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Nonlinear transformation on the transfer entropy of financial time series

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*Department of Mathematics, School of Science, Beijing Jiaotong University, Beijing 100044, P.R. China***Abstract**

Transfer entropy (TE) now is widely used in the data mining and economic field. However, TE itself demands that time series intend to be stationary and meet Markov condition. Naturally, we are interested in investigating the effect of the nonlinear transformation of the two series on the TE. Therefore, the paper is designed to study the TE of five nonlinear "volatile" transformations based on the data which are generated by the linear modeling and the logistic maps modeling, as well as the dataset that come from financial markets. With only one of the TE of nonlinear transformations fluctuating around the TE of original series, the TE of others all have increased with different degrees.

Keywords: transfer entropy; nonlinear transformation; financial time series

1. Introduction

In recent years, financial market has been an active research area for economists and statisticians [1–3]. However, most of them focused on the market tools from economic methods and statisticians tools, such as neural network[4–6], linear regression[7–10], and correlation coefficient[11, 12]. Now, it has been widely accepted in economic system that all those indexes in the stock market are correlated and interconnected, and the interaction therein is highly nonlinear, unstable and long-range correlated[13]. Hence, we not only focus on the variation of the index in stock market, but also enthusiastically attach importance to the interrelation among companies in stock market.

In the information era, economists and statisticians devote themselves to data mining and analysis, which can be presented by rigorous mathematical terms[14], such as the mutual information, and information flow[15–17]. Information flow, the transfer of information from system X to system Y in a given process in an information theoretical context, can reveal the interaction between two systems. Furthermore, the information measuring the interactions in markets is a key to the detection of the direction of information flow between different markets. For example, we can calculate the information flow from Nasdaq index to DAX index during a certain period by using the two index time series[18]. However, the directionality is indispensable to detect who plays an influential role between the two systems, and can be expressed by TE. TE now is a popular measure of information flow from the driving system to response system, and it has been used to reveal the relation among different systems in varied areas[19–21]. Specifically, TE estimates the entropy in the response system caused by its connection to the driving system, accounting for the entropy generated internally in the response system[22, 23]. Nowadays, TE

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