Intertrade times non-stationarity and its impact on autocorrelation of price changes absolute values

J. Klamut, R. Kutner, T. Gubiec

Faculty of Physics, University of Warsaw

Continuous-time random walk (CTRW) is a stochastic process with continuous and fluctuating waiting (interevent) time. It was firstly introduced to physics by Montroll and Weiss [1]. Since then it has been used to model anomalous transport and diffusion, hydrogen diffusion in nanostructure compounds, electron transfer, aging of glasses, transport in porous media, diffusion of epicenters of earthquakes aftershocks, cardiological rhythms, human travel and many more [2].

CTRW is also successfully applied in econophysics [3], for example it is used to describe stock price dynamics. We can consider the stock price as the price of the last transaction, so the value of a process represents the stock price and waiting times correspond to times between transactions. If we take into consideration only the memory between price changes it may describe empirical autocorrelation function (ACF) of price changes satisfactorily (one-step memory [4], two-step and infinite-step memory [5]). However, empirical ACF of price changes absolute values decays much slower than ACF of price changes and cannot be fully explained only by dependencies between price changes.

By using empirical financial data we study the autocorrelations of the following quantities: price changes, their absolute values and corresponding waiting times. We present analytical solutions for one-step memory CTRW model. We argue that it is crucial to include long memory of waiting times to explain slowly decaying ACF of price changes absolute values. We present that considering only short-term dependencies is not enough to explain empirical ACF, we show the decisive role of long-term correlations.

Additionally, we investigate nonstationarity of waiting times. We show that there exist power-law memories other than daily and hourly structures of market activity.

[l] E. Montroll, G. Weiss, J. Math. Phys. **6**, 167 (1965).
[2] R. Kutner, J. Masoliver, Eur. Phys. J. B **90**, 50 (2017).
[3] E. Scalas, Complex Networks **1**, 3 (2006).
[4] T. Gubiec, R. Kutner, Phys. Rev. E **82**, 046119 (2010).
[5] T. Gubiec, R. Kutner, arXiv:1305.6797v3.