Project C

FWD Calibration and Monte Carlo simulation (Arithmetic)

Consider an arithmetic process driven by two Inverse Gaussian processes (p=m=0, n=2). You are asked to calibrate the model on French electricity swaps and price European options by means of Monte Carlo simulation.

The DATA_FREEX file contains all liquid maturity for the French power futures. E.g. the NOV4 swap expires on the 29th of November 2024. It is a monthly contract with monitoring dates over the month of December 2024. Settlement is at the end of the monitoring period. The 3Q25 contract expires on the 28th of June 2025 and has monitoring period over the third quarter of 2025. You are on the 4th of November 2024.

i) Write the spot price considering for both additive OU in (3.14) of Benth 2008 $Y_0 = 1$, $\delta_1 = \delta_2 = 0$ and $\beta_1, \beta_2, \eta_1, \eta_2$ constant. Consider the IG process as driver of the additive OU and assume a yearly seasonal behaviour $\Lambda(t) = A\sin(2\pi\, t) + B + Ct$. Compute all integrals that can be solved analytically. What is the admissible range for the model parameters?

ii) Write the future price (under Q) at time t, consider the Esscher transform coefficients theta=0. Compute also in this case all integrals that can be solved analytically.

iii) Write the swap as in proposition 4.14 of Benth. Consider a continuous monitoring with settlement at the end of the period.

iv) Calibrate the additive model on the French power futures price provided. You should calibrate $\beta_1, \beta_2, \eta_1, \eta_2\ \ (for\ both\ OU\ models) A, B, C$ and the IG parameter (consider it the same for both OU). Comment on the calibration results and on the calibration speed. Are they reliable? Can you propose some modifications to improve the model parsimony?

v) Simulate the geometric model and price European put options on the 2028 future with strikes in the range 200/400 and maturity 2 years.

vi) Repeat points 1-5 for an Arithmetic model based on just a Gaussian OU model (i.e. m=p=1, n=0), do the results change substantially?

Deliver a MATLAB library