ISSN : 0974 - 7435 Volume 10 Issue 15

2014

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(15), 2014 [8323-8329]

The study of governmental functions transforming and public sports service system based on principal component analysis

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ABSTRACT

Sport is an important constituent part of present social culture development. The effect of government is essential, and the service form of public sports is the principal form to achieve the sport function of government. This article clarifies the evaluation from the aspects of public sports service, financial input, and location of governmental functions and so on. And the text ensures three levels index's evaluation system by the means of cluster analysis of the application of molecular analysis aiming at the 18 principal factors. To obtain the rank of the importance in order to provide a reference to the study of governmental functions transforming and public sports service system.

KEYWORDS

Governmental functions; Public sports service; Principal component analysis; Cluster analysis.

INTRODUCTION

Nowadays, with the further reform and opening and development of Chinese economy, all trades and professions are functioning stable and orderly. But it still is a weakness for government on the focus on public sports. So it is very important to set up a complete comprehensive evaluation system of public sports service.

There are plenty of study achievements of former people on the governmental functions and public sports service. For example, Jiang Jiming and other people's analysis of research on the sports public service quality put forward a method to use TOPSIS to access the sports public service quality of 34 cities. And they found out that around the east part of our city, the satisfaction on sports public service was obviously higher than around the west. Yang Qian (2000) studied the relationship between sports industry and economy with grey correlation analysis method, and she pointed out that sports industry sub factor-fitness and entertainment's correlation degree was highest. And she said that national economy has great driving effect on development of sports industry. In 2012, Yang Qian compared and analyzed the statistical data, and did quantification analysis on the benefits of sports and relative industries to provide quantitative basis for the optimization of structure.

This article does deep study on the basis of above with cluster analysis and other methods. This study will contribute to the relative studies of sports public service and governmental functions transforming.

ESTABLISHMENT OF GOVERNMENT'S PUBLIC SPORTS SERVICE SYSTEM

With the further optimization of the idea of service-oriented government, it points out the more clear direction to achieve the idea that government services social and citizens much better. So it is especially important to balance the equilibrium point between government and individuals and organizations' market about sports industry and sports regulation which needs the government to achieve step by step the policy change that education supplemented by management, and do its best to adjust to the social better.

In order to make this article own scientific nature and rationality, we take the statistics of China National Sports Bureau and the State Statistical Yearbook and others as the objects of study, and combine the research results of scholars and experts to get conclusion. In order to ensure the high reliability of questionnaire survey, we adopt *Cronbach'sa*'s coefficient as our standard. If the result makes α very large, it means high consistency and high reliability. And this text's *Cronbach'sa* is 0.85 after the test which proves the good consistency. This article sets 33 evaluation factors after combining with index of former experts and scholars' documents. But because of the relative principal that index of reference documentation's mean value is ≥ 2.5, this article selects 18 kinds of index, as TABLE 1:

ESTABLISHMENT AND ANALYSIS OF HIERARCHICAL STRUCTURE MODEL

Theoretical analysis of the principal component analysis model

Via above text, this article can get the three levels index system of sport functions evaluation of government. Therein, the analysis of each level's factors is picked up from upper grade. The weight is the reasonable evaluation method through the teamwork between the factor analysis and hierarchy analysis.

This article confirms weight's distribution rates through principal component analysis, and its corresponding theory is as following:

Assumed that there are n indexes and p corresponding variables to each index, so we have a matrix of order $\mathrm{n}\times\mathrm{p}$:

$$X=\begin{cases} x_{11} & x_{12} & \cdots & x_{1p} \\ x_{21} & x_{22} & \cdots & x_{2p} \\ \cdots & \cdots & \cdots & \cdots \\ x_{n1} & x_{n2} & \cdots & x_{np} \end{cases}$$

If we definite the original indexes as $\mathrm{x}_1, \mathrm{x}_2, \ldots, \mathrm{x}_\mathrm{p}$, and we comprehensively analyze them. So the corresponding indexes are: $\mathrm{z}_1, \mathrm{z}_2, \ldots, \mathrm{zm}\ (\mathrm{m}\leq\mathrm{p})$, then:

TABLE 1 : Evaluation index of governmental sport functions

First level index	Second level index	Third level index
Evaluation index of governmental sport functions U	Government duties T_1	The construction of sports venues K_1
		Echelon construction management team K_2
		Administrative capacity K_3
		Financial input K_4
		Structural establishment K_5
		Functional programming K_6
		Group influence K_7
		Scale of sports industry K_8
	All kinds of sports organizational performance T_2	Sports events K_9
		Strength of competitive sports K_{10}
		Development of community sports K_{11}
		Development of school physical education K_{12}
		Sports environment K_{13}
	Soft power T_3	Convenience of sports participation K_{14}
		Sports law K_{15}
		Service level K_{16}
	Physical health T_4	Number of sports population K_{17}
		Public health K_{18}

$$\begin{cases} z_1 = l_{11}x_1 + l_{12}x_2 + \cdots, + l_{1p}x_p \\ z_2 = l_{21}x_1 + l_{22}x_2 + \cdots, + l_{2p}x_p \\ \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \\ z_m = l_{m1}x_1 + l_{m2}x_2 + \cdots, + l_{mp}x_p \end{cases}$$

The above formula's l_{ij} 's value should meet the require:

Among z_1 , z_2 , z_{m-1}, z_m is a lonely variable and has no relation with others; z1, z2, …, z_m is respectively called as the corresponding first, second…m-th principal component as for the original index x_1 , x_2 ,.., x_p . And the corresponding variance of z_2 , z_3 ,.. , z_m is a decreasing situation. In addition, z1 is the one that has the largest proportion.

There is no relationship between z_i ,and $z_j (i \neq j ; i , j = 1 2 ,.. , m)$.

From above text, we can respectively find $x(j = 1 2 ,.. , p)$,'s principal components $z_i (i = 1 2 ,.. , m)$,'s weight $l_{ij} (i = 1 2 ,.. , m ; j = 1 2 ,.. , p)$, so we can get the corresponding eigenvectors of matrix about x_1 , x_2 , … , x_p

The relative calculation of the principal component analysis

The calculation about principle component analysis is as following:

As for relative coefficient, first we need to calculate the corresponding matrix, as following:

$$R=\begin{cases} r_{11} & r_{12} & \cdots & r_{1p} \\ r_{21} & r_{22} & \cdots & r_{2p} \\ \cdots & \cdots & \cdots & \cdots \\ r_{p1} & r_{p2} & \cdots & r_{pp} \end{cases}$$

Among the above formula, x_i and x_j's original variables are relative coefficient $r_{ij}(i, j=1,2,\ldots, p)$, so its calculation formula mainly is:

$$r_{ij}=\frac{\sum_{k=1}^{n}(x_{ki}-\bar{x}_i)(x_{ki}-\bar{x}_j)}{\sqrt{\sum_{k=1}^{n}(x_{ki}-\bar{x}_i)^2(x_{ki}-\bar{x}_j)^2}}$$

Obtaining of eigenvector and eigenvalue

As for $|\lambda I-R|=0$, to obtain corresponding eigenvalue λ_i ($i=1,2,\ldots, p$), and to relatively arrange $\lambda_1 \geq \lambda_2 \geq \ldots \geq \lambda_p \geq 0$; then to obtain the corresponding eigenvector $e_i(i=1,2,\cdots, p)$

Calculating principal component contribution rate and accumulative contribution rate

Principal component contribution rate:

$$r_i / \sum_{k=1}^{p}\gamma_k (i=1,2,\cdots, p)$$

So the corresponding accumulative contribution rate:

$$\sum_{k=1}^{m}\gamma_k / \sum_{k=1}^{p}\gamma_k$$

Above all, we know the steps of principal component analysis to obtain objective weight. Next it's the concrete application.

CONFIRMATION OF THE INDEX MODEL

Through KMO method of factor analysis to test, the result is 0.879. So it proves that factor analysis can be adopted and this analysis is effective. According to the relative statistics of each index, we can get cumulative rate TABLE 2 by the means of principal component analysis.

TABLE 2 : Eigenvalue and contribution rate

Index	Characteristic root	Cumulative rate (100%)	Accumulative contribution rate (100%)
1	4.523	26.104	63.214
2	6.958	36.829	36.579
3	1.461	7.126	84.071
4	2.719	13.997	77.161

Factor loading calculation model

According to the factor loading calculation model, variance maximization rotation was used to original loads, and then we got results as TABLE 3:

TABLE 3 : The factor loading matrix and factor grade coefficient matrix after rotation

Variable	Factor loading matrix				Factor grade coefficient matrix			
	F1	F2	F3	F4	F1	F2	F3	F4
Functional programming Y1	0.926	0.214	0.049	0.145	0.237	-0.022	0.009	-0.045
Group influence Y2	0.934	0.215	0.051	0.165	0.227	-0.023	-0.012	-0.041
Scale of sports industry Y3	0.958	-0.198	0.055	0.158	0.237	-0.019	-0.011	-0.049
Sports population Y4	0.920	0.189	0.044	0.169	0.215	-0.026	-0.014	-0.039
Development of community sports Y5	0.080	0.325	0.941	0.045	-0.045	0.114	0.489	-0.035
Sports law Y6	0.842	0.489	-0.123	0.184	0.253	0.167	-0.082	0.059
Management of team construction Y7	-0.005	0.454	0.924	0.085	-0.060	0.170	0.498	0.006
Public health Y8	0.052	0.070	0.098	0.847	-0.025	-0.004	0.032	0.512
Development of school physical education Y9	0.063	0.724	-0.025	-0.085	-0.035	0.279	-0.045	-0.523
Service level Y10	0.165	0.862	0.023	0.076	-0.086	0.336	0.019	-0.115
Construction of sports venues Y11	0.876	-0.041	-0.086	0.198	0.432	-0.015	-0.056	0.110
Convenience of sports participation Y12	0.164	0.221	0.865	0.069	-0.091	-0.014	0.462	0.059
Administrational capacity Y13	0.054	-0.006	0.165	0.809	0.442	-0.017	0.081	0.461
Strength of competitive sports Y14	-0.084	0.936	-0.007	0.055	-0.078	0.356	-0.003	0.039
Sports events Y15	0.010	0.898	0.005	-0.041	0.005	0.341	-0.025	-0.089
Financial input Y16	0.112	0.812	0.142	0.015	-0.031	0.221	0.049	-0.049
Structural establishment Y17	0.114	0.798	0.071	0.046	-0.023	0.298	0.023	-0.036
Sports environment Y18	0.055	-0.012	0.812	0.089	0.006	-0.016	0.468	0.045

Through TABLE 3, we can see that the comparatively large loads on physical health of government are Y8, Y13; the relatively large loads on government's soft power are Y5, Y7, Y12, Y18; the comparatively large loads on government's duties are Y1, Y12, Y3, Y4, Y6, Y11. So we can get corresponding second level indexes: physical health, soft power, all kinds of sports organizations, government's duties.

From the above mentioned, we can respectively gain the four indexes' corresponding eigenvalues: $1.278\ 2.676, 4.843, 7.071$. Through the hierarchy analysis we can get each index's contribution rate: $0.080, 0.170, 0.306, 0.445$. Therefore we can get evaluation index about governmental sports function:

$$F = 0.080F1 + 0.170F2 + 0.306F3 + 0.445F4$$

From TABLE 3 we can respectively get each factor's coefficient matrix, and we put use the matrix to gat each variable's monitoring factor's grade:

$$F1 = 0.237Y1 + 0.227Y2 + 0.237Y3 + \cdots - 0.023Y17 + 0.006Y18$$

$$F2 = -0.022Y1 - 0.023Y2 - 0.019Y3 + \cdots + 0.298Y17 - 0.016Y18$$

$$F3 = 0.009Y1 - 0.012Y2 - 0.011Y3 + \cdots + 0.023Y17 + 0.468Y18$$

$$F4 = -0.045Y1 - 0.041Y2 - 0.049Y3 + \cdots + -0.036Y17 + 0.045Y18$$

Thus we can put each component into the evaluation index of governmental sport function:

$$F = 0.108895Y1 - 0.010Y2 - 0.011Y3 + 0.105961Y4 + 0.054157Y5 + 0.162564Y6 +$$
$$0.069294Y7 + 0.070954Y8 + 0.047463Y9 + 0.0833101Y10 + 0.0191482Y11 +$$
$$0.001918Y12 + 0.080221Y13 + 0.098721Y14 + 0.063754Y15 + 0.05065Y16 +$$
$$0.0754624Y17 + 0.041920Y18$$

Through above calculation we can respectively obtain the evaluation index system of governmental sport function, as TABLE 4:

TABLE 4 : The evaluation index system of government sports function

First level index	Second level index	Third level index
U	$T_1(0.445)$	$K_1(0.138)$
		$K_2(0.137)$
		$K_3(0.134)$
		$K_4(0.136)$
		$K_5(0.207)$
	$T_2(0.306)$	$K_6(0.246)$
		$K_7(0.113)$
		$K_8(0.198)$
		$K_9(0.235)$
		$K_{10}(0.152)$
	$T_3(0.167)$	$K_{11}(0.121)$
		$K_{12}(0.188)$
		$K_{13}(0.325)$
		$K_{14}(0.413)$
		$K_{15}(0.012)$
	$T_4(0.082)$	$K_{16}(0.253)$
		$K_{17}(0.481)$
		$K_{18}(0.528)$

In order to clearly show the relationship of weights of governmental sport function, we can use a bar diagram to display:

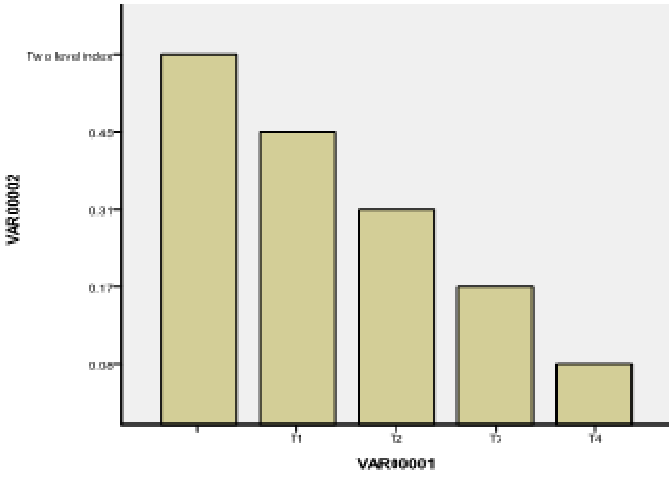

Figure 1 : Two level index

Above figure is the weight analysis chart of second level index. In Figure 1 we can find out the rank of each index. After that, we analyzed the weight of third level index, and we drew Figure 2:

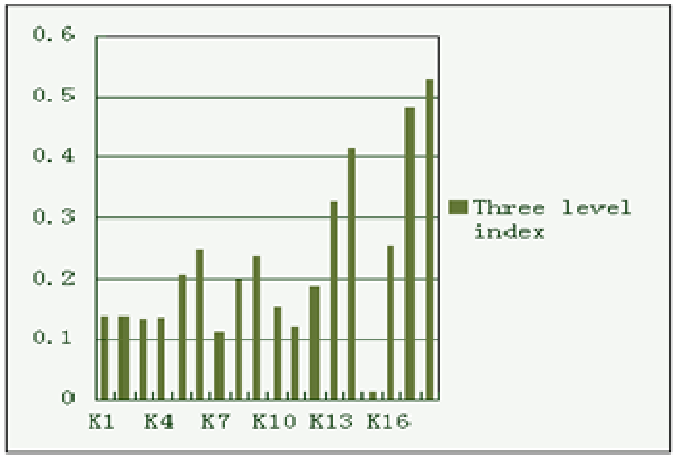

Figure 2 : Three level index

Via the third level index, we can get respectively each index's rank.

CONCLUSION

This text takes the indexes of public sports service system as objects of the study, and it analyzes the indexes deeply. And the text studies factors that affect public sports service. Through the cluster analysis, principal component analysis of factor analysis, we can ensure the weights. Besides, we rank the weight of each index to get the most important one that government duties and sport environment is respectively the most important in second, third level index.

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