Project B

Option Calibration and Pricing (HJM multifactor)

You are asked to calibrate an HJM model on German electricity swaps and price structured pay-offs options by means of Monte Carlo simulation.

The DATA_DEEEX file contains all liquid maturities for the German power futures and the options prices (implied volatility quotes) on the 4Q25 future on the 4th of November 2024.

i. Consider an HJM model for the 4Q25 German power swap driven by two Brownian motions (i.e. 6.9 in Benth 2008 with p=2 and n=0). Consider constant $\Sigma_1(t, t1, t2) and\ \Sigma_1(t, t1, t2)$ What is the admissible range for the model parameters?

ii. You should ensure that futures prices are martingales. Can you write explicitly the condition on the drift (i.e. without using numerical integration)?

iii. Calibrate the model on the 4Q25 German option prices (the entire surface) by minimizing the distance between model and market prices. Comment on the quality of the calibration.

iv. Calibrate the model on the 4Q25 German option prices by considering a generic time-dependent $\Sigma_1(t, t1, t2)$. Is only the integral of $\Sigma_1(t, t1, t2)$ for t that goes from 0 to the time to maturity relevant?

v. Calibrate the model on the 4Q25 German option prices by considering a generic time-dependent $\Sigma_1(t, t1, t2)$ and $\Sigma_2(t, t1, t2)$. Do you notice a significant improvement wrt. case iv?

vi. Price a down and in call option with maturity 6 months with strike K=500 and barrier $L = 450$ with the model calibrated in iv v and in vi. Does a closed formula exist in any of the three cases? Do the three prices differ significantly? If yes which one do you trust the most?

Deliver a MATLAB library.