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B-SPLINE DETRENDED FLUCTUATION ANALYSIS FOR MINIMIZING THE EFFECT OF TRENDS

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Abstract. Detrended Fluctuation Analysis (DFA) and its extension multifractal DFA (MF-DFA) has been established as an important method to determine fractal scaling properties and to reliably detect possible long-range correlations in data. Recent studies have reported the susceptibility of DFA to periodic trends, which can result in spurious crossovers. In this paper, we proposed a new approach based on B-spline method to minimize the effect of periodic trends in DFA estimation. The effectiveness of the proposed technique is demonstrated on stock data corrupted with both exponential trends and periodic trends.

Keywords. B-spline DFA, DFA, MF-DFA, exponential trends, periodic trends.

1 Introduction

In the last decade Detrended Fluctuation Analysis (DFA [1-7], originally introduced by Peng et al. [8] has been established as an important method to determine fractal scaling properties and to reliably detect possible long-range correlations [9-11] in data effected by trends. It also has successfully been applied to diverse fields such as DNA sequence [12], heart rate dynamics [13], neuron spiking, human gait, cloud structure, economics time series, and long-time weather records [14]. In addition, several comparisons of DFA with other methods for stationary and non-stationary time -series analysis have been presented [15-19].

For the reliable detection of long-range correlations, it is essential to distinguish trends from the long-range fluctuations intrinsic in the data. Recently, several modifications of DFA method have been proposed with many different techniques for the elimination of several types of trends [20-32]. DFA and its extension multifractal DFA (MF-DFA) [2] have been used extensively to extract the scaling exponents. Kantelhardt et al. [1] suggested that DFA-k which incorporates the k'th order polynomial detrending has been found to be immune to polynomial trends lesser than k. While the procedure lends itself to be robust to polynomial trends this not true for other types of trends. Recent studies have reported the susceptibility of DFA to periodic trends, which can result in spurious crossovers. Periodic trends are quite common