Pricing under Rough Volatility Models Lab Report

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Abstract

In the present paper we investigate the roughness of the Russian stock market in the context of the rough stochastic volatility model. We obtain the biased estimation of the Hurst parameter and the Zumbach effect. We also obtain an estimation of a bias using modern approaches in Data Science and Applied Statistics. In the end we form the conclusion that the rough volatility model is a XXX working model for the Russian stock market and formulate the future research horizon.

Keywords: Rough Volatility, RFSV Model, Zumbach Effect, Hurst Parameter, Equity, MOEX

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2 Description of the Model

2.1 Nessessary Definitions from Stochastic Calculus

Definition 2.1. The fractional Brownian motion (fBm) $(W_t^H)_{t\in\mathbb{R}_+}$ with Hurst parameter $H \in (0,1)$ is a Gaussian process with the following properties:

1. $W_0^H = 0$,
2. $\mathbb{E}\left[W_t^H\right] \equiv 0$,
3. $\mathbb{E}\left[W_s^H W_t^H\right] = \frac{1}{2}\left(t^{2H} + s^{2H} - |t-s|^{2H}\right)$

2.2 Rough Fractional Stochastic Volatility Model

$$dS_t = \alpha S_t dt + \sigma_t S_t dW_t, \tag{2.1}$$

$$d\log\sigma_t = \nu dW_t^H - \alpha(\log\sigma_t - m)dt \tag{2.2}$$

3 Statistical Analysis

3.1 Data Preprocessing

In our work we used two types of data: high-frequency data from a trading terminal (1m data), and candles from Yahoo Finance (1 day). We made the following preprocessing steps:

1. Created a mean price variable for each time interval ($\frac{high+low}{2}$ for HF, $\frac{open+close}{2}$ for candles)
2. Estimated the realized volatility as an standard deviation of the assets' log-returns, calculated from mean prices (40 minutes estimation for HF, 20 days for candles)
3. Plotted the graphs of RV and looked for anomalies, excluded those time periods from consideration
4.

4 Conclusion

5 Appendix