FX Computer Assignment – 2020

Additional resource: FX Volatility Smile Construction, Reiswich and Wystup, 2009. `http://janroman.dhis.org/finance/FX/FX%20Volatility%20Smile.pdf`

Below is market data for USDBRL from 15-Jan-2019. Assume market conventions : ATM is delta-neutral-straddle, market RR and BF, premium is in USD so delta does include premium. The spot rate is 3.724 BRL per USD.

Tenor	Expiry	ATM	25d RR	25d BF
ON	16-Jan-19	20.98	1.2	0.15
1W	22-Jan-19	13.91	1.3	0.20
2W	29-Jan-19	13.75	1.4	0.20
1M	15-Feb-19	14.24	1.5	0.22
2M	14-Mar-19	13.84	1.75	0.27
3M	15-Apr-19	13.82	2.0	0.32
6M	15-Jul-19	13.82	2.4	0.43
1Y	15-Jan-20	13.94	2.9	0.55

Use a constant USD interest rate of 2.2% and BRL interest rate of 6.5%.

(1) For every row of the table, calibrate the SABR model using the Hagan et. al. approximation for the implied volatility. Use a fixed β of 1. Construct all 5 strikes of the market instruments. Report in a neat table the strikes, implied volatilites at those strikes, and parameters of the SABR model.

(2) For every row of the table, find strikes for put delta of -10% and call delta of 10%. Create of graph of implied volatiltiy vs. strike for this range of strikes.

You can use whatever programming language and mathematical packages you find useful. Please submit your code as well as your results; the code will not be graded but will be checked to see that it is not copying anyone else's work.

Example. I get the following solution for the 1Y maturity.

$$
\begin{aligned}
K_{atm} &= 3.85003 \\
K_{bf\ put} &= 3.42579 \\
K_{bf\ call} &= 4.41875 \\
K_{rr\ put} &= 3.45895 \\
K_{rr\ call} &= 4.45962 \\
vol_{atm} &= 0.1394 \\
vol_{bf\ put} &= 0.184693 \\
vol_{bf\ call} &= 0.202826 \\
vol_{rr\ put} &= 0.179413 \\
vol_{rr\ call} &= 0.208413 \\
S &= 3.724 \\
T &= 1 \\
r_{usd} &= 0.065 \\
r_{brl} &= 0.022 \\
a &= 0.111541 \\
b &= 1 \\
v &= 1.75091 \\
r &= 0.11564 \\
K_{10put} &= 2.62067 \\
K_{10call} &= 8.23799
\end{aligned}
$$