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Competitiveness Study of Ski Sports Tourism Destination Based on Matlab Principal Component Analysis

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Abstract: In this study, it studies the competitiveness of the ski sports tourism destination, conducts indexing and quantitative research on the many aspects of economic, cultural, environmental and social issues of the destination's competitiveness. It uses principal component analysis to analyze the quantized index, obtains the five principle components whose cumulative contribution rate have reached 93.27% and ranks the competitiveness levels of the top ten ski tourism destinations in China using these five main components. In the data operation process this study uses Matlab programming, through Matlab-based studies of the principal component analysis and ski sports tourism destination's competitiveness, provides a good application platform for the principle component analysis and offers a theoretical basis for the evaluation of the competitiveness of tourist destinations.

Key words: Principal component analysis, Matlab realization, sports tourism, competitiveness level, matrix

INTRODUCTION

Sports tourism is a combination of sports and tourism and one part of the tourism industry which is a form of tourism activities that take participatory and spectator sport as the main content in the traveling and touring process of people. Since the basic realization form of the tourism products is the destination's experience, tourism competition mainly focuses and reflects in the tourist destinations. The Ski tourism destination is an important carrier of the ski tourism industry, is the base uniit that the tourism development of many aspects can rely on. With the ski tourism development, the competition of its destinations is increasing more intensely. In recent years, the domestic ski resorts with large and small size have gone through rapid development, the research results of the competitiveness is a major driving force of the project development (Zhang and Yue, 2013).

Since the mid-20th century, in foreign a new trend of sports tourism has emerged and it gradually becomes a new trend of development; to the late 20th century, as two separate disciplines, the inherent relationship are increasingly close; especially in recent years, with the continuous development of sport tourism, the suiting point and the intersection point of two disciplines, the theoretical system of sports tourism are gradually formed, research areas are also expanding. In recent years, with the joint efforts of experts, scholars and researchers in the vast travel, sports and other discipline areas, sports tourism has been gaining more and more attention and we have made some research results, such as: Zhang Hongjian from Department of Physical Education of Fuling Teachers College in the "the sociological analysis of rising motivation for the domestic sports tourism", started from the three elements of sports tourism, conducted sociological research on the rising reasons of sports tourism in the country, obtained that individual needs of tourists and appropriate social environment are the core power for the rising of the sports tourism, colorful natural and human sports tourism resources constitutes the material basis for the rising of sports tourism, tourism and sports physical and functional transition provided for the hardware and software support for the rising of sports tourism and acted as a "catalyst" role (Cui 2013); Ou yang-mei of Physical Institute from Shaanxi University of Technology in the "characteristics and market segmentation of sports tourism product", described the characteristics of sports tourism products, took travel needs and motivations of tourism consumers as the standard, divided the cost of the sports tourism market into recreational fitness, health rehabilitation, adventure, ornamentation and sports culture and other market segments, provided theoretical support for the study of the development of sports tourism market and sports tourism product (Wang and Yang, 2013); Fu Yanhui from China ocean University of tourism

Management major in her master's degree thesis "competitiveness and development evaluation of ski destination tourism", used the fuzzy comprehensive evaluation method to build the fuzzy comprehensive evaluation model of ski tourism destination's tourism competitiveness, finally took the Yabuli Ski Resort as an example empirical research and evaluated by the use of above models, according to the evaluation results, analyzed the Yabuli Ski Resort's competitiveness and proposed countermeasures of competitiveness cultivation (Lu and Song, 2006) while the used principal component analysis also played an important role in various fields, similarly the principle research, practical examples and algorithm implementation of the method are relatively mature, wherein: Chu de-ping and Zheng Yao-xing of School of geographical Sciences from Fujian Normal University, in the " the application of principal component analysis in tourism resources grading", introduced principal component analysis evaluation model, took the state-level key scenic spots Tai-ning big Lake tourism area for example, selected 26 tourism entities, took nine evaluation indexes, analyzed them using this method, divided it into four levels, finally put forward corresponding development and utilization countermeasures (Zang and Zhang, 2005); Zhao Yuliang and Yin Haidong of Northeast Agricultural University in the" principal component analysis and Matlab realization", for the imbalance manufacturing development of mechanical parts of Heilongjiang Province, took 14 machinery manufacturing enterprises in Heilongjiang as the research object, selected eight indicators starting from the economic benefit, analyzed the selected indicators using principal component analysis, calculated and ranked on machinery manufacturing enterprise's economic benefits using Matlab software, provided references for the future economic development of coordination between enterprises in Heilongjiang Province (Zhang, 2005).

From the tourism and tourism management work perspective, we can know that the tourism destination is the locality of a tourist activity; for the emerging sports tourism issues, its destination also is the basic unit to be relied on. In this study, by using the expert questionnaire method it sums up four secondary indexes, 15 third layer indicators and 45 fourth layer indicators, quantifies it, conducts evaluation on the competitiveness of the top ten ski destinations using principal component analysis in order to get the development approach of ski tourism destination.

COMPETITIVENESS EVALUATION OF SKI TOURISM DESTINATION BASED ON PRINCIPAL COMPONENT ANALYSIS

Principal component analysis is a mathematical method of elimination; we can use the method of a linear combination to conduct principal component analysis of the multivariate problem. Tourism competitiveness of ski tourism destination is a multi-level index problem; the number of indexes can be simplified by principal component analysis, it can be simpler and more rapidly evaluated.

Research object appoints the top ten ski destinations in China as: 1-Heilongjiang Yabuli sunshine Resort; -Beijing Nanshan Ski Resort; 3-Hebei Wanlong Ski Resort, 4-Beijing Jundushan Ski Resort; 5-Heilongjiang Yabuli Ski Resort; 6-Xinjiang Silk Road; 7-Beijing Qiao Bo indoor Ski Dome; 8-Jilin Beida Lake Ski Resort; 9-Hebei Duolemeidi ski Resort; 10-Jilin Changbai Mountain Ski Resort (Zang and Zhang, 2005).

Data of evaluation index and scoring results: According to the evaluation criteria of the ski tourism destination's tourism competitiveness, we can build the required evaluation index set; the indicators constructed in this study is divided into three level, as shown in Table 1 below.

The score results of each index for China's top ski resorts are shown in Table 2.

Construction of classification index system and its weight determination: Based on the above data construct four secondary-layer indicator system, wherein Bi is represented by X_i as shown in Eq. 1 below:

$$X_1 = \begin{Bmatrix} x_1, x_2, x_3, x_4, \\ y_1, y_2, y_3, y_4, y_5, \\ z_1, z_2, \\ w_1, w_2, w_3, w_4 \end{Bmatrix} = \begin{Bmatrix} x_{11}, x_{12}, x_{13}, x_{21}, x_{22}, x_{23}, \\ x_{31}, x_{32}, x_{33}, x_{41}, x_{42}, x_{43}, x_{44} \\ y_{11}, y_{12}, y_{13}, y_{21}, y_{22}, y_{31}, \\ y_{41}, y_{42}, y_{43}, y_{51}, y_{52}, y_{53}, y_{54} \\ z_{11}, z_{21}, z_{22}, z_{23}, y_{24}, \\ w_{11}, w_{12}, w_{13}, w_{14}, w_{15}, w_{21}, w_{22}, \\ w_{31}, w_{32}, w_{33}, w_{41}, w_{42}, w_{43}, w_{44} \end{Bmatrix} \quad (1)$$

The evaluation factor weights of skiing tourism destinations' competitiveness can be obtained through AHP on the twelve experts' research table as shown in Table 3.

Table 1: Competitiveness index set of ski tourism destination

Tourism competitiveness of ski tourism destination	Resources B1	Tourism resources C1	Scale and abundance of D1, travel period D2, scope of application D3
		Location resources C2	Regional economic D4, distance from tourists D5, accessibility D6
		Facilities and resources C3	Advancement D7, completeness D8, maintenance D9
		Human resources C4	Educational background structure D10, the structure of professional title D11, seniority structure D12, Human resource investment D13
	Market Ability B2	Marketing capabilities C5	Marketing funding investment D14, marketing team D15, D16 marketing effectiveness D16
		Image C6	Popularity D17, Reputation D18
		Bearing capacity C7	Reception capacity D19
		The level of information C8	Snowmaking technology D20, equipment technology D21, propaganda technology D22
		Market share ability C9	Aunual reception of people D23, average linger days D24, Aunual reception of foreign visitors D25, the average linger days of foreign tourists D26
	Tourism Performance B3	Surrender part of the profits C10	Surrender part of the profits D27
		Profit C11	Total tourism income D28, foreign exchange earnings D29, the total profit D30, Net profit D31
Sustainable development B4	Growth ability C12	Tourism safety and sanitation C13	Per capita consumption growth rate D32, income growth rate D33, profit growth rate D34, iunovation ability D35, resources utilization capacity D36 Tourism safety D37 and tourism sanitation D38
		Community C14	Community recognition D39, community support D40, community involvement D41
		Resource and environment protection C15	Protection of tourism resources D42, destination environment protection D43, surrounding environmental protection D44, community cultural protection D45

Table 2: Score results of each index for China's top ski resorts

Category	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
1	85	92	91	92	92	90	87	91	90	94	91	94	87	91	87
2	90	88	90	87	88	88	91	89	84	87	87	84	83	88	89
3	85	85	86	85	89	88	86	85	90	91	91	84	84	84	85
4	79	80	79	81	83	80	77	78	80	83	81	77	81	80	83
5	75	80	79	75	76	82	78	78	80	77	76	77	75	82	78
6	70	74	81	87	71	79	88	87	87	84	89	74	73	83	86
7	68	65	81	76	74	73	67	80	82	66	76	80	69	74	73
8	90	90	98	92	92	96	93	91	93	94	90	94	90	98	90
9	93	85	85	87	81	92	91	82	93	87	81	93	86	83	92
10	99	74	71	71	73	94	98	73	76	92	99	84	70	87	94
Category	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30
1	85	92	89	93	90	90	94	91	88	85	92	94	92	92	86
2	83	92	91	89	92	85	90	90	87	89	84	85	92	86	84
3	91	92	87	90	88	91	88	87	92	92	85	84	84	84	85
4	78	78	81	82	79	77	81	83	82	84	76	82	77	77	82
5	82	81	80	83	75	77	83	81	75	76	76	79	79	76	75
6	73	78	83	85	70	82	86	79	73	82	71	89	85	87	78
7	75	79	80	71	65	77	70	66	74	69	66	78	82	71	71
8	94	91	98	92	97	99	94	98	98	90	91	91	95	90	95
9	88	81	89	93	88	84	86	83	82	90	94	89	90	88	81
10	97	85	89	99	93	91	96	99	91	93	70	80	79	72	93
Category	D31	D32	D33	D34	D35	D36	D37	D38	D39	D40	D41	D42	D43	D44	D45
1	86	94	92	90	93	91	87	85	91	87	93	86	87	90	94
2	92	86	83	84	91	88	89	84	89	83	86	92	88	86	87
3	90	86	89	86	87	92	87	87	90	90	93	87	88	86	91
4	79	84	76	75	77	83	78	83	82	84	77	78	83	75	77
5	80	82	80	77	83	75	79	75	78	81	77	83	80	79	75
6	89	72	89	70	82	77	80	82	86	82	89	79	79	89	74
7	74	83	79	73	66	81	70	65	71	82	82	73	70	73	72
8	92	99	93	97	93	96	98	97	93	91	93	94	92	98	92
9	91	82	83	93	90	86	94	82	80	82	80	85	85	85	81
10	77	95	97	71	96	97	84	90	81	82	92	90	80	88	85

According to the data in Table 2 and 3, we can draw the score condition of the secondary layer index:

$$\begin{Bmatrix} x_1, x_2, x_3, x_4, y_1, y_2, y_3, y_4, y_5, \\ z_1, z_2, w_1, w_2, w_3, w_4 \end{Bmatrix}$$

in tourism competitiveness among the country's top ten ski destinations as shown in Table 4.

Data standardization: The normalized data is shown in Table 5.

Principle component analysis realized by Matlab: According to the normalized data in Table 5, we can use the Matlab software programming, calls the principle component analysis procedures to output the first five principle components' coefficients, the

Table 3: Three-layer indicator system and the corresponding weights

Index	Weights	Index	Weights	Index	Weights
B1	0.47	D4	0.31	D26	0.25
B2	0.09	D5	0.50	D27	1.00
B3	0.23	D6	0.19	D28	0.51
B4	0.21	D7	0.62	D29	0.24
C1	0.46	D8	0.24	D30	0.14
C2	0.27	D9	0.14	D31	0.11
C3	0.17	D10	0.29	D32	0.20
C4	0.10	D11	0.17	D33	0.22
C5	0.48	D12	0.32	D34	0.18
C6	0.16	D13	0.22	D35	0.20
C7	0.12	D14	0.44	D36	0.20
C8	0.12	D15	0.24	D37	0.75
C9	0.14	D16	0.32	D38	0.25
C10	0.50	D17	0.50	D39	0.57
C11	0.50	D18	0.50	D40	0.29
C12	0.24	D19	1.00	D41	0.14
C13	0.14	D20	0.33	D42	0.28
C14	0.24	D21	0.33	D43	0.17
C15	0.38	D22	0.33	D44	0.33
D1	0.33	D23	0.25	D45	0.22
D2	0.33	D24	0.25		
D3	0.33	D25	0.25		

Table 4: Secondary-layer index score

Category	1	2	3	4	5	6	7	8	9	10
C1	88.44	88.44	84.48	78.54	77.22	74.25	70.62	91.74	86.79	80.52
C2	91.62	87.69	87.57	81.81	76.83	77.48	74.43	92.76	84.95	76.37
C3	88.38	89.54	86.32	77.66	78.28	87.62	72.22	92.52	89.12	88.92
C4	91.95	85.16	87.22	80.30	76.39	79.23	72.84	92.44	87.68	85.79
C5	88.12	86.64	86.48	80.08	81.04	80.52	74.08	94.80	86.76	91.88
C6	90.50	91.50	89.50	79.50	80.50	80.50	79.50	94.50	85.00	87.00
C7	93.00	89.00	90.00	82.00	83.00	85.00	71.00	92.00	93.00	99.00
C8	90.42	88.11	88.11	78.21	77.55	78.54	69.96	95.70	85.14	92.40
C9	89.00	87.50	89.00	81.25	77.00	76.25	68.75	94.25	87.25	88.25
C10	94.00	85.00	84.00	82.00	79.00	89.00	78.00	91.00	89.00	80.00
C11	90.50	89.44	84.80	77.92	77.83	84.94	76.94	93.47	88.37	79.06
C12	92.04	86.38	88.06	79.02	79.46	78.38	76.52	95.52	86.60	91.72
C13	86.50	87.75	87.00	79.25	78.00	80.50	68.75	97.75	91.00	85.50
C14	90.12	86.84	90.42	81.88	78.73	85.26	75.73	92.42	80.58	82.83
C15	89.25	88.24	87.72	77.64	79.41	81.20	72.27	94.54	84.12	86.54

Table 5: Standardized data

Category	1	2	3	4	5	6	7	8	9	10
x_1	0.913	0.913	0.342	0.514	0.704	1.132	1.655	1.389	0.675	0.228
x_2	1.265	0.678	0.660	0.200	0.944	0.847	1.303	1.435	0.269	1.013
x_3	0.503	0.679	0.191	1.121	1.027	0.388	1.946	1.131	0.616	0.585
x_4	1.236	0.194	0.510	0.553	1.153	0.717	1.698	1.311	0.580	0.290
y_1	0.501	0.260	0.234	0.807	0.651	0.735	1.782	1.587	0.280	1.112
y_2	0.840	1.019	0.662	1.126	0.948	0.948	1.126	1.555	0.143	0.215
y_3	0.678	0.166	0.294	0.729	0.601	0.345	2.136	0.550	0.678	1.445
y_4	0.746	0.459	0.459	0.770	0.852	0.729	1.794	1.401	0.090	0.991
y_5	0.662	0.469	0.662	0.334	0.880	0.977	1.941	1.337	0.437	0.566
z_1	1.628	0.018	0.201	0.567	1.116	0.714	1.299	1.079	0.714	0.933
z_2	1.019	0.844	0.078	1.058	1.072	0.101	1.219	1.509	0.667	0.869
w_1	1.001	0.152	0.404	0.953	0.887	1.049	1.327	1.522	0.185	0.953
w_2	0.288	0.445	0.351	0.621	0.777	0.464	1.937	1.699	0.853	0.163
w_3	1.028	0.430	1.083	0.474	1.049	0.142	1.596	1.448	0.711	0.301
w_4	0.790	0.635	0.555	0.988	0.717	0.443	1.811	1.600	0.004	0.375

first five principal components' scores, features, eigenvalue and the contribution rate each principle components. The program code is shown in Fig. 1.

The output results of first five principal components factor are shown in Fig. 2.

The output results of first five principal component scores are shown in Fig.3.

```
x=[0.913    0.913    0.342    0.514    0.704    1.132    1.655    1.389    0.675    0.228
1.265    0.678    0.660    0.200    0.944    0.847    1.303    1.435    0.269    1.013
0.503    0.679    0.191    1.121    1.027    0.388    1.946    1.131    0.616    0.585
1.236    0.194    0.510    0.553    1.153    0.717    1.698    1.311    0.580    0.290
0.501    0.260    0.234    0.807    0.651    0.735    1.782    1.587    0.280    1.112
0.840    1.019    0.662    1.126    0.948    0.948    1.126    1.555    0.143    0.215
0.678    0.166    0.294    0.729    0.601    0.345    2.136    0.550    0.678    1.445
0.746    0.459    0.459    0.770    0.852    0.729    1.794    1.401    0.090    0.991
0.662    0.469    0.662    0.334    0.880    0.977    1.941    1.337    0.437    0.566
1.628    0.018    0.201    0.567    1.116    0.714    1.299    1.079    0.714    0.933
1.019    0.844    0.078    1.058    1.072    0.101    1.219    1.509    0.667    0.869
1.001    0.152    0.404    0.953    0.887    1.049    1.327    1.522    0.185    0.953
0.288    0.445    0.351    0.621    0.777    0.464    1.937    1.699    0.853    0.163
1.028    0.430    1.083    0.474    1.049    0.142    1.596    1.448    0.711    0.301
0.790    0.635    0.555    0.988    0.717    0.443    1.811    1.600    0.004    0.375 ];
x=x';
stdr=std(x);
[n,m]=size(x);
sddata=x./stdr(ones(n,1),:);
[p,princ,egenvalue]=princomp(sddata)
p5=p(:,1:5)
sc=princ(:,1:5)
egenvalue
per=100*egenvalue/sum(egenvalue)
```

Fig. 1: Matlab implementation code of Principal component analysis

```
p5 =

    0.2539    0.2798    0.0913    0.1682   -0.2369
    0.2389   -0.1272    0.4872   -0.0566   -0.0927
    0.2687    0.0227   -0.4649    0.0211    0.1179
    0.2852   -0.0197    0.2300    0.3119    0.1188
    0.2882   -0.1461   -0.1541   -0.2797   -0.1915
    0.2049    0.5549    0.1239   -0.3284    0.0912
    0.2000   -0.5175   -0.3779    0.0679   -0.1774
    0.3016   -0.0996   -0.0452   -0.2451   -0.1742
    0.2891    0.0332    0.0458    0.2059   -0.4160
    0.2104   -0.4304    0.3627    0.0911    0.3126
    0.2239   -0.0275   -0.1863   -0.1947    0.6824
    0.2664   -0.1267    0.2280   -0.4146   -0.0570
    0.2751    0.1917   -0.2615    0.2686   -0.0422
    0.2386    0.1047    0.0717    0.5202    0.2388
    0.2956    0.2163   -0.0869   -0.1295    0.0435
```

Fig. 2: First five principal components' factor

```
sc =

    0.3979   -0.8441    1.9237    0.2786    1.0787
   -2.5200    1.6928   -0.6248   -0.2835    0.0452
   -2.8767    0.6474    0.3967    0.8691   -0.6983
   -0.8345    0.5149   -1.4322   -1.3057    0.8222
    0.5632   -0.0786    0.3797    0.3268    0.8692
   -1.1884    0.4022    1.1243   -0.6155   -1.7447
    6.3046   -0.4796   -1.1388    0.8580   -0.8649
    4.4112    1.2548    0.6295   -0.5579    0.4442
   -2.9678   -0.5330   -0.8993    1.6231    0.3844
   -1.2895   -2.5768   -0.3587   -1.1931   -0.3359
```

Fig. 3: Scores of first five principal components

The output results of eigenvalue and contribution rate is displayed as shown in Fig. 4.

By the output results: the first principal component CR is 64.36%, the second principal component CR is 9.75%, the third principal component CR is 7.65%, the fourth principal component CR is 6.08% and the fifth principal component CR is 5.43%; the cumulative contribution rate of the first five principal components reaches 93.27%, thus we can select the first five factors, five factors are indicated by m_i, (i = 1, 2,…,) in Eq. 2 below:

$$[p5]^T \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \\ z_1 \\ z_2 \\ w_1 \\ w_2 \\ w_3 \\ w_4 \end{pmatrix} = (m_1 \quad m_2 \quad m_3 \quad m_4 \quad m_5)^T \tag{2}$$

Then five principle components, weighted by their contribution rate the respective score in ten cities can be derived, the total score sorting is shown as Fig. 5.

```
egenvalue =                 per =

    9.6542                     64.3613
    1.4621                      9.7472
    1.1487                      7.6580
    0.9121                      6.0808
    0.8149                      5.4328
    0.4365                      2.9101
    0.3144                      2.0959
    0.1999                      1.3329
    0.0572                      0.3810
         0                           0
         0                           0
         0                           0
         0                           0
         0                           0
         0                           0
```

Fig. 4: Output results of eigenvalue and contribution rate

```
>> F=0.643616*princ(:,1)+0.0975*princ(:,2)+0.0765*princ(:,3)+0.0608*princ(:,4)+0.0543*princ(:,5)

F =

    0.3965
   -1.5195
   -1.7431
   -0.6312
    0.4509
   -0.7718
    3.9291
    2.9998
   -1.9113
   -1.1994
```

Fig. 5: Ten total score of the city by serial number

The descending order is 7->8->5->1->4->6->10->2->3->9, the study uses the scientific method and reliable data as a basis and obtains above rankings.

CONCLUSION

This study does a good explanation for the tourism competitiveness of the ski tourism destination using the principal component analysis method and does theoretical explanation on the index evaluation of the future tourist attraction; The study results show that the 10 domestic large resorts ranking from front to back are: Beijing Qiao Bo indoor Ski Dome->Jilin Beida Lake Ski Resort->Heilongjiang Yabuli Sunshine Resort->Heilongjiang Yabuli Resort->Beijing Jundushan Ski Resort->Xinjiang Silk Road->Jilin Changbai Mountain Ski Resort->Beijing Nanshan Ski Resort->Hebei Wanlong Ski Resort->Hebei Duolemeidi Ski Resort. Through research, Matlab software programming achieves a good principal component analysis algorithm; the program has the versatility which can not only be applied in this study, but also be widely used in various fields.

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