Pricing and calibration of path-dependent volatility models

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Abstract

We consider a stochastic volatility model where the dynamics of the volatility process are described by a linear combination of a (exponentially) weighted sum of past daily returns and the square root of a weighted sum of past daily squared returns in the spirit of Guyon and Lekeufack (2023). With respect to the former we discuss the influence of an additional parameter that unlocks enough volatility of volatility to reproduce the implied volatility smiles of SPX an VIX options within a 4-factor Markovian model (4FPDV). The data-driven nature of this class of path-dependent volatility models (PDVs) comes with computational challenges, especially in relation to VIX options pricing and calibration. To address these challenges, we propose an accurate neural network approximation of the VIX leveraging on the markovianity of the (4FPDV). This approximation is subsequently used to tackle the joint calibration problem of SPX and VIX options. We additionally discuss a possible local volatility extension of the 4FPDV, in order to exactly calibrate market smiles.
This is based on a joint on-going work with Julien Guyon.

References

J. Guyon and J. Lekeufack. Volatility is (mostly) path-dependent. *Quantitative Finance*, pages 1–38, 2023.

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