

<http://ansinet.com/itj>

ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSI*net*

Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Research on Evaluation Index System of Chinese Leisure Sports Industry

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Abstract: This study, by concluding relative global studies on leisure sports industry, analyzes the relevant conceptions and theories and combines the basic features and principles of index system. It is classified into 12 indexes, from four factors which are government functions, regional economy, population and sport resources, to build and comprehend the evaluation index system for comprehensive strength and overall evaluate the comprehensive strength of leisure sports industry. Through factor analysis which includes development factor, government factor, potential factor and comprehensive strength, study quantitatively the development of leisure sports industry of 13 provinces and municipalities, indicating the obvious effects of geographic locations and economical development on the development of leisure sports industry. Therefore propose advice for the development of our leisure sports industry.

Key words: Leisure sports industry, factor analysis, evaluation index

INTRODUCTION

Nowadays, people pay more and more attention to pursue self-developing rights like improvements of living qualities, happiness and freedom, etc. Leisure becomes an important part, closely related to sports. So the leisure sports generate and become larger and larger. With the development of economic society and promotion of post Olympic effect, leisure sports industry becomes one of important industries to propel the development of economic society (Rohm *et al.*, 2006). With its unique characters it is about leisure sports and to provide varied products and services in order to propel the transformation of more positive and better life style (Zhang and Feng, 2013). Generally speaking, we hold that leisure sports industry mainly includes three directions which are sports matching performing, outdoor sport and fitness recreation. Obviously it also includes sports goods industry and leisure sports tourism, etc (Liu, 1996). The development of our sports industry is quite rapidly. As an emerging industry, leisure sports industry is just a part of sports industry which has gained much attention of western countries as an important part of national economy. However, we are just getting started (Cui, 2013). Our development of leisure sports industry is still far-behind, in the primary stage which have many problems to progress (Tan, 2013). However our studies on leisure sports industry are not thorough, of which most focus on some basic conceptions and theories (Twan and Jeff, 2003). For example, Liu Yimin proposes leisure sports are combination between leisure activities and sports which is not aiming at competition (Chen, 2001); Chen Yongjun studies leisure sports from the perspective

of consumption characteristics (Moon *et al.*, 1998); Jing Zhihun and Lv Zhigang considers the main factor is economy and predicts “leisure sports doom to be one of important bases for the development of our economic society in the future” (Hu and Zou, 2009).

All in all, few scholars study in the aspects of comprehensive strength. This study studies the comprehensive strength of leisure sports industry, functioning factor analysis from multivariate statistics and provides some references for governments and relevant enterprises. We wish it can perfect the theoretic system of our leisure sports industry.

THEORETICAL BASES OF FACTOR ANALYSIS

Factor analysis is a statistical method, mainly extracting common factor from variable group. Its description is shown as follows (Jing and Lv, 2004).

Imagine N samples and P indexes, $X = (X_1, X_2, \dots, X_p)^T$ is observable random variable and $F = (F_1, F_2, \dots, F_m)^T$ is unobservable random variable, then the model is:

$$X_1 = a_{11}F_1 + a_{12}F_2 + \dots + a_{1m}F_m + \epsilon_1 \quad (1)$$

$$X_2 = a_{21}F_1 + a_{22}F_2 + \dots + a_{2m}F_m + \epsilon_2$$

...

$$X_p = a_{p1}F_1 + a_{p2}F_2 + \dots + a_{pm}F_m + \epsilon_p$$

It is called factor analysis model its matrix form is:

$$X = AF + \epsilon \quad (2)$$

We call F as common factor of X and matrix $A = (a_{ij})$ as component matrix. ϵ is special factor of X, usually

ignored in practice. It is proved, a_{ij} in the component matrix is the correlation coefficient between i th variable and j th factor, reflecting the effects of i th variable on j th factor. $F_1, F_2, \dots, F_m)^T$ is called as main factor or common factor and the content with big load can indicate the significance of factors.

Imagine common factor F is described by the X linear combination:

$$F_i = b_{i1}X_1 + b_{i2}X_2 + \dots + b_{in}X_n \quad (i = 1, 2, \dots, m) \quad (3)$$

Equation 3 is called factor score function for calculating common sample score of each sample. F_i is the score of i th factor. This paper utilizes SPSS software to analyze and process data.

ANALYSIS OF COMPREHENSIVE STRENGTH FACTOR OF OUR LEISURE SPORTS INDUSTRY

This study conducts statistics on 12 indexes (data originates from 2011 statistical yearbook <http://www.stats.gov.cn>) from 13 provinces and municipals (Sichuan, Beijing, Shanghai, Chongqing, Liaoning, Guangdong, Fujian, Zhejiang, Jiangsu, Shandong, Hubei, Guangxi, Yunan). The evaluation indexes are shown as Table 1.

In the following, we analyze the situation of leisure sports industry through factor analysis and evaluate its comprehensive strength.

Standardization primary data: Imagine primary data $X = [X_{ij}]_{n \times p}$, n is the number of samples and p is the number of variables. To comprehensively summary the indexes, we should conduct standardization (zero dimension). The result is shown as Table 2.

The data after standardizing:

$$y_{ij} = (x_{ij} - \bar{x}_j) / d_j \quad (i = 1, 2, \dots, n; j = 1, 2, \dots, p) \quad (4)$$

Arithmetic square root for j th index:

$$\bar{x}_j = \frac{1}{n} \sum_{i=1}^n x_{ij} \quad (5)$$

Sample standard deviation:

$$d_j = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_{ij} - \bar{x}_j)^2} \quad (6)$$

Build correlation coefficient matrix R : Correlation coefficient matrix $R = [r_{ij}]_{p \times p}$, then:

$$r_{ij} = \frac{\sum_{a=1}^n (x_{ai} - \bar{x}_i)(x_{aj} - \bar{x}_j)}{\sqrt{\sum_{a=1}^n (x_{ai} - \bar{x}_i)^2} \sqrt{\sum_{a=1}^n (x_{aj} - \bar{x}_j)^2}} = \frac{1}{n} \sum_{a=1}^n x_{ai} \cdot x_{aj} \quad (7)$$

Due to equation 7, the correlation coefficient matrix is solved. Therefore we find strong correlation exists among varied indexes.

Table 1: Evaluation index system of leisure sports industry

Target layer	Factor layer	Index layer
Comprehensive strength of leisure sports industry	Economy	PGDB X_1
		Engel's coefficient X_2
		PCDI X_3
	Population	Employment number X_4
		Ground area per capita X_5
		Park land per capita X_6
		Fitness equipments per hundred families X_7
	Leisure sports resources	Performance number of relevant studies (per year) X_8
		Lottery income X_9
		GDP of sports goods industry X_{10}
		Transportation density X_{11}
		Capacity of government support X_{12}

Table 2: Standardized data

Region	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}
Sichuan	-1.037	0.935	-1.027	1.692	-0.549	-0.424	-1.634	-0.061	-0.290	-0.695	-1.126	-0.886
Beijing	1.780	-1.482	1.425	1.033	0.940	0.061	1.386	1.526	-0.231	-0.690	0.508	1.859
Shanghai	1.790	-1.025	1.923	0.755	-1.889	-1.834	1.071	1.872	-0.823	0.189	1.946	-0.401
Chongqing	-0.710	0.314	-0.654	-0.862	-0.582	-0.582	0.898	-0.564	0.115	-0.703	0.791	-0.850
Liaoning	0.052	-0.503	-0.622	-0.827	0.122	-0.423	-0.183	-0.060	-0.516	-0.614	-0.778	-0.186
Guangdong	0.175	-0.045	0.493	1.130	2.118	0.942	-0.278	0.556	1.491	0.892	0.007	2.128
Fujian	-0.068	0.8693	0.111	-0.133	-0.271	-0.071	0.682	-1.031	0.001	-0.443	-0.712	-0.509
Zhejiang	0.533	-0.764	1.116	0.721	0.598	-0.027	0.719	-0.678	0.622	0.659	0.072	0.944
Jiangsu	0.591	-0.045	0.320	-0.938	-0.663	0.942	0.257	-0.502	2.201	1.025	0.900	-0.133
Shandong	-0.012	-1.482	-0.219	0.360	-0.418	2.044	1.298	-0.326	0.656	2.458	0.878	-0.168
Hubei	-0.691	0.574	-0.920	-0.473	-0.680	-0.688	-1.158	0.997	-0.671	-0.687	0.094	-0.742
Guangxi	-1.087	1.065	-1.029	-1.278	-0.516	-0.600	-0.307	-1.296	-1.219	-0.708	-1.409	-0.455
Yunnan	-1.316	1.588	-0.919	-1.181	-0.794	-0.821	-1.290	-1.120	-0.190	-0.711	-1.170	-0.600

Table 3: R eigenvalue and accumulative contribution rate

Index	Eigenvalue	Contribution rate	Accumulative contribution rate
PGDB X_1	5.911	50.101	50.101
Engel's coefficient X_2	2.400	18.937	69.038
PCDI X_3	1.232	12.103	81.141
Employment number X_4	0.801	9.782	90.923
Ground area per capita X_5	0.524	4.214	95.137
Park land per capita X_6	0.500	2.281	97.418
Fitness equipments per hundred families X_7	0.328	1.431	98.849
Performance number of relevant studies (per year) X_8	0.164	0.811	99.660
Lottery income X_9	0.122	0.324	99.984
GDP of sports goods industry X_{10}	0.028	0.011	99.995
Transportation density X_{11}	0.001	0.005	100.000
Capacity of government support X_{12}	0.000	0.000	100.000

Table 5: Naming main factors

Main factor	High load index	Significance	Name
Factor one F_1	X_1 : PGDB X_2 : Engel's coefficient X_3 : PCDI X_7 : Fitness equipments per hundred families X_{11} : Transportation density	Effects of economy and society	Growth factor
Factor two F_2	X_4 : Employment number X_5 : Ground area per capita X_{12} : Capacity of government support	Effects of government	Government factor
Factor three F_3	X_6 : Park land per capita X_9 : Lottery income X_{10} : GDP of sports goods industry	Effects of relevant industries and facilities	Potential factor

Solve eigenvalue and eigenvector of R: Set $|R-\lambda I| = 0$ and get eigenvalue λ_i ($i = 1, 2, \dots, 12$) contribution rate:

$$F = 0.501F_1 + 0.189F_2 + 0.121F_3 \quad (9)$$

Utilizing equation (9), get comprehensive scores and total ranks by linear weighted sum of contribution rates of factors, shown as Table 7.

The Table 7 shows:

and result is shown as Table 3.

Factor naming: Table 4 shows the correlation and correlation value among varied variables. The result is shown as Table 5.

Obviously, to F_1 X_1 X_2 X_3 X_7 X_{11} have bigger loads which reflect the effects of economy and society on comprehensive strength of leisure sports industry, named growth factor.

To F_2 X_4 X_5 X_{12} have bigger loads which indicates effects of government, named government factor.

To F_3 , X_6 X_9 X_{10} , have bigger loads which demonstrates influences of relevant industries and facilities, named potential factor.

Factor grade: After confirming three common factors, deduce equation 8 in Thomason regression method:

$$F_j = b_{j0} + b_{j1}X_1 + \dots + b_{jp}X_{jp} \quad j = 1, 2, \dots, m) \quad (8)$$

Solve factor grades, shown as Table 6 (Note: the scores and signs only indicate the relative position between the region and average level, not the minus level).

- The contribution rate of growth factor is 0.501, indicating the greatest effects. The scores of growth factors in Shanghai, Beijing, Shandong, Zhejiang, Jiangsu and Chongqing are greater than 0, demonstrating their levels are higher than average level. Therefore, the effects of growth in other regions are under average level
- The contribution rate of government factor is 0.189 which is mediate. The scores of government factors in Shanghai, Beijing, Zhejiang, Guangdong and Sichuan are greater than 0, demonstrating their levels are higher than average level. Therefore, the effects of government in other eight regions are under average level. Although not the most important, in reality, effects of government can't be ignored. Its policy and help are considerably important for the development of emerging industry
- The contribution rate of potential factor is 0.121 which has the minimal effects. The scores of potential factors in Shandong, Zhejiang, Jiangsu, Guangdong and Fujian are greater than 0, demonstrating their levels are higher than average

Table 6: factor score coefficient matrix

Index	F ₁	F ₂	F ₃
PGDB X ₁	0.199	0.028	-0.059
Engel's coefficient X ₂	-0.230	0.071	-0.040
PCDI X ₃	0.143	0.091	-0.042
Employment number X ₄	-0.168	0.397	0.220
Ground area per capita X ₅	-0.057	0.329	-0.085
Park land per capita X ₆	-0.025	-0.059	0.352
Fitness equipments per hundred families X ₇	0.264	-0.150	0.053
Performance number of relevant studies (per year) X ₈	0.125	0.111	-2.207
Lottery income X ₉	-0.135	0.153	0.340
GDP of sports goods industry X ₁₀	0.900	-0.096	0.298
Transportation density X ₁₁	0.341	-0.231	0.270
Capacity of government support X ₁₂	-0.201	0.419	0.139

Table 7: Scores and ranks

Region	F ₁		F ₂		F ₃		Rank	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Shanghai	2.16	1	0.47	4	-1.60	13	1.19	1
Beijing	1.01	2	1.44	2	-0.42	8	0.91	2
Shandong	1.00	3	-0.89	12	1.89	1	0.60	3
Zhejiang	0.25	5	0.38	5	0.73	4	0.34	4
Jiangsu	0.39	4	-0.72	10	1.45	2	0.29	5
Guangdong	-0.77	10	2.27	1	1.09	3	0.21	6
Liaoning	-0.09	8	-0.25	6	-0.50	10	-0.17	7
Chongqing	0.22	6	-1.18	13	-0.35	6	-0.18	8
Fujian	-0.29	9	-0.29	7	0.03	5	-0.22	9
Hubei	-0.02	7	-0.52	8	-0.95	12	-0.38	10
Sichuan	-1.48	13	0.61	3	-0.47	9	-0.79	11
Guangxi	-0.79	11	-0.77	11	-0.53	11	-0.80	12
Yunnan	-1.39	12	-0.56	9	-0.36	7	-0.94	13

level. Therefore, the effects of government in other eight regions are under average level.

market system by managing regularly and make sure the order competitions of leisure sports industry.

CONCLUSION

By means of factor analysis, this paper studies our comprehensive strength of leisure sports industry in 13 provinces and municipals by building evaluation index system and get the following conclusion: the effects of economy and geographic locations are quite obvious. Although owning strong power but the potential factors of Shanghai and Beijing is low, even Shanghai is the last which indicates the region with strong power has little improvement space. On the contrary, scores of potential factor of eastern coastal regions are high, such as Shandong, Zhejiang, Jiangsu, Guangdong, Fujian, etc which demonstrates such regions maybe become the gold area for developing leisure sports industry in the future. They have great growth space and potentials. The comprehensive strengths of 13 provinces and municipals are imbalanced, with lots of backward regions.

Propose appropriate supporting policies, such as tax preference, to attract relevant investments from enterprises; support the healthy development of small and medium-sided enterprises through finance. Combining with different characteristics of leisure sports industry in 13 provinces and municipals, build

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