Doctoral School of Information and Biomedical Technologies Polish Academy of Sciences

Domain: IT

SUBJECT: Pricing European options on the Bitcoin market

Supervisors, contact: dr hab. Piotr Nowak, prof. IBS PAN (pnowak@ibspan.waw.pl, tel. 223810393)

Assistant supervisors, contact: n/a

Place of research: Systems Research Institute Polish Academy of Sciences

Recruitment & Selection: interview

Number of positions: 1

Project Description

Bitcoin (BTC), one of the best-known cryptocurrencies, was created in 2009. The system of BTC transactions is based on fixed rules, a peer-to-peer network, and cryptography (see [1]). As mentioned in [1] and references therein, Bitcoin behaves as a high volatility stock and the high volatility of its price may depend on market attention for this cryptocurrency.

European options on BTC have been recently traded on appropriate websites. In [1], the BTC price and dynamics of the attention index are modelled by continuous stochastic processes. The authors proved that, under appropriate assumptions, the model is free of arbitrage, derived pricing formulas for European style derivatives on BTC, applying methods of financial mathematics, and estimated the model parameters.

In the traditional Black–Scholes (BS) model, the underlying asset price is described by a geometric Brownian motion. However, since this financial market model has drawbacks (see [2]), some alternatives to this stochastic process have been proposed, including approaches using Levy processes with jumps (see, e.g. [3–6]).

The proposed research work, using advanced stochastic and computer science methods, concerns introducing a jump part to the model considered in [1] or its modification and derivation of the valuation expressions for European options on BTC. The process of fitting this model to market data will require the application of various computational techniques.

References

1. A. Cretarola, G. Figà–Talamanca, M. Patacca, Market attention and Bitcoin price modeling: theory, estimation and option pricing, Decisions Econ. Finan. 43,187–228, 2020.

2. M. Davis. Mathematics of Financial Markets, in: Mathematics Unlimited, Springer, 2001.

3. R. Merton. Option pricing when underlying stock returns are discontinuous. J. Financ. Econ. 3, 125–144, 1976.

4. S. G. Kou. A jump-diffusion model for option pricing. Manag. Sci. 48(8), 1086–1101, 2002.

5. D. B. Madan and E. Seneta. The variance Gamma (V.G.) model for share market returns. J. Bus. 63(4), 511–524, 1990.

6. P. Nowak and M. Pawłowski. Pricing European options under uncertainty with application of Levy processes and the minimal Lq equivalent martingale measure. J. Comput. Appl. Math. 345, 416–433, 2019.

Date: May 21, 2022