Hindawi
Security and Communication Networks
Volume 2023, Article ID 9842467, 1 page
https://doi.org/10.1155/2023/9842467

Retraction

Retracted: Financial and Economic Sequence Forecasting Based on Time Slot Allocation Algorithm

Security and Communication Networks

Received 11 July 2023; Accepted 11 July 2023; Published 12 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] Y. Wu, "Financial and Economic Sequence Forecasting Based on Time Slot Allocation Algorithm," *Security and Communication Networks*, vol. 2022, Article ID 2340521, 13 pages, 2022.

Hindawi
Security and Communication Networks
Volume 2022, Article ID 2340521, 13 pages
https://doi.org/10.1155/2022/2340521

Research Article

Financial and Economic Sequence Forecasting Based on Time Slot Allocation Algorithm

Yuhan Wu

Henan University of Animal Husbandry and Economy, Zhengzhou 450044, China

Correspondence should be addressed to Yuhan Wu; 81705@hnuahe.edu.cn

Received 20 January 2022; Revised 1 March 2022; Accepted 22 April 2022; Published 16 May 2022

Academic Editor: Chin-Ling Chen

Financial and economic series prediction was very important for the study of economic time series. Because the traditional time series analysis method was mainly suitable for stable data and cannot be applied to unstable economic variables, this paper proposed a knowledge model of financial and economic series prediction time slot algorithm, which provided the basis for solving unstable financial data. Firstly, based on the analysis of relevant financial and economic series prediction methods at home and abroad, this paper applied the time slot allocation algorithm to economic series analysis and prediction and designed a path level time slot allocation algorithm, which introduced a fixed time slot to shorten the time required to complete the path level time slot allocation. Secondly, this paper abstracted the calculation of slot allocation as a convex optimization problem and proposed a round slot allocation algorithm based on constraints and optimal solution. The algorithm can improve the end-to-end throughput and the effective utilization of slots. Finally, the model proposed in this paper was used to predict the indicators of relevant industries, and the simulation results were compared with the standard data. The experimental results showed that the financial and economic series prediction system based on time slot allocation algorithm proposed in this paper can effectively improve the accuracy of financial and economic series prediction, which verified the effectiveness and feasibility of this model.

1. Introduction

Although the research on structural mutation in time series analysis has not been long, the research problems in this field have been widely concerned by relevant scholars. Moreover, the analysis of time series with structural mutation is still the frontier and hot topic in this field. The research shows that the trend stationary process with structural mutation has similar characteristics with the unit root process, which is easy to be confused. Therefore, many unit root test methods are prone to misjudgment when distinguishing these two types of processes, which can easily lead to the decline of test ability and the distortion of test level [1]. When considering structural mutation, a new unit root test method is needed to determine the stationarity of the sequence data generation process. At present, researchers in econometrics have proposed several unit root test methods with structural mutation [2]. However, due to the different research basis or relevant assumptions of different methods, using different test methods for the same problem in empirical analysis may lead to different or even contradictory conclusions. Therefore, it is an urgent problem to put forward an objective and scientific unit root test method in theory, which has very important value and significance both in theory and in practical application [3].

The purpose of econometric theory research is to help people understand and grasp the law of economic development more objectively and scientifically. Relevant theories and new methods can make up for and correct the shortcomings of existing methods and then make the conclusion of empirical analysis more scientific. Through the organic combination of unit root test of time series and structural catastrophe theory, we can not only improve and develop relevant theories, but also analyze and solve practical problems. The unit root test of structural mutation is not only the theoretical basis of econometric method and time series analysis, but also the premise of studying the relationship between economic variables such as cointegration analysis and Granger causality test. In addition, because panel data has two-dimensional characteristics of space and time, unit root test is also of great significance to panel data analysis, such as the stationarity analysis of time dimension. In view of the impact of structural mutation on unit root test, this paper proposes a unit root test method and program including structural mutation, which will help to improve the effectiveness of traditional unit root test and provide a scientific basis for revising and perfecting the theoretical research of unit root test.

For the research of practical economic problems, the stability of data generation process can be applied to the effectiveness analysis of economic policies. For example, when an economic variable is proved to be produced by a stable process of structural mutation, it indicates that the economic variable has changed the original growth path at a certain time due to the influence of various factors. When the government wants to change its long-term development trend, it can achieve the purpose of regulation and control by implementing corresponding economic policies. It can be seen that the research on structural mutation and unit root test has certain economic and practical significance.

For the observation of time series, due to the joint action of many factors, there may be a few observations that are significantly different from other observations, which are called outliers. For the whole time series, although the number of outliers is small, their existence may have a certain impact on model identification, parameter estimation, model diagnosis, and even prediction. Some outliers may contain very valuable information. For example, the outliers of the birth rate may reflect changes in national policies and social development, and the outliers of the stock market may reflect changes in national economic conditions. Therefore, the study of outliers in time series has extremely important theoretical and practical significance.

2. Related Works

As the research basis of time series analysis, unit root test is mainly used to analyze the stationarity of time series. The research shows that if the growth path of the economic sequence is affected by the deterministic trend function, the external random impact will cause a temporary deviation from the trend term of the sequence without changing the growth path of the economic sequence. Since this economic series is stable after removing the trend item, the economic variable belongs to the trend stable type or the determined trend type. If there is a unit root in the data generation process of time series, any external random shock may change the growth path of economic series. At this time, this economic series belongs to nonstationary type, which is also called random trend process or unit root process.

In fact, the unit root test of structural mutation proposed earlier is to add the dummy variable reflecting structural mutation (i.e., the mutant dummy variable) to the unit root test of DF (ADF) [4]. Although this method gives the asymptotic distribution and asymptotic critical value of the unit root of the test statistics, the hypothesis of external source mutation point has been questioned. The endogenous determination method of mutation point mainly uses the relationship between data to determine the location of mutation point. Among them, common methods, for example, estimate the mutation point according to the minimum value of the proposed unit root test statistic [5] and estimate the mutation point according to the maximum value of the test statistic (absolute value of F statistic or F statistic) according to the significance of the coefficient estimator of mutation virtual variable [6]. The mutation point is tested by the unit root of DF (ADF) statistic of mutation dummy variable regression [7]. According to the original hypothesis, there are generally two types of testing for mutation points. One is that the original hypothesis has no structural mutation, and the other is that the original hypothesis allows structural mutation [8].

Some people have analyzed the influence of the wrong configuration of mutation points on the asymptotic distribution of unit root test statistics and the properties of finite samples under horizontal mutation [9, 10]. Through the simulation test, it is found that when there is a structural mutation in the process of real data generation, the mutation point is estimated based on the minimum value of the unit root test statistic or the maximum value of the significance test statistic of the mutation pseudovariable coefficient [11, 12]. It is often one cycle earlier than the real mutation point, which will lead to the horizontal distortion of the unit root test and reduce the test power. Some people determine the mutation point according to the minimum value of BIC statistics of test regression or take the time corresponding to the minimum value of the sum of squares of correlation regression residuals as the estimated value of the mutation point [13]. In addition, some scholars have studied the unit root test statistics of endogenous mutation points and the unit root test statistics of exogenous mutation points under different mutation models according to the speed of convergence from the mutation point estimated by the minimum sum of squares of residuals to the true mutation point [14].

After introducing structural mutation into unit root test, the methods related to unit root test have been widely used in structural mutation [15]. For example, some people analyzed the change trend of mutation point and the properties of mutation LM unit root test statistics under the framework of AO model [16]. Some scholars believe that the mutation exists under the assumption and study the properties of LM unit root test statistics to determine the mutation point according to the minimum value of LM statistics [17]. Later, some scholars further studied the LM unit root test statistics of structural mutation. The maximum or minimum value of statistics is tested according to the significance of mutation virtual variable coefficient, and the minimum value of ADF statistics is obtained by using the unit root test of structural mutation, so as to determine the minimum value of LM statistics at the mutation point [18]. In addition, some people introduce structural mutation into KPSS test, construct the corresponding test statistics, and study its asymptotic distribution and finite sample properties [19]. It is known from the existing research that the traditional unit root test method generally believes that the data generation process of time series is linear, and if it is applied to the unit root test of nonlinear trend, it may produce wrong results. Therefore, the single root test with nonlinear trend structure has certain practical significance.

3. Path Level Time Slot Allocation Algorithm and Knowledge Model

3.1. Calculation Method of Path Slot Allocation. Considering the shortcomings of the traditional system in analyzing a large amount of economic data, in order to optimize the economic data analysis nodes, this paper mainly uses the intelligent model to process the economic data when predicting the economic sequence. It is assumed that the information about the available time slots of all nodes on the path has been obtained, and the time slots are allocated to all nodes on the path in order to maximize the end-to-end throughput. Because the bottleneck node on the service path limits the end-to-end throughput to a certain extent, the maximum number of time slots can be obtained at the concave point through time slots. Therefore, the path level slot allocation problem can be abstracted as a convex optimization problem and solved with the help of computational tools.

The goal of path slot allocation calculation is to maximize the number of time slots occupied by time slot pits on the path, and time slot pits are the nodes that obtain the least time slots in the time slot allocation. The specific problems are described as follows:

$x_{i,j}$ indicates whether node i occupies time slot j in this time slot allocation process, $x_{i,j} \in \{0,1\}, x_{i,j} = 1$ shows that node i occupies time slot j, and $x_{i,j} = 0$ indicates that it does not occupy. Among them, i indicates the serial number of node on the path, j is the number of data time slot in the compound frame, we set the number of nodes on the path as n and the total number of time slots as m, and then there are $1 \le j \le m, 1 \le i \le n$. Therefore, the number of time slots occupied by time slot concave points can be expressed as follows:

$$N_{\min} = \min_{i\in[1,n]} \sum_{j=1}^{m} X_{i,j}, \tag{1}$$

where $N_{\min}$ represents the number of time slots occupied by the slot pits, and the goal problem of our time slot allocation is to maximize the value of $N_{\min}$; that is, $\max(N_{\min})$ is expressed as follows:

$$\max(N_{\min}) = \max\left(\min_{i\in[1,n]} \sum_{j=1}^{m} X_{i,j}\right), \tag{2}$$

where $X_i = [X_{i,1}, X_{i,2}, X_{i,3}, \ldots, X_{i,m}]^T$, $X = [X_{1,1}, X_{1,2}, \ldots, X_{1,m}, X_{2,1}, X_{2,2}, \ldots, X_{2,m}, \ldots, X_{i,\ j}, \ldots, X_{n,m}]^T$,

$$\sum_{j=1}^{m} X_{i,j} = [1,1,1,\ldots,1] \cdot X_i. \tag{3}$$

Node i obtains the number of time slots $S = \sum_{j-1}^{m} X_{i,j}$ in this time slot allocation, and it has the following form [20]:

$$S = Q_i \cdot X, \tag{4}$$

where $Q = [0,0,\ldots,0,1,1,\ldots,1.0,0,\ldots,0]$, which is a vector of $n \cdot m$, preceded by $(i-1)\cdot m$ consecutive 0, followed by m consecutive 1, followed by all 0. Then the problem P_0 is of the following form:

$$P_0 = \max\left(\min_{i\in[1,n]} (Q \cdot X)\right), \quad i \in [1,n]. \tag{5}$$

Formula (5) is our original problem P. In order to solve it, we introduce the variable W, which is as follows:

$$W = \operatorname*{mim}_{i\hat{I}[1,n]} (Q \cdot X), \quad i \in [1,n]. \tag{6}$$

In this way, our problem P_0 is transformed into

$$P_1 = \max(w). \tag{7}$$

In problem P_1, w must satisfy

$$w \le Q_i \cdot X, \forall i \in [1,n]. \tag{8}$$

Then the original problem P_0 is transformed into P_1 in formula (9). To solve P_1, X and w must be constrained. We might as well set $V = [X^T, w]^T$, that is, $V = [X_{1,1}, X_{1,2}, \ldots, X_{1,m}, X_{2,1}, X_{2,2}, \ldots, X_{2,m}, \ldots, X_{i,j}, \ldots, X_{n,m}]^T$, and we only need to constrain V. Then the problem P_1 can be described as [21]

$$P_1 = \max([0,0,\ldots 0,1] \cdot V). \tag{9}$$

Condition 1 is described as $w \le Q_i \cdot X, \quad \forall i \in [1,n]$. The constraints in formula (8) can be reduced to

$$w \le A_i \cdot V, \quad i \in [1,n], \tag{10}$$

where $A_i = [Q_i, 0], w = [0,0,\ldots,0,1] \cdot V$; then the following expression is satisfied:

$$([0,0,\ldots,0,1] - A_i) \cdot V \le 0, \quad \forall i \in [1,n]. \tag{11}$$

It can also be written in the following form:

$$[-Q_i, 1] \cdot V \le 0, \quad \forall i \in [1,n]. \tag{12}$$

The following expression can be obtained:

$$Q \cdot V \le [0,0,\ldots 0]^T, \tag{13}$$

where Q is a matrix of $n \cdot (n \cdot m + 1)$ in the following form:

$$Q = \begin{bmatrix} -Q_{1,1} \\ -Q_{2,1} \\ \vdots \\ -Q_{n,1} \end{bmatrix}. \tag{14}$$

Formula (13) is the first constraint condition of problem P_1.

Condition 2 is described as follows: any node i on the path has its own set of occupiable time slots, and the time slot finally obtained in this time slot allocation must belong to its own set of occupiable time slots.

We use $X_i = [X_{i,1}, X_{i,2}, X_{i,3}, \ldots\ldots X_{i,m}]^T$ to represent the time slot allocation result of node i. If i occupies time slot j, then the corresponding X can be set to 1. We introduce $U_i = [u_{i,1}, u_{i,2}, u_{i,3}, \ldots, u_{i,m}]^T$ about the set of occupied time slots of node i, where $u_{ij} \in \{0, 1\}, U_i$ is the input parameter of the target problem. In this way, the constraints of node i can be expressed as

$$U_i \cdot X_i = 0, \quad i \in [1, n]. \tag{15}$$

From formula (15), when $u_{ij} = 1$, $X_{i,j}$ must be 0. At this time, node i cannot occupy time slot j. When $u_{ij} = 0$, $X_{i,j} \in \{0, 1\}$. By analogy, each node on the path meets the following conditions:

$$\begin{aligned} U_1 \cdot X_1 &= 0, \\ U_2 \cdot X_2 &= 0, \\ U_3 \cdot X_3 &= 0, \\ &\vdots, \\ U_n \cdot X_n &= 0. \end{aligned} \tag{16}$$

Through sorting, the following expression can be obtained:

$$U \cdot V = [0, 0, \ldots, 0]^T, \tag{17}$$

where U is an $n \cdot (n \cdot m + 1)$ matrix as shown in the following formula:

$$U = \begin{pmatrix} U_1 & O & O & O & \cdots & O & 0 \\ O & U_2 & O & O & \cdots & O & 0 \\ O & O & U_3 & O & \cdots & O & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ O & \cdots & O & O & U_{n-1} & O & 0 \\ O & \cdots & O & O & O & U_n & 0 \end{pmatrix}, \tag{18}$$

where O is an m-dimensional vector with all zero elements. In summary, formula (17) is the second constraint condition of the objective problem.

Condition 3 is described as follows: the node time slot occupancy within two hops does not conflict, which can be expressed as follows:

When $i = 1$, $x_{ij} + x_{i+1,j} + x_{i+2,j} \le 1, \quad 1 \le j \le m$.

When $i = 2$, $x_{i-1,j} + x_{i,j} + x_{i+1,+j} + x_{i+2,+j}, \quad 1 \le j \le m$.

When $3 \le i \le n-2$, $x_{i-2,j} + x_{i-1,j} + x_i + x_{i,j} + x_{i+1,+j} + x_{i+2,+j} \le 1, \quad 1 \le j \le m$.

When $i = n-1$, $x_{i-1,j} + x_{i-2,j} + x_{i,j} + x_{i+1,+j} \le 1, \quad 1 \le j \le m$.

When $i = n$, $x_{i-1,j} + x_{i-2,j} + x_{i,j} \le 1, \quad 1 \le j \le m$.

Each node on the path should have a restriction condition for all time slots. For any node i, m restriction conditions are required to ensure that the time slot occupancy within two hops does not conflict. Taking the nodes satisfying $3 \le i \le n-2$ as an example, there is the following expression:

$$C_i \cdot V \le [1, 1, \cdots, 1]^T. \tag{19}$$

Node i requires m restriction conditions, and C_i is a matrix of $m \cdot (n \cdot m + 1)$. According to each restriction condition of node i, the specific form of C_i is as follows:

$$C_i = \begin{bmatrix} 0 & \cdots & 0 & 1 & 0 & 0 & 0 & 1 & 0 & \cdots & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & \cdots & \cdots & \cdots & 0 \\ 0 & \cdots & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & \cdots & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & \cdots & \cdots & \cdots & 0 \\ 0 & \cdots & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & \cdots & 0 & 1 & 0 & 0 & 0 & 1 & 0 & \cdots & 0 & 1 & 0 & \cdots & \cdots & \cdots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & \cdots & 0 & \cdots & 0 & \cdots & 0 & 1 & 0 & \cdots & 0 & 1 & 0 & \cdots & 0 & 1 & 0 & \cdots & 0 & 1 & 0 & \cdots & 0 & 1 & 0 & \cdots & 0 \end{bmatrix}. \tag{20}$$

The elements with the value of 1 in the first row of the matrix in formula (20) correspond to $x_{i-2,1}, x_{i-1,1}, x_{i,1}, x_{i+1,1}$, and $x_{i+2,1}$ in V, respectively, which are the constraint coefficients of node i for time slot 1. The elements with the value of 1 in the second row correspond to $x_{i-2,j}, x_{i-1,j}, x_{i,j}, x_{i+1,j}$, and $x_{i+2,j}$ at the center, respectively, which are the constraint coefficients of node i for time slot 2. The elements with the value of 1 in the j-th row correspond to $x_{i-2,j}, x_{i-1,j}, x_{i,j}, x_{i+1,j}$, and $x_{i+2,j}$, respectively, which are the constraint coefficients of node i for time slot j. It can be seen that the matrix C_i is the constraint coefficient matrix of node i for all time slots, that is, the coefficient C_i when $i = 1$, $i = 2$, $i = n-1$, and $i = n$. Similarly, the following formula can be derived:

$$C \cdot V \le [1, 1, \ldots, 1]^T. \tag{21}$$

There is a total of $n \cdot m$ constraint conditions for n nodes. Therefore, C in formula (21) is a matrix of $(n \cdot m) \cdot (n \cdot m + 1)$, as shown below:

$$C = [C_1, C_2, \ldots, C_n]^T. \tag{22}$$

In summary, formula (21) is the third constraint condition of the target problem P_1.

Condition 4 is described as:$X_{i,j} \in \{0, 1\}$, and the value of $Q_{1,1}$ can only be 0 and 1, which is equivalent to $X_{i,j}(X_{i,j} - 1) = 0$. It can be transformed into the form of $V^T Q_{i,j} V - P_{i,j} V = 0$; that is, construct $Q_{i,j}$ and $Q_{i,j}$.

$$\begin{gathered} V^T Q_{i,j} V - P_{i,j} V = 0, \\ \Downarrow, \\ x_{i,j}^2 - x_{i,j} = 0. \end{gathered} \tag{23}$$

We start from X to construct Q and P and get the following expression:

$$Q_{1,1} = \begin{bmatrix} 1 & 0 & 0 & \cdots & 0 \\ 0 & 0 & 0 & \cdots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & \cdots & 0 \end{bmatrix}, \tag{24}$$

$$P_{1,1} = [1, 0, 0, \ldots, 0]. \tag{25}$$

As shown in formula (24), $Q_{1,1}$ is a matrix of $(n \cdot m + 1) \cdot (n \cdot m + 1)$, as shown in formula (25). $P_{1,1}$ is a $P_{1,1}$-dimensional vector.

Similarly, $Q_{i,j}$ can be obtained. For $\forall j \in [1, m]$ and $\forall i \in [1, n]$, then $Q_{i,j}$ is a matrix of $(n \cdot m + 1) \cdot (n \cdot m + 1)$, where $Q_{i,j}(i \cdot j - 1, i \cdot j - 1) = 1$, and the values of other elements are all 0, and $Q_{i,j}^T = Q_{i,j}$.

It is easy to know that $Q_{i,j}$ is a $n \cdot m + 1$-dimensional vector, where the value of the $(i - 1) + j$-th element is 1, and the other elements are all 0.

In summary, condition 4 can be transformed into $m \cdot n$ constraint conditions, which satisfy the following relationship:

$$\begin{gathered} V^T Q_{1,1} V - P_{1,1} V = 0, \\ V^T Q_{2,2} V - P_{2,2} V = 0, \\ \vdots, \\ V^T Q_{n,m} V - P_{n,m} V = 0. \end{gathered} \tag{26}$$

The above constraint conditions include quadratic form $V^T Q_{i,j} V$, so we might as well set $f_{ij}(V) = V^T Q_{i,j} V$. Assuming that V_0 is any feasible point in the feasible region, we carry out a first-order Taylor expansion of $f_{ij}(V)$ at $V = V_0$ and obtain the following relationship:

$$f_{ij}(V) = f_{ij}(V_0) + f_{ij}(V_0)(V - V_0), \tag{27}$$

$$f_{ij}(V) = V_0^T Q_{i,j} V_0 + 2Q_{i,j} \cdot V_0 (V - V_0). \tag{28}$$

$V^T Q_{i,j} V - P_{i,j} V = 0$ is equivalent to

$$V^T Q_{i,j} V - P_{i,j} V \le 0, \tag{29}$$

$$P_{i,j} V - V^T Q_{i,j} V \le 0. \tag{30}$$

Substituting formula (27) into formula (30), the constraints of formula (29) and formula (30) are equivalent to

$$\begin{gathered} 0 \le x_{i,j} \le 1 \quad \forall j \in [1, m], \forall i \in [1, n], \\ P_{i,j} V - \left(V_0^T Q_{i,j} V_0 + 2Q_{i,j} \cdot V_0 (V - V_0)\right) \le 0, \quad \forall j \in [1, m], \forall i \in [1, n]. \end{gathered} \tag{31}$$

Formula (31) is the fourth constraint.

In summary, the target problem P_1 can be transformed into problem P_2, which can be expressed as follows:

$$\begin{gathered} P_2 = \max([0, 0, \ldots, 0, 1] \cdot V), \\ Q \cdot V \le [0, 0, \ldots, 0]^T, \\ U \cdot V \le [0, 0, \ldots, 0]^T, \\ C \cdot V \le [0, 0, \ldots, 0]^T, \\ 0 \le x_{i,j} \le 1, P_{i,j} V - \left(V_0^T Q_{i,j} V_0 + 2Q_{i,j} \cdot V_0 (V - V_0)\right) \le 0 \forall j \in [1, m], \forall i \in [1, n]. \end{gathered} \tag{32}$$

3.2. Parameter Analysis of Time Slot Allocation Algorithm. So far, we have described the objective problem P as a convex optimization problem, and we only need to organize the matrix U according to the initial set of occupied time slots of each node on the path; that is, we can calculate V with the help of CVX tool in MATLAB, where X^T is the situation of time slots obtained by each node in this assignment, and W is the optimal solution of the objective problem, that is, the number of time slots obtained by the time slot concave point. When the obtained W value is greater than the number of time slots required by the nodes, it indicates that the current time slots are sufficient and only the required number of time slots needs to be taken from the time slots allocated to each node.

From the above analysis, the time required for the time slot allocation algorithm based on USAP protocol to complete the path time slot allocation can be expressed as follows:

$$t_{to} = n(T_s + T_c), \tag{33}$$

where T_s indicates the superframe time and T_c is the multiframe time. According to the solution idea design plan, then this time can be expressed by the following expression:

$$t_{\text{to}} = t_{\text{cal}} + t_{\text{sum}} + t_{\text{dis}} + t_{\text{res}}, \tag{34}$$

where t_{sum} and t_{dis} are the time required for the time slot aggregation and the calculation of the result distribution, respectively. If the classical USAP protocol superframe structure as described is used, the aggregation of time slots and distribution of results can only be encapsulated in NMOP broadcast out at the broadcast time slot. The service flow path in a self-organizing network is random, and it is basically impossible to be in the same direction as the occupation of broadcast time slots by nodes on the service flow path. If the BS occupancy happens to be in the opposite direction of the service flow transmission, it is assumed that there are n nodes on the path, and then $t_{\text{sum}} = nT$, and by the same token $t_{\text{dis}} = nT$, this overhead is not tolerable. Therefore, we need to let each node occupy a small number of time slots upon entering the network to transmit the relevant control frames for time slot allocation. Therefore, PL-TDMA introduces a certain number of fixed time slots into each complex frame of superframe for transmitting control frames related to time slot allocation. At this time, nodes occupy fixed time slots without reservation and conflict. The fixed time slots only transmit control frames, and their length should be much smaller than that of data time slots so that their overhead can be neglected. Thus, PL-TDMA can reduce the length of t_{sum} and t_{dis} from superframe multiples to complex frame multiples.

In formula (34), t_{cal} is the same as the USAP protocol allocation algorithm, and t_{sum} is related to the number of hops n. According to the PL-TDMA frame format design, nodes occupy a fixed time slot for at least 4 compound frames, the number of nodes on the path is n, the length of a compound frame is T_c, the length of a superframe is T_s, $t_{\text{sum}} = n \cdot 4T_c$, and $t_{\text{dis}} = t_{\text{sum}} \cdot 4T_c$. The reservation time is the same as the classical USAP protocol for one superframe, that is, $t_{\text{res}} = T_s$. By bringing t_{sum}, t_{dis}, t_{cal}, and t_{res} into formula (34), the following expression can be obtained:

$$t_{to} = (8n + 1) \cdot T_C + T_S. \tag{35}$$

From formula (33) and formula (35), it can be seen that the time required for PL-TDMA path time slot allocation is significantly reduced compared to USAP protocol when the hop count is greater than 2.

PL-TDMA classifies the time slots in the superframe into three types, which are synchronous broadcast time slots, fixed time slots and dynamic time slots. Among them, synchronous broadcast time slot is the time slot used by nodes to broadcast service frames, which is similar to NMOP information frames in USAP and is used for information interaction between nodes to complete network establishment and maintenance. Fixed time slots are mainly used to transmit control frames related to time slot reservation, while dynamic time slots are used for service data transmission. Assuming that the maximum number of nodes in the network is $4n$, the super frame structure is shown in Figure 1.

The PL-TDMA frame structure is cyclic in a unit cycle of superframes. Each superframe consists of $4n$ complex frames, each of which is composed of one simulcast time slot, n fixed time slots, and m dynamic time slots. A node is connected to the network through distributed information interaction with other nodes, while the node occupies one synchronous broadcast time slot in each superframe. After the node is successfully connected to the network, it occupies the fixed time slots through the mapping of broadcast time slots. Nodes do not occupy dynamic time slots directly after joining the network, but use them as reserved time slot resources. When the service load of the node reaches the dynamic time slot occupancy condition, it can occupy the free dynamic time slot resource through the dynamic time slot allocation algorithm.

The synchronous broadcast time slot is the control time slot of the protocol. In the synchronous broadcast time slot, the node broadcasts the service frame containing the information of itself and neighboring nodes. The establishment and maintenance of the network are completed by the interaction of the service frame between the nodes.

The introduction of fixed time slots allows nodes to transmit information about dynamic time slot allocation after they are on the network, which will greatly reduce the time required for the completion of path time slot allocation. The allocation of fixed time slots is based on the mapping rules and the broadcast time slots occupied by the nodes. The node occupies its own broadcast time slot when it enters the network according to the node's occupancy of the broadcast time slot within two hops, so it can be guaranteed that the occupancy of the broadcast time slot is nonconflicting. Therefore, it is easy to generalize the mapping rules to ensure that the fixed time slot occupation is also conflict-free in the two-hop range. In order to improve the time slot utilization, the fixed time slot occupation is determined by the number of nodes in the two-hop range.

According to the superframe structure, the maximum number of nodes in the two-hop range in the network is set to $4n$, and then each superframe contains $4n$ broadcast time slots, and each multiframe contains n fixed time slots, and the time slot number is from FS_0 to FS_{4n-1}, cycling in sequence with a period of four multiframes. The fixed time

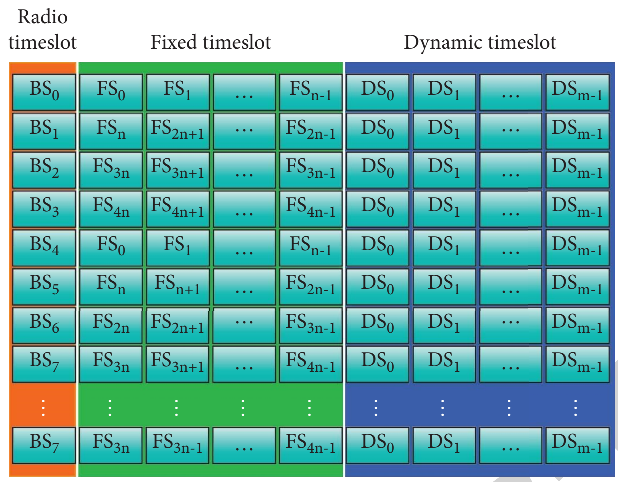

Figure 1: PL-TDMA super frame structure diagram.

slots are occupied according to the number of nodes in the two-hop range, and the specific occupation method is as follows:

(1) When the number of nodes in the two-hop range does not exceed n, the node can occupy a fixed time slot in each multiframe. We assume that the broadcast time slot occupied by the node is the BS, and the occupied set mapped to the fixed time slot is $S = \{FS_i + FS_{n+i} + FS_{2n+i}, FS_{3n+i}\}$; that is, each multiframe occupies a fixed time slot.

(2) When the number of nodes in the two-hop range is greater than n and not more than $2n$, the node can occupy a fixed time slot in every two multiframes. We assume that the broadcast time slot occupied by the node is BS, and the occupied set mapped to the fixed time slot is $S = \{FS_i, FS_{2n+i}\}$; that is, every 2 multiframes occupy a fixed time slot.

(3) When the number of nodes in the two-hop range is greater than $2n$ and not more than $4n$, the node can occupy a fixed time slot in every four multiframes. We assume that the broadcast time slot occupied by the node is BS, and the occupied set mapped to the fixed time slot is $S = \{FS\}$; that is, every 4 multiframes occupy a fixed time slot.

The abovementioned fixed time slot allocation method makes the node occupy a certain fixed time slot after entering the network. The occupancy of the fixed time slot provides the transmission condition of the relevant protocol control frame for the dynamic time slot allocation and is the key to shorten the path delay of the time slot allocation by the PL-TDMA designed in this paper. The node first transmits the protocol data frame related to the dynamic time slot allocation in the fixed time slot and then can transmit other data frames.

According to the above solution and the abstraction of the path slot allocation problem, this paper designs a path level slot allocation scheme, as shown in Figure 2(a). The computing node of the service flow path summarizes the time slot information that can be occupied by each node on the path and performs time slot allocation calculation. The calculation method is based on the round distribution, and the distribution principle is the following: within two hops, the node time slot occupation does not conflict and makes full use of the space multiplexing characteristics of the time slot to ensure that each node on the path gets the same number of time slots after the allocation is completed. The main steps of the PL-TDMA time slot allocation algorithm are three steps, as shown in Figure 2(b).

Service flow detection is the first step of the algorithm. After the MAC layer detects the arrival of a new service flow from the application layer, it determines the service flow type based on the transport layer header information of the service data. The source and destination addresses are obtained based on the self-organizing network frame header information, and the routing table of the self-organizing network is queried to obtain the information of all nodes on the path. We obtain the service flow rate based on the rate at which the service flow arrives at the MAC layer and define a self-increment as the service flow number. The above service flow information is stored and maintained locally and encapsulated into a service flow information frame with the service flow information format shown in Figure 3(a). The time slots available for nodes are appended to the end of the service information frame in ascending order by time slot number, and the format is shown in Figure 3(b). The destination address and receiving address in the header information of the data frame of the self-organized network are filled as the next hop of the path, and the next hop node receives the frame, saves the service flow information locally, and appends its own occupiable time slot information at the end of the frame to the path to the next hop node, until the computing node, which is the previous hop node of the destination node. The format of the information received by the computing node is shown in Figure 3(c).

We assume that there are M nodes on the path. After the above steps, each node on the path can obtain the type of service flow, the arrival rate of service flow V_{in}, and the set of nodes on the service path $S = \{n_1, n_2, \ldots, n_M\}$. The order of the nodes in the set is arranged in the order on the path.

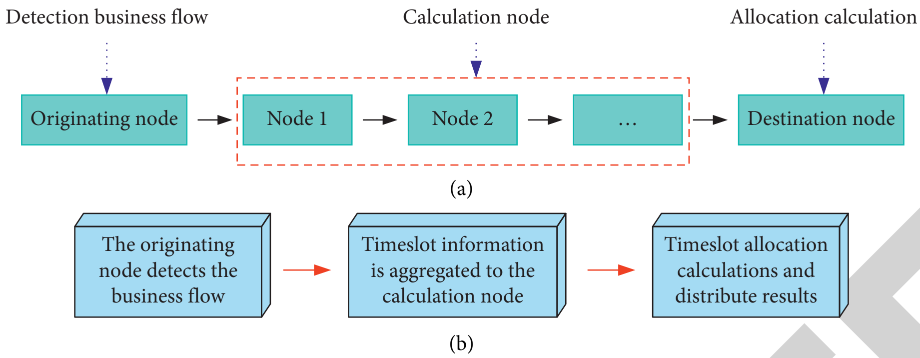

FIGURE 2: The main steps of PL-TDMA time slot allocation algorithm. (a) Schematic diagram of path-level time slot allocation. (b) Schematic diagram of PL-TDMA time slot allocation algorithm steps.

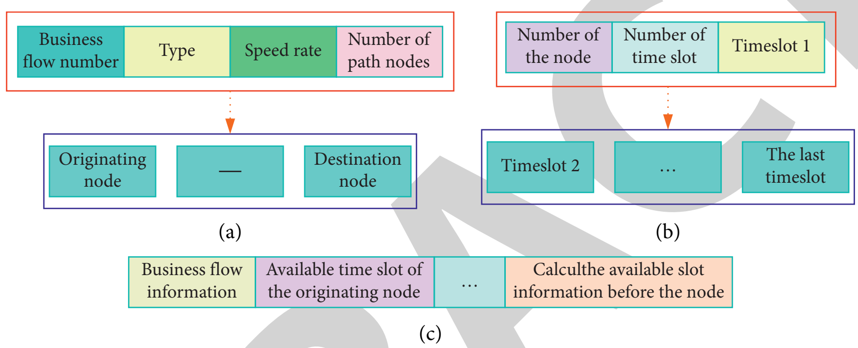

FIGURE 3: Summary of message format. (a) Business flow information format. (b) Node available time slot information format. (c) Format of summary message information.

In addition to service flow information, computing nodes can also obtain the set of time slots that can be occupied by each node on the path.

3.3. Prediction Model of Financial and Economic Series Based on Time Slot Allocation Algorithm. The subsequent prediction of error in this paper is based on the autocorrelation of error series. Generally, modeling within the scope of econometrics assumes that there is no correlation between the early and late stages of random errors. However, in an economic system, there may be correlation between the front and rear economic variables, so the random error can not meet the assumption of no autocorrelation. For autocorrelation test, it mainly includes graphic test method and DW test method. Among them, the graphical method is relatively intuitive. It uses the least square estimation method to obtain its parameters and then uses the estimation method to draw the residual scatter diagram after obtaining the residual term.

From the model established in this paper to predict the change trend of the original sequence, it is known that, due to the defects of the model itself, the predicted residuals may have a certain autocorrelation. Therefore, a model can be established to predict the residual term and correct the prediction results. As shown in Figure 4, it is a process of predicting the residual term and correcting the result by using the model.

Taking regional economy as the research object, this paper constructs the architecture of regional economic trend prediction system. The design of the architecture is mainly based on the general process of data mining and adopts the construction method of conventional application platform, as shown in Figure 5.

As shown in Figure 6, it shows the functional structure of the regional economic trend prediction and analysis system.

The regional economic trend prediction and analysis module mainly uses the constructed regional economic trend prediction model to predict the change trend of relevant indicators in regional economic analysis. The prediction indicators mainly include the development prediction of market subjects, the development prediction of industrial structure, and the development prediction of enterprises. As shown in Figure 7, it describes the process of predicting the future development trend of regional economy from macro- to microaspects according to the main body of regional economy market, industrial structure, and enterprise development.

4. Experimental Analysis and Discussion

In order to test the financial and economic series prediction model based on time slot allocation algorithm proposed in this paper, the network simulation platform is used to simulate the model in various network scenarios. At present,

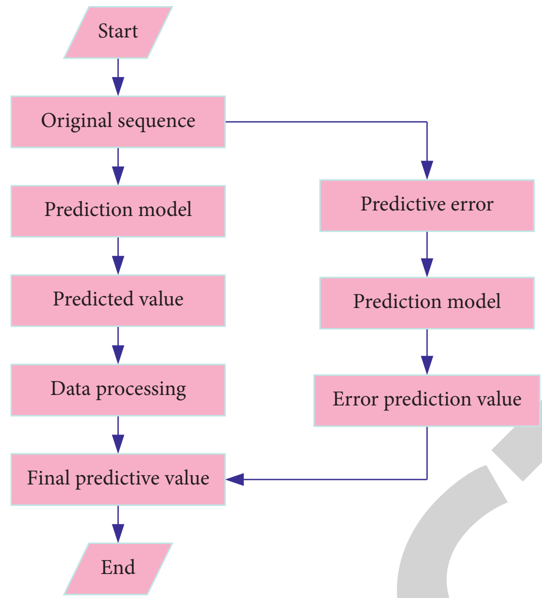

Figure 4: The process of using the model to predict the remaining items and correct the results.

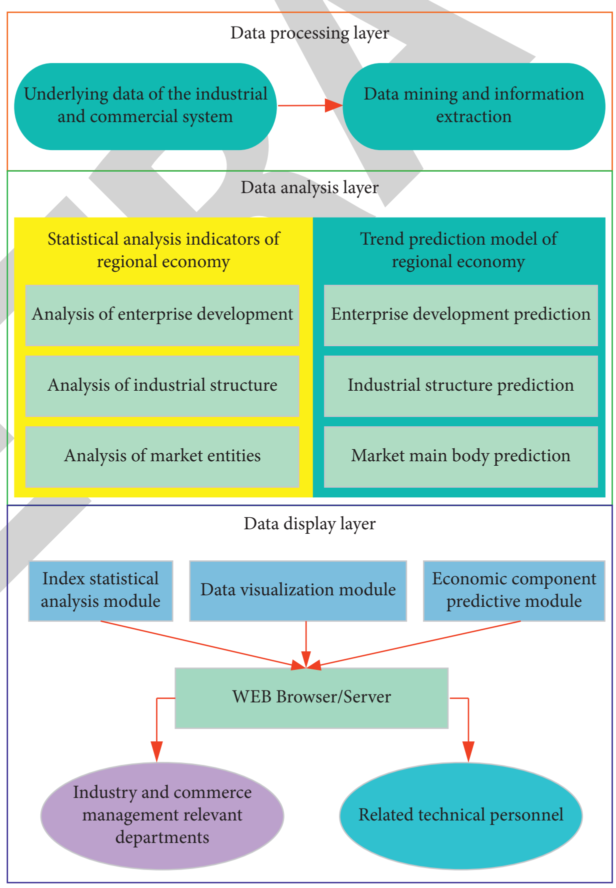

Figure 5: Architecture construction process of regional economic trend prediction system.

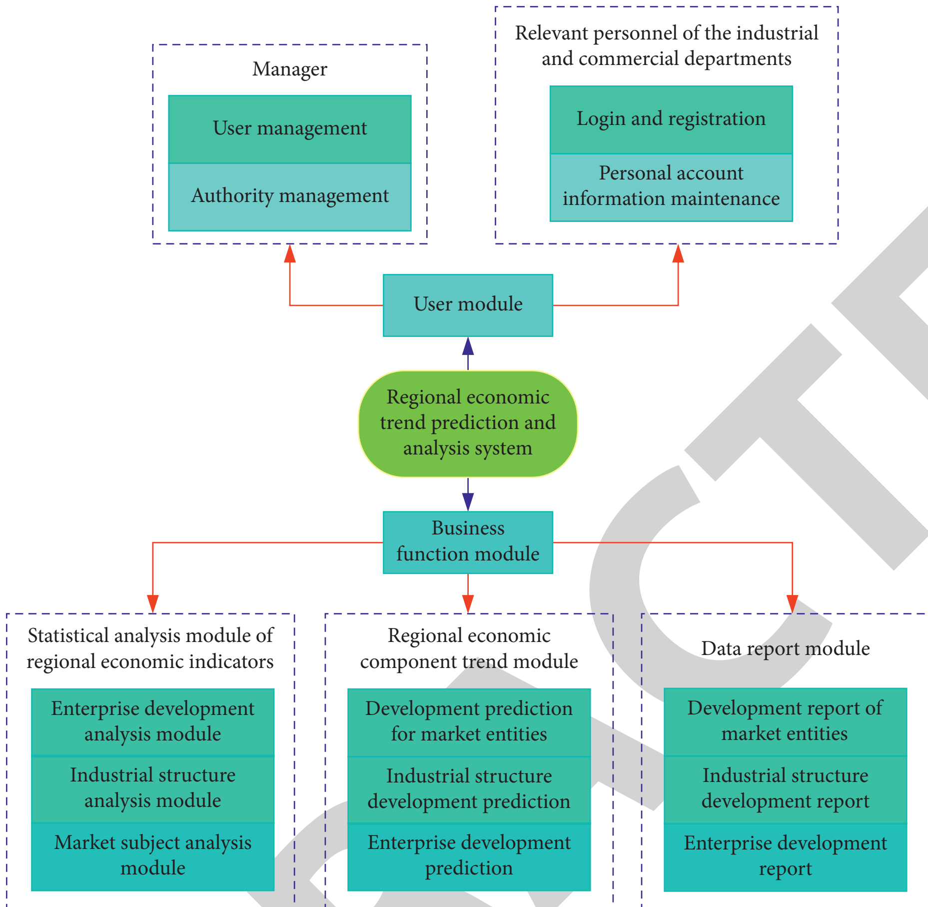

Figure 6: Composition diagram of regional economic trend prediction and analysis system.

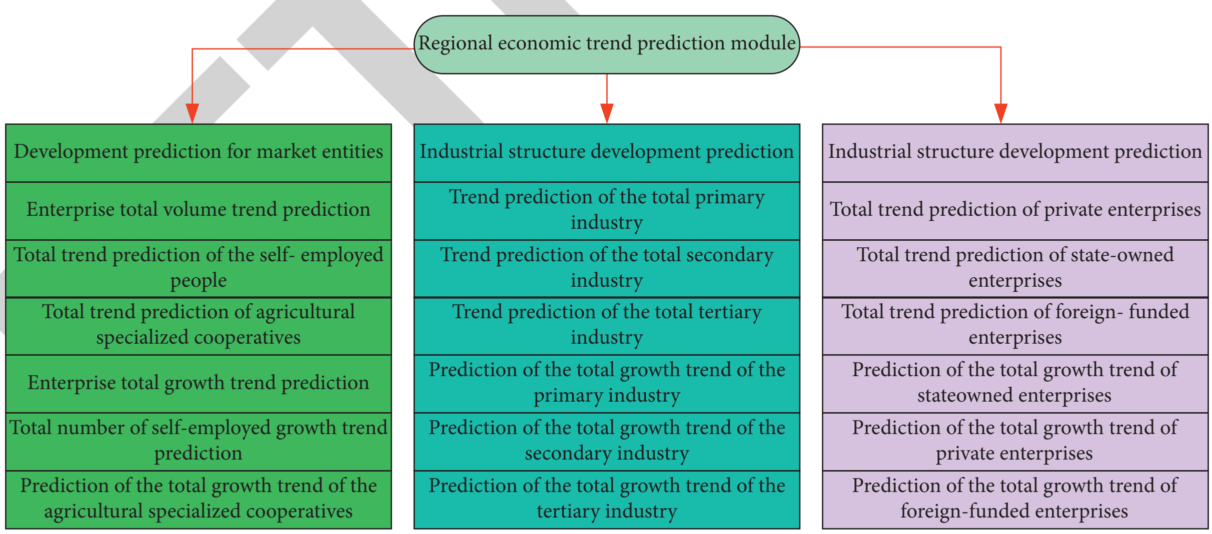

Figure 7: Composition diagram of data report export module.

the mainstream simulation tools include OPNET, NS, and MATLAB. In this paper, OPNET is used as a simulation tool to simulate the performance of the proposed BR-TDMA time slot allocation algorithm.

Through the financial and economic series prediction system based on time slot allocation algorithm, the relevant models in this paper are verified. This paper takes the China Purchasing Managers' Index (PMI) as the economic prediction index and the PMI index from January 2008 to December 2020 as the benchmark (data source: National Bureau of Statistics). In the experiment, the model proposed in this paper is used to predict the indicators of relevant

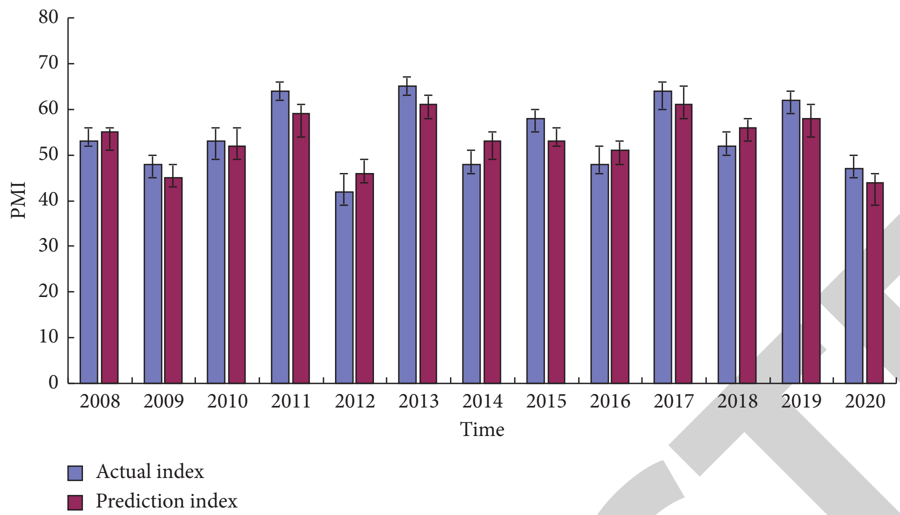

FIGURE 8: Comparison diagram of manufacturing PMI.

FIGURE 9: Comparison diagram of nonmanufacturing PMI.

industries, and the simulation results are compared with the standard data. As shown in Figure 8, the comparison results of manufacturing PMI index are shown. As shown in Figure 9, it reflects the comparison results of PMI index of nonmanufacturing industry.

In addition, in order to further verify the effectiveness of the model in this paper, based on the above experimental verification, the model proposed in this paper and the system model in literature [18] are used to predict the statistical economic series. As shown in Table 1, it reflects the prediction results of economic series obtained by using different models.

From the comparison between the model prediction results and the actual values reflected in Figures 8 and 9, it can be seen that the algorithm performance obtained by using the model in this paper is basically consistent with the actual results. From the prediction results of different models on economic series reflected in Table 1, it can be seen that the financial and economic series prediction model based on time slot allocation algorithm constructed in this paper has good robustness and effectiveness, indicating that the model can provide a certain theoretical basis for predicting financial and economic series.

Table 1: Prediction results of economic series obtained by using different models.

Num.	The method of this paper	The method of [18]
1	85.10	70.15
2	85.29	63.88
3	81.01	64.11
4	82.40	67.74
5	86.48	61.40
6	83.84	59.21
7	82.58	59.11
8	83.84	62.91
9	82.32	65.52
10	83.23	62.12
11	81.61	64.25
12	83.71	60.81
13	86.25	68.71
14	82.89	61.61
15	86.37	58.55
16	83.49	68.94
17	83.16	68.15
18	85.50	69.98
19	84.56	67.88
20	84.12	60.84
21	83.78	63.11
22	82.80	61.22
23	86.29	70.45
24	86.05	70.13
25	82.28	61.09
26	81.39	67.39
27	81.07	61.65
28	86.33	62.70
29	83.51	65.50
30	83.44	68.31
31	84.84	67.26
32	81.56	62.55
33	81.72	69.53
34	86.85	69.61
35	85.06	60.02
36	86.49	67.07
37	84.79	61.96
38	83.98	67.94
39	84.53	66.66
40	81.27	65.79

5. Conclusion

The traditional time series analysis method was difficult to apply to the unstable economic variables in the financial industry. Therefore, in order to effectively solve the analysis of unstable financial data, this paper proposed a knowledge model of time slot algorithm for financial and economic series prediction. In order to effectively analyze and predict the economic sequence, this paper designed a path level slot allocation algorithm based on the slot allocation algorithm, and used the fixed slot to improve the efficiency of path level slot allocation. Then, a round slot allocation algorithm based on constraints and optimal solution was proposed, which can improve the end-to-end throughput and the effective utilization of time slots. Finally, this paper forecast and analyzed the relevant industry indicators through experiments and using the algorithm. The results showed that the financial and economic series prediction model based on time slot allocation algorithm proposed in this paper can better realize the effective prediction of financial and economic series. The algorithm proposed in this paper had important reference significance for the application of computer intelligent algorithm in the financial field.

Data Availability

The labeled dataset used to support the findings of this study is available from the author upon request.

Conflicts of Interest

The author declares no conflicts of interest.

Acknowledgments

This study was sponsored by the Henan University of Animal Husbandry and Economy.

References

[1] W. Montford and R. E. Goldsmith, "How gender and financial self-efficacy influence investment risk taking," *International Journal of Consumer Studies*, vol. 40, no. 1, pp. 101–106, 2016.

[2] S. M. Wanjohi, J. G. Wanjohi, and J. M. Ndambiri, "The effect of financial risk management on the financial performance of commercial banks in Kenya," *International Journal of Finance and Banking Research*, vol. 3, no. 5, pp. 70–81, 2017.

[3] J. Magendans, J. M. Gutteling, and S. Zebel, "Psychological determinants of financial buffer saving: The influence of financial risk tolerance and regulatory focus," *Journal of Risk Research*, vol. 20, no. 8, pp. 1076–1093, 2017.

[4] C. Lucarelli, P. Uberti, and G. Brighetti, "Misclassifications in financial risk tolerance," *Journal of Risk Research*, vol. 18, no. 4, pp. 467–482, 2015.

[5] E. Y. Chan, "Physically-attractive males increase men's financial risk-taking," *Evolution and Human Behavior*, vol. 36, no. 5, pp. 407–413, 2015.

[6] T. Tanimura, E. Jaramillo, D. Weil, M. Raviglione, and K. Lönnroth, "Financial burden for tuberculosis patients in low-and middle-income countries: A systematic review," *European Respiratory Journal*, vol. 43, no. 6, pp. 1763–1775, 2014.

[7] T. K. Scharding, "Imprudence and immorality: A Kantian approach to the ethics of financial risk," *Business Ethics Quarterly*, vol. 25, no. 2, pp. 243–265, 2015.

[8] J. Su and E. Furman, "A form of multivariate Pareto distribution with applications to financial risk measurement," *ASTIN Bulletin*, vol. 47, no. 1, pp. 331–357, 2017.

[9] G. W. Y. Wang, S. H. Woo, and J. Mileski, "The relative efficiency and financial risk assessment of shipping companies," *Maritime Policy & Management*, vol. 41, no. 7, pp. 651–666, 2014.

[10] J. Linarelli, "Luck, justice and systemic financial risk," *Journal of Applied Philosophy*, vol. 34, no. 3, pp. 331–352, 2017.

[11] P. Allen and C. Petsoulas, "Pricing in the English NHS quasi market: A national study of the allocation of financial risk through contracts," *Public Money & Management*, vol. 36, no. 5, pp. 341–348, 2016.

[12] J. Thomä and H. Chenet, "Transition risks and market failure: A theoretical discourse on why financial models and

economic agents may misprice risk related to the transition to a low-carbon economy," *Journal of Sustainable Finance & Investment*, vol. 7, no. 1, pp. 82–98, 2017.

[13] O. Sosnovska and M. Zhytar, "Financial architecture as the base of the financial safety of the enterprise," *Baltic Journal of Economic Studies*, vol. 4, no. 4, pp. 334–340, 2018.

[14] D. Acemoglu, A. Ozdaglar, and A. Tahbaz-Salehi, "Systemic risk and stability in financial networks," *The American Economic Review*, vol. 105, no. 2, pp. 564–608, 2015.

[15] R. Castellano, R. Cerqueti, and G. Rotundo, "Exploring the financial risk of a temperature index: A fractional integrated approach," *Annals of Operations Research*, vol. 284, no. 1, pp. 225–242, 2020.

[16] A. Cohn, J. Engelmann, E. Fehr, and M. A. Maréchal, "Evidence for countercyclical risk aversion: An experiment with financial professionals," *The American Economic Review*, vol. 105, no. 2, pp. 860–885, 2015.

[17] M. Maggiori, "Financial intermediation, international risk sharing, and reserve currencies," *The American Economic Review*, vol. 107, no. 10, pp. 3038–3071, 2017.

[18] I. Pinelis, "An optimal three-way stable and monotonic spectrum of bounds on quantiles: A spectrum of coherent measures of financial risk and economic inequality," *Risks*, vol. 2, no. 3, pp. 349–392, 2014.

[19] N. Hautsch, J. Schaumburg, and M. Schienle, "Financial network systemic risk contributions," *Review of Finance*, vol. 19, no. 2, pp. 685–738, 2015.

[20] C. N. Noussair, S. T. Trautmann, and G. Van de Kuilen, "Higher order risk attitudes, demographics, and financial decisions," *The Review of Economic Studies*, vol. 81, no. 1, pp. 325–355, 2014.

[21] R. Rodríguez-Aguilar, J. A. Marmolejo-Saucedo, and S. Tavera-Martínez, "Financial risk of increasing the follow-up period of breast cancer treatment currently covered by the Social Protection System in Health in Mexico," *Cost Effectiveness and Resource Allocation*, vol. 16, no. 1, pp. 1–11, 2018.