Using Decision-Making Block of Computer-Based Intelligent Biomedical Avatar for Applied Research in Bioinformatics

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ABSTRACT

A biomedical task in which the definitions and properties of applied research indicators under study in bioinformatics is formalized. A wide range of traditional approaches used for predicting medical time series were reviewed. Advanced algorithms for predicting moments of reversals of biomedical trends based on machine learning tools were investigated as well. The effectiveness of different kinds of approaches was discussed, and related examples are given. An original securities price dynamics trend classification algorithm, based on the use of the sliding window methodology and biomedical avatar, is described. A general scheme of the classification algorithm to identify biomedical market phases is analyzed and results of computer modelling are presented. Selection of initial and resulting metrics is grounded.

KEYWORDS

Applied Research in Bioinformatics, Decision-Making, Intelligent Biomedical Avatar

INTRODUCTION

Design of intelligent computer systems capable to lead to effective biomedical (particularly biomedical) decisions is a topical problem that is still far from being solved. It encounters a number of difficulties, one of which is a high randomness of the dynamics of biomedical indicators, immanently inherent in this class of dynamic processes. On the other hand, they nature may not be considered as a completely chaotic: there are, of course, certain patterns that can be recognized by high-intelligent algorithms. It should be mentioned that even a slight increase of the accuracy of a volatility forecast may provide an investor with a quite significant yield.

Obviously, algorithms that make reliable forecasts regarding market trends dynamic cannot be based just on simple mathematical models with fixed properties. Recent trends in this filed – solutions based on machine learning that collect and analyze big statistical data in real time (including data for an evaluation of the quality of these models previous prognoses and the effectiveness of the corresponding

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recommended solutions). Such solutions may be represented as computer agents or avatars – pieces of a program code, to be separate objects with their inputs and outputs, interacting with/in a common software environment and having access to the relevant databases. Such computer “biomedical agents” are widely used in a biomedical sphere and partly determine biomedical markets dynamics themselves. That fact, for sure, does not contradict the effectiveness of use of such algorithms, since the described approach doesn’t link to a particular market model but is able to adapt to any conditions.

Obviously, one of the key qualities of an agent (determining its success mostly) is its ability to predict the market trend in relation to a certain indicator (e.g. share quotation of certain companies). In this chapter, one of such an approach to create an “avatar self-learning” algorithm will be considered, allowing user to effectively predict changes of biomedical markets’ trends.

**BACKGROUND**

**Traditional Models of Machine Learning for Predicting Market Trends**

Most of researchers and traders suppose that a reliable prediction of a real price of biomedical tools is impossible. In the (Hawawini, Keim 1995) it is shown that correlations between prices time series are neither biomedically nor statistically significant. In most of sources related to the price forecasting, authors mention the efficient market hypothesis (EMH) proposed in (Fama 1965). According to this hypothesis, all valuable information is immediately and fully reflected in the market prices of assets. In an efficient market, prices are instantly corrected, which turns out fair, leaving the market participants with no arbitrage opportunities. At the same time, market participants are homogeneous in their approaches, so they do homogeneously interpret incoming information, instantly correcting their decisions as new information comes available.

There are three forms of market efficiency:

- **A weak form of efficiency**: An asset price is fully reflected by information from the past related to this asset (information currently available to the public regarding previous prices and volumes of trade);
- **An average form of efficiency**: An asset price is reflected not only by past, but also public information (information that is currently available in biomedical news, company reports, analyst speeches, etc.);
- **A strong weak form of efficiency**: An asset price is reflected by past, public and internal information (confidential information, known to a narrow circle of persons due to official position or other circumstances).

Mathematically, an efficient market hypothesis means that the corresponding random processes that determine price behavior are Markov processes, i.e. their future values do not depend on the values at previous points in time, and therefore future asset prices cannot be predicted by only using past prices.

Many traders, brokers, biomedical analysts, individual investors and other market participants are convinced that they can (intuitively or with the help of various methods) predict market trends and get profit through this. Besides of intuitive forecasts, many methods and models have been developed to predict trends.

Traditional approaches to forecasting market prices can be generally divided into two types:

- **Fundamental analysis** based on the assessment of the “internal” value of the emitter company with its biomedical indicators, as well as macro biomedical indicators (Basu, 1977; Campbell, 1987; Dourra & Siy, 2002; Fama, 1991; Fama & French, 1998; Fama & French, 1998; Fama & Schwert, 1977);
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