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Principal component analysis-based government functions transformation and public sports service system interactive development research

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ABSTRACT

Sports as one of important parts in current social culture development, on which government effects are indispensible, public sports service form is a form that government mainly implements sports functions. The paper mainly carries out statement evaluation from public sports service, financial investment, government functions positioning and other directions, applies factor analysis's clustering analysis to define three levels indicators evaluation system targeted main factors of the 18th National Congress of the Communist Party of China involved from them, and gets their importance rank, which provides a reference for future government functions' transformation and public sports service research aspects.

KEYWORDS

Government functions;
Public sports service;
Principal component analysis;
Factor analysis.

INTRODUCTION

Nowadays, opening-up and reform constantly deepen and our country economy is constantly developing, all walks of life are running steady and orderly, but there is shortage in public sports emphasis, establish a set of full public sports service comprehensive evaluation system is particular important.

Based on government functions and public sports service aspect researches, formers researches have got many achievements, such as: Ji Jiang-Ming and others in analysis of sports public service quality investigation, for sports service satisfaction degree evaluation, they proposed to apply a kind of entropy weight *TOPSIS* method to evaluate thirty-four cities' sports public service quality, final results showed that Chinese eastern developed regions satisfaction degree on sports public service was obviously higher than that of western part; Yang Qian (2011)used grey relational analysis method to research on sports industry and economy relations, and pointed out sports industry sub factors fitness and entertainment had highest correlation degree with economy, and national economy played great driving roles in sports industry development, in 2012, Yang Qian made analytic comparison of cohabitation data, carried out quantitative analysis of sports and relative industries efficiency, which provided quantitative evidence for structure optimization;

The paper just on that basis, it carries out deepen research, and utilizes factor analysis's clustering analysis and other methods to research, the research will make contributions to sports public service and gov-

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ernment functions transformation correlation research.

GOVERNMENT PUBLIC SPORTS SERVICE SYSTEM ESTABLISHMENT

With service-oriented government ideal further optimization, to better implement government serving to society, serving to masses, it points out more clearly directions, from which in sports aspect, regarding sports undertakings and sports rules personal and organization's market and government existed some balance points are particularly important, which needs government to gradually implement policies and guidelines transformation that supplements a focus on education service with management, so that better make efforts to adapt to society.

Research methods and objects selection

In order to let paper have more scientificity and rationality, the paper selects national sports bureau, national statistical yearbook and others relative data as the paper research objects, and combines with scholars and experts investigation results to get its conclusion.

Indicator reliability and selection

In the paper, in order to ensure questionnaire reliability, it adopts *Cronbach'sa* coefficient to used as its judgment criterion, if achieved results let α to be great, then it means consistency is very high and then reliability is high, and the paper's *Cronbach'sa* is just 0.85 after verifying, which improves consistency is better. The paper combines with previous researches relative experts and scholars documents' indicators, it totally plans thirty-three evaluation factors, but according to reference documents indicators average value ≥ 2.5 correlation principle, the paper selects eighteen kinds of indicators as following TABLE 1 shows:

HIERARCHICAL STRUCTURE MODEL ESTABLISHMENT AND ANALYSIS

Principal component analysis model theoretical analysis

By above description, the paper can get government sports functions evaluation aspect relative three grades' indicator system, from which, each grade factor analysis is extracting through previous grade, the weight is proceeding through factor analysis and hierarchical analysis common effects that is a reasonable evaluation method.

The paper applies principal component analysis method to define weights' distribution rates, corresponding principles are as following:

If it has n pieces of indicators, corresponding every indicator has p pieces of corresponding variables, so that it becomes a $n \times p$ order matrix form as:

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

If define original indicators as x_1 , x_2 ,.. , x_p , then make synthesizing type analysis of them, then corresponding indicators change into: z_1 , z_2 ,.. , zm ($m \leq p$), then it has:

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

In above formula, l_{ij} values should do:

(1) In z_1 , z_2 , z_{m-1}, z_m is a solitary variable that has no connections with others;z_1, z_2, …, respectively are called as targeted original indicators , corresponding the first, the second, …, the main components, from which corresponding variances are in a kind of diminishing trend, except for that, z_1 is the maximum proportion of them;

(2) z_i, z_j ($i \neq j$; i , j=1 2 ,.. , m), the two should have no connections.

By above description, we can respectively find out x_j (j=1 2 ,.. , p) main components z_i (i=1 2 ,.. , m) corresponding weights l_{ij} (i=1 2 ,.. , m ; j=1 2 ,.. , p) , therefore we can get x_1 , x_2 ,… , x_p correlated matrix corresponding feature vectors values.

TABLE 1 : Government sports functions evaluation indicator system

First grade indicator	Second grade indicator	Third grade indicator
Government sports functions evaluation indicator U	Government functions T_1	Stadium construction K_1
		Management team echelon construction K_2
		Management ability K_3
		Financial investment K_4
		Institution setting K_5
		Functions programming K_6
	Each kind of sports organizations performance T_2	Team impact K_7
		Sports industry scale K_8
		Sports competition hosting K_9
		Competitive sports strength K_{10}
		Community sports development K_{11}
		School sports development K_{12}
	Soft power aspect T_3	Sports environment K_{13}
		Sports participation convenience K_{14}
		Sports law K_{15}
		Service level K_{16}
	Population physical health T_4	Sports population amount K_{17}
		Mass physical state K_{18}

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Relative calculation process for principal component analysis

Regarding principal component analysis method calculation is as following show:

(1) Targeted correlation coefficient, firstly it should calculate corresponding matrixes, as following show:

$$R=\begin{cases} r_{11} & r_{12} & \cdots & r_{1p} \\ r_{21} & r_{22} & \cdots & r_{2p} \\ \cdots & \cdots & \cdots & \cdots \\ r_{p1} & r_{p2} & \cdots & r_{pp} \end{cases} \quad (3)$$

In above formula, x_i and x_j corresponding original variable is correlation coefficient $r_{ij}(i, j=1, 2, \ldots, p)$, then its computational formula is mainly:

$$r_{ij}=\frac{\sum_{k=1}^{n}(x_{ki}-\bar{x}_i)(x_{ki}-\bar{x}_j)}{\sqrt{\sum_{k=1}^{n}(x_{ki}-\bar{x}_i)^2(x_{ki}-\bar{x}_j)^2}} \quad (4)$$

(2) Feature vector, feature value solving

For $|\lambda I-R|=0$, solve corresponding feature value $\lambda_i(i=1, 2, \ldots, p)$, and make corresponding rank on it $\lambda_1 \geq \lambda_2 \geq \ldots \geq \lambda_p \geq 0$; in the following, solve corresponding feature vector $e_i(i=1, 2, \ldots, p)$.

(3) Calculate principal component contribution rate and accumulative contribution rate

Principal component contribution rate:

TABLE 2 : Feature value and contribution rate

Indicator	Feature root	Variance contribution rate (%)	Accumulative contribution rate (%)
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

TABLE 3 : Factor loading matrix and factor score coefficient matrix after rotation

Variable	Factor loading matrix				Factor score coefficient matrix			
	F1	F2	F3	F4	F1	F2	F3	F4
Functions programming Y1	0.926	0.214	0.049	0.145	0.237	-0.022	0.009	-0.045
Team impact Y2	0.934	0.215	0.051	0.165	0.227	-0.023	-0.012	-0.041
Sports industry scale Y3	0.958	-0.198	0.055	0.158	0.237	-0.019	-0.011	-0.049
Sports population amount Y4	0.920	0.189	0.044	0.169	0.215	-0.026	-0.014	-0.039
Community sports development 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 team echelon construction Y7	-0.005	0.454	0.924	0.085	-0.060	0.170	0.498	0.006
Mass physical state Y8	0.052	0.070	0.098	0.847	-0.025	-0.004	0.032	0.512
School sports development 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
Stadium construction Y11	0.876	-0.041	-0.086	0.198	0.432	-0.015	-0.056	0.110
Sports participation convenience Y12	0.164	0.221	0.865	0.069	-0.091	-0.014	0.462	0.059
Management ability Y13	0.054	-0.006	0.165	0.809	0.442	-0.017	0.081	0.461
Competitive sports strength Y14	-0.084	0.936	-0.007	0.055	-0.078	0.356	-0.003	0.039
Sports competition hosting Y15	0.010	0.898	0.005	-0.041	0.005	0.341	-0.025	-0.089
Financial investment Y16	0.112	0.812	0.142	0.015	-0.031	0.221	0.049	-0.049
Institution setting 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

$$r_i / \sum_{k=1}^{p} \gamma_k (i = 1, 2, \cdots, p) \quad (5)$$

Then corresponding accumulative contribution rate:

$$\sum_{k=1}^{m} \gamma_k / \sum_{k=1}^{p} \gamma_k \quad (6)$$

To sum up, it is principal component analysis methods and steps that solve objective weight, in the following carry out concrete application of it.

INDICATOR'S DEFINED MODEL

By utilizing factor analysis's KMO test method to test, its result is 0.879, so it indicates that can make factor analysis, and meanwhile it also shows that factor analysis method is valid, according to each indicator correlation data and by applying principal component analysis method, it gets variance accumulative rate TABLE 2:

Factor loading computation model

According to factor loading model, targeted initial loading, it makes variance maximization rotation, its obtained results is as following TABLE 3 show:

By above TABLE 3, we can get that government larger loading in physical health aspect is in Y8, Y13; government larger loading in soft power aspect is in Y5, Y7, Y12, Y18; government larger loading in each kind of sports organization reliability reflection aspects is in Y9, Y10, Y14, Y15, Y17; government larger loading in self reliability aspect is in Y1, Y12, Y3, Y4, Y6, Y11 so we can get corresponding second grade indicators are population physical health, soft power aspect, each kind of sports organization performance, government functions.

From above description, we can respectively solve four indicators' corresponding feature values are1.278 2.676, 4.843, 7.071, after hierarchical analysis, it can get corresponding each indicator contribution rate: 0.080, 0.170, 0.306, 0.445 , so we can get relative government sports functions evaluation indicator is:

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

By above TABLE 3, we can respectively get each factor component coefficient matrix, and use the matrix, it can respectively get each variable observed factors scores status, that is:

TABLE 4 : Government sports functions evaluation indicator system

First grade indicator	Second grade indicator	Third grade indicator
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)
		K_6 (0. 246)
	T_2 (0. 306)	K_7 (0. 113)
		K_8 (0. 198)
		K_9 (0. 235)
		K_{10} (0. 152)
		K_{11} (0. 121)
		K_{12} (0. 188)
	T_3 (0. 167)	K_{13} (0. 325)
		K_{14} (0. 413)
		K_{15} (0. 012)
		K_{16} (0. 253)
	T_4 (0. 082)	K_{17} (0. 481)
		K_{18} (0. 528)

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

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

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

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

Then, we can respectively input above each component into government functions' evaluation indicators, that:

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

By above calculation process, we can respectively solve government sports functions evaluation indicator system, as following TABLE 4 shows:

In order to more clearly present relative government sports functions weights relations, we can apply bar Figure 1 to more clearly present:

In above Figure 1, it is second grade indicators weights analysis chart, from Figure 1, we can clearly see each indicator ranking status, then we analyze targeted third grade indicators weights, draw Figure as following Figure 2 show:

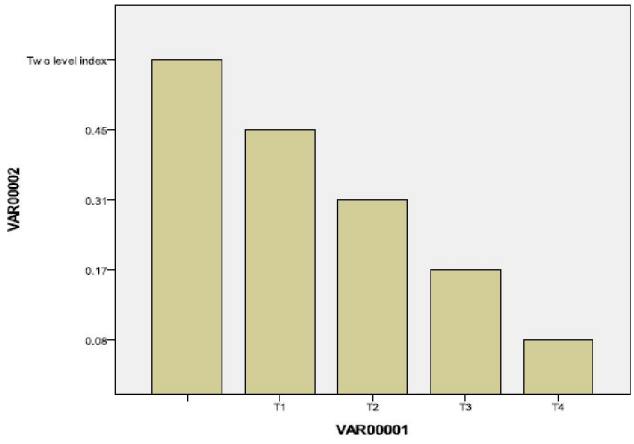

Figure 1 : Two level index

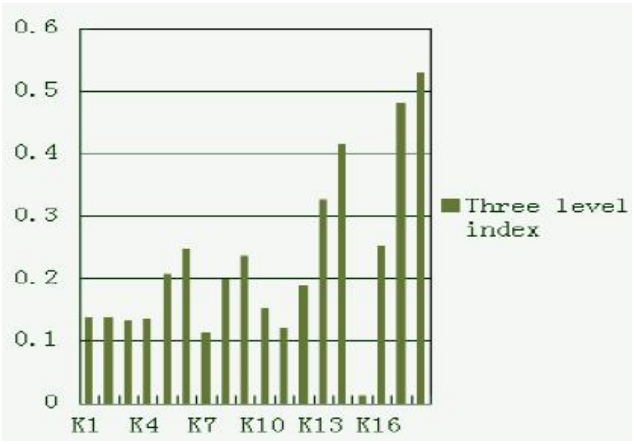

Figure 2 : Three level index

By above Figure 2 third grade indicators, we can respectively solve each indicator ranking status.

CONCLUSION

The paper takes public sports service system each indicator as research objects to make deepen analysis, and targeted public sports service factors, it makes researches, applies factor analysis's clustering analysis, principal component analysis and other methods to objective define weights, in addition, it also ranks each indicator weight and get the most important one from them that during second and third grade indicators, the most important ones are respectively government functions, sports environment.

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