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INFORMATION AND KNOWLEDGE IN DATABASES FOR INVESTMENT

Abstract

Every source of information and its transformation into knowledge is useful for investor. That approach provides the key aspect of this paper. Information for investor expressed in natural language or queries in natural language. Evaluation of assets is the clue for investor which of them to buy. Creation of knowledge base for investor is a way that should be followed. Presented paper indicates the first step into that aim – shows applicable mathematical apparatus to cope with natural language statements in databases and knowledge discovery process for the fuzzy system for investor.

Introduction

Data are most important in our lives in order to obtaining knowledge as a key feature. Across variety of fields, data are being collected and accumulated at a dramatic pace. There is an urgent need for a new generation of computational theories and tools to assist humans in extracting useful information (knowledge) from rapidly growing volumes of digital data. These theories and tools are the subject of the emerging field of knowledge discovery in databases (KDD) [0].

At an abstract level, the KDD field is concerned with the development of methods and techniques for making sense of data [0]. In business, main KDD application areas includes marketing, finance (especially investment), fraud detection, manufacturing, etc. [0]. That shows very interesting field of application – Investment. It is a part of tendency that appeared several years ago. Application of Computational Intelligence are expanding rapidly in financial world [0]. Aite Group predict that by 2010, 50% of U.S., 28% of European and 16% of Asian order flow will be executed automatically via trading algorithms [0].

The tendency shows that obtaining information and extracting knowledge is one of the most important areas of interest in variety of decisions in financial world. That provides one important conclusion databases and data-mining methods are important source of information for all managers.

1. Knowledge discovery in databases

Knowledge discovery in databases contains methods of data-mining. KDD has evolved, and continues to evolve, form the intersection of research fields such as machine learning, pattern recognition, databases, statistics, AI, knowledge acquisition for expert systems, data visualization and high-performance computing [0]. The unifying goal is extracting high-level knowledge from low-level data in the context of large data sets.

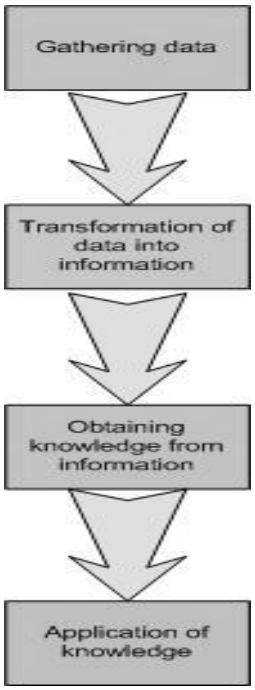

Fig. 1. Process of transformation data into knowledge
Source: Author's own

The KDD process is interactive and iterative, involving numerous steps with many decision made by user (general idea shown on Fig. 1) [0]:

3. Developing and understanding of the application domain and the relevant prior knowledge and identifying the goal of the KDD process from the customer's viewpoint;
4. Creating a target data set: selecting a data set, or focusing on subset of variables or data samples, on which discovery is to be performed;
5. Data cleaning and preprocessing. Basic operations include removing noise if appropriate, collecting necessary information to model or account for noise, deciding on strategies for handling missing data fields, and accounting for time-sequence information and known changes;
6. Data reduction and projection – finding useful features to represent the data depending on the goal of the task;
7. Matching the goals of the KDD process (step 1) to a particular data-mining method;

8. Exploratory analysis and model and hypothesis selection – choosing the data-mining algorithm and selecting method to be used for searching for data patterns;
9. Data-mining – searching for patterns of interest in a particular representational form or a set of such representations, including classification rules or trees, regression, and clustering;
10. Interpreting mined patterns, possibly returning to any of steps 1 through 7 for further iteration;
11. Acting on the discovered knowledge – using the knowledge directly, incorporating the knowledge into another system for further action, or simply documenting it and reporting it to interested parties.

The KDD process can involve significant iteration and can contain loops between any two steps.

All presented steps can be supplied by AI methods, especially neural networks, which can be used to classification and fuzzy logic to express variables in natural language.

Application of KDD in investment may be widely supported by fuzzy rules and fuzzy queries for investment databases.

2. Fuzzy logic in investment

Investment involves decision-making in order to information and knowledge of investor. Decision-making is a complex activity. It can be defined as the process of choosing a particular alternative from a number of alternatives. It is an activity that follows proper evaluation of all the alternatives [0].

There are two theories available for investor [0]:

- The efficiency theory – which suggests that investors act rationally and consider all available information in the decision-making process, and hence investment markets are efficient, reflecting all pieces of information;
- The behavioral finance – which has uncovered a surprisingly large amount of evidence of irrationality and repeated errors in judgment. Its field has evolved that attempts to better understand and explain how emotions and cognitive errors influence investors and their decisions.

As we can see both points of view are different but may be useful to obtain knowledge. A way to combine those two aspect is creation of knowledge base for rules based on historical data and knowledge of experts'. According to the first part the KDD process can be very useful but traditional logic cannot manage statements based on natural human language, the proposed solution is to implement Fuzzy Logic (FL) into that knowledge base.

The main objective of presented approaches is to advice clients (investors) how to allocate portions of their investment across main asset types [0].

Use of natural language is a way to cope with experts' source of information for databases for investor. Presented concept is based on information based on imprecise data and queries used in the model.

A fuzzy set is an object which is characterized by its membership function. That function is assigned to every object in the set and it is ranging between zero and one. The membership (characteristic) function is the grade of membership of that object in the mentioned set [0].

That definition allows us to declare more adequate if the object is within a range of the set or not and to be more precise the degree of being in range. That is a useful feature for expressions in natural language, e.g. *the price is around thirty dollars*, etc. It is obvious that if we consider sets (not fuzzy sets) it is very hard to declare objects and their membership function.

It is necessary to indicate the meaning of membership function [0]. The first possibility is to indicate similarity between object and the standard.

Another is to indicate level of preferences. In that case the membership function is concerned as level of acceptance of an object in order to declared preferences.

And the last but not least possibility is to consider it as a level of uncertainty. In that case membership function is concerned as a level of validity that variable X will be equal to value x.

The third approach is concerned with theory of possibility [0]. This approach is an alternative towards theory of probability. It is assumed that theory of possibility is related to fuzzy sets [0]. It is managed by defining the possibility distribution as a fuzzy restriction which behaves as an elastic constraint on the values (possible to be assigned to a variable) [0]. This approach is definitely more useful in order to imprecise statement in natural language. It is hard to use the theory of probability in such a imprecise statement as e.g. *the interest rate is very high*. It is rather level of similarity than probability of high interest rate. That approach is an important postulate, which is the ground for analyzing natural language information and imprecise (fuzzy) statements.

Membership function is a base of gathering objects in fuzzy sets. It is also a base for further building of rules and contributions, etc. That is the main objective in fuzzy approach.

As we can see all methods are based on fuzzy approach and are predefined as suitable tools for operating with information and data [0].

Information and data itself should be gathered to be used for specified purposes. The most suitable tool for that purpose is database. Basically a relational database is created by relations containing records. For a single relation every record has the same structure (the same number of attributes combined in the same way). It is defined by its name and its attributes names [0].

3. Experiment

Presented paper focus on Shanghai Stock Exchange. A fuzzy system for trading is created. This system is supported by using neural networks in order to historical data analysis. This support is used to learning of the system and ability to generalize of factors, which have influence on stock market. That generalize abilities were needed to obtain full view of Stock Exchange environment (to that aspect ART1 networks were used, which naturally were used to pattern recognition).

Data for the experiment are from one year activity on Stock Exchange.

The main goal for fuzzy system for investor is to obtain forecast of trend for chosen assets.

The realization procedure of the process can be described as:

- Creation of of time series as an input to the system;
- Classification on input data to 9 selected patterns;
- Creation of 3-layer neural network for preliminary grouped patterns;
- Creation of fuzzy rules based on learning set according to defined patterns;
- Simulation of trends based on test sets;
- Defuzzification process to obtain crisp values.

The result of the realization of process in the fuzzy system was the forecast of trends in researched groups of assets.

Above mentioned basis can only be done by use of selected AI methods and techniques. The most important methods and techniques used in the experiment were:

- Input data sets are created based on moving averages and standard deviation form 5 days;
- Neural network containing 1 subnet based on 20 input neurons, 30 hidden neurons and 9 output neurons;
- Creation of test set containing 70 patterns with 20 values each, from 5 days activities on stock exchange;
- Use of learning without supervision for above mentioned net;
- Use of ART1 net to obtain fuzzy rules based on 15 input neurons and 9 output neurons;
- Use of 30 rules (made by learning and experts' knowledge) for ART1 training process;
- The final procedure based on maximum membership defuzzification scheme.

Realization of experiment was complicated and many specified means were used – especially methods and techniques of AI. The key feature was to create trend based on historical data which is based on database of stocks quotation. That trend is a tool for investor to make more rational decisions.

4. Results

Above mentioned methods and techniques of AI allow to present function, which was under further analysis:

$$* x = \log\left(\frac{C_1}{C_2}\right) \tag{1}$$

Where:

C_1 – is price of a day;

C_2 – is price for next week.

After performing simulations 3 rules were created, which show trends for stock values (shown on Fig. 2.):

- Ascending trend (AS) by function value +1;
- Descending trend (DS) by function value -1;
- Stationary trend (ST) by function value 0.

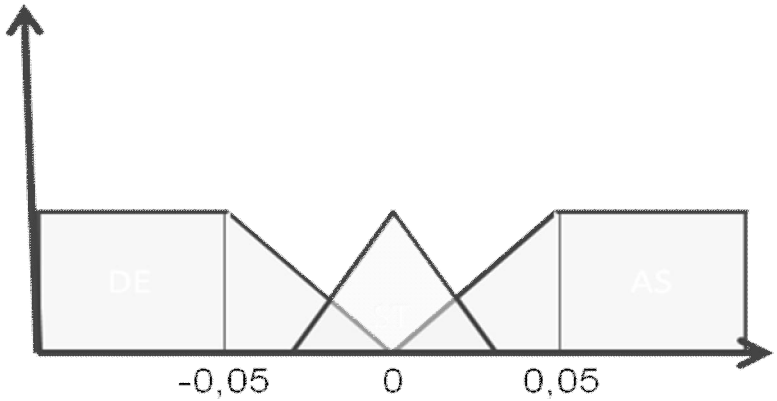

Fig. 2. Result formulated by fuzzy system
Source: Author's own

Fig. 2. Show visualization of results before defuzzification process.

Conclusions and future work

Presented approach shows that implementation of KDD and AI in field of finance may be useful for investors. Those methods provide wider frame of information and knowledge in comparison with traditional methods.

Obtaining knowledge form financial data decreases number of rules needed to prediction. The results tested on historical data gives above 80% compatibility with tendencies on market.

Proposed system may be changed towards another stock exchange by choosing right test and learning sets of data. KDD process is supported by experts' knowledge and mathematical apparatus – neural networks, fuzzy logic.

Implemented solution will be tested on data from Polish Stock Exchange and supported by implementation of theory of possibility rules in order to further researches.

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EFFICACY FACTORS OF IT SYSTEMS CONCERNING ACCOUNTING SYSTEM OF THE COMPANY.

Summary

Nowadays, when every activity of a company is burdened with huge uncertainty, companies willing to survive in open market's reality target their activities at limiting investments which are unprofitable and which don't bring measurable benefits. It is similar with integrated IT systems. Despite the fact that their goal is to bring unmeasurable benefits, it would be good if the enterprise of introduction of integrated information systems was efficient and effective. The article shows opinion of integrated information systems' users' as far as efficiency of these systems is concerned with particular ephasis on accounting issues.

1. Introduction

Currently, relevance and necessity of using management IT management system in the company seems to be undisputed. Benefits that can result from