Local Volatility Prediction with Gaussian Processes

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Abstract

The celebrated Black-Scholes(BS) model is a most acceptable way to explain the prices of all vanilla and exotic options using only single parameter for each underlying. This model adopts constant volatility. However, reality shows that the implied BS volatility depends strongly on strike price and time to maturity. This relationship is called the volatility smile effect. The constant-volatility model can not reveal this relationship, and inevitably produces a large pricing error for the corresponding option. A lot of researches have been conducted to extend the BS model to estimate the smile effect. One of them is to use a one-factor risk-neutral process for the underlying spot. In one-factor process, volatility is a deterministic function of exercise prices and maturities, that is called a local volatility function(surface). This study proposed a new method to estimate the local volatility function in a jump-diffusion model. To do that, the proposed function model is constructed from our training option data. Simulations are conducted to estimate the local volatility functions for S&P500 index option market data and show that the proposed method not only accurately approximates local volatility, but also reveals a desirable volatility surface structure.

Keywords
local volatility, gaussian process, option pricing model, levy process

References

References

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