTA_TERM_B	false
FXOption	VV_REFERENCE_DELTA	25

3.7 Tested Version

-user ird_user -password calypso -env v17



More Info

Installed Patches | Classpath

No hotfix information available.

Module	CI Project	Version
calypso-irdpricing		17.22.9.1-FRONTOFFICE_17-SNAPSHOT
calypso-analytics-...	CALYPSO-ANALYTICS-API-MULTIBRANCH/CA...	3.0.2
calypso-pricingscri...	CALYPSO-PRICINGSCRIPT-API-MULTIBRANCH...	2.0.1
calypso-core	CALYPSO-CORE-MULTIBRANCH/CALYPSO-CO...	13.6.2
calypso-healthcheck	HEALTHCHECK-MULTIBRANCH/HEALTHCHECK...	4.2.1
calypso-hibernate...	HIBERNATE-CORE-MULTIBRANCH/master	5.1.0
calypso-accessper...	CALYPSO-ACCESSPERM-EXT-MULTIBRANCH/...	2.0.1
calypso-logging	CALYPSO-LOGGING-MULTIBRANCH/CALYPSO-...	9.2.1
calypso-infosec	CALYPSO-INFOSEC-MULTIBRANCH/CALYPSO-...	5.0.7
calypso-infosec-xs...	CALYPSO-INFOSEC-MULTIBRANCH/CALYPSO-...	5.0.7
calypso-infosec-jd...	CALYPSO-INFOSEC-MULTIBRANCH/CALYPSO-...	5.0.7
calypso-infosec-jd...	CALYPSO-INFOSEC-MULTIBRANCH/CALYPSO-...	5.0.7
calypso-infosec-d...	CALYPSO-INFOSEC-MULTIBRANCH/CALYPSO-...	5.0.7
calypso-random	CALYPSO-RANDOM-MULTIBRANCH/master	3.2.0
calypso-swift-xml	SWIFT-XML-MULTIBRANCH/SWIFT-XML_3-0...	3.0.1
calypso-jaxb-impl-...	CALYPSO-JAXB-IMPL-RUNTIME-MULTIBRANC...	3.0.0
calypso-persistenc...	PERSISTENCE-SERVICE-MULTIBRANCH/master	5.1.0
calypso-sqlinputva...	SQLINPUTVALIDATOR_TRUNK	2.0.0
calypso-foundatio...	CALYPSO-FOUNDATION-MULTIBRANCH/CALY...	3.2.2
calypso-foundatio...	CALYPSO-FOUNDATION-MULTIBRANCH/CALY...	3.2.2
calypso-jboss-ma...	CALYPSO-EXTENSION-JBOSS-MULTIBRANCH/...	10.0.2
calypso-weblogic-...	CALYPSO-EXTENSION-WEBLOGIC_1-0-2	1.0.2
calypso-jboss-clie...	CALYPSO-EXTENSION-JBOSS-MULTIBRANCH/...	10.0.2
calypso-executesql	EXECUTESQL-MULTIBRANCH/master	6.4.0-17.0.0.0
calypso-schemer	SCHEMER-MULTIBRANCH/master	7.2.0
calypso-schedulin...	SCHEDULING-ENGINE-MULTIBRANCH/master	7.0.3-17.0.0.0
calypso-elasticsea...	CALYPSO-DEVOPSCENTER-MULTIBRANCH/m...	5.8.2
calypso-elasticsea...	CALYPSO-DEVOPSCENTER-MULTIBRANCH/m...	5.8.2
calypso-bean-core	MICROSERVICES-FRAMEWORK-MULTIBRANC...	9.8.5
calypso-microserv...	MICROSERVICES-FRAMEWORK-MULTIBRANC...	9.8.5
calypso-persistenc...	MICROSERVICES-FRAMEWORK-MULTIBRANC...	9.8.5
calypso-id-api	CALYPSO-ID-API-MULTIBRANCH/CIA_2-0_PA...	2.0.1-17.0.0.0
calypso-jboss-logi...	CALYPSO-EXTENSION-JBOSS-MULTIBRANCH/...	10.0.2
calypso-swingx	CALYPSO-SWINGX-MULTIBRANCH/CALYPSO-...	3.0.1
calypso-calibinteg...	CALIB-MULTIBRANCH/CALIB_401-3_PATCHES	401.3.2-17.0.0.0
calypso-calib	CALIB-MULTIBRANCH/CALIB_401-3_PATCHES	401.3.2-17.0.0.0
calypso-lowlatenc...	CALYPSO-LOWLATENCYMESSAGING-MULTIB...	10.4.0
calypso-pricingscri...	CALIB-MULTIBRANCH/CALIB_401-3_PATCHES	401.3.2-17.0.0.0
calypso-autodiff	CALIB-MULTIBRANCH/CALIB_401-3_PATCHES	401.3.2-17.0.0.0
calypso-schedulin...	SCHEDULING-ENGINE-MULTIBRANCH/master	7.0.3-17.0.0.0
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calypso-schedulin...	SCHEDULING-ENGINE-MULTIBRANCH/master	7.0.3-17.0.0.0
calypso-hdtools	CALYPSO-HDTOOLS-MULTIBRANCH/master	2.1.0
calypso-launcher	CALYPSO-HDTOOLS-MULTIBRANCH/master	2.1.0
calypso-graphics	CALYPSO-GRAPHICS-MULTIBRANCH/CALYPS...	3.0.1
calypso-navigator		17.22.9.1-FRONTOFFICE_17-SNAPSHOT