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ВИБІР СХЕМИ СТИСНЕННЯ

У роботі досліджено нижню межу схеми стиснення у відкритих інформаційних системах з використанням чотиризначної системи кодування. Доведено доцільність кодування в чотирисимвольному алфавіті.

Ключові слова: схеми стиснення, ітеративні структури, коефіцієнт стиснення.

Матеріал надійшов 31.07.2013

УДК 512.7

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PREFORECAST TIME-SERIES ANALYSIS OF FINANCIAL DATA

The main result is the conclusion that the possibility of pre-forecast analysis of financial time series in order to prepare them for use in the prediction using neural networks.

Keywords: data series, neural networks, financial data, pre-forecast analysis.

In the article the pattern of use of fractal analysis to identify the basic characteristics of financial time series data, basic element of which is the ability to R/S-analysis.

According to the algorithm in Borland C++ Builder has developed a software product that allows you to identify and numerically evaluate the fundamental characteristics of the time series, such as the presence and depth of long-term memory, persistence or anti-persistence etc [2].

Fractal analysis is a new method to describe the evolutionary processes and forecasting of economic time series. The basic tool for the fractal analysis of time series analysis is an algorithm R/S-analysis. Methodology for R / S-analysis was developed in the mid XX century hydrologist Hurst during the study time series of river flow volumes. The inspection of the assumption that the data series are subject to the normal law, Hearst defined a new statistic – Hurst index (H). In the course of his research Hurst measure fluctuations of water in the reservoir relative to the average over time and introduced the dimensionless ratio by dividing the amplitude of R by the standard deviation S. This method of analysis has been called by the rescaled range (R / S-analysis). Hurst found that most natural phenomena, including river flows, temperatures, precipitation, sun spots should be "shifted to a random walk" – a trend with noise. The strength of the trend and the noise level can be measured by how the normalized amplitude with time, or in other words, as far as the value of H greater than 0,5.

We describe the algorithm for R / S-analysis in the form in which it is implemented in modern methods of fractal analysis [1; 2]. Given a time series:

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$$X = \{x_i\} i = 1,2,\cdots,n \qquad (1)$$

which consistently highlight its initial segments:

$$X_\tau = x_1, x_2, \cdots, x_\tau; \tau = 3,4,\cdots,n$$

for each of which we compute the current average:

$$\overline{X}_\tau = \frac{1}{\tau}\sum_{i=1}^{\tau} x_i .$$

Then for each fixed $X_\tau, \tau = 3,4,\cdots,n$ compute the accumulated deviation for its segments of length t:

$$Y_{\tau,t} = \sum_{i=1}^{t}\left(x_i - \overline{X}_\tau\right), where t = \overline{1,\tau} .$$

After that, we calculate the difference between the maximum and minimum accumulated deviations:

$$R = R(\tau) = \min_{1\le t\le Ā}(Y_{\tau,t}) - \max_{1\le t\le Ā}(Y_{\tau,t})$$

which is called the term "range of R». This scale is normalized, that is represented as a fraction of R/S, where

$$S = S(\tau) = \sqrt{\frac{1}{\tau}\sum_{j=1}^{\tau}\left(x_j - \overline{X}_\tau\right)^2} .$$

– standard deviation for the interval time series $X_\tau, \tau = 3,4,\cdots,n$.

Hurst exponent H = H (τ), which characterizes the fractal dimension of the considered time series and the corresponding color noise, we obtain the relation [1]

$$\frac{R}{S} = (a\tau)^H .$$

Logarithms of both sides of this equation and assuming $a = \frac{1}{2}$ [3] obtain the Cartesian coordinates (x_τ, y_τ) points of H – trajectory ordinate and abscissa are respectively:

$$y_\tau = H(\tau) = \frac{\log\left(\frac{R(\tau)}{S(\tau)}\right)}{\log\left(\frac{\tau}{2}\right)}, x_\tau = \tau .$$

Required for the fractal analysis of (1) R / S-trajectory is in Cartesian logarithmic coordinates a sequence of points, the abscissa $x_\tau = \log\left(\frac{\tau}{2}\right)$ and ordinates $y_\tau = \log\left(\frac{R(\tau)}{S(\tau)}\right)$.segment connecting adjacent points (x_τ, y_τ) and $(x_{\tau+1}, y_{\tau+1})$ where t=3.4...... n-1 obtain a graphical representation of R / S-path (H-path) in logarithmic coordinates (in the conventional Cartesian coordinates).

One of the main characteristics of fractal time series is color noise, which corresponds to this series at one or another point in time. The values of H ≥ 0,6 define a black noise.

The higher the value the greater the stability of the trend to the relevant segment of the time series. The values in the vicinity of $\sim 0.5 \mp 0.1$ define a region of white noise, which corresponds to the "chaotic behavior of the time series," and therefore, the lower the reliability of the forecast.

As shown below, considered in this paper are inherent in Black series, and loosely speaking, the "gray noise", corresponding to the region of a fuzzy distinction between areas of black and white noise [1].

On the availability of long-term memory of the Time series (1) is not possible to give a positive or negative opinion if its H-trajectory is not a long time in the field of black noise, and the behavior of R / S-trajectory is chaotic, from the initial point.

The basis for the claim that the time series (1) has long has a long-term memory is the fulfillment of the following conditions:

1. H-path through some of his initial points is in the black noise, and for. path specified points entering the black noise is a trend showing. Determines the depth of the memory condition at H-trajectory gets decremented, R / S-trajectory at this point shows a sharp change in the trend.
2. If in this time series of random shuffle its elements and the resulting series to present to the input of the algorithm R / S-analysis, the output of the algorithm maximum value of Hurst and R/S-trajectory will be much lower compared with the values of H for the original time series, in this case the time series has a long memory.

In this work, R / S-analysis were subjected to the following time series (Table 1).

Used in the time series are consistent sample (of n) for the period from ______ to _______, the year of market statistics for each element of the time series corresponds to the result of trades on the financial asset in a single trading day.

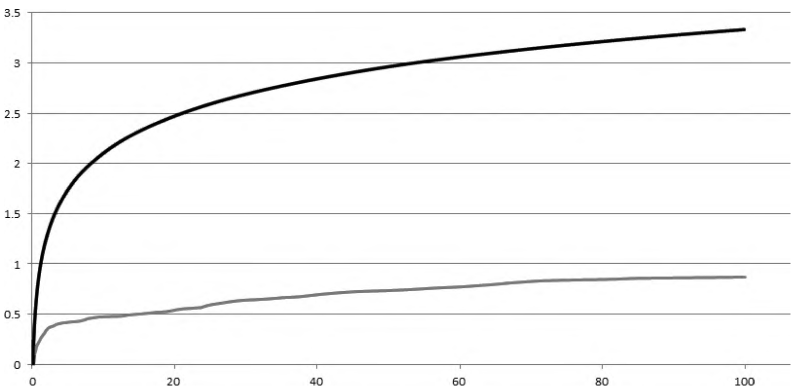
In Figures 1 show produced at the output of R/S-analysis, H and R/S – path for the corresponding time series. For graphs H-trajectory on abscissa length segments of the τ. For schedules R/S-trajectory on abscissa values ln(τ / 2)

As a result of R / S-analysis yielded the following results, which are common to all considered in the series:

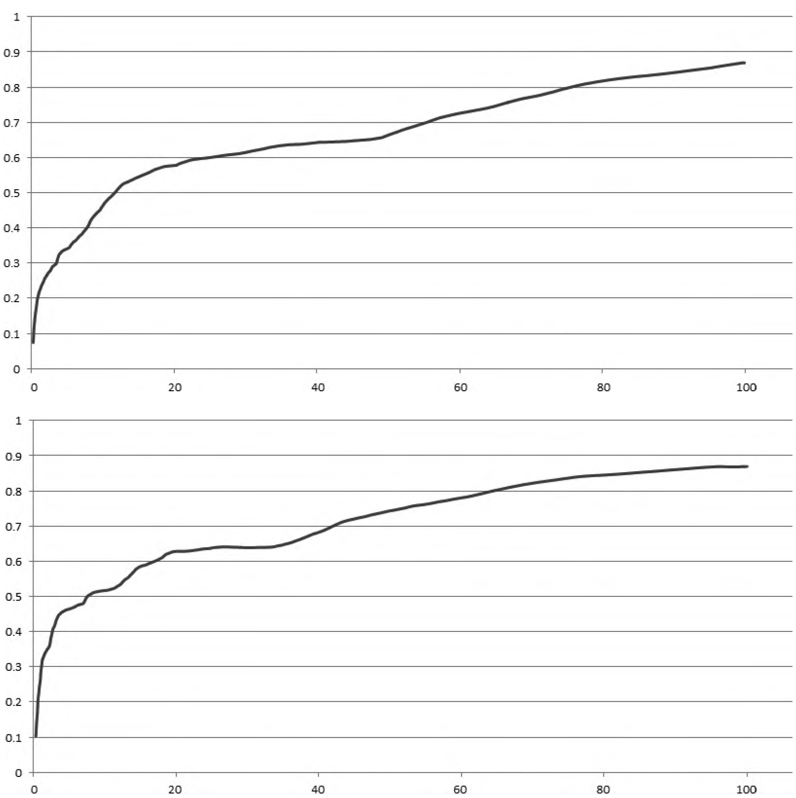
- For each time series, its H-trajectory after some of its first value is in the area of "black noise", allowing talk about trend persistence relevant time series and their inherent effect of long-term memory .
- For each of the series can estimate the amount of the first elements (m), after which the Hurst goes into the zone of "black noise". This quantity characterizes the minimum allowable sample of a time series, which carries information about future values of the time series, that is, allows you to build prediction of the behavior of the time series. The corresponding values of m are in between 5–9.
- The results of R / S-analysis allows also argue that some of the considered time series inherently cyclical, rather quasi-cyclic. Moreover, analysis

Table 1. **The analyzed time series**

Name of analyzed time series	Sample size
stock quotation – MSFT (X_1)	1050
stock quotation – IBM (X_2)	1100



Figures 1a. R/S and H-trajectory of the time series (X_1 time series)



Figures 1b. H-trajectory of the time series (X_1 and X_2 time series)

of R / S-path indicates that the points of change of trend is most often corresponds to the end of quasi-cycle. Additional expansion of the series to the quasi-cycles will appreciate the depth of long-term memory of the series.

- To identify properties quasi-cyclic time series and determine the depth of long-term memory of a time series of only one R/S-analysis may not be enough. Requires additional methods and algorithms (for example, the mechanism of phase trajectories and aggregation).

The main result is the conclusion that the possibility of Pre forecast analysis of financial time series using an algorithm Hurst rescaled range (using R / S-analysis). As a result of this analysis, we can conclude that there in the time series effect long-term memory, to estimate its depth, you reveal the presence of cycles (quasi-cycle). However, the R / S-analysis is not exhaustive tool pre forecast research enter-time series, since it does not always provide full details of the behavior of the time series without additional methods and algorithms.

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ПЕРЕДПРОГНОЗНИЙ АНАЛІЗ ФІНАНСОВИХ ЧАСОВИХ ДАНИХ

Основним результатом роботи є висновок про доцільність проведення передпрогнозного аналізу фінансових часових рядів з метою їх підготовки до використання при прогнозуванні за допомогою нейронних мереж.

Ключові слова: часові ряди, нейронні мережі, фінансові дані, передпрогнозний аналіз.

Матеріал надійшов 31.07.2013