ISSN 2706-6827 Vol. 3, Issue 5: 110-114, DOI: 10.25236/IJFS.2021.030520

Research on the U.S. Economic Status under the Epidemic Based on the Comprehensive Evaluation Model of Projection Pursuit

Xiaorou Li[1], Yingying Diao[1], Lujie Mao[2], Donghan Wu[1], Chang Su[1], Xiaobo Li[1]

[1]*Southwest Minzu University, Chengdu, Sichuan, 610225, China*
[2]*Wuhan University of Technology, Wuhan, Hubei, 430070, China*

Abstract: *Aiming at the impact of different candidates in the United States on the Chinese and American economies, this paper established a projection pursuit comprehensive evaluation model based on improved butterfly optimization algorithm to analyze the US economy and economy. We establish project pursuit comprehensive evaluation model based on improved butterfly optimization algorithm. First, perform data preprocessing on the 9 evaluation index data to eliminate the influence of outliers; then, establish a projection pursuit evaluation model for high-dimensional data. Secondly, use improved butterfly optimization algorithm to solve the model, and finally it is obtained that without considering the epidemic situation, Trump's score is 8.76 and Biden is 7.89. When considering the epidemic situation, Trump's score is 5.23, and Biden scores As 6.17. Further sensitivity analysis of the solution results proves that the model is stable.*

Keywords: *Coronavirus, projection pursuit comprehensive evaluation model, improved butterfly optimization algorithm*

1. Introduction

2020 is a special year, facing the threat of the new crown pneumonia to the global economy. It is also the year of the US presidential election. Republican candidate Donald Trump and Democratic opponent Joe Biden are running for president. The candidates on both sides have their own unique governance in various fields. As the United States has a pivotal position in the world economic system, the results of the election will also have an important impact on the future development of the world. [1]

China and the United States are the two largest economies in the world, and their development will shape the pattern of the world economy. Since the Sino-US trade war, the two countries have suffered economic shocks to varying degrees. Leaders' decision-making has a crucial impact on the economies of both countries. It is necessary for this group to collect candidates' policy propositions in different fields. , Policy guidelines and related data, establish a mathematical model to quantitatively analyze the impact of different candidates on the Sino-US economy.

2. Model Building

We obtained data on various economic indicators of the United States from 2009 to 2020 through the U.S. Bureau of Economic Analysis. Considering that Biden has not yet taken office, but he served as the vice president during Obama's period. Because the Democratic Party's governing direction is consistent, so this group uses various economic indicators of the United States during the Obama Biden administration to replace Biden's future governance level. Analyze the impact of different candidates on the US economy from considering the epidemic situation and comparing the situation with the epidemic situation. [2]

Due to the selection of many indicators, the general comprehensive evaluation model cannot get a good result. In terms of processing nonlinear high-dimensional data, the projection pursuit evaluation model has better benefits.

We collected 9 US economic impacts from the US Bureau of Economic Analysis, including total import and export, fiscal budget revenue, fiscal budget expenditure, total sales, GDP, S&P 500 volatility index (VIX), unemployment rate, CPI, and taxes. Quantitative factors, a total of 72 sets of data. Use

ISSN 2706-6827 Vol. 3, Issue 5: 110-114, DOI: 10.25236/IJFS.2021.030520

SPSS to check all the data. Some outliers should be eliminated.

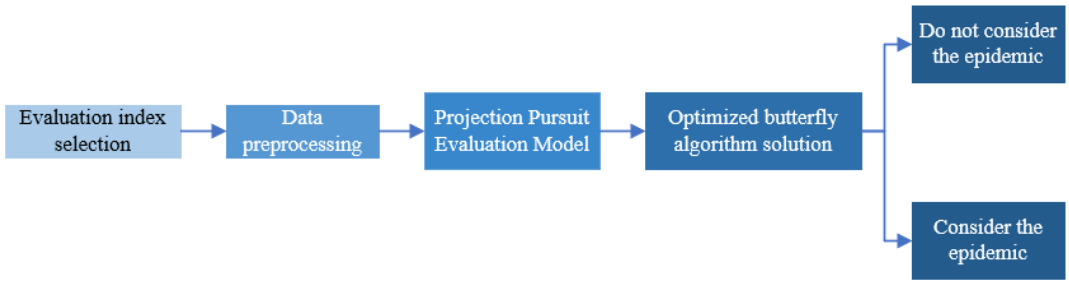

Figure 1: Process analysis

The Projection Pursuit Model is an emerging statistical method for processing multi-factor nonlinear high-dimensional data. The basic idea is to project high-dimensional data to low-dimensional space, and investigate the distribution structure of low-dimensional projection data. High-dimensional data features. The impact on a country's economy includes GDP and other macro indicators. This group mainly includes total imports and exports, fiscal budget expenditures, total sales, fiscal budget revenue, taxes, unemployment, CPI, Standard & Poor's 500 Volatility Index (VIX), etc. Analysis and evaluation of two important indicators, as shown in the figure 2.

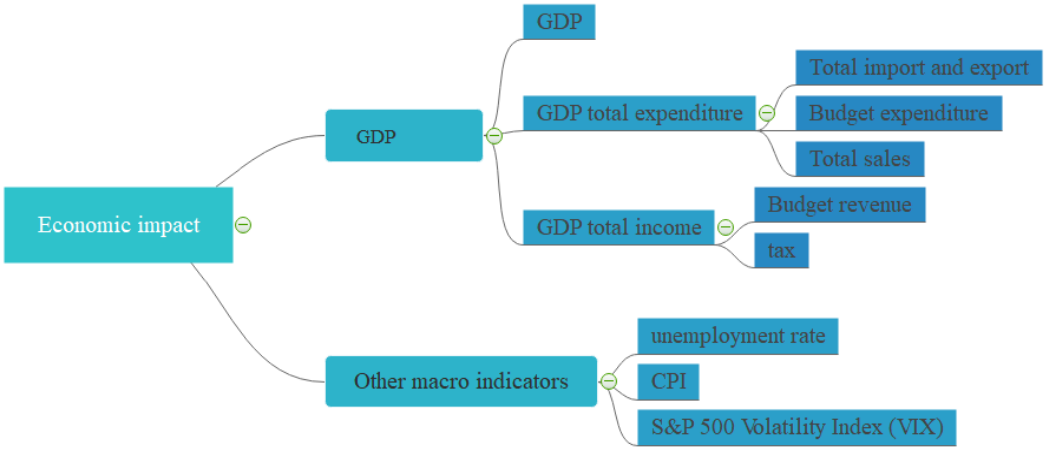

Figure 2: Index diagram

Because there are as many as nine indicators in the evaluation model, the general evaluation model has certain defects in the processing of high-dimensional data. For this reason, we established an evaluation model of the impact of different candidates on the US economy based on the projection pursuit theory. And adopt an improved butterfly optimization algorithm to solve.

Normalize the data of nine evaluation indicators:

$$\begin{cases} x'(i,j) = \dfrac{x(i,j) - x_{\min}(j)}{x_{\min}(j) - x_{\min}(j)}, \\ x'(i,j) = \dfrac{x_{\min}(j) - x(i,j)}{x_{\max}(j) - x_{\min}(j)}, \end{cases}$$

Among them$x'(i,j)$ is the normalized sequence of index characteristic value; $x_{\max}$ and $x_{\min}$ are the upper and lower limit of the index value.

Use linear projection to project high-dimensional data into one-dimensional linear space for research. Let a be the m-dimensional unit projection vector $a = (a_1, a_2, \cdots a_m)$, the one-dimensional projection eigenvalue z_i can be expressed as:

$$z_i = \sum_{j=1}^{m} a_i \, x'(i,j) \quad i = 1, \cdots n.$$

Among them, the projection component of the i sample j index, $z = (z_1, z_2, \cdots \cdots, z_n)$ is the

ISSN 2706-6827 Vol. 3, Issue 5: 110-114, DOI: 10.25236/IJFS.2021.030520

projection feature value.

In order to find the structural combination characteristics of the data in the multi-dimensional index, the projection value z_i is required to extract as much as possible the variation information of x_{ij} during the comprehensive projection, that is, z_i is one-dimensional The class spacing S_z for spatial dispersion is as large as possible; at the same time, the local density D_z of the projection value z_i reaches the maximum, that is, the indicators in the same projection space are concentrated as much as possible. Therefore, the projection objective function can be constructed as:

$$Q(a) = S_z D_z,$$

Among them, S_z can be used to calculate the standard deviation of the projected eigenvalues of the sample sequence, where E_z is the mean value of the projected eigenvalues z_i, as follows:

$$S_z = [\sum(z_i - E_z)^2/(n-1)]^{0.5},$$

The calculation formula of the local density D_z is:

$$D_z = \sum_{i=1}^{n}\sum_{j=1}^{n}(R - r_{ij})\,u(R - r_{ij}),$$

R is the density window width, which is related to the data feature. Generally, the value can be αS_z, where α can be 0.1, 0.01 or 0.001, etc., according to the projection point z_{ij} The distribution between regions is adjusted appropriately. In the third question, α is taken as 0.01. The distance $r_{ij} = |z_i - z_k|(k = 1 \cdots n)$ is the distance between the eigenvalues of the two projections. u is the unit step function. When $R - r_{ij} > 0$, the function value is 1; when $R - r_{ij} \le 0$, the function value is 0.

When the sample value of the evaluation index is given, the projection index function only changes with the change of the projection direction. Different projection directions reflect different data structure characteristics. The best projection direction is the projection direction that most likely exposes a certain type of characteristic structure of high-dimensional data. The best projection direction can be estimated by solving the projection index function maximization, namely:

$$\max Q(a) = S_z D_z,$$
$$\text{s.t.} \sum_{j=1}^{m} a_j^2 = 1 \quad a \in [-1,1].$$

Calculate the projection value z_i of each index according to the best projection direction value a_j, and the projection value is the best projection of each evaluation index. The weighting of the direction and the standard value can evaluate and analyze the sample according to the size of the projection value.

3. Model solving

The Butterfly Optimization Algorithm (BOA) is a new type of swarm intelligence bionic algorithm proposed by imitating the foraging and spouse-finding behaviors of butterflies in nature. [3] Compared with the traditional swarm intelligence algorithm, it not only has a simple algorithm, but also has a better convergence speed. And the optimization accuracy, the solution steps applied to the projection pursuit model are as follows:

ISSN 2706-6827 Vol. 3, Issue 5: 110-114, DOI: 10.25236/IJFS.2021.030520

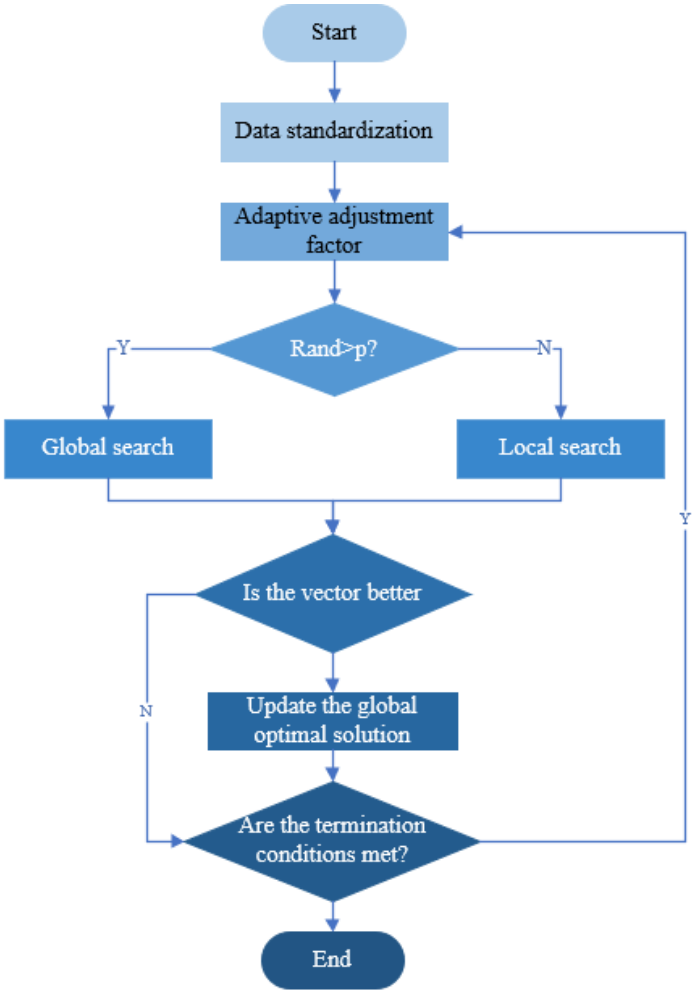

Figure 3: Butterfly optimization algorithm flow chart

During the Obama Biden administration, there was an outbreak of H1N1 avian influenza in 2009. This group uses the data of various economic indicators this year as the difference between Biden's ability to respond to the epidemic and the Trump administration's response to the new coronavirus in 2020. The economic indicators are added together as the input of the model to solve, and the evaluation results are in the following table 1:

Table 1: Comprehensive score for the impact on the U.S. economy

candidate	Overall rating
Trump	5.23
Biden	6.17

4. Conclusion

We conducted sensitivity analysis on the relevance of indicators and results and the stability of the system. Under the condition of fixing other parameters unchanged, the single evaluation indicator was changed, fluctuating up and down by 5%, and the relevance of indicators and results was analyzed. The index fluctuates up and down by 5% to analyze the stability of the model system. Finally, the test statistics in the steady state are obtained: mean, standard deviation and MAD.

The evaluation result is less sensitive to all indicators when 99.8786, and the mean curve is similar, and the maximum fluctuation does not exceed 1.5%, indicating that the model system is relatively stable; Index fluctuations have a greater impact on the average absolute error (MAD) of the solution data. Corresponding to the exponent part of the function expression, if the index increases slightly, the trend of the curve will change significantly, indicating that the selected index is very important to the economy and is related Strong sex.

ISSN 2706-6827 Vol. 3, Issue 5: 110-114, DOI: 10.25236/IJFS.2021.030520

References

[1] Tang Qian, Wang Jinman, Jing Zhaorui. Tempo-spatial changes of ecological vulnerability in resource-based urban based on genetic projection pursuit model [J]. Ecological Indicators, 2021, 121.
[2] Chen Xue. Research on evaluation of high-quality development of construction enterprises based on projection pursuit method [D]. Harbin Institute of Technology, 2020.
[3] Gao Wenxin, Liu Sheng, Xiao Ziya, Yu Jianfang. Butterfly optimization algorithm based on global optimization [J]. Application Research of Computers, 2020, 37(10): 29662970.