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The high order dispersion analysis based on first-passage-time probability in financial markets

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Abstract

The study of first-passage-time (FPT) event about financial time series has gained broad research recently, which can provide reference for risk management and investment. In this paper, a new measurement — high order dispersion (HOD) — is developed based on FPT probability to explore financial time series. The tick-by-tick data of three Chinese stock markets and three American stock markets are investigated. We classify the financial markets successfully through analyzing the scaling properties of FPT probabilities of six stock markets and employing HOD method to compare the differences of FPT decay curves. It can be concluded that long-range correlation, fat-tailed broad probability density function and its coupling with nonlinearity mainly lead to the multifractality of financial time series by applying HOD method. Furthermore, we take the fluctuation function of multifractal detrended fluctuation analysis (MF-DFA) to distinguish markets and get consistent results with HOD method, whereas the HOD method is capable of fractionizing the stock markets effectively in the same region. We convince that such explorations are relevant for a better understanding of the financial market mechanisms.

Keywords: First-passage-time (FPT) probability, High order dispersion (HOD), Multifractal detrended fluctuation analysis (MF-DFA), Financial time series

1. Introduction

Financial market is a typical complex system which has provoked great interest of many researchers in recent decades [1–5]. It has been proved that studying financial market has significant practical applications like evaluating the risk of an investment and guiding to design good portfolios. A range of statistical methods, such as empirical mode decomposition(EMD), neural network, multifractal and correlation analysis [6–11], proposed to investigate financial markets and a range of accomplishments have been achieved in the previous studies. In this article, we introduce a innovative tool which is first-passage-time (FPT) statistics to discuss the fluctuation features of financial time series. First-passage-time, which concerns the estimation

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