Team Number :	2020190030058

Problem Chosen :	B

How does the economy develop after the US presidential election?

Abstract

For task 1, this paper first compares Trump's and Biden's campaign policies on **trade, economy and employment**. Then, 38 third level indicators **(Tab 3.1)** were selected from the perspective of **Infrastructure and other indicators** and the correlation coefficient between multiple variables was calculated by using the **improved comprehensive correlation algorithm (Fig. 3.1-3.2)**. Later, we use **TOPSIS and entropy weight method** to calculate the **comprehensive economic index**. The results show that affected by the epidemic, the US economic composite index **dropped to 1.8** from 2020.09. Secondly, this paper analyzes the impact of Trump's **new COVID-19 control measures and trade protection policy** on the domestic economy, which show that the policy has a **potential impediment** to the development of the U.S. economy. Finally, **the ARIMA model** is used to predict the trend of the economic index under the two policies. The results show that after the full adoption of Biden's policy, the economic index will **slowly rise to 1.86** in March 2021, and the **maximum recession** degree is about **45.8%**, which is better than that of **1.76** and **60%** under trump policy. However, the economic index must be **at least 70%** of Biden's policy implementation level before it will show an **upward trend (Fig 3.12)**.

For task 2, considering that the impact of the US election on China's economy is mainly reflected in the aspect of **foreign trade**, this paper adds a number of **third-level indicators** to the trade secondary indicators in China's economic impact system model **(Tab 4.1)**.In order to measure the impact of policy changes in the United States on China, this paper constructs a **complex network of global economy** to analyze **the differences among different regions**, and gives weights. The trade impact index of the United States to China is **0.65** by **Leadrank**, which shows that China has a strong **dependence** on American materials and commodities. Then, this paper uses the **policy impact matrix** to quantitatively analyze the impact of the **four** measures of the United States, such as **tariff increase**, on China's economic index, which are **-12%, -19%, 5% and 9% (Tab 4.2 and Fig 4.12**).Finally, the policies for the two candidates predict that Biden and trump will slow down China's economic growth by **4.5%** and **6.3%** respectively after becoming the president of the United States **(Fig 4.13)**.

According to above analysis, this paper puts forward **three** main suggestions. Such as, **we should vigorously promote the development of high-tech industry**. And use **the policy impact matrix** to simulate that after adopting the policy, China's economic index can increase by about **20% from 1.01 to 1.22** in the **long or short** term **(Fig. 5.1)**.

Key words: Economic inde; TOPSIS model combined with entropy weight; Economic complex network; Leadrank algorithm; Policy impact matrix; Policy simulation.

Contents

1. Introduction

The election of the president of the United States is held every four years. The change of the president of the United States will have an important impact on the economy of the United States and other countries. In the 2020 presidential election, Biden and trump have different economic policy propositions in trade, environment, employment, tax and other aspects. Therefore, different candidates will have an important impact on the economy of the United States, China and even the world. In this context, how to quantify and predict the coming of different candidates in the US election has important reference value for the future economic situation analysis.

1.1 Outline

Our objective is to develop and implement models to better assess the economic impact of the election of different candidates in the United States, China and the world, and give targeted policy recommendations. To realize this target, we will proceed as follows:

- ★ Build the impact system of US economic indicators, and analyze and predict the impact of Biden and trump on the U.S. economy after taking office.
- ★ Build an indicator system of China's economic impact, and analyze and predict the impact of Biden and trump on China's economy after taking office as president of the United States.
- ★ According to the simulation results of question 1 and 2, corresponding improvement suggestions are put forward for trump and Biden.

1.2 Main Assumptions

Index system construction and the impact of different candidates' election on the future has some uncertainty and as a result are di cult to describe and predict. In order to quantify the uncertainty in model and solution process, it is necessary to make some simplifying assumptions. Listed below are several of the main assumptions we make regarding how we view the problem.

★ Suppose that the data published by the economic website is true and reliable. The statement disclosure of the Statistics Bureau and relevant government departments is one of our main data sources, so we assume that the data published by these agencies has high credibility.

★ It is assumed that the candidate becomes President according to the election policy. In our article, there is an overall forecast of the future economic situation. The data we are based on is based on the policy views expressed by the candidates in public, so we assume that the candidates will implement most of the policies promised after they are elected.

★ Suppose that there will be no large-scale war in the next US administration. As a result, the U.S. strategic deviation will not be ignored in the next four years.

★ It is assumed that the United States and China will not have another outbreak of natural disasters similar to the new outbreak or more serious. The outbreak of the new epidemic is a major blow to the world economy. With the increase of the number of epidemic cases, the impact of the new epidemic situation has caused irreparable economic losses to the whole world. Therefore, we assume that in the next four years, there will be no more disasters similar to the new epidemic or more serious.

2. Notations

Symbol	significance
r	Correlation coefficient
p	Comprehensive correlation coefficient
E_i	Information entropy
x_{ij}	Attribute evaluation value of scheme
w	Weight vector
C_i^+	Relative closeness
q	The order of autoregression
k	Moving average coefficient
$P(k)$	Degree distribution function
Γ	Factor influence matrix

3. Model and Solution of Task 1

3.1 comparison of presidential candidates' opinions

As the president of a superpower, the election results of the US president have always been the focus of global attention. Different presidential candidates have different policies on economy, culture, environment and so on. Due to the development of globalization, the results of the US presidential election will not only have an impact on the United States, but also have a considerable impact on other countries. Take the election claims of Donald Trump and Joe Biden in 2020 as an example to show the different policy propositions of the two candidates.

There are obvious differences between trump and Biden. Trump pursues cultural conservatism and economic classical liberalism, emphasizing freedom and efficiency, fair trade, limiting the scale of government and government regulation, supporting tax reduction, opposing illegal immigration, reducing the level of social security, and retaining the right to hold guns. Biden supported the liberal concept of the new deal, advocated narrowing the gap between the rich and the poor, increasing government economic intervention, more social welfare, lenient treatment of immigrants and tolerance of multiculturalism. From this we make a simple conclusion

- ★ In trade, trump continues to insist on imposing punitive tariffs on countries that carry out "unfair dumping and subsidies"; Biden does not support the use of tariff weapons, but also pays attention to the issue of "unfair competition", and tends to unite allies to suppress "trade policy abusers" such as China.
- ★ In terms of economy and employment, trump advocated comprehensive tax reduction, encouraged the return of manufacturing industry and employment, emphasized the driving role of economic growth on employment and income growth; Biden opposed tax reduction, and emphasized the promotion of minimum wage and racial equality in employment.

In order to analyze the impact of different candidates' opinions on the overall economy after being elected. This paper first constructs the economic impact index system. We choose COVID-19 epidemic control, infrastructure, taxation, medical insurance, employment and trade as the secondary index system, and construct the index system including employment rate as the third level index system. The related

index system structure is shown in the table.

Table 3.1 selection of index system

Primary indicators	Secondary indicators	Third level index	
Economic system influences economy	Epidemic control of COVID-19	Investment budget …	New crown control attitude
	Infrastructure construction	Infrastructure budget Infrastructure construction budget	Degree of policy inclination …
	Domestic economic development	Dow Jones index Personal monthly expenditure	gross domestic product …
	medical insurance	Budget input …	Policy support intensity
	obtain employment	Employment rate forecast Mainly supporting industrial distribution	Employment subsidy budget …
	Trade	Trade policy tendency Global economic attitude	Tariff rate …

3.2 construction of economic impact system and index extraction

Because more variables are selected, it is difficult to analyze and calculate directly. In order to simplify the analysis, this paper first solves the correlation coefficient between multiple variables, selects some representative variables from the variables with higher correlation coefficient, extracts them and applies them to subsequent analysis.

In order to explore the correlation between variables, this paper adopts a unique comprehensive correlation coefficient method, which combines Pearson correlation coefficient method and improved absolute grey correlation coefficient method. The principle of comprehensive correlation coefficient algorithm is as follows:

Calculation of correlation coefficient r

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

Improved calculation of absolute grey correlation coefficient

*S*tep 1: set the order of system behavior:

$$X_0 = (x_0(1), x_0(2), \cdots, x_0(m))$$
$$X_1 = (x_1(1), x_1(2), \cdots, x_1(m))$$
$$\cdots\cdots$$
$$X_i = (x_i(1), x_i(2), \cdots, x_i(m))$$
$$\cdots\cdots$$
$$X_n = (x_n(1), x_n(2), \cdots, x_n(m))$$

*S*tep2: correlation coefficient was calculated

$$\gamma_{0i}(k) = \frac{c}{c + \tan\left(\frac{\beta_{0i}(k)}{2}\right)}$$

*S*tep3: calculate the application weight WOI (k)

$$W_{0i}(k) = 1 - \frac{\left|x_i(k) - x_0(k)\right|}{\sum_{k=1}^{m}\left|x_i(k) - x_0(k)\right|}$$

*S*tep4: correlation calculation:

$$\gamma_{0i} = \frac{1}{m-1}\sum_{k=1}^{m-1} W_{0i}(k)\gamma_{0i}(k)$$

Calculation of comprehensive correlation coefficient

$$p = \frac{\left|\gamma_{0i}\right| + \left|r\right|}{2}$$

Then, this paper selects the calculation results of some indicators, and takes the correlation between the first index and the second to ninth index as an example to show the relationship between the comprehensive correlation coefficient, Pearson correlation coefficient and the improved absolute grey correlation degree. For most of the indicators, the difference between grey correlation coefficient and Pearson correlation coefficient is small, and they verify each other. For index 3 and indicator 7, the difference between grey correlation coefficient and Pearson correlation coefficient is large, which indicates that the linear relationship and trend between them are not completely the same. Therefore, the results of comprehensive correlation coefficient take into account the above two relations and obtain a compromise result.

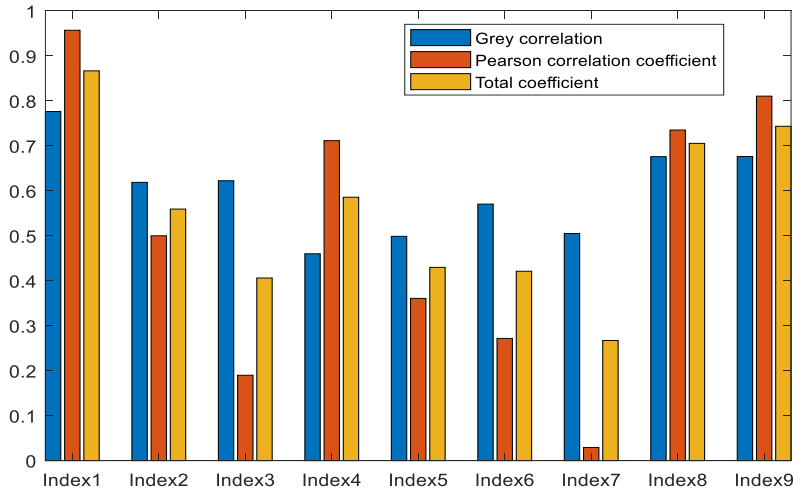


Figure 3.1 correlation coefficient of some indexes

Then, this paper shows the comprehensive coefficient relationship among the 38 indexes selected preliminarily, as shown in the figure. It can be seen that there is a similar correlation between the selected indicators, so these indicators can be integrated and extracted to obtain a simplified system table, as shown in the table.

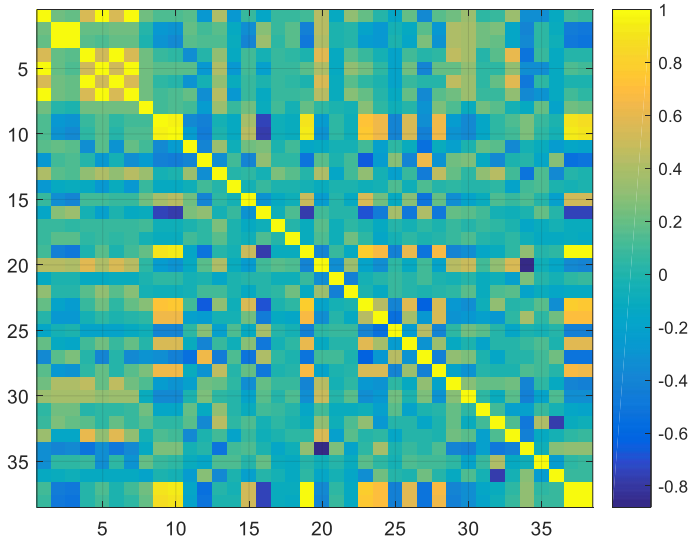


Figure 3.2 correlation coefficient of all selected indicators

Table 3.2 simplified economic impact system

Primary indicators	Secondary indicators	Third level index	
Economic system		Capital investment	New crown control attitude

influences economy	Epidemic control of COVID-19	Number of confirmed cases	
	Infrastructure construction	Infrastructure investment amount	Degree of policy inclination
		Number of construction	Number of jobs provided
	Domestic economic development	Dow Jones index	gross domestic product
		Personal monthly expenditure	Personal tax rate
		Producer price index	House price index
	medical insurance	Medical funds	Number of people applying for unemployment benefits
		Medical beds	
	obtain employment	unemployment rate	Nonfarm Payrolls
		Number of layoffs in Enterprises	Index of labor market conditions
	Trade	Trade policy tendency	Tariff rate
		Import price index	Trade surplus / deficit
		Global economic attitude	…

Then, this paper selects part of the third level index data from January 2020 to September 2020 for descriptive analysis, as shown in the figure.

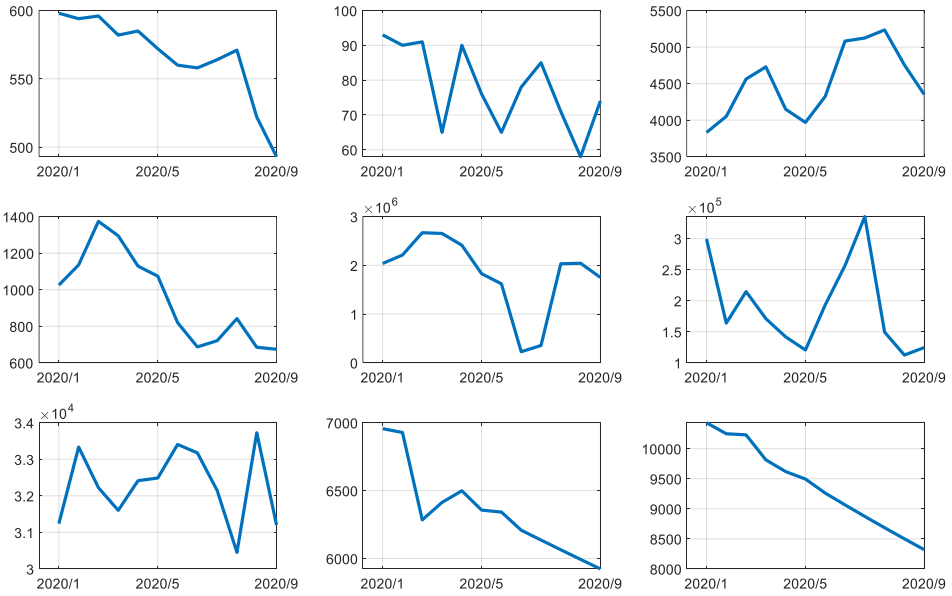


Figure 3.3 change trend of partial data

After getting the index data, in order to quantitatively describe the trend of economic change, this paper uses TOPSIS and entropy weight method to calculate the

economic comprehensive index. Firstly, the entropy weighting method, which is less subjective and can make full use of the data characteristics, is used to weight each index in the evaluation system, so as to obtain the proportion of each index in the evaluation system.

Step 1: calculate the proportion of normalized data m_{ij},

$$p_{ij} = \frac{M_{ij}^{'}}{\sum_{j=1}^{n} M_{ij}^{'}}$$

Step 2: calculate the information entropy of each index:

$$E_i = -\ln(n)^{-1} \sum_{j=1}^{n} p_{ij} \ln p_{ij}$$

Information entropy is a measure of disorder degree. The higher the value of information entropy $e_i$is, the higher the disorder degree of information $x_i$is, the greater the value of information utility is, that is, the greater the influence of this index on the evaluation system.

Step 3: calculate the weight of each index:

$$Q_i = \frac{1-E}{\sum_{i=1}^{N}(1-E_i)} \qquad (i = 1, 2, 3.....)$$

Step 4: calculate the weight of each index on the economic impact index:

$$w = \sum_{i=1}^{k} Q_i M^{'}_{ij}$$

Step 5: construct decision matrix:

$$D_{m\times n} = \begin{array}{c} \\ A_1 \\ A_2 \\ \vdots \\ A_m \end{array} \begin{array}{c} \begin{array}{cccc} X_1 & X_2 & \cdots & X_n \end{array} \\ \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \end{array}$$

Step 6: establish standardized decision matrix:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$$

Step 7: establish the weighted decision matrix

$$V=\begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1j} & \cdots & v_{1n} \\ \vdots & \vdots & & \vdots & & \vdots \\ v_{i1} & v_{i2} & \cdots & v_{ij} & \cdots & v_{in} \\ \vdots & \vdots & & \vdots & & \vdots \\ v_{m1} & v_{m2} & \cdots & v_{mj} & \cdots & v_{mn} \end{bmatrix}=\begin{bmatrix} w_1r_{11} & w_2r_{12} & \cdots & w_jr_{1j} & \cdots & w_nr_{1n} \\ \vdots & \vdots & & \vdots & & \vdots \\ w_1r_{i1} & w_2r_{i2} & \cdots & w_jr_{ij} & \cdots & w_nr_{in} \\ \vdots & \vdots & & \vdots & & \vdots \\ w_1r_{m1} & w_2r_{m2} & \cdots & w_jr_{mj} & \cdots & w_nr_{mn} \end{bmatrix}$$

Step 8: determine the positive and negative ideal solutions:

$$A^+=\left\{\left(\max_i v_{ij}\,\middle|\, j\in J\right),\left(\min_i v_{ij}\,\middle|\, j\in J'\right)\middle|\, i\in M\right\}=\left\{v_1^+,v_2^+,\cdots,v_j^+,\cdots,v_n^+\right\},$$

$$A^-=\left\{\left(\min_i v_{ij}\,\middle|\, j\in J\right),\left(\max_i v_{ij}\,\middle|\, j\in J'\right)\middle|\, i\in M\right\}=\left\{v_1^-,v_2^-,\cdots,v_j^-,\cdots,v_n^-\right\},$$

Step 9: calculation distance:

$$S_{i^+}=\sqrt{\sum_{j=1}^{n}\left(v_{ij}-v_j^+\right)^2},\ i\in M$$

$$S_{i^-}=\sqrt{\sum_{j=1}^{n}\left(v_{ij}-v_j^-\right)^2},\ i\in M$$

Step 10: calculate the relative closeness of each scheme:

$$C_{i^+}=\frac{S_{i^-}}{S_{i^-}+S_{i^+}},\ 0<C_{i^+}<1,\ i\in M$$

Firstly, the entropy weight algorithm is used to calculate the weight of the index, and then the attribute of the index system is analyzed. Some results are shown in the table.

Table 3.3 weight and attribute table of partial economic comprehensive index system

index	weight	Index attribute
Investment in new epidemic situation	0.0125	Positive indicator
Number of confirmed cases of COVID-19 epidemic	0.0178	Negative index
Number of infrastructure construction	0.0263	Positive indicator
Dow Jones index	0.0494	Positive indicator
gross domestic product	0.0307	Positive indicator
Number of people applying for benefits	0.0358	Negative index
unemployment rate	0.0457	Negative index
Nonfarm Payrolls	0.0285	Positive indicator
Import price index	0.0172	Positive indicator
…	…	…

Finally, the composite index of the U.S. economy for nearly a year has been calculated, as shown in the figure. In the calculation results, the higher the

comprehensive economic index is, the better the economic situation is.From September 2019 to November 2019, the U.S. economy maintains a steady upward trend, with the index rising from 2.2 to 2.5. However, from 2020, affected by the new crown pneumonia, the U.S. economy continues to decline. After some states start the closure order in March 2020, the economic situation plummets. The calculation result of the latest month is 1.8, which is consistent with the actual situation.

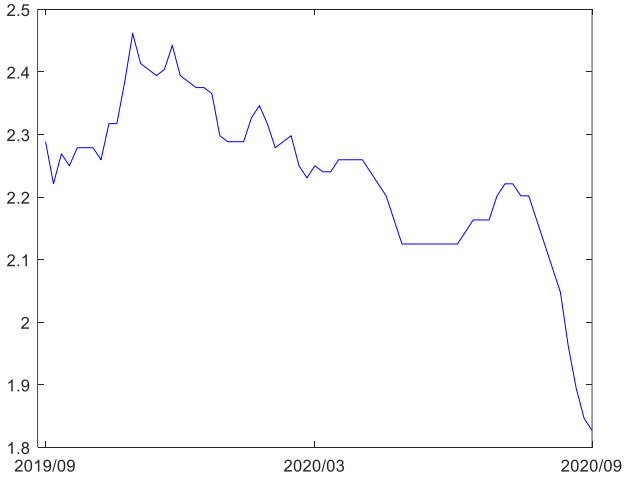


Figure 3.4 US economic composite index

3.3 trump policy analysis and impact

Using the control variable method to analyze the comprehensive economic index and the secondary variables, firstly, the relationship between the economic comprehensive index and the new epidemic situation control is analyzed. By keeping the other secondary variables unchanged, the expression of the comprehensive economic index and the control status of the new epidemic situation can be obtained, and the relationship can be drawn. Then, in order to evaluate the impact of policy changes on the economy, the relationship between the comprehensive economic index and the new epidemic situation can be obtained, assuming that the control of COVID-19 epidemic situation is improved by 20% and deteriorated by 20%, the changed image can be obtained as shown in the figure.

When COVID-19 epidemic situation is improved by 20% on this basis, the relative curve of economic comprehensive index moves upward. Therefore, the control of COVID-19 epidemic situation will make the economic trend better, and the worsening of COVID-19 epidemic situation will cause a heavy blow to the economy.

In addition, this paper evaluates the impact of Trump's trade protection policy on

the domestic economy. On the basis of the current trade protection policy, it increases by 20% and decreases by 20%, and obtains the relationship between the economic comprehensive index and the status of trade policy. When the trade protection policy is continuously improved, the domestic economy will first improve, but it will eventually be lower than the current level due to the trend of economic globalization,Trade protection policy seems to be beneficial to the domestic economy, but it will eventually damage the domestic economy.

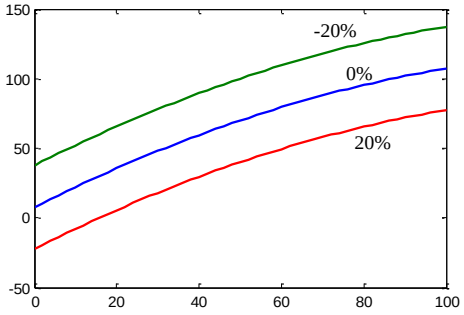


Figure 3.5 comprehensive relationship between economic index and epidemic situation

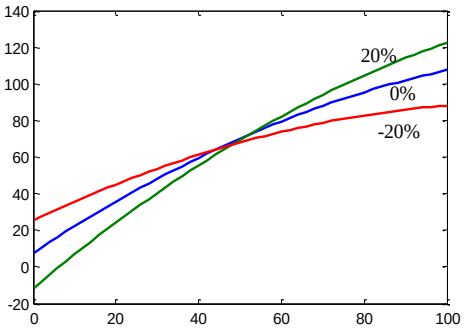


Figure 3.6 economic composite index and trade relations

3.4 Biden policy analysis and impact

Since Biden has not formally mastered the state power, it is unable to directly calculate the impact of its policies from the existing data. This paper first forecasts the relationship between the subsequent trump policies and the economic composite index, and then introduces the influence of Biden policy on the economic composite index and makes a comparative analysis. First, ARIMA model is used to predict the development of the comprehensive economic index. ARIMA model includes AR model, MA model and ARMA model. The basic idea of time series prediction is to use the existing time series to approximate the random value.

If the numerical value of a time series is composed of the preceding data and random items, namely:

$$y_t = \varphi_1 y_{t-1} + \varphi_2 y_{t-2} + ... + \varphi_p y_{t-p} + u_t$$

$$y_t = \varphi_1 B y_{t-1} + \varphi_2 B^2 y_{t-2} + ... + \varphi_p B^p y_{t-p} + u_t$$

$$\varphi\ B\ = 1 - \varphi_1 B - \varphi_2 B^2 - ... - \varphi_p B^p$$

The model is converted to:

$$\varphi\ B\ y_1 = u_1$$

The stationary condition of the model is that all solutions of φ (b) lie outside the unit circle, i.e. greater than 1. If the value of a time series is a linear function of its current data value and random term, that is:

$$y_t = \mu_t - k_1 u_{t-1} - k_2 u_{t-2} - ... - k_q u_{t-q}$$

Then the sequence is called moving average sequence, where q is the order of autoregression. By introducing the lag operator, the function can be transformed into:

$$y_t = k\ B\ u_t$$

If a time series value is a linear function of the data in front of it, the current random term and the preceding random term, that is:

$$y_t = \varphi_1 y_{t-1} + \varphi_2 y_{t-2} + ... + \varphi_p y_{t-p} + u_t - u_t + k_1 u_{t-1} + k_2 u_{t-2} + ... + k_q u_{t-q}$$

Then the sequence is called the autoregressive moving average sequence, and the P and Q in the formula are called the order of autoregressive and moving average. Parameters φ and K are called autoregressive moving average coefficients. By introducing the lag operator, the function can be transformed into:

$$\varphi\ B\ y_t = k\ B\ u_t$$

The stationary condition of the model is that all the roots of the autoregressive polynomial are outside the unit circle, and the roots of the moving average polynomial are also outside the unit circle. ARIMA time series prediction steps:

Step 1: according to the time series, calculate the corresponding autocorrelation function and partial correlation function and test their variance, and then judge the stability of the sequence;

Step 2: stabilize the unstable sequence: if the signal is nonstationary, make a difference for it, and then calculate the corresponding autocorrelation and partial autocorrelation function values until the autocorrelation and partial autocorrelation functions of the sequence tend to zero;

Step 3: model discrimination: according to the distribution of the calculated functions in the time series, select the corresponding function model and determine the order of the model at the same time;

Step 4: parameter estimation: determine the parameters of the model after the order is determined;

Step5: model validation and prediction: use the model after determining the parameters to analyze the residual error of the model, and use the obtained model for prediction analysis.

First of all, the autocorrelation and partial autocorrelation of the original data are

shown in the figure.

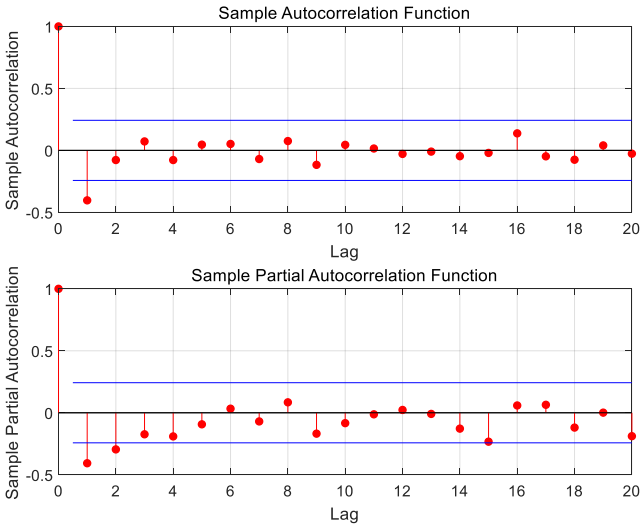


Figure 3.7 autocorrelation and partial autocorrelation

ARIMA (2,1,3) time series model is selected to train the existing data. The residual graph, QQ chart, autocorrelation graph and partial autocorrelation graph are shown in the figure.

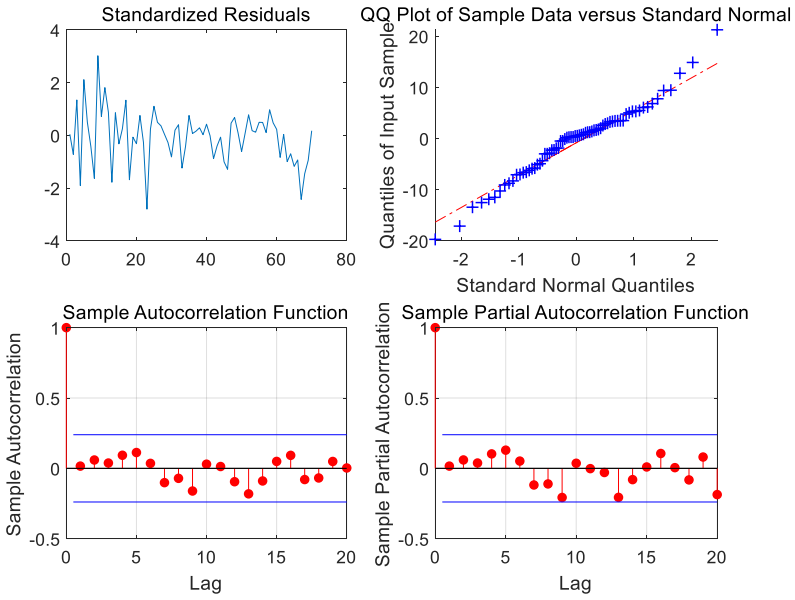


Figure 3.8 ARIMA model process diagram

Through the residual graph, we can see that the residuals are randomly distributed around 0. Each point in QQ chart falls on the red straight line. The autocorrelation graph and partial autocorrelation graph show the truncation effect. Therefore, the ARIMA (2,1,3) model constructed in this paper is reasonable and effective.

The expression is:

$$y_t = -1.68 - 0.0651y_{t-1} - 0.742y_{t-2} + u_t + 0.290u_{t-1} + 0.965u_{t-2} + 0.381u_{t-3}$$

The ARIMA (2,1,3) model is used to predict the economic index of the next six months. The results are shown in the figure. The red curve represents the mean value of the forecast, while the black dotted line represents the confidence interval. The trump index will continue to decline even at the level of 76.76 in January 20201.

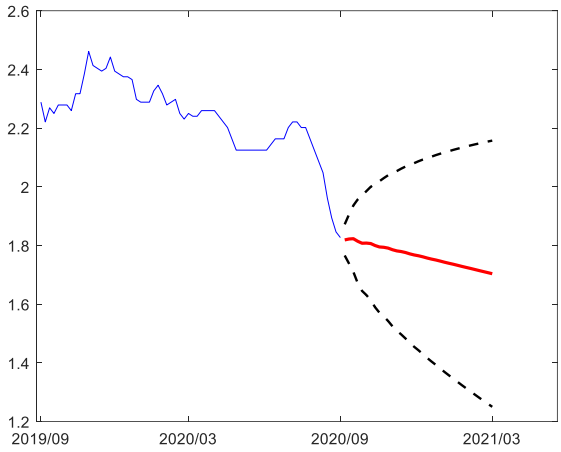


Figure 3.9 economic forecast chart

The ARIMA (2,1,3) model is used to predict the economic index of the next six months. The results are shown in the figure. The red curve represents the mean value of the forecast, while the black dotted line represents the confidence interval. The trump index will continue to decline even at the level of 76.76 in January 20201.

Then, this paper introduces Biden's campaign policy to revise the forecast results, and compares it with trump policy. Biden's campaign policies include, and are not limited to: not supporting the use of tariff weapons, opposing tax cuts, raising the minimum wage, adopting stronger epidemic response measures, and so on. The calculation results are shown in the figure.

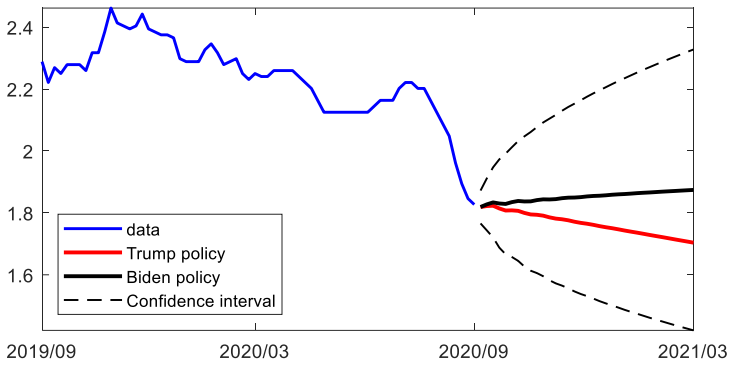


Figure 3.10 comparison chart of economic index forecast

Compared with trump, Biden's campaign policy pays more attention to the response to the epidemic, which is also the biggest problem affecting the U.S. economy. At the same time, the rational use of tariff weapons can promote the economic development of other countries in the world, but opposing tax reduction has advantages and disadvantages. On the one hand, reducing tax rates can increase residents' disposable income and promote consumption, This is one of the most effective and fast ways in the recovery period; on the other hand, reducing the tax rate will increase the risk of the federal government's debt default, etc. Based on all the above factors, the score of secondary index in economic index is revised and compared with trump. The results show that after the adoption of Biden's policy, the economic index will rise steadily at 1.82, which is expected to reach 1.86 by March 2021, which is higher than 1.76 of trump policy, but the confidence interval still has a downward range. In addition, the recovery of economic index depends not only on the slogan, but also on the implementation degree of the policy. Then, this paper calculates the change trend of economic index when Biden's policy implementation degree is from 0% to 100%.

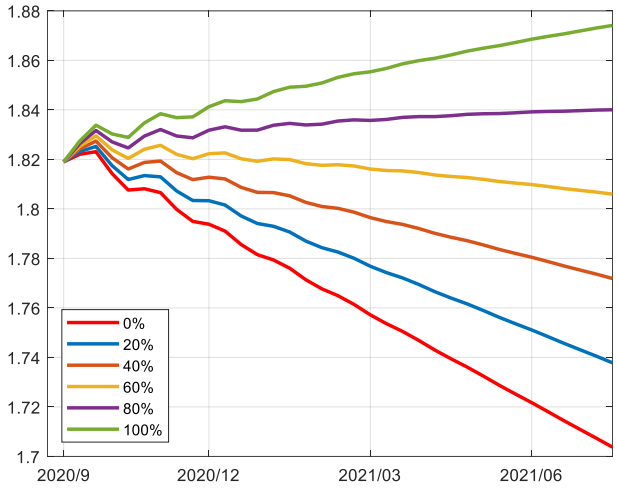


Figure 3.11 forecast chart of economic index with policy implementation degree

The Biden index will return to the lowest in January and March of 2021.In addition, as Biden's policy implementation continues to increase from zero, the economic index will change from a decline to a flat level, and finally rise in a stable state. In particular, when the implementation of the policy is around 70%, the economic index will remain unchanged at the current level of 1.82.

Subsequently, this paper further analyzes the measures taken by the two candidates in response to the impact of the epidemic and the degree of economic recession. Biden policy is on the left and trump policy is on the right. Biden's slogan is to respond positively to the epidemic, so the period of economic impact will be shorter than trump. A series of measures adopted by Biden can effectively reduce the economic recession. The maximum recession is about 45.8%, lower than 60% of trump. As a result, Biden should be more popular than trump, and the same as the actual election results.

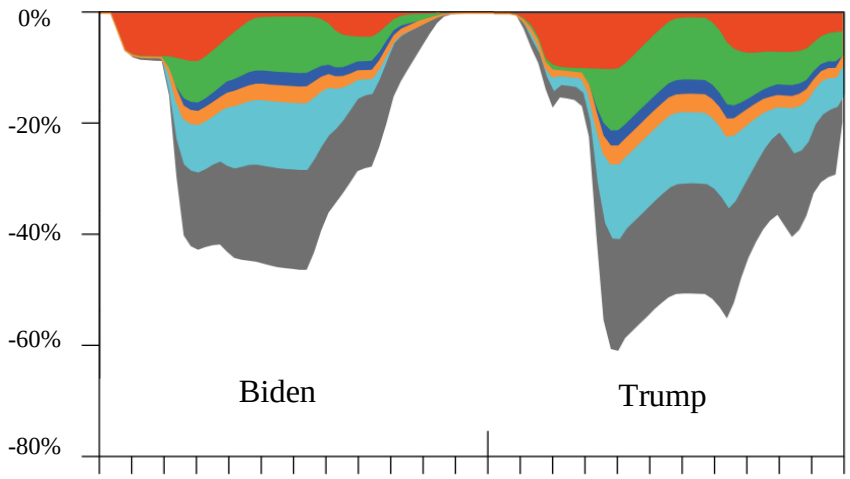
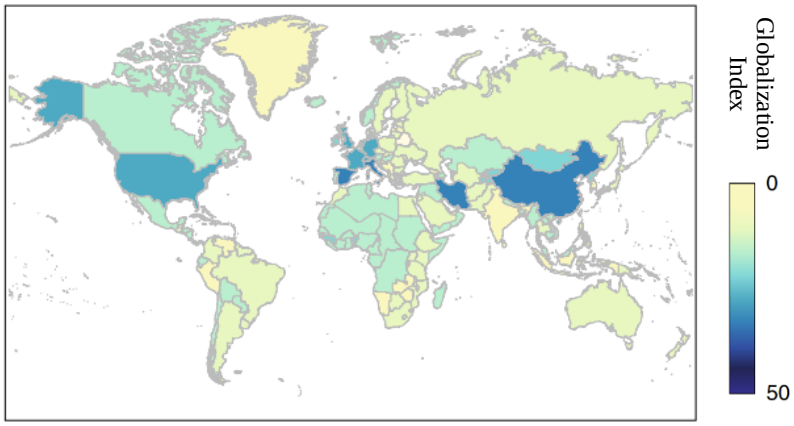


Figure 3.12 comparison of economic recession results

4. Model and Solution of Task 2

In today's economic globalization, when a country's economy declines, it will inevitably affect the world economic structure, especially the superpower like the United States. Therefore, the US election will affect the US economy and China, the world's second largest economy. This paper first draws the globalization index of each country and the proportion of global supply chain in the process of economic globalization. Western European countries, China and the United States are in the forefront of the globalization index and global supply chain, which is in line with the actual situation. Therefore, it is necessary to analyze the impact of the US election and the US economy on China.



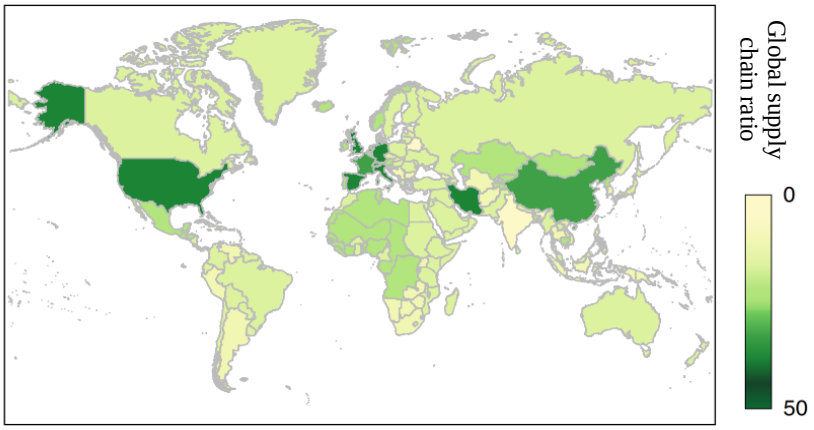


Figure 4.1 Global supply chain index and global distribution

4.1 construction of economic impact system

The US election can not directly affect China's economy, but the changes of US foreign policy, including military and economic policies, can affect China's development. Therefore, after considering these differences, it is necessary to modify China's economic impact index system on the basis of question one. The revised economic impact index system is shown in the table.

Table 4.1 China's economic impact system

Primary indicators	Secondary indicators	Third level index	
Economic system influences economy	Epidemic control of COVID-19	Capital investment	Number of confirmed cases
	Infrastructure construction	Infrastructure investment amount	Number of jobs provided
		Number of construction	
	Domestic economic development	Shanghai and Shenzhen stock market index	gross domestic product
		personal income	Personal tax rate
		Gross industrial product	Producer price index
		Purchasing manager index	House price index
	medical insurance	Medical funds	Number of people applying for unemployment benefits
		Medical beds	
	obtain employment	unemployment rate	Number of layoffs in Enterprises
		Index of labor market conditions	Reemployment rate
	Trade	Import price index	Tariff rate

		Foreign trade volume	Trade surplus / deficit
		International trade volume	Trade volume
		Commodity structure	Technology licensing limits
		Product sales limit	Number of relevant jobs
		Total freight volume	…

Different from the economic impact system of the United States, in order to measure the economic impact of the US election on China, a number of three-level indicators have been added under the secondary index of foreign trade. The main impact of the U.S. election on China is in the trade part. However, China's overseas trade is not only the United States, but also the trade with other countries is often affected by the United States. In order to measure the impact of changes in American policies on China, Taking each country as a node to build a global economic network system, this paper quantitatively calculates the main impact of U.S. policy changes on China's trade.

4.2 construction of global economic network and calculation of trade impact index

For the construction of global economic network, we divide it into three stages. First of all, for the first stage, we conduct data survey and calculation according to the current situation of different regions, and finally use ArcGIS to draw a visual diagram. In the second stage, we analyze the difference of each region as a node based on the complex network, and assign the node weight with multiple indicators. After that, we calculate the difference index through the leadrank algorithm, and finally reach the third stage, We calculate the economic impact matrix according to the regional difference distribution index obtained by the leadrank algorithm, and calculate the trade impact index between specific countries.

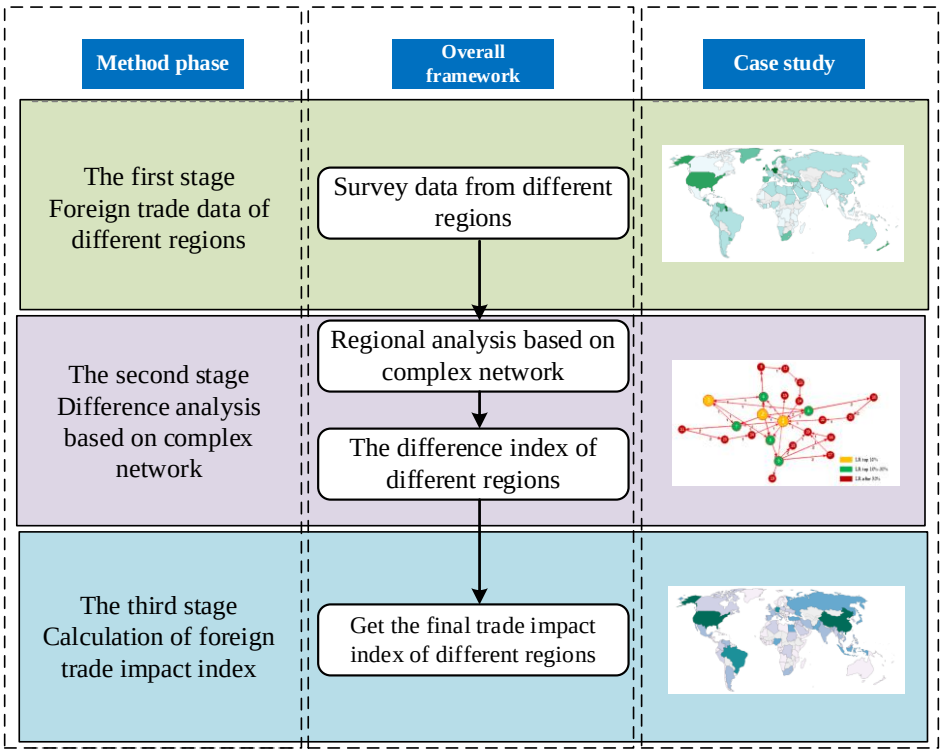


Figure 4.2 construction and solution of global economic network

We collected the global trade volume from 1950 to 2015. Since 1950, the global trade volume is relatively small, only about 20 billion. However, we can see that it reached 3.81 trillion yuan in 2015, and there was a short-term decline in 2009 and 2010. This is because the global financial crisis broke out in 2008, which caused a huge impact on the global economy, but then there was a sharp rise.

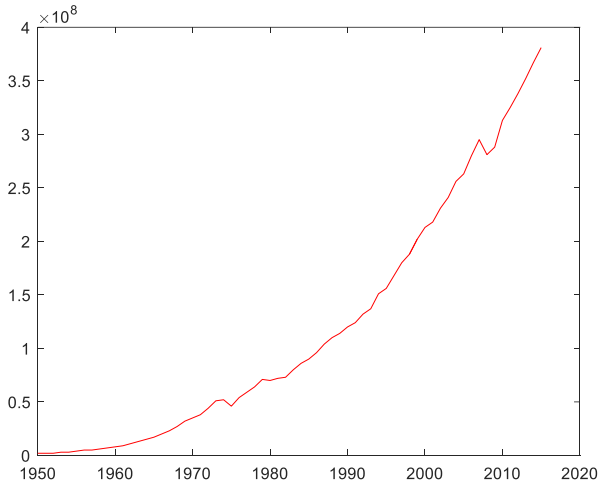


Figure 4.3 total global trade

Through the above data collection, we can get the overseas trade volume of

different countries and regions in different years, and use ArcGIS to draw it to get a visual diagram, and select the overseas trade volume in 2010 as an example. In the amount of more than 50 trillion US dollars, we can see that the largest amount of trade between Western Europe and other countries is the United States and China. In the figure, we use different colors to show the size of the value. The heavier the color, the greater the overseas trade volume.

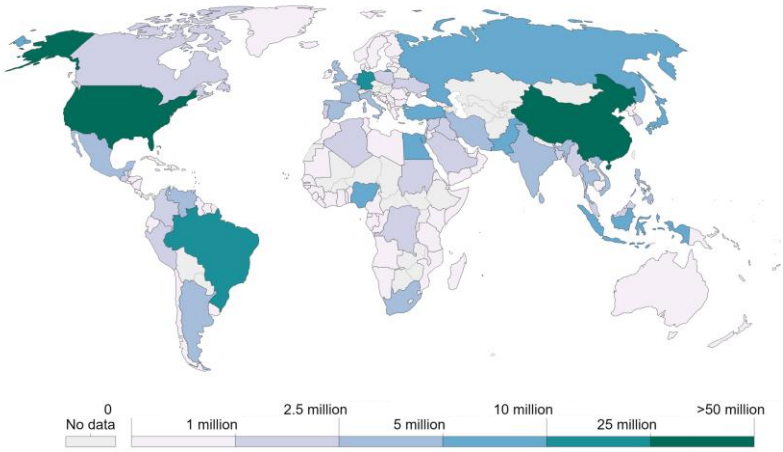


Figure 4.4 distribution of overseas trade volume

Then the network computing trade network is constructed. The network is composed of nodes and edges. The nodes in the network are connected with each other through the edges in the network. These edges can form a set of edges in the network. The network example shown in the figure below is only a representative of simple networks. In the real world, the network is more complex and huge, such as traffic network, communication network, Internet network, social network, e-commerce network, etc. the network with many nodes and complex structure is generally called complex network. A simple example of a network is shown in the following figure.

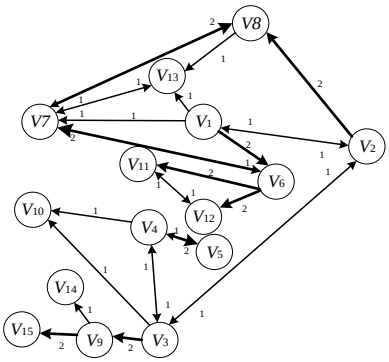


Figure 4.5 graphical representations of one typical complex networks

The nodes and edges of the network can be represented by a matrix, which is generally represented by the letter W. each value in the matrix w can be transformed into a network relationship. We take undirected and unauthorized networks as an example to illustrate the matrix w as follows:

$$W_{ij} = \begin{cases} 1, & \text{If nodes I and j are connected} \\ 0, & \text{other} \end{cases}$$

There are many parameters in complex networks, such as the degree of nodes, clustering coefficient, and betweenness. Each node has a degree, which is the number of connected edges of nodes.For a directed network, including out degree and in degree, the distribution of degree can be expressed by a function p (k), that is, the probability that the degree of nodes in the network is k, and the degree distribution function is as follows:

$$P(k)=\frac{1}{N}\sum_{i=1}^{N}\delta(k-k_i)$$

N is the total number of network nodes; when $k = K_i$, $\delta (K-K_i) = 0$, *when* $k \neq K_i$, $\delta (K-K_i) = 1$.

Firstly, the trade volume and other index data of each country and region are counted for preprocessing. Then we take each country or region as a node in the network to establish the connection between the edges of the network. Finally, we get the network through the numerical weighted sum of each index, and solve the difference of the leader rank.We have collected the data of 186 countries and finally got the following network chart:

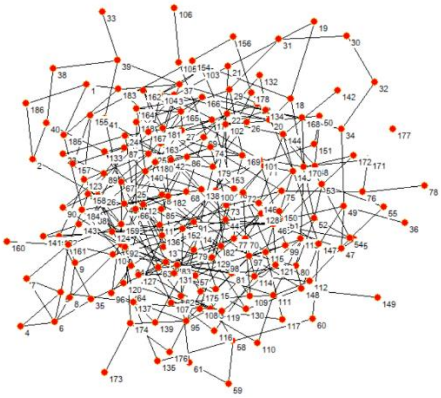


Figure 4.6 weighted network of 186 countries

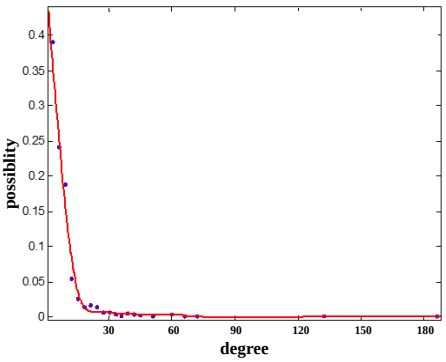


figure 4.7 distribution of association network

Through the statistics of node degree in the network, the following fitting curve is

obtained. From the fitting curve, we can see that the degree distribution conforms to the power-law distribution characteristics of small world network, and there is serious heterogeneity between nodes. Then, this paper uses the leadrank algorithm to calculate the regional differences and get the impact index.

Suppose that there is a COMPLEX NETWORK that consists of p nodes and q directed links. To prioritize the nodes, a ground node which connects to each node through the bidirectional link is introduced, then, there are p+1 nodes and q+2p links in this network. Every node except the ground node is assigned with a unit resource for the nodes ranking process. The resource will be distributed to the neighbors through the directed links consistently until it attains a steady state. Mathematically, this process is similar to the standard random walk process in COMPLEX NETWORK. And the probability that a random walker at node i goes to node j in the next step is described by the stochastic matrix **G** with elements

$$G_{ij} = \begin{cases} w_{ij} / \sum_{j=1}^{p} w_{ij}, & \text{if node } i \text{ points to node } j, \\ 0, & \text{otherwise.} \end{cases}$$

where w_{ij} is the element of the adjacency matrix of the COMPLEX NETWORK. Suppose that the score of node i at time t is $s_i(t)$, then

$$s_i(t+1) = \sum_{j=1}^{p+1} \frac{w_{ji}}{w_j^{out}} s_j(t)$$

describes the dynamics of this iterative process. Where w_j^{out} is the out-strength of node j. At the beginning of the iteration, all initial scores of nodes (other than the ground node) are set to be “1”, while that of the ground node is set to be “0”, after the iteration process, $s_i(t)$ will converge to a unique steady state denoted as $s_i(t_c)$, where t_c is the convergence time. At the time t_c, the final score of the ground node is $s_g(t_c)$. Then $s_g(t_c)$ is evenly distributed to other nodes so that it can conserve scores on the nodes of interest. Thus, we define the final score of node i as S_i,

$$S_i = s_i(t_c) + \frac{s_g(t_c)}{p}$$

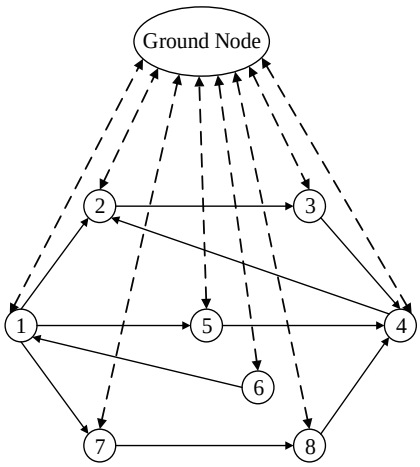


Figure 4.8 Illustration of the ground node and the LeaderRank algorithm

The economic impact index of the United States on other countries is calculated by leadrank algorithm. The results are as follows:

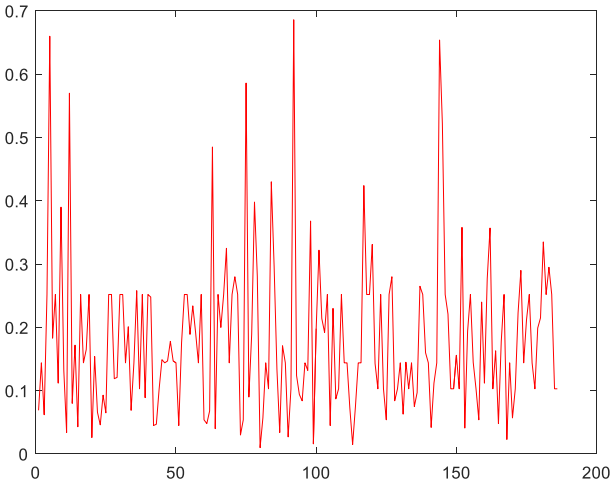


Figure 4.9 US trade impact index on other countries

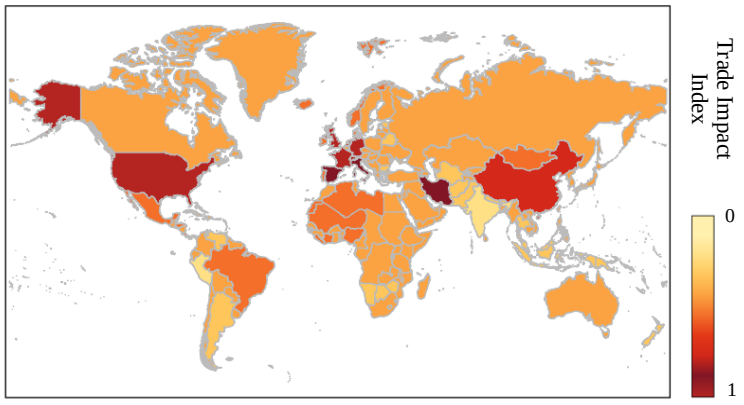


Figure 4.10 global distribution of trade impact index

4.3 establishment of policy impact matrix

In fact, when the US policy changes, China's economic index will also fluctuate. The main reason can be attributed to the impact of the change of US policy on China's foreign trade volume, and then cause a series of changes in China's economy.

This paper selects four representative cases: Event 1: the United States raised punitive import and export tariffs against China; event 2: the United States restricted the import and export of high-tech goods and authorization; event 3: the United States cancelled the punitive import and export tariffs against China; event 4: the United States cancelled the import and export restriction and authorization for China's high-tech goods.

Firstly, the paper analyzes the relationship between the above four representative events and China's trade-related indicators, as shown in the table.

Table 4.2 interaction of events on indicators

	Event 1	Event 2	Event 3	Event 4
Indicator 1	Reaction	Reaction	Positive effect	Positive effect
Indicator 2	Reaction	0	Positive effect	0
Indicator 3	Reaction	Reaction	Positive effect	Positive effect
…	…	…	…	…
Indicator 10	Reaction	Reaction	Positive effect	Positive effect
Indicator 11	Reaction	Reaction	Positive effect	Positive effect

Event 1: when the United States raises punitive import and export tariffs against China, the import price index increases and the tariff collection rate increases. In order to avoid losses, domestic enterprises will reduce the number of foreign trade, so the number of relevant jobs will decrease, and the total amount of goods transportation will decrease.

When event 2: the United States restricts the import, export and authorization of high-tech goods in China, under this background, the import price index, especially high-tech products, will have a serious adverse impact on the import price index, but has no impact on the tariff rate. In this context, the volume and volume of foreign trade will decline, the commodity structure will be simpler, unable to provide higher employment opportunities and so on.

Similarly, the influence of event 3 and event 4 on each index can be further obtained.

For the above four cases, let the influence of the I intangible factor on the j tangible

factor is η_{ij}, and the unrelated influence is 0.Construct factor influence matrix $\Gamma = (\eta_{ij})_{nm}$

$$\Gamma = \begin{pmatrix} \eta_{11} & \eta_{12} & \eta_{13} & \cdots & \eta_{110} & \eta_{111} \\ \eta_{21} & 0 & \eta_{23} & \cdots & \eta_{210} & \eta_{211} \\ \eta_{31} & \eta_{32} & \eta_{33} & \cdots & \eta_{310} & \eta_{311} \\ \eta_{41} & 0 & \eta_{43} & \cdots & \eta_{410} & \eta_{411} \end{pmatrix}$$

Referring to the relevant literature, the elements in the matrix are assigned, and the factor influence matrix Γ is constructed

$$\Gamma = \begin{pmatrix} -0.042 & -0.047 & -0.024 & \cdots & -0.033 & -0.019 \\ -0.021 & 0 & -0.015 & \cdots & -0.078 & -0.030 \\ 0.042 & 0.047 & 0.024 & \cdots & 0.033 & 0.019 \\ 0.021 & 0 & 0.015 & \cdots & 0.078 & 0.030 \end{pmatrix}$$

The function relationship between the trade index and the third level index is obtained by polynomial fitting of 11 third level indicators under the second level index trade. The residual diagram is shown in the figure.

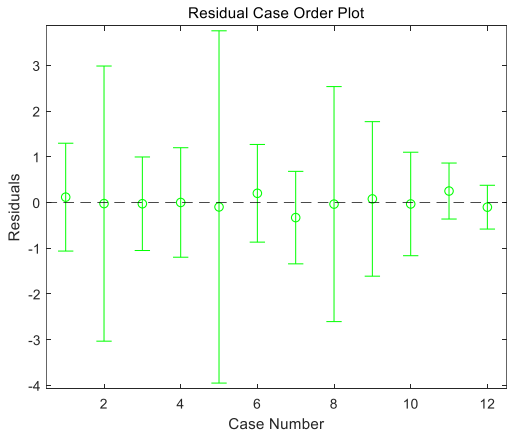


Figure 4.11 multiple regression residual diagram

The multiple regression equation was as follows

$$y = 0.938x_1 + 0.063x_2 + 0.250x_3 + \ldots + 0.445x_{10} + 0.510x_{11}$$

After introducing the factor influence matrix, the multiple regression equation becomes

$$\begin{cases} y_1 = 0.938x_1e^{-0.042} + 0.063x_2e^{-0.047} + 0.250x_3e^{-0.024} + \ldots + 0.445x_{10}e^{-0.033} + 0.510x_{11}e^{-0.019} \\ y_2 = 0.938x_1e^{-0.021} + 0.063x_2 + 0.250x_3e^{-0.015} + \ldots + 0.445x_{10}e^{-0.078} + 0.510x_{11}e^{-0.030} \\ y_3 = 0.938x_1e^{0.042} + 0.063x_2e^{0.047} + 0.250x_3e^{0.024} + \ldots + 0.445x_{10}e^{0.033} + 0.510x_{11}e^{0.019} \\ y_4 = 0.938x_1e^{0.021} + 0.063x_2 + 0.250x_3e^{0.015} + \ldots + 0.445x_{10}e^{0.078} + 0.510x_{11}e^{0.030} \end{cases}$$

Take the impact of the above four events on China's economy. The blue curve shows the forecast curve of China's economic index. In the next decade, China's economy will continue to increase from 0.97 in 2020 to 1.11 in 2030.If event 1 occurs, China's economy will be greatly impacted, and the trend will be flat in the next ten years; while event 2 will have a more serious impact on China's economy, and there will be a risk of recession in China's economy, even falling to 0.9 in 2030; on the contrary, when event 3 and event 4 occur, China's economy will be greatly promoted, reaching the level of 1.1 will be advanced to 2027 and 2025 respectively.

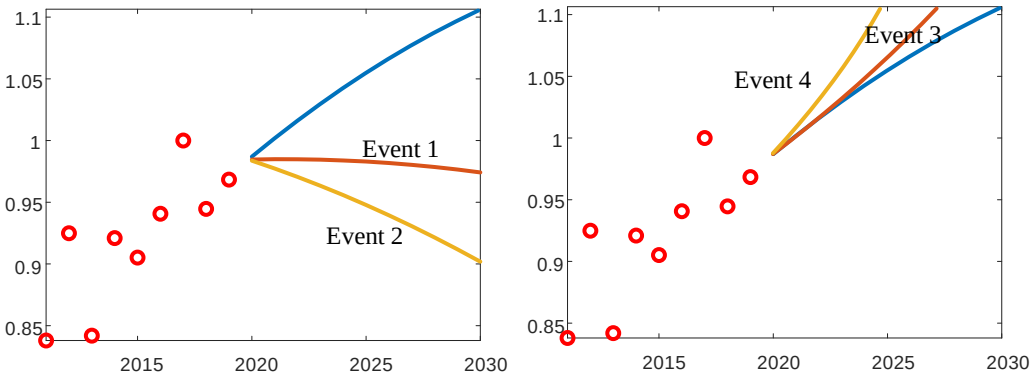


Figure 4.12 prediction chart of impact of various events on China's economy

Considering the different measures taken by Biden and trump, combined with the above analysis, this paper forecasts the impact of Biden and trump on China's economy after becoming the president of the United States. The results show that the United States will become an obstacle to China's development to a certain extent - no matter which candidate succeeds, China's economic development will be slowed down by Biden policy by 4.5%, China's economic index will be 1.06 in 2030, while trump policy will be reduced by 6.3% of China's development speed, and China's economic index will be 1.03 in 2030.

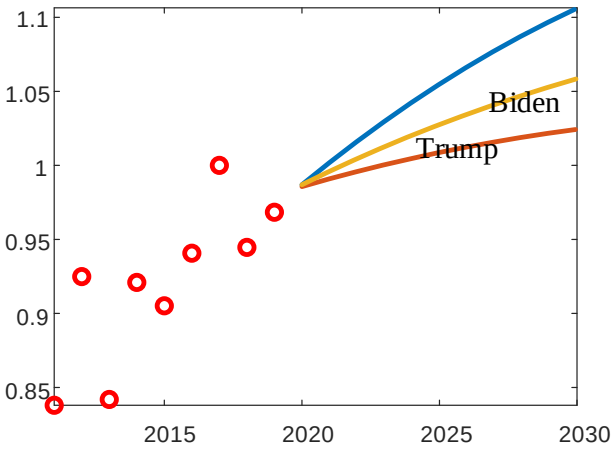


Figure 4.13 prediction of the impact of the two candidates on China's economy

5. Model and Solution of Task 3

Combined with the above analysis, this paper gives the policy of related fields as follows:

1. Vigorously promote the development of high-tech industries. In China's economic index system, the development of science and technology occupies a large proportion, and the import and export of high-tech products will greatly affect the import and export commodity structure, import and export commodity trade volume and other factors. The policy of restricting the import, export and authorization of high-tech commodities in China has seriously affected the development of China's dependence on high-tech upstream and downstream industries recently, and then has a negative impact on China's economic situation. Therefore, it is necessary for us to continuously promote the development of science and technology, promote the industrialization of high and new technology, and inject new vitality into social development.

2. Through the calculation of global economic network, the trade impact index of the United States to our country is as high as 0.65, which shows that China's society is highly dependent on American goods or raw materials. Although high tariffs have been imposed, we can only import specific raw materials and equipment from the United States, indicating that China's industrial chain is not perfect and independent. Therefore, it is necessary for us to improve the development of different industrial chains, reduce the degree of dependence on specific countries, and when we are again subjected to unreasonable sanctions, we can rely on our own industrial chain or seek alternative industrial chain from other countries to alleviate this adverse impact.

3. Take the protection of national jobs as an important cornerstone of development: when the epidemic occurs, the direct cause of economic recession is the increase of unemployment rate. The increase of unemployment rate will bring large default rate of debt, seriously damage the income and consumption level of national economy, and then affect the overall economy of the country. Therefore, in order to ensure a smooth economic transition, we should ensure that national jobs are the important cornerstone of development, reasonably promote the reemployment of the unemployed, improve economic vitality, and promote social development.

Then, in order to measure the impact of this policy, in order to analyze the impact

of policy changes on the economic index, this paper introduces the policy impact matrix Γ ', which directly acts on the secondary indicators.

$$\Gamma' = \begin{pmatrix} 0 & -0.15 & -0.32 & 0 & -0.41 & -0.27 \\ 0 & 0.15 & 0.32 & 0 & 0.41 & 0.27 \end{pmatrix}$$

The policy impact matrix is applied to the data of post recovery and long-term development of the epidemic situation, and the comparison chart before and after the implementation of the policy is shown in the figure. Whether in the long-term or short-term, the adoption of the policy can increase China's economic index from 1.01 to 1.22, an increase of about 20%.

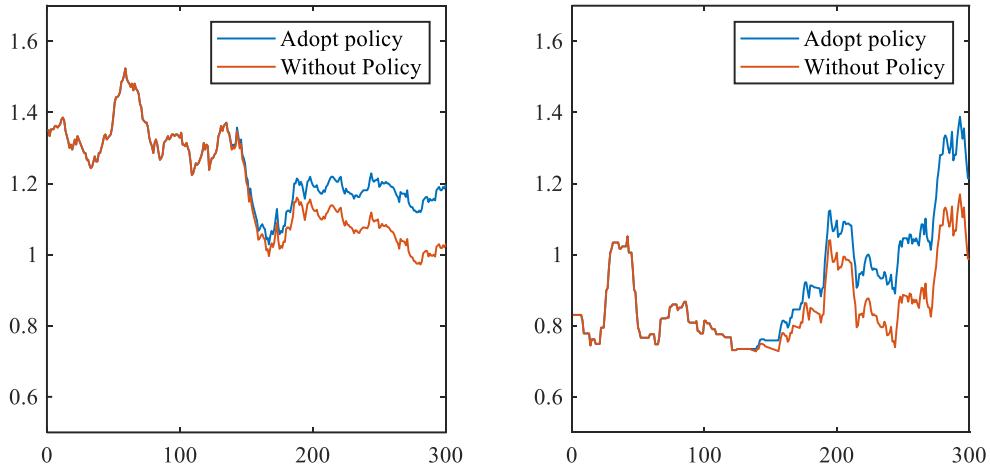


Figure 5.1 comparison before and after the implementation of the policy

6. Strength and Weakness of Our Model

6.1 Model strength

- Considering the economic background of globalization, we comprehensively analyzed the direct and indirect impacts of different candidates on China. In addition, the prediction of the policy is compared and verified by simulation.
- This paper not only makes quantitative analysis of the problem, but also combines reasonable qualitative analysis, which makes the main logic of the article more perfect. Moreover, in order to improve the preciseness of the problem, the algorithm is compared and analyzed, so as to improve the overall calculation accuracy of the problem.
- Make full use of data visualization technology, with the help of graphic visualization method to make data display more intuitive and efficient.

6.2 Model weakness

- Due to time constraints, the data features and correlation indicators can not be fully mined, and the accuracy of the model needs to be further improved. This can also be used as the next research direction of this paper;
- Although we have quantified some uncertain factors, the actual policy simulation is still a very complex system, which can be further improved and analyzed in the future research.

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Appendix

Appendix 1: TOPSIS code

```
clc, clear
load a w;
b=zscore(a);
w=repmat(w,n,1);
c=b.*w
cstar=max(c)
c0=min(c)
for i=1:n
    sstar(i)=norm(c(i,:)-cstar);
    s0(i)=norm(c(i,:)-c0);
end
f=s0./(sstar+s0);
xlswrite('book3.xls',[sstar' s0' f'])
[sc,ind]=sort(f,'descend')
```

Appendix 2: Association Code

```
function r1 = gld_gjjd(x)
s = size(x);
len = s(2);
num = s(1);
for i = 1: num
    x(i,:) = x(i,:)./x(i,1);
end
dx(num,len-1) = 0;
for i = 1 : num
    for j = 1 : len - 1
        dx(i,j) = x(i,j+1) - x(i,j);
    end
end
c = 1;
beta(1,1:len-1) = 0;
w(1,1:len-1) = 0;
for i = 2 : num
    temp = sum(abs(x(i,:) - x(1,:)),2);
    for k = 1 : len - 1
        beta(i,k) = atan((dx(i,k) - dx(1,k))/(1 + dx(i,k)*dx(1,k)));
        if beta(i,k) < 0
            beta(i,k) = pi + beta(i,k);
```

```
            end
            w(i,k) = 1 - abs(x(i,k) - x(1,k))/temp;
        end
```

Appendix 3: Prediction Code

```
clc,clear,close all
load a;
y=cost(end-70+1:end);
plot(    y );
figure
subplot(211),autocorr( y );
subplot(212),parcorr( y );
figure
dy = diff( y );
ddy = diff( dy );
subplot(211),autocorr( ddy );
subplot(212),parcorr( ddy );

Mdl = arima(2,1,3);
EstMdl = estimate(Mdl,y);
res = infer(EstMdl,y);
figure
subplot(2,2,1)
plot(res./sqrt(EstMdl.Variance))
title('Standardized Residuals')
subplot(2,2,2),qqplot(res)
subplot(2,2,3),autocorr(res)
subplot(2,2,4),parcorr(res)
[yF,yMSE] = forecast(EstMdl,35,'Y0',y);
UB = yF + 1.96*sqrt(yMSE);
LB = yF - 1.96*sqrt(yMSE);

figure
h4 = plot(y,'b');
hold on
h5 = plot(71:105,yF,'r','LineWidth',2);
h6 = plot(71:105,UB,'k--','LineWidth',1.5);
plot(71:105,LB,'k--','LineWidth',1.5);

clc,clear,close all
load('data_cost.mat');

for i=1:72
```

```
    y(i)=mean(a(379+i*4+1:379+i*4+4));
end
plot(    y );
y=y';
figure
subplot(211),autocorr( y );
subplot(212),parcorr( y );
figure
dy = diff( y );
ddy = diff( dy );
subplot(211),autocorr( ddy );
subplot(212),parcorr( ddy );

Mdl = arima(3,1,3);
EstMdl = estimate(Mdl,y);
res = infer(EstMdl,y);
figure
subplot(2,2,1)
plot(res./sqrt(EstMdl.Variance))
title('Standardized Residuals')
subplot(2,2,2),qqplot(res)
subplot(2,2,3),autocorr(res)
subplot(2,2,4),parcorr(res)
[yF,yMSE] = forecast(EstMdl,36,'Y0',y);
UB = yF + 1.96*sqrt(yMSE);
LB = yF - 1.96*sqrt(yMSE);

figure
h4 = plot(y,'b');
hold on
h5 = plot(73:108,yF,'r','LineWidth',2);
h6 = plot(73:108,UB,'k--','LineWidth',1.5);
plot(73:108,LB,'k--','LineWidth',1.5);
```

Appendix 4: Network Related Code

```
function [x,z,flg,sgma]=networkfun(A,A1,b,c,m,n,n1,cb,xx)
n1 variables in x.
x=zeros(n,1);
z=0;B1=A1(:,n-m+1:n);sgma1=c-(cb*B1)*A;[masg,kk]=max(sgma1);
k=kk(1);flg=0;ll=0;while (masg>0)&&(ll<20)
ll=ll+1; for i=1:m
if A1(i,k)>0
thita(i)=A1(i,k)\b(i);
```

```
end
end
[r8,c8]=find(thita>999);if sum(c8)<m[mith,rr]=min(thita);r=rr(1);aa=A1(r,k);
for i=1:m
if i==r
b(r)=b(r)/aa;for j=1:n
A1(r,j)=A1(r,j)/aa ; end
end
end
for i=1:m
if i~=r
cc=A1(i,k)
b(i)=b(i)-b(r)*cc;for j=1:n
A1(i,j)=A1(i,j)-A1(r,j)*cc; end
end
end
cb(r)=c(k);xx(r)=k;B1=A1(:,n-m+1:n);sgma1=c-(cb*B1)*A;[masg,kk]=max(sgma1);
k=kk(1);thita=100+zeros(m,1);elseflg=3;masg=-1;
x='unbound solution';z='inf';
end
end
if flg~=3
if n1==0
sgma1=c-(cb*B1)*A
end
x=zeros(n,1);for i=1:mx(xx(i))=b(i);
end
z=c*x;elsex=zeros(n,1);for i=1:mx(xx(i))=b(i);
end
xa=x((n-n1+1):n,:);ra=find(xa);
if sum(ra)==0
flg=1;elseflg=2;
end
z=c*x;else
flg=4;x='nothing';z='nothing';
end
end
end
sgma=sgma1;
ll;A=input('please input:');A1=A;b=input('please input:');
c=input('please input:');m=3;n=5
cb=input('please input:');xx=input('please input:');
function [a1,b1]=lingb(B1,b,r)
for i=1:m
```

```
if B1(i,r)>0
aa(i)=-b(i)/B1(i,r);end
if B1(i,r)<0
bb(i)=-b(i)/B1(i,r);end
enda1=max(aa);
b1=min(bb)
```

Appendix 5: Entropy Weight Code

```
function weights = EntropyWeight(R)
[rows,cols]=size(R);
k=1/log(rows);

f=zeros(rows,cols);
sumBycols=sum(R,1);
for i=1:rows
    for j=1:cols
        f(i,j)=R(i,j)./sumBycols(1,j);
    end
end
lnfij=zeros(rows,cols);
for i=1:rows
    for j=1:cols
        if f(i,j)==0
            lnfij(i,j)=0;
        else
            lnfij(i,j)=log(f(i,j));
        end
    end
end
Hj=-k*(sum(f.*lnfij,1));
weights=(1-Hj)/(cols-sum(Hj));
end
```