

A study on development system of characteristic tourism souvenirs in big data era based on fuzzy mathematics

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Abstract. At present, big data era has attracted more and more attention and also gradually participates in various industries. Due to the rapid development of tourism industry, there is a series of problems in the process of characteristic tourist souvenirs. So for tourism souvenir sales and tourism development, there is asymmetric condition. In this paper, according to the problems of the current souvenir development process, based on the comprehensive evaluation method of fuzzy mathematics, the evaluation model of characteristic tourism souvenir is established and evaluation model in the era of big data to analyze the process of the souvenirs development. The model has the function of comprehensive evaluation of modern souvenirs. By method of combining model with practical application, the development of modern tourism souvenirs is guided and a good souvenir market is built. At the same time, it should be further optimization and improved, to do better serves for the development of the tourism industry.

Key words. tourism souvenir development system, big data era, fuzzy mathematics.

1. Introduction

Fuzzy mathematics is mathematical methods to study the problems that a lot of decomposition is not very clear or fuzzy in real life^[1]. By now, the application of fuzzy mathematics in biological engineering, agricultural and forestry operations or regional planning has been effectively developed. In recent years, with the development and trend of tourism industry ^[2], some scholars in country-regionplaceChina have carried out some research on the development of tourist souvenirs. But there is still a lack of research on the method of fuzzy mathematics. This paper attempts to use the fuzzy mathematics method to carry on the related research of the tourism souvenir development system.

Now, big data era has four basic characteristics: scale, diversification, rapid and valuation^[3]. They are recognized by the international community. Today, tourism

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industry has a lot of characteristics; the most typical is the experience of the economy. After tourist, the experience not only exists in the memories of the tourists, so it gives birth to the tourism souvenirs. It generally refers to the tourism products that tourists buy goods in scenic spots; they have local culture and higher technological level. These tourism products are different from the general tourism products because of ornamental value and collection value. They are the pursuit of people's emotion and spiritual sustenance. However, the sales of tourism souvenirs in our country are not commensurate with the rapid development of the tourism industry. There are many problems in the development of tourist souvenirs: market orientation is not enough, the development of professional institutions is not enough and so on. Big data era promotes the reform and innovation of the entire tourism industry, to a certain extent, promotes the development of tourism souvenirs. In this paper, based on some previous research results, with the rapid development of the big data era as the background, fuzzy mathematics method is used to analyze souvenir development system and tourism souvenir development system is built. The starting point is the respect for tourists; the purpose is the pursuit of tourist satisfaction^[4]. It will provide an important reference for the future development of the tourism souvenir development system.

2. A research on the development of tourism souvenirs in big data Era

2.1. The current situation of research on the development of tourist souvenirs in the era of big data

On the one hand, the development of tourism souvenirs reflects the promotion of national economy. On the other hand, whether tourists shopping are effectively promoted often reflects the development of a country or region's tourism industry^[4]. The proportion of direct economic income from tourist shopping accounts for economic income driven by tourism in the whole region usually reflects tourism economic efficiency of a country or a region.

At present, the research of tourism souvenirs in the domestic tourism industry is still in the primary stage^[5]. It mainly focuses on the following aspects:

(1) economic benefits of souvenirs

Cui Lingping analyzed the current situation of the development of tourism souvenirs, she said that because there has been information behind, the real value of the talent cannot be introduced in the development stage of souvenirs, a series of problems inhibit tourism souvenir market makes a greater economic benefit. In The significance meaning of the development of tourist souvenirs in China??, Yuan Guohong stressed the need to find a new economic growth mode,the increase of the local residents income, the promotion of industrial restructure, the formation of dominant industries, and expanding of the development of tourism souvenirs market is a very important part.

(2)the market development of tourist souvenirs^[6]

In *Vigorously develop Yangzhou tourism souvenirs market*, Zhao Tao pointed out

that in order to change the status of the development of Yangzhou tourism souvenir market, we must strengthen the following aspects: accurate market planning around the needs of tourists, develop a new brand of souvenirs, full play to the role of government, supervise the market volatility, establish the large-scale tourism souvenir shopping mall, and create a good tourism shopping platform.

(3)the development of tourist souvenirs

In *Enhance the development of tourism souvenirs innovation awareness*, Zhao Renping proposed that at present, it is very important to promote the use of innovative awareness in the development stage of the souvenirs. In *Vigorously develop Shanxi tourism souvenir market*, Yu Jie uniquely proposed to establish a special souvenir development model^[7], a unique charm of the broad market should be formed. At the same time, Zheng Hong analyzed the main problems and the main factors which cause the low efficiency of the tourism souvenir market in our country, and researched several factors that should be paid attention to in the development of tourism souvenirs, and specially emphasis the characteristics of the development stage of the souvenir should be paid attention. Zhang Wenmin defined the meaning of tourism souvenirs in the paper, proposed the specific model. The main reasons for the poor status of StateplaceHunan tourist souvenir market are analyzed. This paper expounds the countermeasures of promoting the development of Stateplace-Hunan tourism souvenirs. Taking Zhangjiajie tourism souvenirs as an example, how to use tourism resources efficiently to develop ways is discussed.

The souvenirs shopping in the tourist market is likely to become important local tourism characteristics. It attracted some foreign scholars long time ago. These foreign scholars did much further study. For example, Hongkong and other places, where the development of tourism shopping industry is more developed nowadays, usually analyze tourist destination and satisfaction degree. ElsaWong and YeePing^[8]used service performance model to analyze the satisfaction of tourists in Hongkong. NormanAu uses a new combination theory to imitate the shopping decision of tourism shopping information system in journey. And in 1982-1997 by comparing the Hongkong official data, data accuracy is determined.

From research status at home and abroad, people find that the attention of tourist souvenirs in a place is less, some research results are difficult to be applied in practice, and these researches are lack of practical guidance for the development of tourism souvenirs in most places. Therefore, the trend of the future study of regional tourism souvenirs is the combination of the theory and practice.

2.2. The concept of tourism souvenirs in big data era

(1)The concept of tourist souvenirs

What are the tourist souvenirs has not been summed up a more comprehensive summary yet. There is the following summary:

Tourist souvenirs are a kind of merchandise with the local cultural background, which has a commemorative value^[9].

Tourist souvenirs and crafts refer to the goods with tourism logo, using professional skills to create the multiple significance and value. The forms are textiles,

abrasives, and portrait and so on. Tourist souvenirs are goods that by purchasing or gifting visitors give them to other people. The definition of tourism goods and the construction of tourism consumption object are as shown in Figure 1.

(2)The characteristics of tourist souvenirs^[10]Commemoration

It is the most basic requirements of the tourist souvenirs, its image content, form and decorative art reflect the tourist destination of historical sites, the national, public, regional style and other characteristics. The commemoration is generally reflected in two aspects: the one is to show the characteristics of tourist destination. Through handling of product form and packaging, the most representative of the local natural scenery, scenic spots and historical sites are added in the external environment of souvenirs to increase sales.

Territoriality

Territoriality is the image of the regional culture, and it originates from the regional culture that is formed by unique geographical background and cultural isolation. Because of the different cultural background and regional flavor, so there is different regional culture, inevitably affect the development process of souvenirs.

Technology

Technology refers to the technical characteristics in the process of the production by using superb technology. It depends on the technology master means and technical characteristics formed by the mode of production. It is not purely manual operation, but the use of modern industrial manufacturing technology for mass production, and the use of modern decorative techniques.

(3)Tourism souvenir development principles

The principles of following market demand

The most important principle in the development phase of a souvenir is to develop desirable goods as much as possible. Product development must be guided by the market, production category and function must be compatible with the buyer's preferences and purchasing power. The research on the market and tourists' psychology must be strengthened and market researches must be paid more attention.

The principles of reflecting regional culture

The regional culture is fully reflected, the characteristics of local culture are fully dug so that tourists enjoy the local cultural activities as much as possible. When customers buy souvenirs, the deeper things they need are local cultural conservation.

The principle of innovation

Tourists shopping have strong volatility characteristics; the repeat purchase rate for the same product is very low. Therefore, enterprises should continue to promote customers to buy souvenirs, strengthen technological innovation, develop new products, at the same time, enterprises should update the business philosophy of self management to promote the customer's shopping desire.

The principle of maximum benefit

The development of tourism souvenirs is not easy. All products in the market have their own life cycle, they will experience the investment period, the adaptation period, the mature period and the period of weakness. Because of gradual optimization of national environment and sharp increase of tourists, tourist souvenirs will enter the market circulation through various stages test. With the changing needs,

tourist souvenirs need to design again. The development process of tourist souvenirs is usually divided into the following steps: 1, the market survey; 2, innovative development; 3, to enter the market; 4, product updates. The details are as shown in Figure 1.

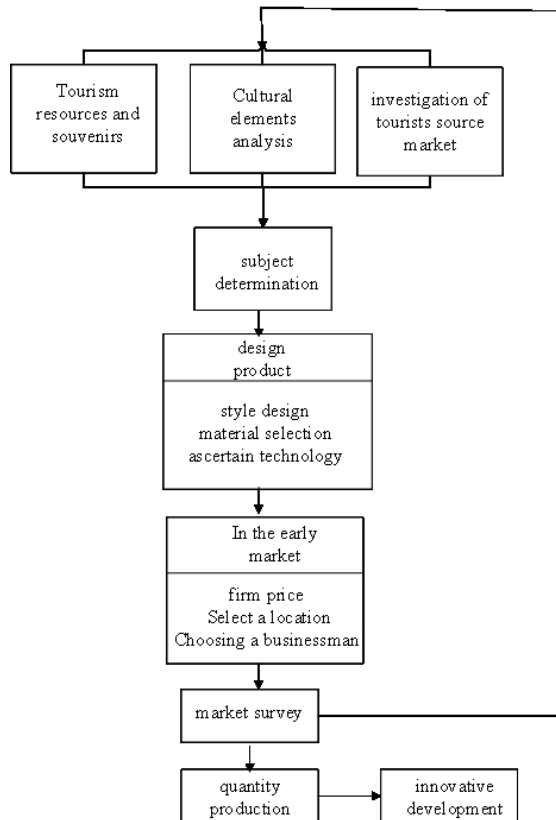


Fig. 1. Tourism souvenirs development pattern

2.3. The problems of tourism souvenir development in big data era

In many countries and regions of the more prosperous tourism industry, more than 70% of the total tourism industry revenue comes from the travel shopping behavior. However, the world average is about 40%, the average level of our country is only half of the world. Through all kinds of data, we can find that the sales of souvenirs in country-regionplaceChina and the rapid development of the tourism industry have asymmetric situation, the reasons are:

Tourism souvenirs in the development stage of the market are not clear enough.

Tourism souvenirs development institutions are not strong.
 Tourism souvenir market sales management mechanism is not perfect.
 The sales channels of tourism souvenirs are narrow, and promotional efforts are not enough.

3. A research on the establishment of tourism souvenir development system model in big data era based on fuzzy mathematics

3.1. Fuzzy mathematics evaluation theory

(1). Single factor fuzzy comprehensive evaluation
 the establishment of factor level set and factor level

Factor set is a big set of many factors that can cause any evaluation object volatility.

$$U = \{u_1, u_2, \dots, u_i, \dots, u_n\} \quad (1)$$

u_i represents various factors set. u_{ij} represents the j level of i factor.

$$u_i = \{u_{i1}, u_{i2}, \dots, u_{ij}, \dots, u_{in}\} \quad (2)$$

the establishment of evaluation level set Q

The results of the rating set may have n , its evaluation set is

$$Q = \{q_1, q_2, \dots, q_n\} \quad (3)$$

For example, $q_i (i = 1, \dots, n)$ respectively are good, better, common, worse and poor, etc.

the establishment of weight set

The weight set is the subordinate degree of the lower layer evaluation to the upper level evaluation index including the weight set and the grade weight set.

$$B = (b_1, b_2, \dots, b_i, \dots, b_n) \quad (4)$$

$$B_i = (b_{i1}, b_{i2}, \dots, b_{ij}, \dots, b_{in}) \quad (5)$$

b_i is the weight of i factor, and meets $0 \leq b_i \leq 1, \sum_{i=1}^M b_i = 1$. b_{ij} is the degree of membership of the j level to i factor, and meets $0 \leq b_{ij} \leq 1, \sum_{i=1}^M b_{ij} = 1$.

the establishment of a single factor grade evaluation matrix

The membership degree of the evaluation object to the factor grade is ensured^[16]. p_{ijk} represents the membership degree of the j evaluation level q_{ij} of the i evaluation

factor to evaluation set, so the grade evaluation matrix of the i evaluation factor is

$$P = \begin{bmatrix} pi11, pi12, \dots, pi1n \\ pi21, pi22, \dots, pi2n \\ \dots, \dots, \dots, \dots \\ pim1, pim2, \dots, pimn \end{bmatrix} \tag{6}$$

$$i = 1, 2, \dots, M.$$

the establishment of a single factor fuzzy comprehensive evaluation matrix
The comprehensive evaluation of the i factor can be expressed

$$Ci = Bi \circ Pi = (ci1, ci2, \dots, cin) \tag{7}$$

cin is that when all grades of the i factor are comprehensively evaluated, the membership degree of evaluation set to the n factor in the evaluation set.

(2) Comprehensive fuzzy evaluation of all aspects

The principle of fuzzy comprehensive evaluation is to use the method of fuzzy transformation in mathematics.

$$M = (\wedge*, \vee*) \tag{8}$$

$\wedge*$ represents generalized fuzzy "and" operation, $\vee*$ represents generalized fuzzy "or" operation. There are four models.

Model 1: Principal determinant $M = \wedge\vee$. Results only consider the decisive factor in all factors, but this kind of operation is easy to cause the evaluation result is difficult to identify.

Model 2: Main factors prominent I type $M(\bullet, \vee)$.

$$cj = \bigvee_{k=1}^M (bk \bullet pkj) \tag{9}$$

Model 3: placeMain factors prominent II type $M(\wedge, \oplus)$

$$cj = \bigoplus_{k=1}^M (bk \wedge pkj) = \sum_{k=1}^M (bk \wedge pkj) \tag{10}$$

The calculation \oplus is bounded summary.

$$a \oplus b = \min(1, a + b) \tag{11}$$

Model 4: Weighted average $M(\bullet, +)$,

$$cj = \sum_{k=1}^M (bk \bullet pkj) \tag{12}$$

Generally, the model 4 appropriately considers the overall situation of the factors

that may occur, so it is the most accurate, the other models are generally suitable for the use of the evaluation system dominated by the main factors.

3.2. Fuzzy mathematics evaluation system model

The main method of fuzzy mathematics is to use fuzzy set. The ordinary two value set transform, like citation $\{0, 1\}$, is transformed to the continuous distribution fuzzy sets on the interval $[0, 1]$ by a series of methods. The application of fuzzy mathematical method of fuzzy measure (hamming distance) and similarity priority ratio are used to compare all samples and fixed samples. By determining the more similar samples and fixed samples, the degree, which is similar to fixed degree, is selected.

(1) The sample set $X = \{x_1, x_2, \dots, x_n\}$ is confirmed. The fixed sample x_k is given.

(2) The difference between the two samples is judged by hamming distance, $d_{ki} = |x_k - x_i|$. d_{ki} is Hamming distance, x_k is fixed sample data, x_i is data of the i sample.

(3) The priority ratio is established. The selection matrix $P = p_{ij}$, $p_{ij} = d_{kj} / (d_{ki} + d_{kj})$ is conformed. d_{ki} is Hamming distance between the i sample and the fixed sample, p_{ij} is similarity degree of the i sample and the j sample that is relative to fixed samples. And it meets the following conditions: if p_{ij} in the $[0.5, 1]$, x_i is more prior than x_j . If p_{ij} in the $[0, 0.5]$, x_j is more prior than x_i . Under the extreme condition, there are 3 kinds of situations: 1, $p_{ij}=1$, x_i is more prior than x_j . 2, $p_{ij}=0$, x_j is more prior than x_i . 3, $p_{ij}=0.5$, it means it is in the middle value, the priority can't be determined, fuzzy evaluation is the maximum.

p_{ij} has the nature $p_{ij} + p_{ji} = 1 (i \neq j)$. By this method, p_{ij} can be the needed fuzzy similar priority ratio matrix $P = p_{ij}$, the fuzzy correlation matrix of the corresponding factors is

$$P = \begin{bmatrix} 0 & P_{12} & P_{13} & \cdots & P_{1n} \\ P_{21} & 0 & P_{23} & \cdots & P_{2n} \\ P_{31} & P_{32} & 0 & \cdots & P_{3n} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ P_{(n-1)1} & P_{(n-1)2} & P_{(n-1)3} & \cdots & P_{(n-1)n} \\ P_{n1} & P_{n2} & P_{n3} & \cdots & 0 \end{bmatrix} \quad (13)$$

n is the sample number, the value of p_{ij} is 0.

(4) The application of λ intercept. For every matrix, the value of λ is selected from large to small. The range is in $[0, 1]$. The value of λ is the significant level of similarity with standard samples. If the value of λ is bigger, similarity significant priority level is higher.

3.3. The specific ways of tourism souvenir development

Five elements of Tourist souvenirs are: performance subject, materials, development process and packaging. When they change or the combination forms change, it will lead to a new generation of tourist souvenirs. The specific ways of the devel-

opment and innovation of tourism souvenirs is that ethnic cultural background and fashion elements in different regions are added into five elements.

Mathematical functions are used to simulate this relationship.

$$J = f(a, b, c, d, e) \quad (14)$$

J represents tourism souvenirs, and it is dependent variable. a, b, c, d, e respectively represents five elements. According to this relationship, we can sum up the mathematical formula of the development and innovation of tourist souvenirs:

$$F_i = f(x_a, x_b, x_c, x_d, x_e) \quad (15)$$

$$Xa = \{a, A\}, Xb = \{b, B\}, Xc = \{c, C\}, Xd = \{d, D\}, Xe = \{e, E\}$$

a, b, c, d, e are five traditional elements. A, B, C, D, E are non-traditional five elements. So through the combination of "new" and "old", more innovative ways can be created to develop tourism souvenirs. Through the calculation of permutation and combination principle of Higher Algebra, there are 32 ways providing references.

Now some ways are as follows:

$$F1 = f(a, b, c, d, e) \quad F2 = f(A, b, c, d, e)$$

$$F3 = f(a, B, c, d, e), F4 = f(a, b, C, d, e)$$

$$F5 = f(a, b, c, D, e), F6 = f(a, b, c, d, E)$$

(1) Imitation strategy ($F1$). With the local natural and cultural background as the basis, tourist souvenirs packaging is designed. With the local characteristics of the product as a material, the products are produced by traditional technology.

(2) Theme innovation strategy ($F2$). The characteristic cultural connotation is given by traditional type, to enrich the cultural heritage of souvenirs and to achieve the innovation of souvenirs.

(3) Material innovation type ($F3$). It is that by current comparison cycle and organic high - quality materials, so, at the most basic level, it can attract tourists' curiosity.

(4) Technological reform type ($F4$). The traditional souvenirs are processed by new techniques, making those traditional products with a long history have more lasting vitality.

(5) Shape innovation ($F5$). The shape of the tourism souvenirs is explored, more popular and trendy elements are added to attract tourists to chase.

(6) Packaging innovation ($F6$). It takes much more time and energy to explore and create the product packaging to have their own value and have a unique style of packaging image.

3.4. The application example of the tourism souvenir development evaluation system

Through the above analysis of the establishment of the tourism souvenir development evaluation system in big data era, the main factors in the process of souvenir development are understood. The following is the evaluation analysis process to a handicraft in placePlaceNameHeilongjiang PlaceTypeProvince by using souvenir development evaluation system model. This is a show in the third session of the placePlaceNameHeilongjiang PlaceTypeProvince excellent tourism souvenirs exhibition. This handicraft is wooden wall that the length and width is. The raw material is derived from Unique wood in Greater Khingan Range; the picture is a natural log cabin. Because the target market positioning of the tourist souvenirs is higher, it generally applicable to all the tourists. In the evaluation process, 20 tourists are randomly selected as participating personnel. Fuzzy evaluation forms are designed by evaluation analysis model, and then these forms are distributed to 20 tourists. By collecting the table data, the needed single factor evaluation matrix $P_i(i = 1, 2, 3, 4, 5)$ is established, shown in Table 1. The data in the table are the results of the statistical data obtained from the evaluation persons.

Table 1. Statistics of judgment

first indexes	second index	better	good	common	bad	worse
local color	cultural connotation		4	11	4	2
	The uniqueness of the place	5	9	6		
	The uniqueness of material	4	8	7	2	
	The uniqueness of appearance	2	7	8	4	
	The embodiment of the scenic spot		2	7	11	
innovation	The innovation of the subject matter	2	7	10	2	
	The innovation of the material	3	8	9		
	The innovation of the technology	6	7	6		
	The innovation of the shape		4	12	3	
	The innovation of the packaging		4	15	2	
commemorative value	The souvenir collection value	5	9	7		
	The value of the souvenir	3	6	12		
	The rationality of the price of souvenirs		8	9	3	
	The practicability of souvenirs		6	12	3	
portability	Vulnerability degree of souvenirs		7	8	4	
	The volume of a souvenir		4	6	10	
	The weight of the souvenir		9	8	2	
	The packing of the souvenir		5	12	2	

So the Single factor evaluation matrix is

$$P1 = \begin{bmatrix} 0 & 0.15 & 0.55 & 0.2 & 0.1 \\ 0.25 & 0.45 & 0.3 & 0 & 0 \\ 0.2 & 0.4 & 0.35 & 0.05 & 0 \\ 0.05 & 0.35 & 0.4 & 0.2 & 0 \\ 0 & 0.1 & 0.35 & 0.55 & 0 \end{bmatrix}$$

$$P2 = \begin{bmatrix} 0.1 & 0.35 & 0.5 & 0.05 & 0 \\ 0.15 & 0.4 & 0.45 & 0 & 0 \\ 0.3 & 0.4 & 0.3 & 0 & 0 \\ 0 & 0.2 & 0.65 & 0.15 & 0 \\ 0 & 0.2 & 0.75 & 0.05 & 0 \end{bmatrix}$$

$$P3 = [0.25 \quad 0.45 \quad 0.3 \quad 0 \quad 0]$$

$$P4 = \begin{bmatrix} 0.1 & 0.3 & 0.6 & 0 & 0 \\ 0 & 0.4 & 0.45 & 0.15 & 0 \\ 0 & 0.3 & 0.55 & 0.15 & 0 \end{bmatrix}$$

$$P5 = \begin{bmatrix} 0 & 0.35 & 0.45 & 0.2 & 0 \\ 0 & 0.2 & 0.3 & 0.5 & 0 \\ 0 & 0.45 & 0.45 & 0.1 & 0 \\ 0 & 0.25 & 0.65 & 0.1 & 0 \end{bmatrix}$$

Because the rationality of the evaluation of tourist souvenirs is mainly based on the rationality of the determination of weight coefficient, so in the analysis process, in this paper, the second level weight index is determined by the five experts hired group to determine the expert groups. The second level weight coefficient is got by AHP.

$$B1 = (0.0413 \quad 0.4276 \quad 0.2947 \quad 0.076 \quad 0.1604)$$

$$B2 = (0.0612 \quad 0.2711 \quad 0.4635 \quad 0.1817 \quad 0.0523)$$

$$B3 = (1)$$

$$B4 = (0.1633 \quad 0.301 \quad 0.5166)$$

$$B5 = (0.0644 \quad 0.4010 \quad 0.4011 \quad 0.1678)$$

Fuzzy comprehensive evaluation vectors are

$$C1 = B1 \circ P1 = (0.1711 \quad 0.3594 \quad 0.3512 \quad 0.1354 \quad 0.0041)$$

$$C2 = B2 \circ P2 = (0.2011 \quad 0.3621 \quad 0.4522 \quad 0.0244 \quad 0)$$

$$C3 = B3 \circ P3 = (0.25 \quad 0.46 \quad 0.3 \quad 0 \quad 0)$$

$$C4 = B4 \circ P4 = (0.0173 \quad 0.3297 \quad 0.5877 \quad 0.1255 \quad 0)$$

$$C5 = B5 \circ P5 = (0 \quad 0.3156 \quad 0.4578 \quad 0.3654 \quad 0)$$

$$P = \begin{bmatrix} 0.1711 & 0.3594 & 0.3512 & 0.1354 & 0.0041 \\ 0.2011 & 0.3621 & 0.4522 & 0.0244 & 0 \\ 0.25 & 0.46 & 0.3 & 0 & 0 \\ 0.0173 & 0.3297 & 0.5877 & 0.1255 & 0 \\ 0 & 0.3156 & 0.4578 & 0.3654 & 0 \end{bmatrix}$$

$$C = B \circ P = (0.1498 \quad 0.3573 \quad 0.3742 \quad 0.1233 \quad 0.0015)$$

According to the principle of maximum membership degree, the comprehensive evaluation of the tourism souvenirs is general. The key factor affecting its comprehensive evaluation is that volume and weight are too large; the degree of portability is too low. If these factors can be improved, it may be able to achieve a higher comprehensive evaluation result.

4. Conclusion

This paper focuses on the tourism souvenir development system model in big data era based on fuzzy mathematics model. First of all, tourism industry transformation and the development of tourism souvenirs in big data era are presumptively studied. The related concept of tourism souvenirs is explained. The problems existing in the process of development of modern tourism souvenirs are analyzed. Then the conclusion that the sales of tourism souvenirs are not symmetrical with the development of tourism industry is got. Secondly, the tourism souvenirs development system is established by fuzzy mathematics comprehensive evaluation method, the development process of tourism souvenirs detailed evaluation, to evaluate the process of the development of tourism souvenirs. Finally, the evaluation of a handicraft in placePlaceNameHeilongjiang PlaceTypeProvince is analyzed by this model, and the conclusion is the evaluation of a handicraft is general. At the same time, the model is still in the primary stage and it need to the further optimized and improved to provide better services for tourism industry.

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