

Research on the Fuzzy Statistical Theory and Its Application in Economic Forecasting and Decision Making

Hai Sun

College of Mathematic & Information, China West Normal University, Sichuan, 637009, China

Corresponding author is Hai Sun

Abstract

In this paper, the author mainly discusses fuzzy statistical theory and its application in economic forecasting and decision making. Firstly, some concepts, classification, rules, methods, procedures, research goal and significance in the economic forecasting are briefly presented, which provide a fundamental for establishment of economic forecasting models. Secondly, economy development is introduced with its algorithm. Fuzzy statistical learning theory and realization of the support vector machine (SVM) are also detailed. In addition, SVM and Fuzzy Algorithm are compared based on training process and network structure.

Keywords: SUPPORT VECTOR MACHINE, FUZZY STATISTICAL THEORY, ECONOMY FORECASTING, DECISION MAKING

1. Introduction

Forecasting is a process of digging out the underlying rules of future things on the basis of observing and analyzing of the objects during the history and former status. The theories and methods of forecasting can be widely applied into various fields of both nature and society, developed into subjects like social forecasting, weather forecasting, medical forecasting, biology forecasting, disaster forecasting, military forecasting, economic forecasting, etc. In market economy, economic activities are changing all the time, with high complexity and uncertainty. In order to get rid of the risks of decision-making and improve management and foreseeable ability, people pay more and more attention to economic forecasting. Either the macroscopically or microcosmic decision-making is closely attached to reasonable economic forecasting. Forecasting and decision-making are two important components of management. The key of management lies in decision-making and its precondition

is forecasting. In commercial circumstance, leaders need to make various kinds of decisions which mean a lot to the success of their corporations. Market demand, productive ability and other aspects need to be forecasted during operation. Via forecasting, leaders could understand the supply-demand relationship, grasp the direction and trend of market, further adjust the competitive strategies, production scale and gain more benefits. Before the emerging of modern forecasting methods and computer technology, managers carried out forecasting only based on their subjective judgment which absolutely lacked accuracy compared to quantities forecasting technology. As information technology develops and computers come into common life, forecasting methods have evolved to make it possible that massive data can be stored, gathered, processed and analyzed in Zhang's paper [1]. As a vital part of quantities forecasting, time series analysis has been highly developed during the last decades, and shaped into mature mechanism of

forecasting. Time series is a serial data of observing results according to time sequence. Most of data that are gathered by common corporations are time series, like Earning Per Share, text message income per month, revenue of voice service per month and so on. In recent years, as the rapid growing of information software and hardware industry, data analysis is playing more and more important role in decision-making process of government and corporation. Time series analysis is widely used by many fields. Forecasting future observing data through the relativity in unique time series is important to economy development [2-3]. Understanding the relativity between data in series through analyzing several interrelated series can improve the accuracy of forecasting. Dividing the series into several main parts (trend ingredients, seasonal factors, and circulation factors, irregular factors) can understand the dynamic action of series. Checking the similarity of theoretical patterns and series may discuss the accuracy of pattern demonstrating the phenomenon. 5. Estimating the influence of special policy or events. Ling [4] propose a procedure to forecast short seasonal time series. It is a modification of method developed for forecasting series with stable seasonal patterns. The new method is motivated by the observations that seasonal patterns may be evolving over time and that short time series arise in many situations. The new method would be more effective when seasonal patterns are not stable and only a small amount of data is available. Real data analyzed in the literatures and new data from telecommunication industry will be collected and analyzed by the proposed procedure.

Economic system is intrinsically nonlinear and non-stationary, making the general linear forecasting model is inaccurate. The fuzzy algorithm as an excellent tool for nonlinear function approximation, due to its nonlinear quality, self-organization, self-learning, robustness, distributed storage and parallel computing power, has been playing a more important role in economic projections. The fuzzy algorithm is one of the most widely used fuzzy algorithm model, being proved that it has a strong spatial mapping ability. However, the result was not ideal when using the fuzzy algorithm to do the forecasts.

2. The Model for Economic Forecasting and Decision Making

Optimization theory and methods is the most important subject in application areas, it studies the best method of the decision-making problem. The Input-output model and portfolio investment model are the most important parts in economy.

The algorithm converges more slowly, and the network is easy to fall into local minimum when the parameters are selected inappropriately, which all affect the model's reliability and accuracy. Wavelet analysis with good time-frequency localization and zoom features, and with strong nonlinear function approximation ability, becomes a strong black box identification tools in nonlinear system. In Gary's paper [5] from the famous French scientific research institutions, proposed wavelet fuzzy algorithm, composed of wavelet transform and based on fuzzy algorithm model, that is, using wavelet function to replace nonlinear activation function of fuzzy algorithm (such as the Sigmoid function). It integrates the wavelet transform and fuzzy algorithm organically and inherits the advantages of both. With the development of the nonlinear theory and artificial intelligence technology, wavelet network will be a strong tool in financial market analysis and forecasting. Lee's [6] paper attempts to analysis the structure and algorithm of wavelet network and propose four wavelet networks, two of which with the different network structures based on the same algorithm, namely fuzzy model; the others with the different algorithms based on the same structure, that is, the wavelet network based on the genetic algorithm and the wavelet network based on particle swarm optimization algorithm. Here uses wavelet networks for time series prediction, and makes analysis and comparison of the predicted results. The wavelet network based on the quantum particle swarm optimization is applied to forecast stock price in the last section. From the perspective of quantum mechanics, Mu [7] proposed the quantum particle swarm optimization algorithm, which is a new PSO algorithm. They supposed that the particles have quantum behavior. While in the quantum space, according to uncertainty principle, the position and velocity of a particle cannot be determined simultaneously, so that the particle can search for the global optimal solution in the whole feasible solution space. Simulation results are ideal.

3. The Fuzzy Theory

Intelligence research could improve operation's level of automation and intelligent, and it could achieve exact point job so that it advance production continued development. And in modern intelligence research, fuzzy neural net is attention research realm in recent years, it connected with neural net's low layer and computing power and fuzzy logic system's high layer copy thought and deduce ability, and come off superiority complementary between them. Neural net and fuzzy control are two important intelligence control technology, they can imitate person's intelligence behave, solve not sure non-

linear, complication automation problem, have very wide applied foreground. The research of neural net and fuzzy control has been 30 year's history. In recent years, they not only get the catch man's eye's development and achievement in their each subject realm, but also develop many new realms in the edge of the two subjects, connected with neural net and fuzzy control algorithm, make themselves osmosis each other, will bring a new revolution in the realm of information science. Fuzzy control is a typical and prior form of intelligence control, as a branch of intelligence control, it get very fast development in recent years. exceptional for big time-lag non-linear and others complicate systems that it's hard to build exact math model, we use fuzzy control theory, through computer come true real-time control, can get content control effect, and need equipment simply, economic benefit notable. in process of modern industry, fuzzy control is widely used to complicate process or project's control. At present, research of fuzzy neural net has been a notice research way and fuzzy neural net, which is a new net system that connected fuzzy theory and neural net, which is traditional neural net model fuzziness in some degree, it's a distinct feature is, each node fuzzy neuron is different from traditional MP neuron's two-value state, could get the interval $[0, 1]$, so, each node could express fuzzy concept. Fuzzy neural net has the function that integrated neural net and expert system, when we use neuron net solve the problem of fault diagnosis, it has an obvious trend that hope to integrated qualitative knowledge in the neuron net's frame. For this, fuzzy neural net has been a hot point with research. Fuzzy neural net is often entering a fuzziness layer in the ordinary feed forward neural net, complete an input subsidiary function's computing. Put neural net into fuzzy control, could ameliorate and improve adapting ability of fuzzy logic derive, connect neural net and fuzzy control could lead to new algorithm and structure's finding and development, make it could improve its adapting ability of keeping fuzzy logic system strongly knowledge's express. As the fast development of modern agricultural and science technique, production facilities and system more and more large-size, complication and automation, its acquire more and more high with system's reliable and security, agricultural machine intelligence has been a kind of trade in modern times, and we make fuzzy technique and neural net technique osmosis and cooperation each other, has been an indomitability development aspect.

The research on fuzzy algebra has become one of the most active topics in fuzzy mathematics in recent years. Since Rosenfeld [50] introduced the fuzzy sub-

sets into the realm of group theory, many mathematicians have been involved in extending the concepts and results of abstract algebra to the broader framework of the fuzzy setting. The study of fuzzy algebra relates to various aspects of algebra, such as fuzzy group, fuzzy ring, fuzzy module and fuzzy homology and so on. One of the basic principles of such fuzzy subsystems is that a fuzzy subset of an algebraic system R is a fuzzy subsystem of R if and only if the level subsets $\mu_t = \{x \in R, \mu(x) \geq t, \text{ for } 0 \leq t \leq 1\}$ are subsystems of R . There out, we can study the subsystems of R by fuzzy subsystems. and also characterize the fuzzy subsets by the subsystems of R . Following from this basic principle, Lie super algebras are introduced into fuzzy subsets and the framework of fuzzy Lie theory are established. Considering Hoof algebras and quantum groups are the generalizations of Lie theory, we introduce the algebras into fuzzy subsets, and attempt to establish the theory of fuzzy quantum groups. Moreover, commodes as new objects are also introduced in this paper; we can discuss fuzzy Como duels' properties. The main results of this thesis are presenting the fuzzy theory of Lie super algebras.

4. The Fuzzy and SVM Algorithm

Fuzzy comprehensive evaluation method is the application of fuzzy mathematics broader method. In the evaluation of a transaction often encounter this kind of problem. Because evaluation of the transaction is determined by many factors, and therefore must be evaluated for each factor; Make a separate comment for each factor on the basis of how to consider all factors and make a comprehensive comment. This is a comprehensive evaluation.

For the decision problem of green public buildings, and its influencing factors of great complexity. Exact cause of reducing the ability of the system described in the fuzziness. Using fuzzy means to deal with the ambiguity of the problem, it will make the evaluation results more real, more reasonable. Fuzzy comprehensive evaluation model to go through the following steps:

(1) Given alternative set of objects: Here is the all green public buildings;

(2) Determine the index set;

(3) Establish weight set: As important indicators of the degree of centralization of each index are different, so be on the level indicators and secondary indicators were given corresponding weights. The first level of the weight set is $A(a_1, a_2, \dots, a_n)$, and the second level of the weight set is:

$$A(a_{i1}, a_{i2}, \dots, a_{ij}), (i = 1, 2, \dots, n)$$

Here use factor analysis to determine the right number;

(4) Determine reviews set $v = (v_1, v_2, \dots, v_m)$. We put evaluation set to $v = \{\text{safety, general, dangerous}\}$;

(5) Identify the evaluation matrix $R = (r_{ij}v)_{n \times m}$. First determine the membership function U for v , and then calculate the stock evaluation for each class of membership r_{ij} ;

(6) Obtained fuzzy comprehensive evaluation set $B = AoA: (b_1, b_2, \dots, b_m)$, namely ordinary matrix multiplication. According to the final results of the evaluation judgment was set.

This paper has made a close look into three economic increment models commonly used in economics and their features, making sure that some internal unknown relations in an economic system can be revealed by the proposed algorithm through simulation. As a result, the hypotheses for the economic models can be lessened and the forecast work can be done, resulting in an even better agreement with the fact. Finally, economic forecast models are established and a case study is carried out using acquired data from China. The result from the case study shows that the proposed economic forecast method is not as useful and effective. Fuzzy algorithm-based economic forecast method can be a reference for decision-makers of economics.

Assuming the system is synchronous with the output basic equation which is shown in the equation (1):

$$\omega(t) = \sum_{i=0}^{M_s} \sum_{k=i}^K y_k(i) c_k(t) \quad (1)$$

In the uncertain system, the degree M is defined as

$$c(t+1) = \cos(M \cos^{-1}(c(t))), -1 \leq c(t) \leq 1 \quad (2)$$

If there is no MUD, the receiver estimates the transmitted symbol by making a hard-decision at the output which is given by

$$z_k(i) = \sum_{t=3\beta(i-1)-2}^{4\beta i} r(t) c_k(t) + r^2(t) \quad (3)$$

This receiver is not optimal because it treats the multiuser interference and Figure (1) shows the overall system model.

As we know, the MMSE detector is the symbol from the output of matched index for user k by

$$\hat{y}_k = \text{sgn} \left(\left(R + \sigma^2 A^{-2} \right)^{-1} z_k \right) \quad (4)$$

Therefore, the whole training dataset is given as $(x_1, y_1), \dots, (x_H, y_H)$, $x \in \mathbb{R}^{2\beta}$, $y \in \{-1, 1\}$. After training is completed, the decision function of a nonlinear SVM is shown as

$$u(x) = \sum_{h=1}^H y_h \alpha_h \kappa(x, x_h) + b \quad (5)$$

Therefore, the decision function in (5) with a linear kernel can be expressed as

$$u(x) = \sum_{h=1}^H y_h \alpha_h (x_h^T x + 1) + b \quad (6)$$

After the training stage is completed, the SVM detector is ready to estimate the transmitted symbol via

$$\hat{y} = \text{sgn}(u(x)) \quad (7)$$

4. Experiment and Data Analysis

Adapting to large-scale social production, economic forecasts develops as a science study the course of economic development objective and changes in its trends. Economic forecasting is especially important in China such an emerging market economy country. However, with the rapid development of science and technology, economic system has become increasingly evident that the dynamic complexity and uncertainty. Economic forecasts of knowledge faces a serious dilemma because traditional quantitative methods of economic forecasting can no longer enable the people to grasp the development of future. Fuzzy Analysis is a new type of prediction method which able to cope with the impact of complexity and uncertainty. There are two roles of fuzzy analysis in the field of economic forecasts.

Firstly, fuzzy analysis is able to combine qualitative forecasting method with quantitative forecasting method organically which enable prediction model to fully integrate both subjective and objective information. Secondly, fuzzy analysis takes multiple expected futures into account so that the results are more robust. In this paper, multi-level combined forecast thinking is involved and a fact is pointed that the core

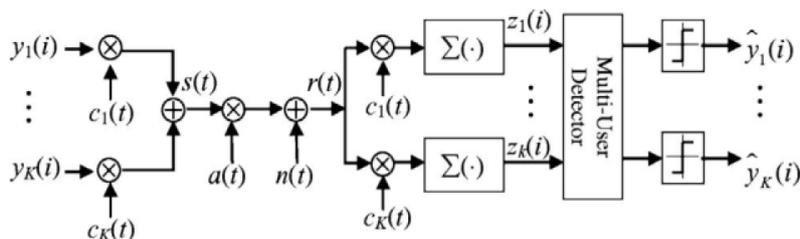


Figure 1. The Model with A Multiuser Detector

idea of combined forecast and fuzzy analysis is the same: use integrated information to predict. Logically, it's a reasonable way to resolve the current difficulties which the economic forecasts are facing by organically combining with both of them. Accordingly, this paper attempt to build an economic forecast with the characteristic of subjective and objective information integrated which named fuzzy-based multi-layer combination forecasting method. The figure 2 shows series generated by using fuzzy algorithm, that is: (a) Two Series of Close Initial Conditions; (b) Autocorrelation of the First 50 Indexes

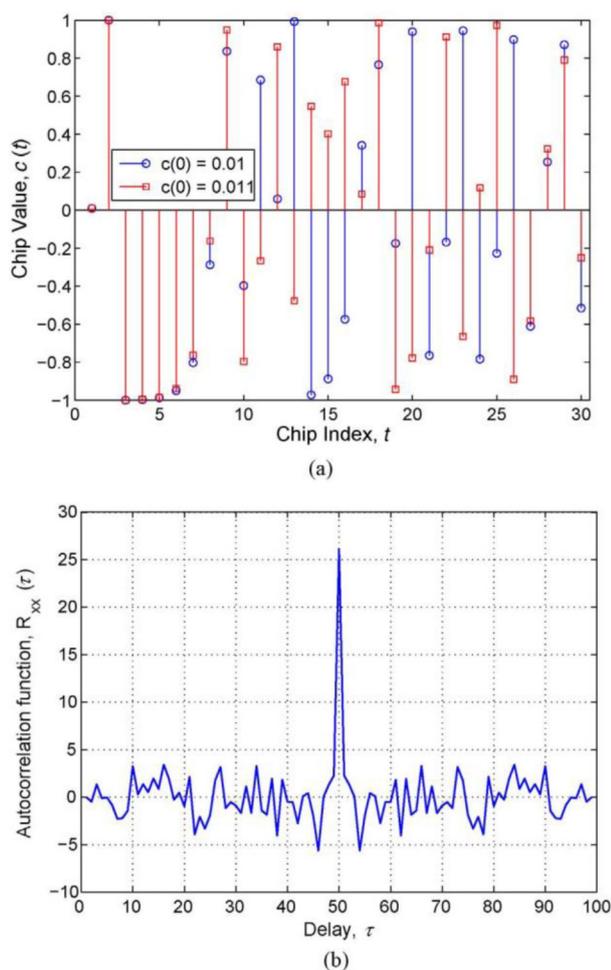


Figure 2. Series Generated by Using Fuzzy Algorithm. (a) Two Series of Close Initial Conditions; (b) Autocorrelation of the First 50 Indexes

In order to illustrate the actual effect after using fuzzy and SVM based algorithm in prediction of typical economy index, we choose ten sets of typical economy index which is shown in Table I.

The comparison before and after using fuzzy and SVM based algorithm in prediction of typical economy index can be seen from figure 3. The result shows that in the same experimental time, after using the fuzzy and SVM based algorithm it can achieve better performance in calculating time than before using it.

Table 1. Ten sets of typical economy index

No.	index	weight
1	CPI	25
2	NRV	10
3	NOV	10
4	E0	5
5	E1	5
6	E2	5
7	PPI	15
8	KPI	10
9	WSV	8
10	KPR	7

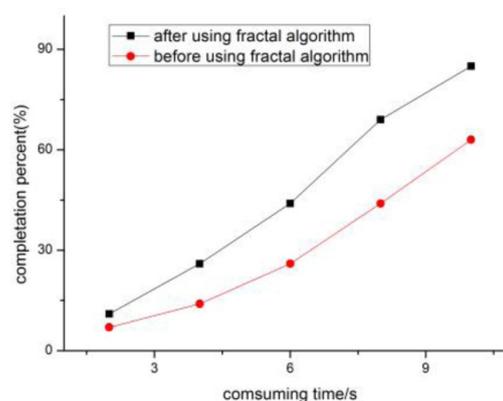


Figure 3. The comparison before and after using fuzzy algorithm in calculating time

Conclusions

In this paper, the author mainly discusses fuzzy statistical theory and its application in economic forecasting and decision making. Some concepts, classification, rules, methods, procedures, research goal and significance in the economic forecasting are briefly presented, which provide a fundamental for establishment of economic forecasting models.

The algorithm converges more slowly, and the network is easy to fall into local minimum when the parameters are selected inappropriately, which all affect the model's reliability and accuracy. Wavelet analysis with good time-frequency localization and zoom features, and with strong nonlinear function approximation ability, becomes a strong black box identification tools in nonlinear system. Either the macroscopically or microcosmic decision-making is closely attached to reasonable economic forecasting. Forecasting and decision-making are two important components of management. The key of management lies in decision-making and its precondition is forecasting. In commercial circumstance, leaders need to make various kinds of decisions which mean a lot to the success of their corporations. Market demand, productive ability and other aspects need to be forecasted during operation. The result shows that in the

same experimental time, after using the fuzzy and SVM based algorithm it can achieve better performance in calculating time than before using it.

References

1. Mingzhu Zhang, Changzheng He, Xin Gu, Panos Liatsis, Bing Zhu. D-GMDH: A novel inductive modelling approach in the forecasting of the industrial economy. *Economic Modelling*, 2013, pp. 30-38.
2. Lihua Feng, Jianzhen Zhang. Application of artificial fuzzy algorithm s in tendency forecasting of economic growth. *Economic Modelling*, 2014, pp. 40-53.
3. Guihuan Zheng, Wang Yu. Financial Conditions Index's Construction and its Application on Financial Monitoring and Economic Forecasting. *Procedia Computer Science*, 2014, pp. 31-45.
4. Ling T. He, Chenyi Hu. Impacts of interval measurement on studies of economic variability: Evidence from stock market variability forecasting. *The Journal of Risk Finance*, 2007, pp. 85-101.
5. Gary A. Nowakowski, Michael P. Hahn. Forecasting the Future of Alternative Energy Technologies Using Economic Payback Curves. *Distributed Generation and Alternative Energy Journal*, 2013, pp. 283-297.
6. Lee Bruce Y, Wateska Angela R, Bailey Rachel R, Tai Julie H Y, Bacon Kristina M, Smith Kenneth J. Forecasting the economic value of an Enterovirus 71 (EV71) vaccine. *Vaccine*, 2010, pp. 2849-2859.
7. Jing MU, Li LIU. The Establishment and Effectiveness of Incentive Mechanism for Teaching Faculty Management in Universities. *Studies in Sociology of Science*, 2014, pp. 53-67.
8. Gupta Namit B, Khadilkar Satish V, Bangar Sachin S, Patil Tukaram R, Chaudhari Chetan R. Neurology as career option among post-graduate medical students. *Annals of Indian Academy of Neurology*, 2013, pp. 164-177.



Comparative Study on the Effect of Risk Control Organization of Inform Finance Institutions

He Yong^{1,2}

1. *School of Business, Central South University, Changsha, 410083, China*
2. *School of Finance & Economy, Hunan University of Technology, Zhuzhou, 412007, China*

Corresponding author is He Yong

Abstract

The organization mode of the process risk control and the risk control organization mode are two kinds of typical risk control organization forms, which has their own characteristics as the main body of the risk of inform finance control, Through the empirical analysis, the risk control ability of the inform finance under the two risk control