Problem Chosen	2021	Team Control Number
C	ShuWei Cup Summary Sheet	202111087175

Summary

COVID-19 has affected the tourism industry to varying degrees. Effective measures must be taken to tackle the problems.

To address Question 1, we first collected further information on the latitude and longitude of 5A scenic spots nationwide based on the scenic spot information provided in Annex I. We also drew relative distribution maps and scatter plots through **particle swarm algorithm** and **Origin mapping** to visualize the distribution of these scenic spots nationwide, and finally concluded that the distribution of 5A scenic spots is related to the geographical location. After that, we analyzed the factors that might affect the evaluation level of scenic spots and the correlation between them by using **DESTEP analysis model** and **PESTEL analysis model.**

For Question 2, we first quantified and assigned weights to the factors in problem 1 that might have an impact on the evaluation level of scenic spots by using **AHP hierarchical analysis** and **entropy value method, and finally** obtained the formula for the comprehensive score of scenic spots, constructed an index system to measure the reception capacity of scenic spots. Finally, the method of **K-Means cluster analysis was** used to classify scenic spots, and the comprehensive score of scenic spots in the collected data was finally determined.

To address Question 3, we first proposed a differentiated flow restriction scheme for scenic areas in different risk levels with the help of **a metacellular automaton model** and **a Mersenne rotation algorithm**, and conducted a scenic area visitor flow simulation. Then we extended the flow restriction model and consider various factors that affect the emergency evacuation of tourists in the case of epidemic outbreak in the context of differentiated flow restriction, and simulated these factors by randomly constructing **two-dimensional raster diagrams**, and compared the evacuation status under different situations.

For Question 4, we first analyzed our constructed quantitative model by applying **Grey Wolf multi-objective dynamic planning algorithm** and **NSGA-II multi-objective optimization model**, and used **BP convolutional neural network algorithm to** test the constructed multi-objective planning and optimization model for prediction, and finally concluded that the lower the potential risk of epidemic in the area, the lower the limit of scenic spot. The lower the potential risk of epidemic in the region, the smaller the flow rate, the larger the maximum and instantaneous carrying capacity of the scenic spot, which in turn leads to the increase of the revenue of the scenic spot and the improvement of the tourist experience of the tourists.

In response to Question 5, we first based on the research and analysis of the first four questions, and combined with the ideas conveyed in the policy documents issued by the National Office of Culture and Tourism and the governments of provinces, autonomous regions and municipalities directly under the central government, we proposed differentiated management solutions for scenic spots in areas with different risk levels, with the government as the main actor.

For the problem solving of this question, the model we built and applied solves the five problems in the question well. After the error test and sensitivity analysis of the model by **wavelet analysis algorithm**, **RBP neural network algorithm** and **GRNN-PNN joint neural network algorithm**, it is proved that the model we built has more reliable sensitivity and higher reliability.

Keywords: **particle swarm algorithm, K-Means cluster analysis algorithm, metacellular automata model, grey wolf multi-objective dynamic planning algorithm, NSGA-II multi-objective optimization model, BP convolutional neural network algorithm, wavelet analysis algorithm, RBP neural network algorithm and GRNN-PNN joint neural network algorithm**

Content

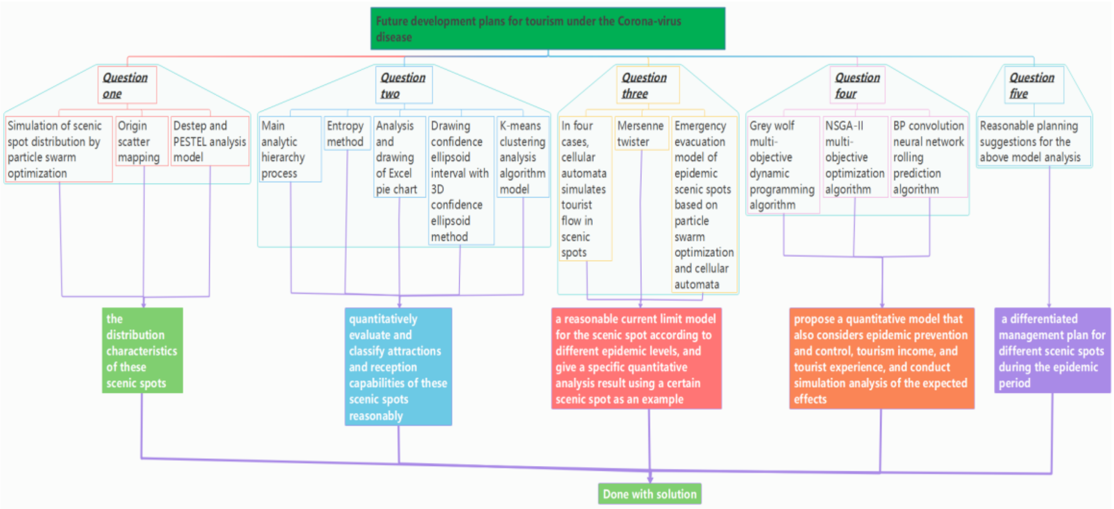
Content 2
1. Introduction 3
1.1 Background 3
1.2 Work 3
2.Problem Analysis 3
2.1 Data analysis 3
2.2 Analysis of question one 3
2.3 Analysis of question two 4
2.4 Analysis of question three 4
2.5 Analysis of question four 4
2.6 Analysis of question five 4
3. Symbol and Assumptions 4
3.1 Symbol Description 4
3.2Fundamental Assumptions 5
4. Model 5
4.1 Analysis and solution of question one 5
4.2 Analysis and solution of question two 7
4.3 Analysis and solution of question three 12
4.4 Analysis and solution of question four 16
4.5 Analysis and solution of question five 17
5. Test the Models 19
6. Sensitivity Analysis 20
7. Strengths and Weakness 21
7.1 Strengths 21
7.2 Weakness 21
8. Conclusion 21
References 22
Appendix 23

1. Introduction

1.1 Background

The epidemic of pneumonia infected with new coronavirus has had varying degrees of impact on all walks of life, with a particularly severe impact on In an effort to prevent the spread of the COVID-19 virus, different countries have taken diverse measures to restrict the movement of population, which leads to a decline in the number of visitors to the scenery. And this has directly led to a reduction in the sources of economic income and slowed down the growth rate of the national economy. At the same time, problems such as the reduction of the labor income of scenic workers and the increase of So, measures must be taken to weigh the interests of all parties and put forward the scientific tourism Therefore, measures must be taken to weigh the interests of all parties and put forward the scientific tourism plans under the circumstance of the pandemic.

1.2 Work



2. Problem analysis

2.1 Data analysis

We applied particle swarm algorithm, DESTEP and PESTEL analysis models, hierarchical analysis method, entropy method, 3D-confidence ellipsoid method, K-Means clustering algorithm, metacellular automata algorithm, Gray Wolf multi-objective dynamic programming algorithm, NSGA-II multi-objective optimization algorithm, BP convolutional neural network prediction algorithm, wavelet analysis algorithm, RBP neural network algorithm, GRNN neural network algorithm, PNN neural network algorithm for the data analysis of this question. The algorithms are: wavelet analysis algorithm, RBP neural network algorithm, GRNN neural network algorithm, PNN neural network algorithm.

2.2 Analysis of question one

According to the scenic spot information provided in Annex I, we further collected the latitude and longitude information of 5A scenic spots in China, and used the particle The cluster algorithm and Origin mapping mapped the relative distribution of these scenic spots in the country and the scatter diagram, and analyzed the factors that might influence the evaluation level of scenic spots and the correlation between them using the DESTEP analysis model and the PESTEL analysis model.

2.3 Analysis of question two

We quantified and assigned weights to the factors in question one that might have an impact on the evaluation level of scenic spots by using AHP hierarchical analysis and entropy value method, and finally obtained the formula for the comprehensive rating of scenic spots as an index to measure the reception capacity of scenic spots, and conducted the tests of variance and standard deviation. Finally, the scenic spots were classified using the method of K-Means cluster analysis.

2.4 Analysis of question three

In the context of an epidemic, we propose a differentiated flow restriction scheme for scenic spots in areas with different risk levels with the help of a metacellular automaton model and a Mason rotation algorithm, and perform simulations. Then we extend the model to consider various factors affecting the emergency evacuation of tourists in the context of differential flow restriction in the case of an epidemic outbreak, and simulate and model these factors by constructing a two-dimensional raster map randomly.

2.5 Analysis of question four

This problem is a multi-objective dynamic planning and optimization problem. We analyze our constructed quantitative model by introducing the Gray Wolf multi-objective planning algorithm and the NSGA-II multi-objective optimization model, and use the BP convolutional neural network algorithm to test the constructed multi-objective planning and optimization model for prediction.

2.6 Analysis of question five

Based on the research and analysis of the first four questions, and combined with the ideas conveyed in the policy documents issued by the National Office of Culture and Tourism and the governments of the provinces, autonomous regions and municipalities directly under the central government, we proposed a differentiated management scheme for scenic spots in areas with different risk levels, with the government as the main actor.

3. Symbols and Assumptions

3. 1 Symbol Description

Symbol	Description
C_1	Instantaneous spatial carrying capacity
C_2	Daily capacity
S	Comprehensive evaluation score
Q	Index of suitability for sightseeing
A	Index of accessibility
P	Index of popularity
PTf	Index of toilet visitors flow pressure
Cf	Index of catering visitors flow pressure
Af	Index of accommodation visitors flow pressure
Tf	Index of convenience of public transportation
C	Index of tourist flow pressure in scenic spots
M	Index of safety management in scenic spots

3.2Fundamental assumptions

We assume that visitors in the scenic area are under the command of the scenic staff during the visit, and they have a constant speed, none of tourists will be stranded and blocked in the scenic area for a long time;

We also assume that among the many factors that affect the overall score of scenic spots, the impact of the other factors is negligible, except for the factors mentioned in the article.

4. Model

4.1 Analysis and solution of question one

Based on the names and latitude and longitude information of some of the attractions in Beijing given in Annex I, we inquired about the evaluation levels and the maximum daily carrying capacity of the eight attractions in the Annex, based on the approved guidelines for the maximum carrying capacity of scenic spots in the tourism industry standard of the People's Republic of China, and the instantaneous spatial carrying capacity that affects the maximum carrying capacity C_1 and daily carrying capacity C_2 made the following definitions.

Instantaneous space carrying capacity of scenic spots C_1:

$$C_1 = \sum X_i/Y_i \qquad (4-1)$$

X_i--the effective visitable area of the ith site;

Y_i--Tourist unit visit area of the first attraction, i.e., the basic space carrying standard.

Scenic area daily carrying capacity C_2:

$$C_2 = \sum X_i/Y_i \times Int\left(\frac{T}{t}\right) = C_1 \times Z \qquad (4-2)$$

T -- the effective opening hours of the scenic spot per day;

t -- the average visit time of each tourist in the scenic area;

Z-- the average daily turnover rate of the whole scenic area, i.e. Int (T/t) is the integer part of the value of T/t.

The evaluation level of the scenic spot generally depends on the environmental quality and service quality of the scenic spot, and the evaluation level generally uses A~5A to divide the evaluation level, we have made a table drawing by using Excel for the evaluation level of the eight scenic spots and the data of the maximum daily reception, the table is shown as follows.

Scenic Area	Evaluation level	Daily carrying capacity (million people)	Instantaneous carrying capacity (million people)
Beijing Palace Museum	5A	8	2.3
Beijing Tiantan Park	5A	17.5	5.8
Beijing Gongwangfu Scenic Area	5A	4	1
Beijing Summer Palace	5A	18	8

Beijing Olympic Park	5A	50	21.7
The Thirteen Ming Tombs in Beijing	5A	11.7	5.8
Beijing Badaling-Mutianyu Great Wall Tourist Area	5A	14.3	3.7
Beijing Yuanmingyuan	5A	7	2.2

Based on the collected data, we used Origin mapping and Matlab's particle swarm algorithm to show the distribution characteristics of these famous scenic spots through raster network relative distribution and distribution scatter plot, and the specific scenic spots relative distribution raster map and scatter plot are as follows:

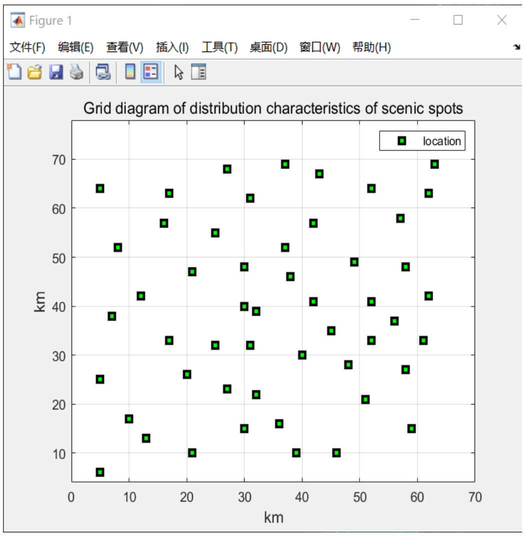


Figure 1

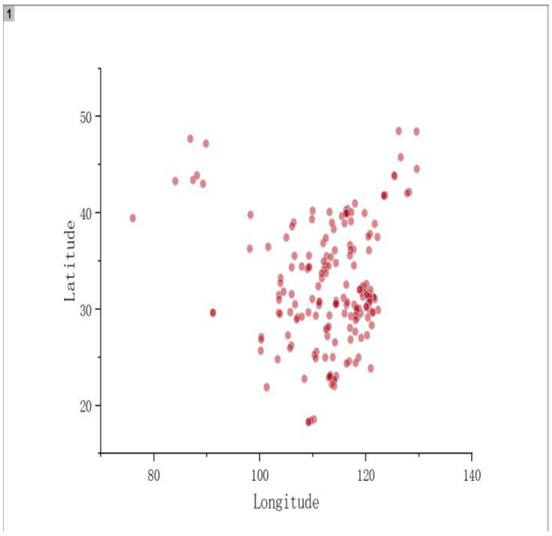


Figure 2 with scatter diagram of scenic spot distribution

From the above images, we can find that the distribution of 5A scenic spots is related to the geographical location where the scenic spots are located, and the geographical location depends on the latitude and longitude where the area is located. Through the above analysis, we can conclude that, taking the Heihe—Tengchong geographical divide as the boundary, the distribution of 5A scenic spots in the southeast direction is more and hotter compared to the northwest.

In addition, the location of the scenic spot also affects the level of economic development, consumption level, urban population density, geographical advantages and transportation conditions, which in turn will have an impact on the evaluation level of the scenic spot and the number of guests received, we can conduct an in-depth analysis of the above factors to explore the relevance of them, we based on the DESTEP analysis model and PESTEL analysis model, which are These two big data models are effective tools applied to analyze the macro environment, not only to analyze the external environment, but also to identify all the forces that have an impact on the organization, and are a way to investigate the external influences on the organization. The hierarchical correlation is mapped by Mindmaster software and the image is shown below:

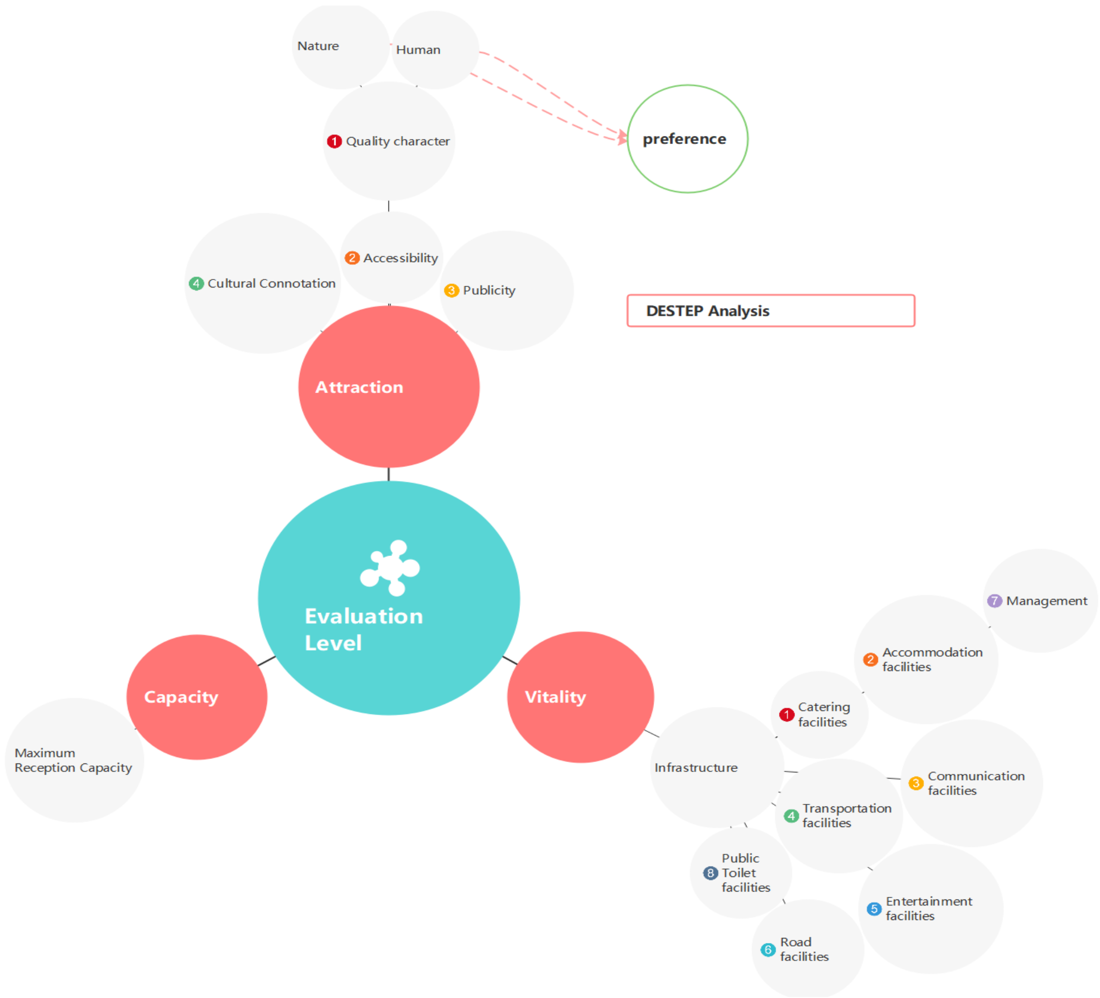


Figure 3 with DESTEP Analysis

4.2 Analysis and solution of question two

Based on the first question of DESTEP analysis model and PESTEL analysis model applied to the mapping of Mindmaster software, we came up with various factors affecting the reception capacity of scenic spots, and we used the evaluation model to construct the index evaluation system of scenic spots and to quantitatively assess and reasonably classify them, and the steps of using the entropy value method to determine the index weights include.

First, using the comprehensive evaluation method, construct the original index data matrix: X= $(\{X_{ij}\}_{m\times n}$ 0≤i≤m, 0≤j≤n)

Data normalization: Positive indicators: $X = \frac{X - X_{min}}{X_{max}-X_{min}}$ (4 − 3)

$$X = \frac{X_{max}-X}{X_{max}-X_{min}} \quad (4-4)$$

Negative indicators:

$Y = \{y_1, y_2, \dots, y_n\}$ Y_j— the weight of each evaluation index

Calculate the composite score for each year.

$$Z = \sum_{i=1}^{n} X_{ij} Y_j \qquad (4—5)$$

Then the integrated weight determination method is used. Comprehensive weighting is a method to determine the weight of each factor by combining objective and subjective weights according to a certain proportional relationship. In order to achieve the unification of subjective and objective weights and to reflect the information of subjective and objective weights to the greatest extent, this paper selects the integrated weighting method which combines subjective assignment (AHP) and objective assignment (entropy method), and the composite weight coefficient of the index obtained has the characteristics of both subjective and objective assignment methods, which makes the final evaluation results more reasonable and scientific. The analysis is as follows:

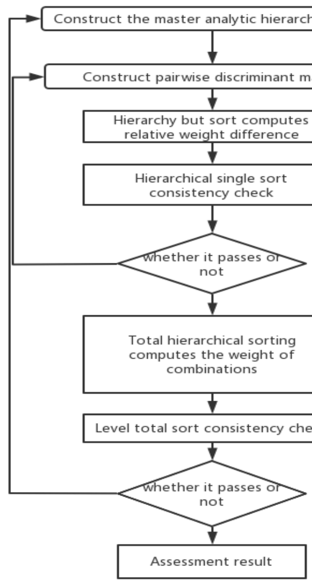


Figure 4 with main analytic hierarchy process chart

As in the flowchart analysis above, the hierarchical analysis (AHP), which is a multi-objective evaluation decision method, is used to construct the problem and to represent, relate and quantify the elements. The various elements of the evaluation level of our analysis concerning the program are first decomposed into levels such as the objective level and the criterion level, on the basis of which qualitative and quantitative analysis is performed. The hierarchical analysis diagram is shown in the following figure.

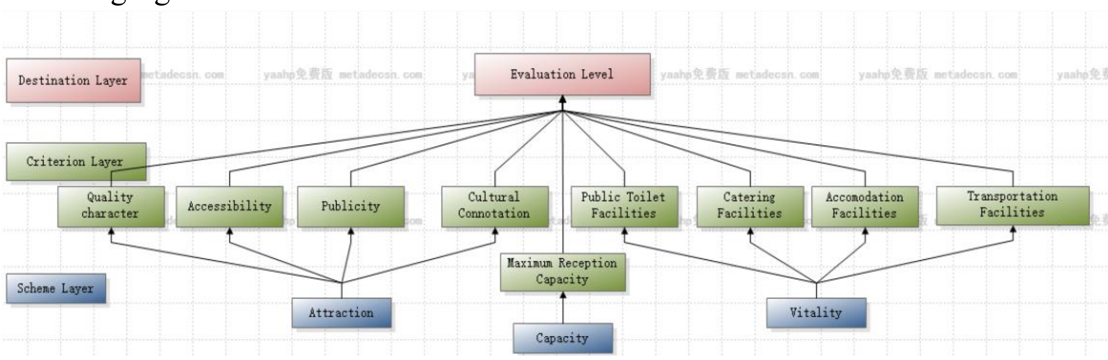


Figure 5 with Multi-objective evaluation

Based on the above principle analysis, we can deduce its judgment matrix as follows:

	Maximum...	Public Toi...	Catering F...	Accomod...	Transport...	Cultural C...	Publicity	Accessibili...	Quality ch...
Maximum Reception Capacity		2	5	5	6	6	3	2	3
Public Toilet Facilities			5	5	2	3	4	2	2
Catering Facilities				2	2	2	2	1/3	1
Accomodation Facilities					3	1/2	2	1	1
Transportation Facilities						1/3	2	1	1/2
Cultural Connotation							3	1/2	1/2
Publicity								1/2	1/3
Accessibility									3
Quality character									

Second, the entropy method is a method to objectively determine the weight of each indicator, which is mainly used to judge the dispersion degree of a certain indicator. Generally, the greater the degree of dispersion of the index value, the better the orderliness, and the smaller the entropy value, the greater the final weight given. The steps to determine the weight of indicators using entropy method include.

The weight of the value of indicator j in year i.

$$M_{ij} = \frac{X_{ij}^{'}}{\sum_{i=1}^{n} X_{ij}^{'}} \tag{4—6}$$

Information entropy of the j^th indicator

$$t_j = -k\sum_{i=1}^{n}(M_{ij} \times \ln M_{ij}) \tag{4—7}$$

Let $k = \frac{1}{ln\,n}$ Then there are $0 \le t_j \le 1$

Information entropy redundancy of the j^th metric.

$$m_j = 1 - t_j \tag{4—8}$$

Weight of the j^th indicator.

$$Y_j = \frac{t_j}{\sum_{j=1}^{n} t_i} \tag{4—9}$$

The weight vector of each evaluation index determined by hierarchical analysis .

The weight vector of each evaluation index determined by the entropy value method

Then the combined weight size of each evaluation index is: $Y_j = \frac{y_j^{(e)} y_j^{(a)}}{\sum_{j=1}^{n} w_j^{(e)} w_j^{(a)}}$ (4—10)

Therefore, we used MATLAB to assist in calculating its weights based on its discriminant matrix, the

Input discriminant matrix

A=[1,2,5,5,6,6,3,2,3;
1/2,1,5,5,2,3,4,2,2;
1/5,1/5,1,2,2,2,2,1/3,1;
1/5,1/5,1/2,1,3,1/2,2,1,1;
1/6,1/2,1/2,1/3,1,1/3,2,1,1/2;
1/6,1/3,1/2,2,3,1,3,1/2,1/2;
1/3,1/4,1/2,1/2,1/2,1/3,1,1/2,1/3;
1/2,1/2,3,1,1,2,2,1,3;
1/3,1/2,1,1,2,2,3,1/3,1;]

Weight vector:

0.2813
0.1986
0.0777
0.0690
0.0532
0.0751
0.0399
0.1207
0.0846

Maximum eigenvalue:

9.9437

The consistency of this matrix is acceptable!

CI=

0.1180

CR=

0.0808

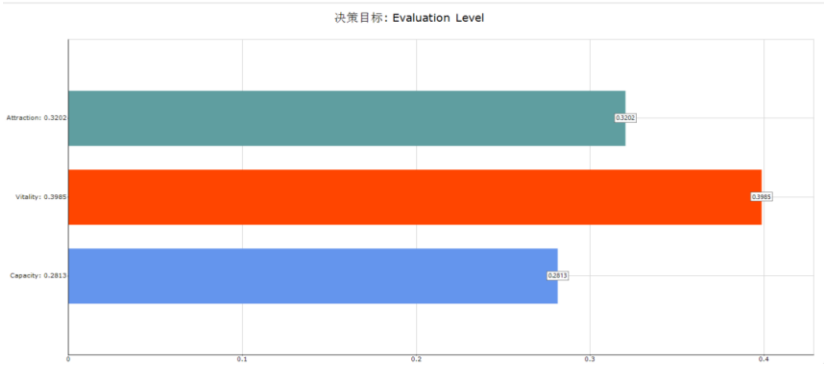


Figure 6 with correlation weights and decision objectives

Thus, according to the above deduction process, we construct the following formula for the calculation of the comprehensive scoring of scenic spots by giving the weight coefficients, as shown below.

$$S=(Q+A+P)\times 32.02\%+(\mathrm{PTf}+\mathrm{Cf}+\mathrm{Af}+\mathrm{Tf})\times 39.85\%+\mathrm{C}\times 28.18\% \qquad (4—11)$$

Afterwards, we conducted a test analysis of the results calculated using the above formula and calculated that the mean of the scores was 4.81, the variance was 0.03, and the standard deviation was 0.16, and the mean, variance, standard deviation, and numerical count fan charts were drawn via excel as follows:

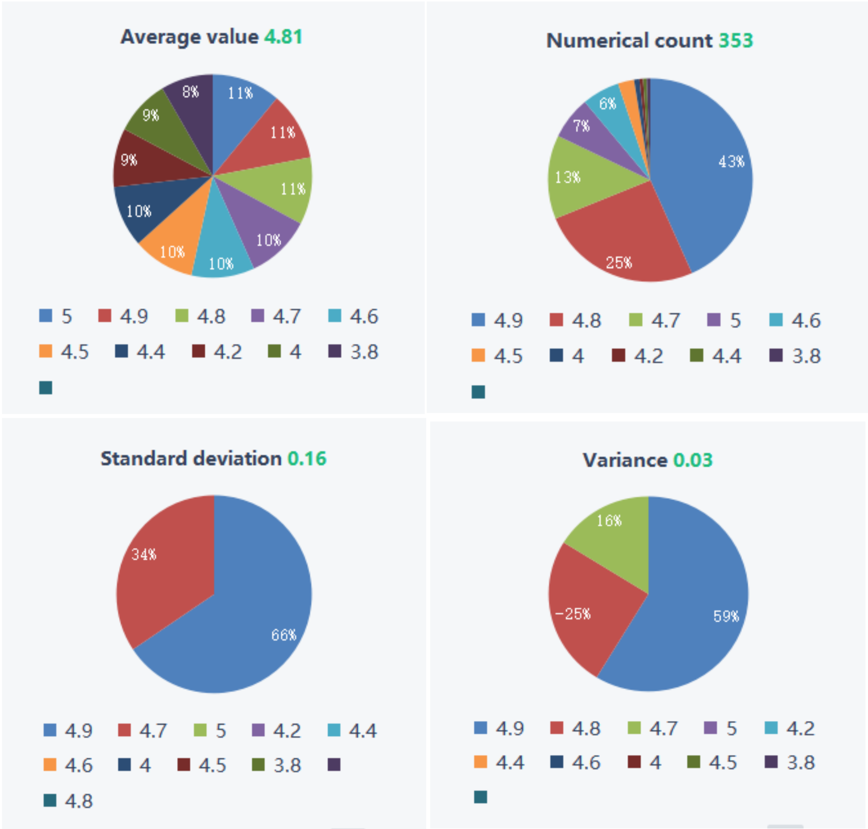


Figure 7

The 3D Confidence Ellipsoid method was used to process the 3D scatter images from the Origin software, which resulted in the 3D confidence ellipsoidimages between the scenic evaluation level index, the number of network evaluations, and the composite score, as follows:

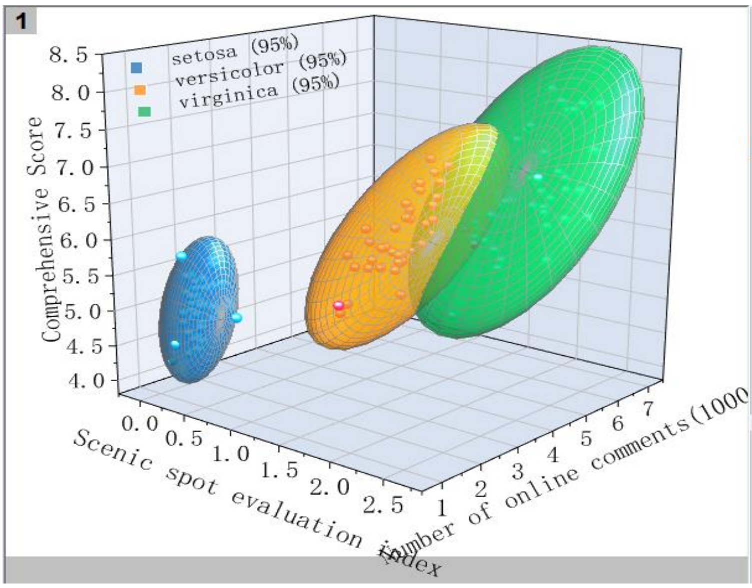


Figure 8 with three dimensional confidence ellipsoid interval image

Based on the observation of the above three-dimensional ellipsoidal confidence interval graph, we can find that the data shows a clustering distribution, so we use the K-means cluster analysis algorithm model to perform cluster analysis and classification of the data we collected and the calculation results of the comprehensive score determined by the entropy method, and the results are shown in the following figure.

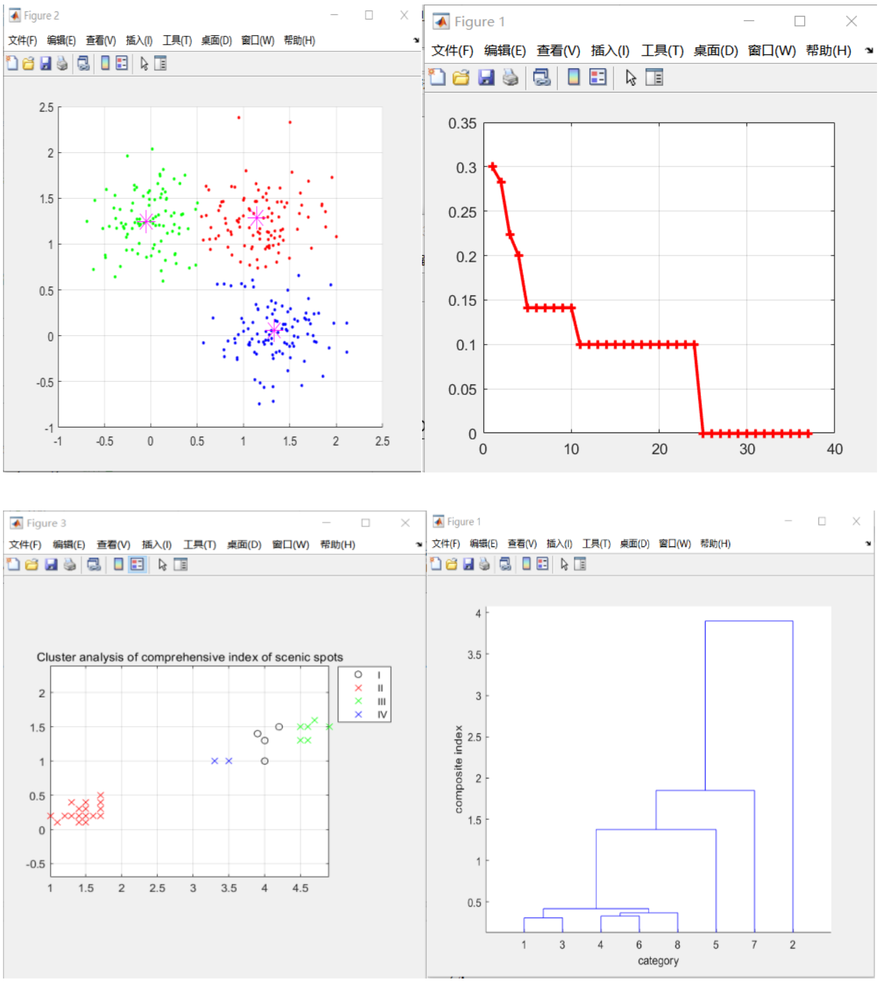


Figure 9 with a cluster analysis scatter plot

4.3 Analysis and solution of question three

Under the influence of the epidemic, each scenic spot nationwide needs to build a more reasonable flow restriction scheme by combining its own characteristics and the epidemic trend. First, we introduce a metacellular automaton model to construct a scenic spot flow restriction model under different circumstances. We analogize the visitors in the scenic area to the ideal state of the metacell for analysis, and we use the metacellular automaton model with the Mason rotation algorithm to first analyze the flow of visitors in front of the entrance of the scenic area in the normal state (i.e. the state of the scenic area without the epidemic) in a two-dimensional simulation to make its characteristics more intuitive, and the specific images are shown as follows:

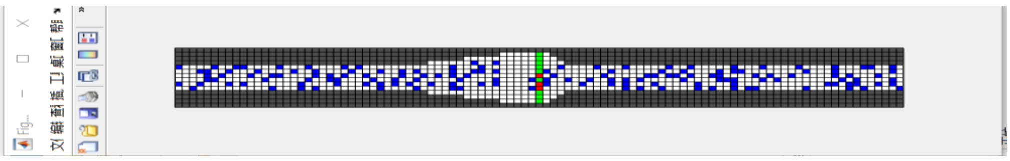


Figure 10 with simulation of tourists without epidemic situation based on cellular automata

After that, we simulated the flow of visitors at the entrance channels of two different types of scenic spots in 3D, and the specific results are as follows:

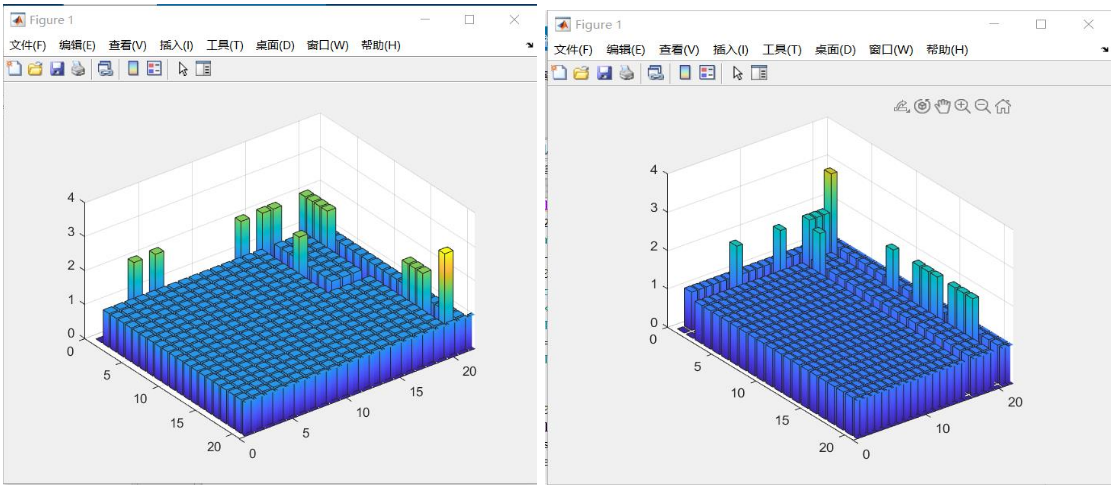


Figure 11 with three-dimensional simulation of tourist flow at different scenic spots

Due to the impact of the epidemic, the scenic area needs to plan the visitor restriction scheme in the context of different epidemic prevalence levels. Based on the international epidemic prevention and control guidelines, we first restrict the flow of visitors to the scenic area in the low-risk area, and the specific flow restriction is 30% of the maximum carrying capacity under normal conditions, and we achieve the low-risk flow restriction scheme by closing a part of the scenic area channels, and we base on the meta-cellular automata model and the Mason rotation algorithm of the simulation results are as follows:

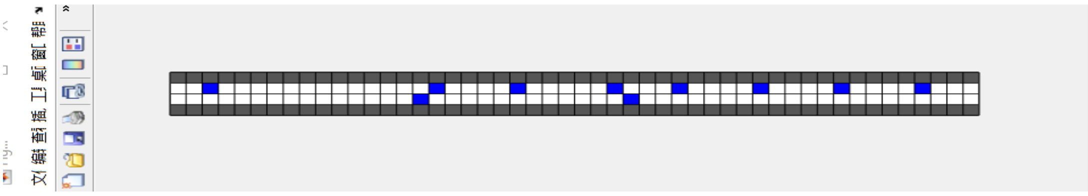


Figure 12 with simulation diagram of tourist flow restriction in low-risk areas

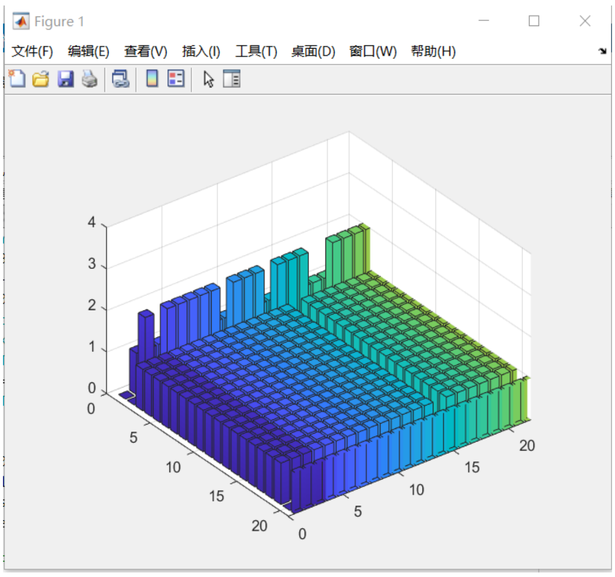


Figure 13 with three-dimensional simulation of tourist flow at tourist entrance of low-risk area

After that we implemented 60% visitor flow restriction scheme for scenic spots in medium risk areas through the assessment of medium risk areas, we closed 2/3 of the entrance channels outside the scenic spots to complete the scheme of 60% restriction on the maximum carrying capacity of the scenic spots, and the simulation results of visitor flow in the scenic spots in this case are as follows:

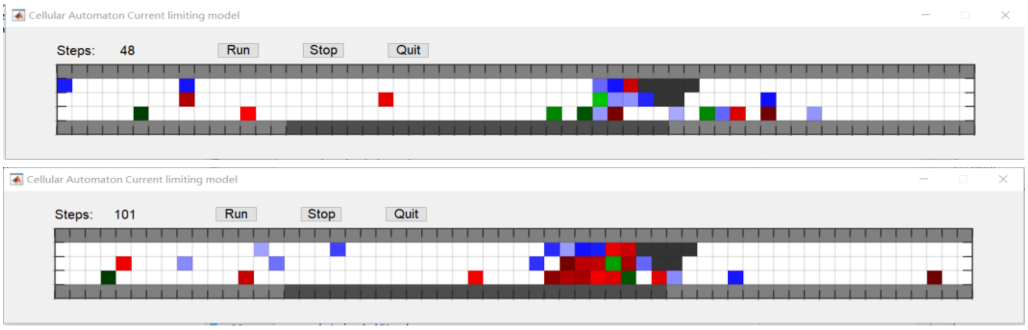


Figure 14 simulation of tourist flow restriction in medium risk area

Finally, for the high-risk areas, we use the scenic area to suspend business for full closure management to prevent and control the epidemic, and then regulate the flow of visitors to the scenic area according to the situation and the adjustment of risk areas.

Due to the accidental nature of the epidemic outbreak, we integrated the scenic area visitor restriction model with the scenic area evacuation model under emergency conditions, and simulated the emergency evacuation model of scenic area visitors during the epidemic outbreak. Whether they have the general knowledge of emergency evacuation and the psychological state in the face of emergency evacuation, and the guidance of the staff of the scenic spot for emergency evacuation. On this basis, we conducted a simulation.

We simulated the scenic tour route in the event of an epidemic by randomly constructing a two-dimensional raster network map.

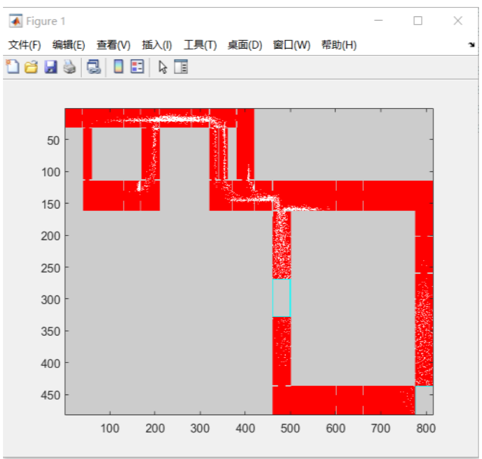


Figure15 with tourist flow of scenic route

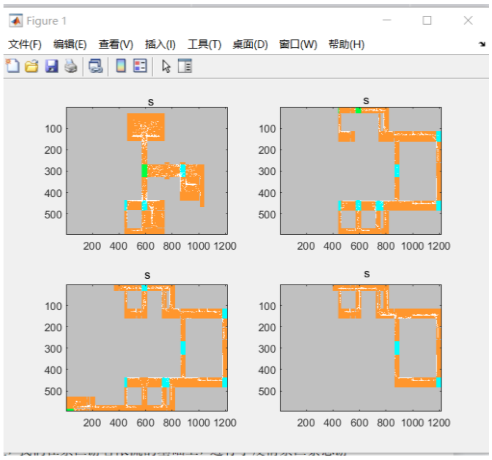


Figure 16 with tourist flow inside scenic buildings

In addition to the tour route of the scenic area, different buildings within the scenic area and different floors within the building will also have an impact on the evacuation of the epidemic. We simulated the evacuation of different buildings within the scenic area and different floors within the building, as follows:

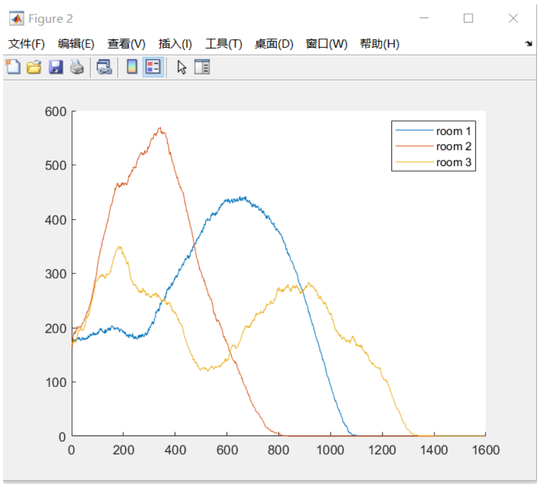


Figure 17 with evacuation of tourists inside scenic buildings

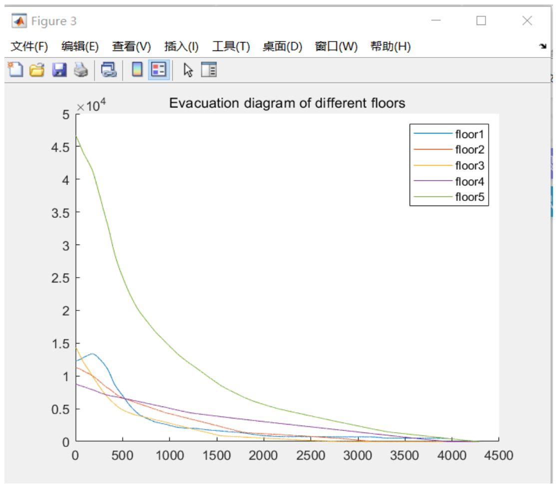


Figure 18 with evacuation of tourists on different floors inside the scenic building

We further investigate and simulate the effect of evacuation on the guidance of staff in the scenic area and whether visitors have the basic knowledge of emergency evacuation and whether they have good psychological quality in the face of emergency.

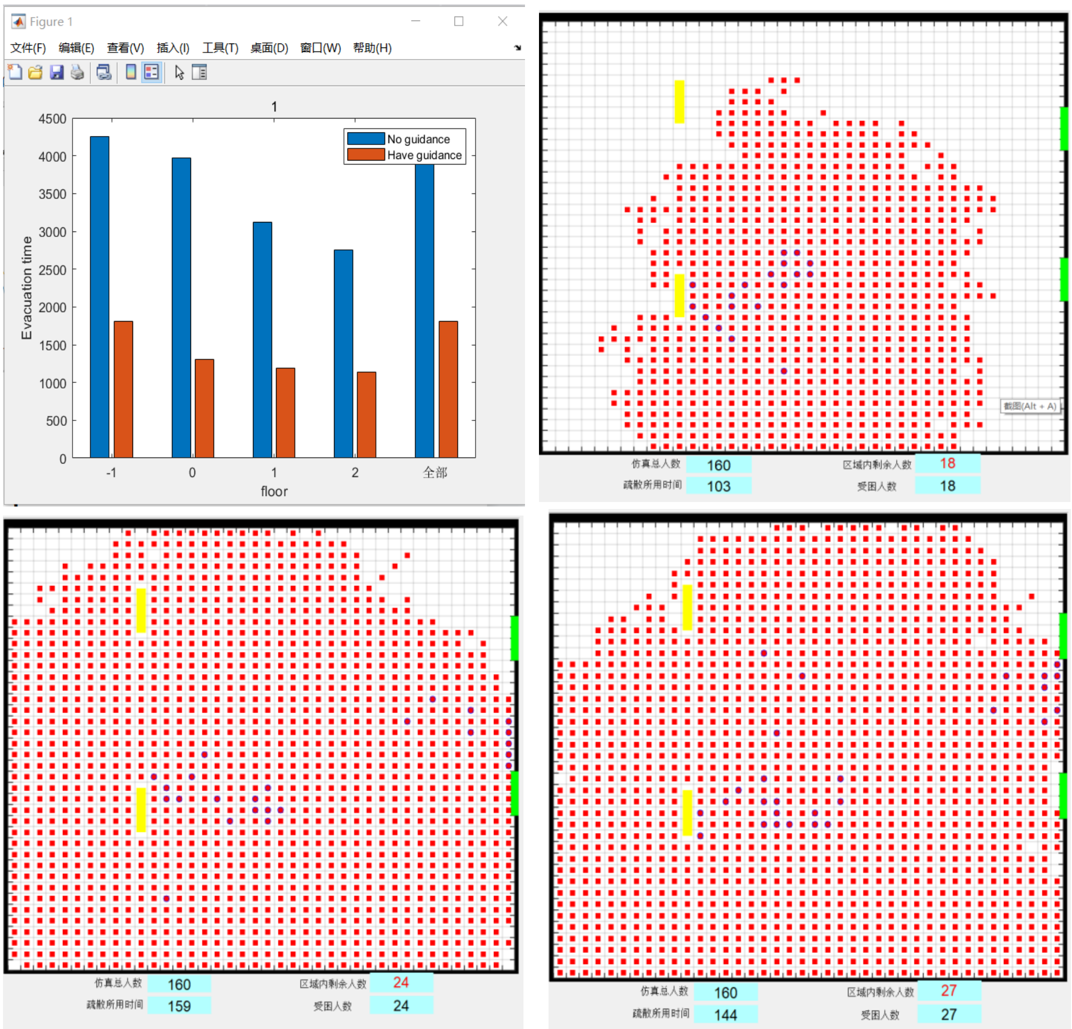


Figure 19 with the comparison figure of scenic tourists emergency evacuation under different conditions based on cellular automaton

Based on the above simulation results we can find that in the case of epidemic flow restriction, the scenic area emergency evacuation situation for tourists, the closer the location of tourists to the entrance, the lower the floor of the building they are on, the higher the level of self-emergency evacuation awareness and common sense, the more timely the staff guidance to evacuate, the more the number of successful evacuation.

We use the above influencing factors as the benchmark for measuring the epidemic flow restriction and carrying evaluation indexes of scenic spots, and randomly select the scenic spot of Shanghai World Expo for comprehensive analysis and evaluation with the help of hierarchical analysis (AHP) and entropy value method used in the second question, and find that the results of our evaluation match with the comprehensive rating of the scenic spot derived from the second question, so we can consider the evaluation constructed by our second and third questions The evaluation system constructed by our second and third questions is better and more accurate.

4.4 Model assumption and solution of question four

Based on the data we collected, we considered three factors: epidemic prevention and control, tourism revenue, and tourists' experience, and we constructed simulation functions by mathematical modeling to transform them into quantitative models and conducted in-depth investigation and analysis.

First of all, the quantization model belongs to the multi-objective planning and optimization model, we introduce the Gray Wolf multi-objective planning algorithm and NSGA-II multi-objective optimization model to analyze the quantization model, and the specific analysis planning and optimization images are as follows:

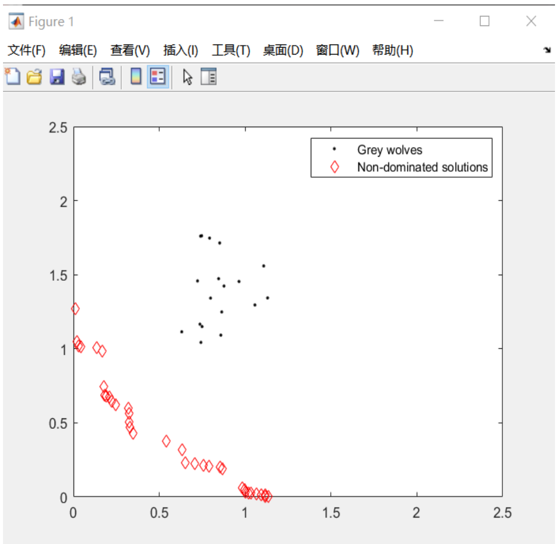


Figure 20 with Gray Wolf multi-objective dynamic programming

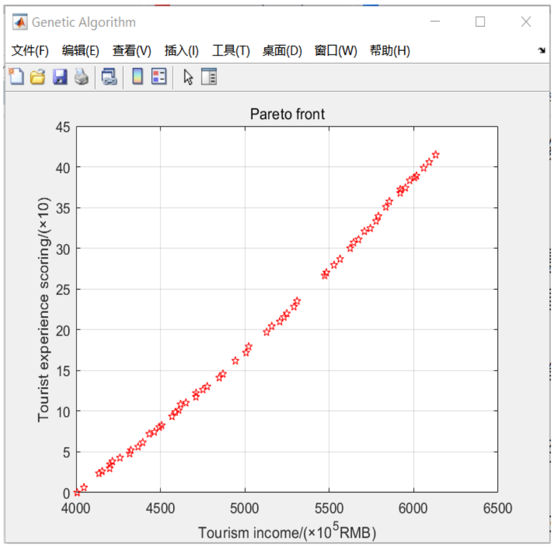


Figure 21 with NSGA-II multi-objective optimization model

Based on the establishment of the model above, we conducted rolling prediction tests on our constructed multi-objective planning and optimization model by BP convolutional neural network prediction model, and the specific training results as well as iteration curves and linear regression analysis results are shown below.

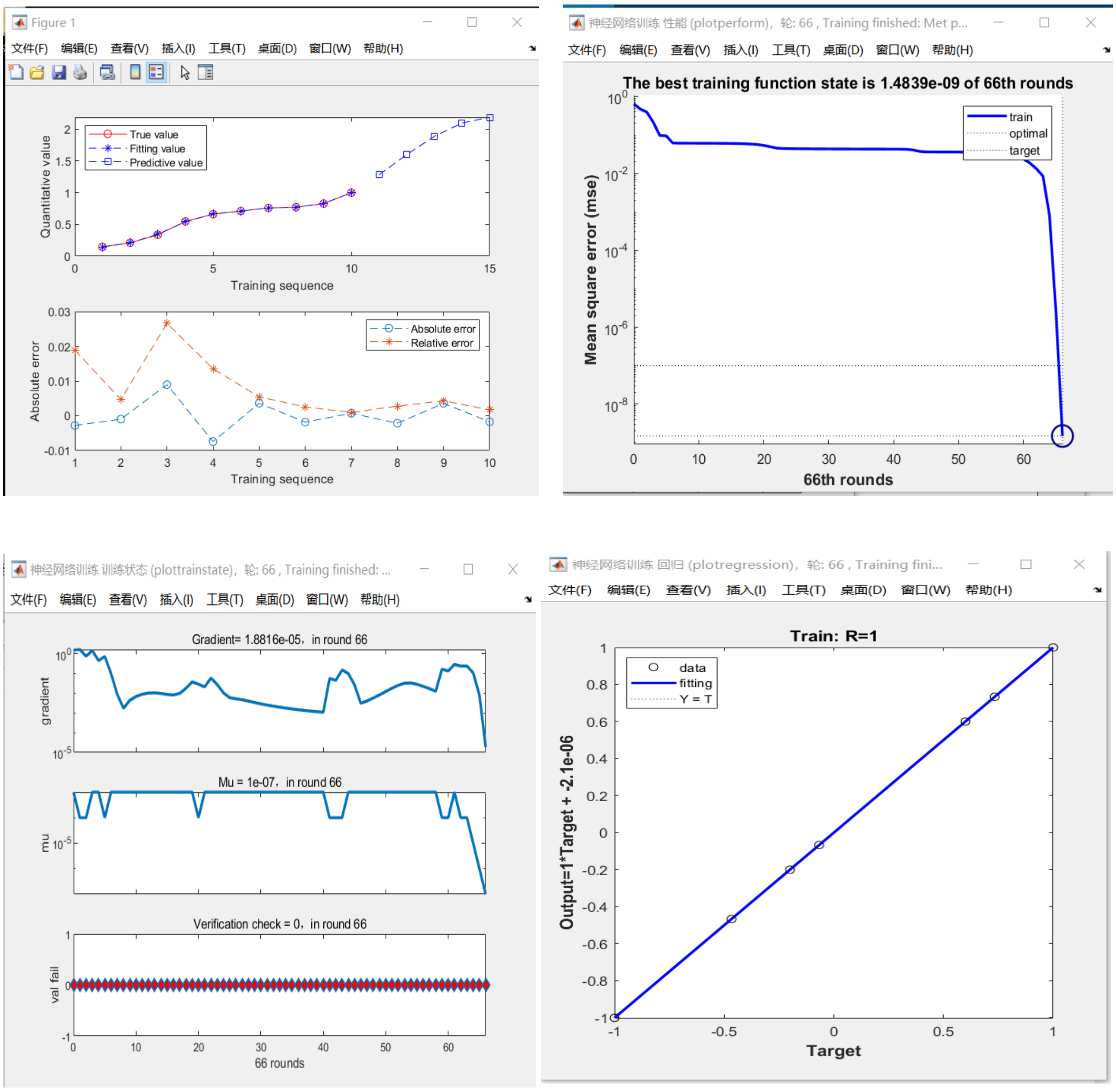


Figure 22 with RBP neural optimization algorithm

Based on the above model algorithm test for in-depth analysis, we conclude that the lower the potential risk of epidemic in a certain area, the lower the limited flow rate of the scenic spot will be, so that the maximum carrying capacity and instantaneous carrying capacity of the scenic spot will increase, which in turn will increase the revenue and tourism experience of the scenic spot.

4.5 Analysis and solution of question five

Under the background of the up-and-down trend of domestic epidemic, and with the increasing pace of the recovery of tourism market, and, owing to the fact that the government is the main body responsible for public management of the tourism industry, it has become an issue which should be put adequate emphasis on about how to formulate scientific and reasonable countermeasures for the risk management of scenic spots in the context of the epidemic to ensure and promote the normal development of the tourism industry.

In February 2020, the State Administration of Culture and Tourism promulgated the Notice on the Suspension of Part of the Travel Service Quality Guarantee to Support Travel Agencies' Operational Difficulties, and temporarily withdrew 80% of the Travel Service Quality Guarantee for Travel Agencies. Take Hubei Province for example. In the early 2020, after the major outbreak of COVID-19 in Wuhan, Hubei Province, the local government promulgated the "Provincial People's Government Office on the issuance of support for the cultural tourism industry to revive a number of measures" and other related policies to help enterprises ease difficulties, cross difficulties, in order to stimulate tourism consumption, increase popularity and restore tourism in Hubei Province to create a good atmosphere.

For scenic spots in low-risk areas

First of all, the government should provide policy support for the development of tourism enterprises in such factors as talent, capital and land, realizing the reasonable integration of tourism resources, reasonable control of the development and utilization of tourism resources, and reasonable support for tourism enterprises to carry out innovative reproduction of tourism resources. In the process of implementation.

Secondly, the government should also strictly do a good job in supervision and management, and formulate corresponding supervision and management mechanism, safeguard mechanism and complaint handling mechanism to restrain tour operators and protect the legitimate rights and interests of consumers.

Thirdly, governments can also support the design of urban tourism slogans and use the media owned by themselves to advertise the local tourism resources so that more people can become aware of local tourism resources. Meanwhile, strengthen the construction of tourism emergency management system, combine emergency response with epidemic prevention and control, and have the ability of to assess the risk of tourism industry in the post-epidemic era, manage and prepare emergency plans, and respond to health emergencies, so as to ensure the operational capacity of emergency situations.

Last but not least, governments are supposed to provide financial support to enterprises, encourage financial institutions to reduce lending rates, and encourage small and medium-sized enterprises in tourism to apply for loans to reduce capital pressure and tide over difficulties. For example, the temporary withdrawal of 80% of the existing service quality margin to help travel agencies cope with economic difficulties during the outbreak, and ICBC signed a strategic cooperation agreement, by ICBC to provide 100 billion yuan of new credit lines to help small and medium-sized tourism enterprises to solve financial difficulties. For example, Beijing, Shanghai, Hainan and other developed areas of tourism have introduced tax relief, interest-bearing loans, monetary subsidies and other policies to help local tourism enterprises recover as soon as possible through supportive policies. Governments can also take measures such as issuing tourist vouchers to tourists to reduce the price of tickets to scenic spots.

For scenic spots in the middle risk areas

Firstly, governments should work hard to do safety management planning, establish and improve the tourism crisis emergency management plans, establish and improve tourism laws and regulations and relevant systems, improve the emergency response mechanism, improve the response speed of the tourism industry to deal with emergencies, and present better handling methods, to promote sustainable development of tourism.

Secondly, governments are expected to set up specialized agencies and establish a "sharing system" of big data and information on tourism network platforms, realize the emergency linkage system with public health care system, tourism industry and other public management systems, and enhance the public risk prevention and control capabilities of tourism enterprises. Meanwhile, it's a good idea to establish and realize the link between ID card and electronic health QR code. Through the network ticketing platform can be informed of the epidemic prevention and control information, then the system will automatically alarm to the public management system. Consequently, a safe and effective major disease surveillance and control system can be built.

Last but not least, establishing the ticket purchase "booking system" to achieve public management of tourism control and traceability is also a terrific idea, which means realizing the real name system model of online ticket purchase and establishing the big data analysis module of tourists via the online access of each tourist attraction. According to the epidemic situation or other scenario requirements, the public administration in the network platform can set the epidemic level of scenic spots and the tourist activity area, and control the source and flow of the tourists through online ticket sales.

For scenic spots in high-risk areas

First of all, governments should explicitly prohibit the opening up of scenic spots in high-risk areas, establish the "cloud tourism" mechanism in these scenic spots, and realize the tourism public management "cloud construction".

Besides, governments should also introduce policies to support "cloud tourism", which is based on "Interim Provisions on the Administration of Online Tourism Business Services" published by Chinese Culture and Tourism Department, requiring the competent department of culture and tourism at all levels actively coordinate with relevant departments in finance, taxation, finance, insurance and other aspects to support the construction of online tourism public management system and ensure and promote the high-quality and healthy development of tourism.

5.Test the Models

We analyzed the data obtained by comparing the wavelet analysis algorithm model with our previous model using multiple linear fitting using REGRESS to determine more precisely the accuracy and credibility of the model, and tested the results as follows:

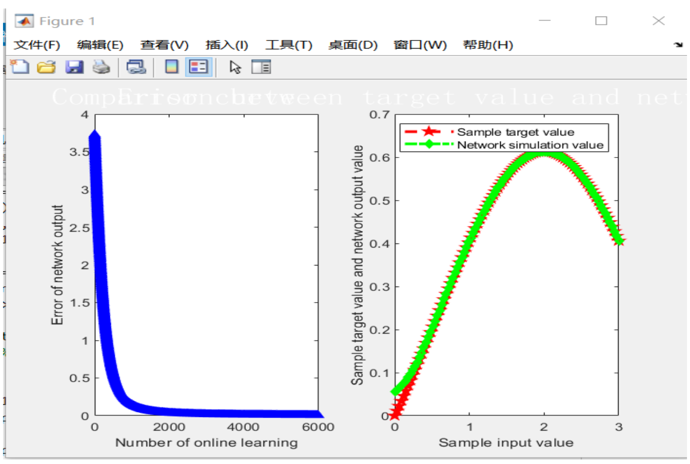


Figure 23 with Wavelet analysis scatter plot

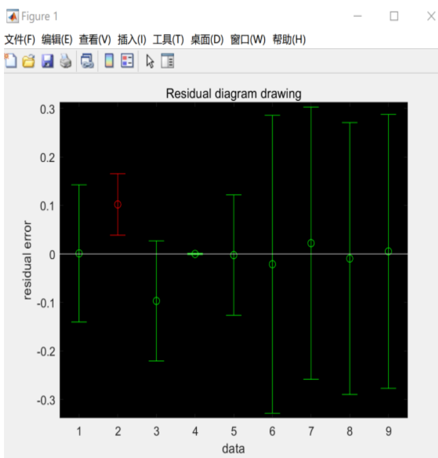


Figure 24 with residual diagram drawing

We can find that the algorithm model we have constructed for the solution of this problem has high reliability and accuracy through the above fitted images.

6. Sensitivity Analysis

We investigate the accuracy of our constructed model for trend prediction analysis based on the data sensitivity test and comparison with theoretical expectation by means of RBP neural network model, and the specific validation results are shown below.

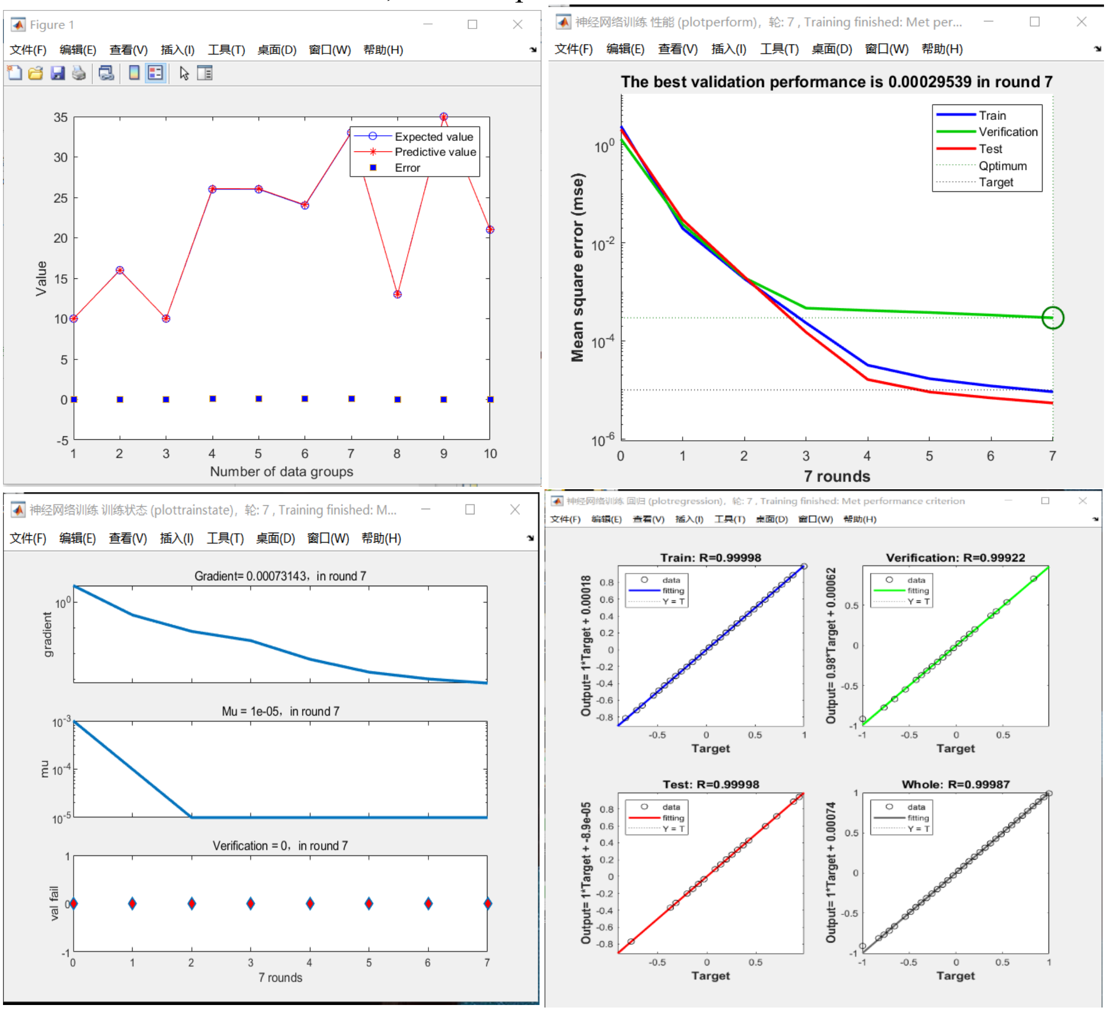


Figure 25 with RBP network sensitivity analysis and verification

From the above images we can see that the test values based on our constructed model by RBP neural network algorithm model are consistent with the actual theoretical expectations and the error value is 0 and the optimal number of iterations is at 7. In addition, the correlation regression coefficient test shows that the coefficient of the model is 0.99998, which has high accuracy and good sensitivity.

After that, we test our model by GRNN and PNN algorithm models for multiple data states, and we select ten sets of data from the collected data using random sampling method to compare the sensitivity of different neural networks for multiple data training.

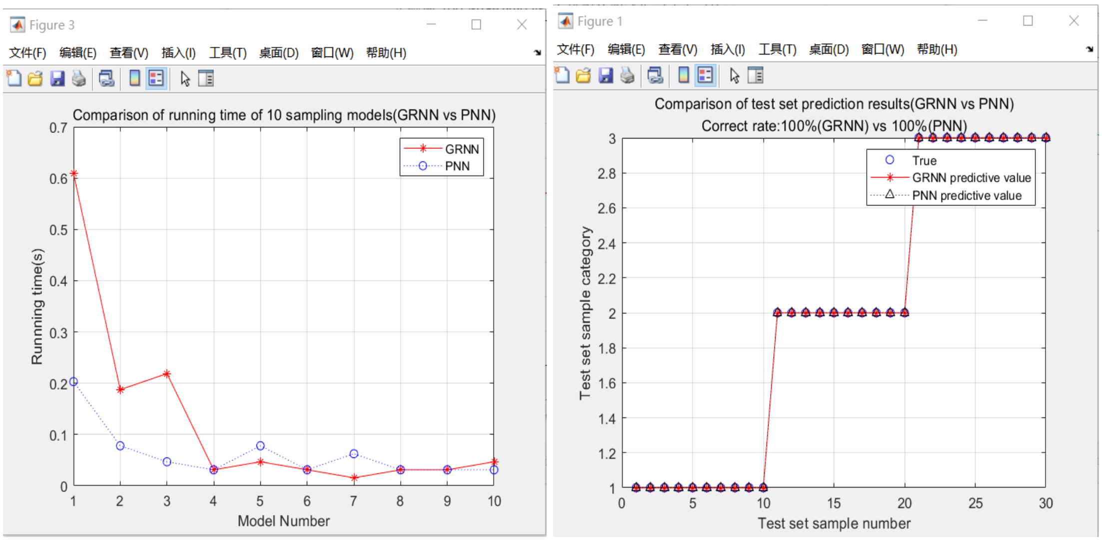


Figure 26 with GRNN and PNN combined neural network sensitivity analysis test

From the above figure, it can be seen that the model has the same test values under two different neural network algorithm models, GRNN and PNN, when dealing with multiple data sets and different neural network algorithm predictions, and both of them are consistent with the actual expected values, so the model has high sensitivity and high reliability in practical applications in dealing with this problem.

7. Strengths and Weakness

7.1Strengths

Through various neural network algorithms, we verify and test the sensitivity of the model we have built, and the final results show that the model has good sensitivity and high reliability, and has a wide range of applications.

7.2Weakness

We have assumed that visitors in the scenic area are under the command of the scenic staff during the visit, and they have a constant speed, none of tourists will be stranded and blocked in the scenic area for a long time, which overlooks the uncertainty and the complexity of tourists' tracks.

8. Conclusion

We can conclude that taking the Heihe—Tengchong geographical divide line as the boundary, the dense of the distribution of 5A scenic spots in the southeast direction is larger compared to the northwest; we classified scenic spots and calculated the comprehensive score of scenic spots of the collected data; we found that the composite score obtained after incorporating the new influencing factors approximately matches the results we obtained in the second question; we finally concluded that the lower the potential risk of epidemic in the area, the lower the limit of scenic spot, the lower the potential risk of epidemic in the region, the smaller the flow rate, the larger the maximum and instantaneous carrying capacity of the scenic spot; we proposed differentiated management solutions for scenic spots in areas with different risk levels, with the government as the main character.

References

[1] РУТКОВСКАЯД., ПИЛИНЬСКИЙМ., РУТКОВСКИЙ Л.НЕЙРОНННЫЕ СЕТИ, ГЕНЕТИЧЕСКИЕ АЛГОРИТ МЫ И НЕЧЕТКИЕ СИСТЕМЫ, 2013.
[2] L. Ingber.Simulated annealing:Practice versus theory.Mathematical and Computer Modelling, December 1993.
[3] Li Jiasong, Zhang Bimbin, Zhao Jianbo. A study on simulation of evacuation of people in buildings based on metacellular automata. Digital World, Vol. 7, 2019.
[4] Nie Jing, Chang Tao, Liu Wei, Lv Xiaohong, Wang Chen, Yang Zhi Fang. Personalized heterogeneous data publishing based on clustering analysis. Science Technology and Engineering, Vol. 14, 2021.
[5] Feng Shumin, Chen Yong, Xin Mengwei. Optimization model of coordinated flow restriction of subway under sudden large passenger flow. Journal of Harbin Institute of Technology, Vol. 2, 2019.
[6] Feng YJ, Chen M, Gong Y, Cheng TS, Wang YANYAN. Research progress on dynamic multi-objective optimization evolutionary algorithms. Journal of Automation, Vol. 11, 2020.
[7] Liu T.Y., Wang Soar. A multi-objective particle swarm algorithm for diversity control. Journal of Xi'an University of Electronic Science and Technology, Vol. 3, 2021.
[8] Qiyuan Jiang. Mathematical Modeling. Beijing Higher Education Press, 1993.
[9] Zhao X.F. MATLAB Mathematical Statistical Analysis. Defense Industry Press, 2004.
[10] Chen, W.J.,Duan, Xiang-Hui. Research on crisis management mechanism and reorganization strategy of tourism epidemic, 2020.
[11] Fan, L. L., Zhao, H. W., Zhao, H. Y., Hu, H. S., Wang, Z.. A Review of Target Detection Research Based on Deep Convolutional Neural Networks. Journal of Optical Precision Engineering, Vol. 5, 2020.
[12] Wang ZD, Liu YD, Hu CD, Li HH, Wang JL. Optimized BP Neural Network for Intrusion Detection Using Improved Gray Wolf Algorithm. Small Microcomputer Systems, Vol. 4, 2021.
[13] Xie C.W., Wang H.S., Zhang B., Huang X.X.. A multi-structured convolutional neural network model for urban extended metacellular automata. Journal of Surveying and Mapping, Vol. 3, 2020.
[14] Yang S. H., Ji F., Cao X. D., Wu W. G., Li B., Chen Y. Q. Research on non-invasive load identification terminal comprehensive evaluation method based on hierarchical analysis and entropy power method. Journal of Electrical Measurement and Instrumentation, Vol. 4, 2021.

Appendix

```
clc;clear

%% Download Data
data=load('quanguojingqujingweidu.txt');
cityCoor=[data(:,2) data(:,3)]; % city coordinate matrix

figure
plot(cityCoor(:,1),cityCoor(:,2),'ms','LineWidth',2,'MarkerEdgeColor','k','MarkerFace
Color','g')
legend('Scenic location')
ylim([4 78])
title('scenic distribution map','fontsize',12)
xlabel('km','fontsize',12)
ylabel('km','fontsize',12)
%ylim([min(cityCoor(:,2))-1 max(cityCoor(:,2))+1])

grid on

% Calculate inter-city distance
n=size(cityCoor,1); %Number of cities
cityDist=zeros(n,n); %city distance matrix
for i=1:n
for j=1:n
if i~=j
cityDist(i,j)=((cityCoor(i,1)-cityCoor(j,1))^2+...
(cityCoor(i,2)-cityCoor(j,2))^2)^0.5;
end
cityDist(j,i)=cityDist(i,j);
end
end
nMax=200; %evolution number
indiNumber=1000; %Number of individuals
individual=zeros(indiNumber,n);
%^ Initialize particle position
for i=1:indiNumber
individual(i,:)=randperm(n);
end

%% Calculation of population fitness
indiFit=fitness(individual,cityCoor,cityDist);
[value,index]=min(indiFit);
tourPbest=individual; %Current individual best
```

```
tourGbest=individual(index,:) ; %Current global optimum
recordPbest=inf*ones(1,indiNumber); %individual best record
recordGbest=indiFit(index); %Group best record
xnew1=individual;

%% Loop to find the optimal path
L_best=zeros(1,nMax);
for N=1:nMax
N
% Calculate the fitness value
indiFit=fitness(individual,cityCoor,cityDist);
% Update current best and historical best
for i=1:indiNumber
if indiFit(i)<recordPbest(i)
recordPbest(i)=indiFit(i);
tourPbest(i,:)=individual(i,:);
end
if indiFit(i)<recordGbest
recordGbest=indiFit(i);
tourGbest=individual(i,:);
end
end
[value,index]=min(recordPbest);
recordGbest(N)=recordPbest(index);
%% Crossover operation
for i=1:indiNumber
% Crossover with individual optimal
c1=unidrnd(n-1); %generate crossover bits
c2=unidrnd(n-1); %generate crossover bits
while c1==c2
c1=round(rand*(n-2))+1;
c2=round(rand*(n-2))+1;
end
chb1=min(c1,c2);
chb2=max(c1,c2);
cros=tourPbest(i,chb1:chb2);
ncros=size(cros,2);
% Delete the same element as the intersection area
for j=1:ncros
for k=1:n
if xnew1(i,k)==cros(j)
xnew1(i,k)=0;
for t=1:n-k
temp=xnew1(i,k+t-1);
```

```
xnew1(i,k+t-1)=xnew1(i,k+t);
xnew1(i,k+t)=temp;
end
end
end
end
% Insert crossover area
xnew1(i,n-ncros+1:n)=cros;
Accept if the new path length becomes shorter
dist=0;
for j=1:n-1
dist=dist+cityDist(xnew1(i,j),xnew1(i,j+1));
end
dist=dist+cityDist(xnew1(i,1),xnew1(i,n));
if indiFit(i)>dist
individual(i,:)=xnew1(i,:);
end
% Crossover with all optimal
c1=round(rand*(n-2))+1; %generate crossover bits
c2=round(rand*(n-2))+1; %generate crossover bits
while c1==c2
c1=round(rand*(n-2))+1;
c2=round(rand*(n-2))+1;
end
chb1=min(c1,c2);
chb2=max(c1,c2);
cros=tourGbest(chb1:chb2);
ncros=size(cros,2);
% Delete the same element as the intersection area
for j=1:ncros
for k=1:n
if xnew1(i,k)==cros(j)
xnew1(i,k)=0;
for t=1:n-k
temp=xnew1(i,k+t-1);
xnew1(i,k+t-1)=xnew1(i,k+t);
xnew1(i,k+t)=temp;
end
end
end
end
% Insert crossover area
xnew1(i,n-ncros+1:n)=cros;
Accept if the new path length becomes shorter
```

```
dist=0;
for j=1:n-1
dist=dist+cityDist(xnew1(i,j),xnew1(i,j+1));
end
dist=dist+cityDist(xnew1(i,1),xnew1(i,n));
if indiFit(i)>dist
individual(i,:)=xnew1(i,:);
end
%% Variation operation
c1=round(rand*(n-1))+1; %generate variant bits
c2=round(rand*(n-1))+1; %generate variant bits
while c1==c2
c1=round(rand*(n-2))+1;
c2=round(rand*(n-2))+1;
end
temp=xnew1(i,c1);
xnew1(i,c1)=xnew1(i,c2);
xnew1(i,c2)=temp;
Accept if the new path length becomes shorter
dist=0;
for j=1:n-1
dist=dist+cityDist(xnew1(i,j),xnew1(i,j+1));
end
dist=dist+cityDist(xnew1(i,1),xnew1(i,n));
if indiFit(i)>dist
individual(i,:)=xnew1(i,:);
end
end

[value,index]=min(indiFit);
L_best(N)=indiFit(index);
tourGbest=individual(index,:);
end

%% Results for graphing
figure
plot(L_best)
title('Algorithm training process')
xlabel('number of iterations')
ylabel('Adaptation value')
grid on


figure
```

```
hold on
plot([cityCoor(tourGbest(1),1),cityCoor(tourGbest(n),1)],[cityCoor(tourGbest(1),2),...
cityCoor(tourGbest(n),2)],'ms-
','LineWidth',2,'MarkerEdgeColor','k','MarkerFaceColor','g')
hold on
for i=2:n
plot([cityCoor(tourGbest(i-1),1),cityCoor(tourGbest(i),1)],[cityCoor(tourGbest(i-
1),2),...
cityCoor(tourGbest(i),2)],'ms-
','LineWidth',2,'MarkerEdgeColor','k','MarkerFaceColor','g')
hold on
end
legend('x')
scatter(cityCoor(:,1),cityCoor(:,2));
title('x','fontsize',10)
xlabel('km','fontsize',10)
ylabel('km','fontsize',10)

grid on
ylim([4 80])
```

```
% Transformation of input data into statistical data
close all;clear;
%% Loading data
path_train = 'TrainData_2021.2.1_2021.2.19.txt';
path_test = 'TestData_2021.2.20_2021.2.27.txt';
[traind_flavor,train_time] = readtxt(path_train);
[testd_flavor,test_time] = readtxt(path_test);

% Prediction of data
% % When the VM is 0 in all moments, the prediction is that these data are also 0
% sum_flavor1 = sum(train_flavor);
% sum_flavor2 = sum(test_flavor);
% ind_zero = find(sum_flavor1==0);
% ind_pre(1:ind_zero) = 0;


% Number prediction for virtual machine specifications that are not 0
data_nuum = length(traind_flavor(:,1));
```

```
traind = traind_flavor(1:data_nuum - 7,:);
trainl = traind_flavor(8:data_nuum,:);

% data_nuum2 = length(testd_flavor(:,1));
% testd = testd_flavor(1:data_nuum2 - 6,:);
% testl = testd_flavor(7:data_nuum2,:);

%% Create Network
net = feedforwardnet(31);
net.trainFcn = 'trainbfg';
% net.trainFcn = 'trainlm';
net.trainParam.epochs=1000;%Maximal number of training steps allowed 1000
net.trainParam.max_fail = 10;
% view(net);

%% Training Network
net = train(net,traind',trainl');

%% Test
test_out=sim(net,traind_flavor((data_nuum - 6):data_nuum,:)');
test_out = test_out';
test_out(test_out<10)=0;
test_out = round(test_out);

% % Data Evaluation

N = 15;
for i =1:7
s1(i) = sqrt(sum((sum(test_out(i,:)) - testd_flavor(i,:)). ^2)/N);
s2(i) = sqrt(sum(test_out(i,:). ^2));
s3(i) = sqrt(sum(testd_flavor(i,:). ^2));
score(i) = 1- (s1/(s2+s3));
end


function main()
clc;clear all;close all;
% Use Mexihat function as sample input and output
x=0:0.03:3; %Sample input value
c=2/(sqrt(3). *pi.^(1/4));
d=1/sqrt(2);
u=x/2-1;
targ=d.*c.*exp(-u.^2/2). *(1-u.^2); % sample output value of the objective function
```

```
eta=0.02;aerfa=0.735; %Give initial values of network learning rate and momentum factor
% Initialize the connection rights wjh the output layer and the hidden layer and the connection rights of the hidden layer and the output layer.
% Assume that the number of wavelet function nodes is H, the number of samples is P, the number of output nodes is J, and the number of input nodes is I.
H=15;P=2;I=length(x);J=length(targ);
b=rand(H,1);a=rand(H,1); %initialize wavelet parameters
whi=rand(I,H);wjh=rand(H,J); % initialize the weight coefficients.
b1=rand(H,1);b2=rand(J,1); %Threshold initialization;
p=0;
Err_NetOut=[]; % saved errors.
flag=1;count=0;
while flag>0
flag=0;
count=count+1;
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
xhp1=0;
for h=1:H
for i=1:I
xhp1=xhp1+whi(i,h)*x(i);
end
ixhp(h)=xhp1+b1(h);
xhp1=0;
end
for h=1:H
oxhp(h)=fai((ixhp(h)-b(h))/a(h));
end
ixjp1=0;
for j=1:J
for h=1:H
ixjp1=ixjp1+wjh(h,j)*oxhp(h);
end
ixjp(j)=ixjp1+b2(j);
ixjp1=0;
end
for i=1:J
oxjp(i)=fnn(ixjp(i));
end
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
wuchayy=1/2*sumsqr(oxjp-targ);
Err_NetOut=[Err_NetOut wuchayy]; %Save the error for each time;
% Solve the wavelet network using BP algorithm, the amount of adjustment of each parameter learned each time
```

```
for j=1:J
detaj(j)=-(oxjp(j)-targ(j))*oxjp(j)*(1 - oxjp(j));
end
for j=1:J
for h=1:H
detawjh(h,j)=eta*detaj(j)*oxhp(h);
end
end
detab2=eta*detaj;
sum=0;
for h=1:H
for j=1:J
sum=detaj(j)*wjh(h,j)*diffai((ixhp(h)-b(h))/a(h))/a(h)+sum;
end
detah(h)=sum;
sum=0;
end
for h=1:H
for i=1:I
detawhi(i,h)=eta*detah(h)*x(i);
end
end
detab1=eta*detah;
detab=-eta*detah;
for h=1:H
detaa(h)=-eta*detah(h)*((ixhp(h)-b(h))/a(h));
end
% Introduce momentum factor aerfa to speed up convergence and hinder falling into
local minima.
wjh=wjh+(1+aerfa)*detawjh;
whi=whi+(1+aerfa)*detawhi;
a=a+(1+aerfa)*detaa';
b=b+(1+aerfa)*detab';
b1=b1+(1+aerfa)*detab1';
b2=b2+(1+aerfa)*detab2';
% This algorithm uses sample-by-sample processing instead of data batch processing
p=p+1;
if p~=P
flag=flag+1;
else
if Err_NetOut(end)>0.008
flag=flag+1;
else
figure;
```

```
plot(Err_NetOut);
xlabel('number of times the network learned');ylabel('error of network output');
title('network learning error curve','fontsize',20,'color',[0 1 1],'fontname','scribe');
end
end
if count>6000
figure(1);
subplot(1,2,1)
plot(Err_NetOut,'color','b','linestyle','-','linewidth',2.2,...
'marker','^','markersize',3.5);
xlabel('number of times the network learned');ylabel('error of network output');
title('error-curve','fontsize',20,'color',[1 1 1],'fontname','scribe');
subplot(1,2,2)
handle1=plot(x,targ,'color','r','linestyle','--','linewidth',2.2,...
'marker','p','markersize',3.5);
hold on
handle1=plot(x,oxjp,'color','g','linestyle','-.' ,'linewidth',2.2,...
'marker','d','markersize',3.5);
xlabel('sample input value');ylabel('sample target value and network output value');
title('Comparison of target and network output values','fontsize',20,'color',[1 1
1],'fontname','scribe');
legend('sample target value','network simulation value');
break;
end
end
function y3=diffai(x) % subroutine
y3=-1.75*sin(1.75*x). *exp(-x.^2/2)-cos(1.75*x). *exp(-x.^2/2). *x;
function yl=fai(x) % subroutine
yl=cos(1.75.*x). *exp(-x.^2/2);
function y2=fnn(x) % subroutine
y2=1/(1+exp(-x));


%% I. Clear environment variables
clear all
clc

% II. Training set/test set generation
%%
% 1. Importing data
load iris_data.mat

%%
% 2 Randomly generated training set and test set
```

```
P_train = [];
T_train = [];
P_test = [];
T_test = [];
for i = 1:3
temp_input = features((i-1)*50+1:i*50,:);
temp_output = classes((i-1)*50+1:i*50,:);
n = randperm(50);
% Training set - 120 samples
P_train = [P_train temp_input(n(1:40),:)'];
T_train = [T_train temp_output(n(1:40),:)'];
% Test set - 30 samples
P_test = [P_test temp_input(n(41:50),:)'];
T_test = [T_test temp_output(n(41:50),:)'];
end

% III. Modeling
result_grnn = [];
result_pnn = [];
time_grnn = [];
time_pnn = [];
for i = 1:4 % two FOR fetching a total of ten free combinations of 4 features
for j = i:4
%1,2 1,3 1,4 2,3 2,4 3,4 1,2,3 1,2,4 1,2,3,4 2,3,4
p_train = P_train(i:j,:);
p_test = P_test(i:j,:);
%%
% 1. GRNN creation and simulation test
t = cputime; %start timing
% Create a network
net_grnn = newgrnn(p_train,T_train);
% Simulation test
t_sim_grnn = sim(net_grnn,p_test);
T_sim_grnn = round(t_sim_grnn); % rounding operation
t = cputime - t; %Get the time this code ran
time_grnn = [time_grnn t];
result_grnn = [result_grnn T_sim_grnn'];
%%
% 2. PNN creation and simulation test
t = cputime;
Tc_train = ind2vec(T_train);
% Create a network
net_pnn = newpnn(p_train,Tc_train);
% Simulation test
```

```
Tc_test = ind2vec(T_test); % convert to sparse matrix
t_sim_pnn = sim(net_pnn,p_test);
T_sim_pnn = vec2ind(t_sim_pnn);
t = cputime - t;
time_pnn = [time_pnn t];
result_pnn = [result_pnn T_sim_pnn'];
end
end

% IV. Performance evaluation
%%
% 1. correctnessaccuracy
accuracy_grnn = [];
accuracy_pnn = [];
time = [];
for i = 1:10
accuracy_1 = length(find(result_grnn(:,i) == T_test'))/length(T_test);
accuracy_2 = length(find(result_pnn(:,i) == T_test'))/length(T_test);
accuracy_grnn = [accuracy_grnn accuracy_1];
accuracy_pnn = [accuracy_pnn accuracy_2];
end

%%
% 2. Comparison of results
result = [T_test' result_grnn result_pnn]
accuracy = [accuracy_grnn;accuracy_pnn]
time = [time_grnn;time_pnn]

%% V. Mapping
figure(1)
plot(1:30,T_test,'bo',1:30,result_grnn(:,4),'r-*',1:30,result_pnn(:,4),'k:^')
grid on
xlabel('test set sample number')
ylabel('Test set sample category')
string = {'Comparison of test set prediction results (GRNN vs PNN)'; ['Correctness:'
num2str(accuracy_grnn(4)*100) '%(GRNN) vs ' num2str(accuracy_pnn(4)*100)
'%(PNN)']};
title(string)
legend('true value','GRNN predicted value','PNN predicted value')
figure(2)
plot(1:10,accuracy(1,:),'r-*',1:10,accuracy(2,:),'b:o')
grid on
xlabel('model number')
ylabel('Test Set Correctness')
```

```
title('Comparison of test set correctness of 10 models (GRNN vs PNN)')
legend('GRNN','PNN')
figure(3)
plot(1:10,time(1,:),'r-*',1:10,time(2,:),'b:o')
grid on
xlabel('model number')
ylabel('Run time(s)')
title('Run time comparison of 10 models (GRNN vs PNN)')
legend('GRNN','PNN')
% look at edit newgrnn 97hang edit newpnn
```