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Research on the development of traditional sports based on analytic hierarchy process

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ABSTRACT

The paper analyzes national traditional sports events system, applies investigation interview, documents literature, mathematical statistics, logic analysis method, analytic hierarchy process and other research methods, it goes deeper analysis and research into national traditional sports events system influential factors and mechanism, respectively analyzes from national traditional sports events spirits, national traditional sports events system layer, as well as national traditional sports events material layer three main directions, finally it gets that in national traditional sports events system, season requirements and location requirements occupied proportions are minimum, while apparatus requirements, event activities forms, organization structure analytic forms as well as activities forms comprehensive proportions are maximum,the conclusion is fair and reasonable, which builds good foundation for the field development in future.

KEYWORDS

National traditional sports; Influence factors; Analytic hierarchy process.

INTRODUCTION

In report of the 17th National Congress of CPC, China should highly carry forward Chinese cultures, especially for successfully hosting the third plenary session of the 18th CPC National Congress, Chinese cultural development has been pushed towards a new climax, chairman Xi pointed out that culture was a kind of soft power that surely could not be ignored, just based on this, research on national traditional sports events is particularly important.

Regarding national traditional sports events researches, formers have made many efforts, such as Cai Zong-Xin had even put forward that national traditional sports was one country or an ethic group as well as certain regions local national sports activities, and meanwhile it was also a kind of national sports entertainment activities; Tang Li-Xu in national traditional sports events hierarchical evaluation system research, he proposed that national sports traditional education development, and meanwhile it also put forward that national traditional sports events bigger proportions influence factors,at the same time it also highlighted national traditional sports cultural development.

The paper just on the basis of former researches, it goes deeper analysis of national traditional events system aspects, by applying multiple methods, it studies national traditional sports events influence factors, finally gets relative ideal results, the research provides theoretical support for researching national traditional sports events system.

NATIONAL TRADITIONAL SPORTS EVENTS SYSTEM ANALYTIC MODEL

China's national traditional sports events are important parts of Chinese nation, research on Chinese national traditional sports events have important effects on carrying forward Chinese culture, the paper just on the basis of the thought, goes deeper research from national traditional sports events spirits, national traditional sports events system layer, as well as national traditional sports events material layer three main directions.

Indicator system definition

By combining with previous scholars, experts' research theories and experiences, it preliminarily defines national traditional sports events system analytic model's three grades indicators as following TABLE 1 shows:

Construct hierarchical structure

Firstly establish an orderly, well-arranged system for problem; firstly establish three layers relations, target layer, medium layer, and scheme layer. Classified layers amount is related to research objects complex degree and details degree. The paper makes quantization on national traditional sports event system based on analytic hierarchy process. Establish target layer, criterion layer, scheme layer relationships, corresponding flow chart is as following Figure 1 shows:

National traditional sports events system analytic hierarchy process

AHP model also calls analytic hierarchy process method, it has stronger logicality and hierarchical structure property, and algorithm is mainly calculating indicators weights. It can apply to comprehensive evaluation system, is a powerful mathematical method that transforms problems into quantitative researches. National traditional sports events system analysis involves multiple reference indicators; the decision-making problem is fit for analytic hierarchy process.

TABLE 1: National traditional sports events system indicator

First grade indicator	Second grade indicator	Third grade indicator
National traditional sports events spirits A1	Event sense of identity U1	Sense of honor on eventsT11
		Satisfaction on eventT12
		National confidenceT13
	Development levelU2	Event development chainT21
		Event participation in commercial sponsorshipT22
		Combination degree with tourist spotsT23
	Organizational communicationU3	Event activity formsT31
		Organizational structural hierarchical propertiesT32
		Activity formT33
	Etiquette U4	ConcordanceT41
		NormalizationT42
		UniversalityT43
National traditional sports events system layer A2	Religious customU5	Religious national rationalityT51
		Religious national charateristicsT52
		Religious strongnessT53
	Organizational system U6	Theoretical system maturityT61
		Rules rationalityT62
		System rationalityT63
	Event national dressU7	Event national universalityT71
		Dress national characteristicsT72
		Matching between dress and eventT73
	Event technological drills U8	Scientificity of event drillsT81
		Interests of event drills T82
		Artistry of event drillsT83
	Event social throngs fitnessU9	Participants age limitationT91
		Participants gender limitationT92
National traditional sports events material layer A3	Even space-time conditionsU10	Number of participantsT93
		Season requirementsT101
		Field requirementT102
	Event action techniques U11	Apparatus requirementsT103
		Action techniques features as easily learning and trainingT111
		Action techniques system completeness T112
		Action techniques scientificityT113

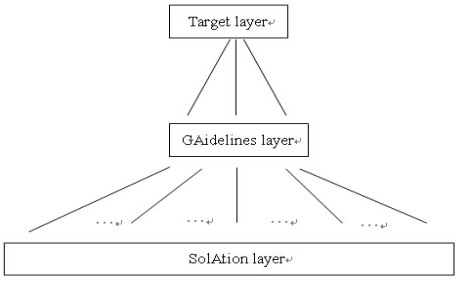

Figure 1 : Hierarchical model

Construct judgment matrix

For above three kinds of indicators, it makes meticulous comparison of the two relative importance to construct judgment matrix. Such as :Take K_i, K_j to make important comparison, the structure is using K_{ij} to express, and then all factors after comparing can get judgment matrix U. Its expression is as following:

$$U=\begin{pmatrix} T_{11} & T_{12} & \mathrm{L} & T_{1j} \\ T_{21} & T_{22} & \mathrm{L} & T_{2j} \\ \mathrm{M} & \mathrm{M} & \mathrm{O} & \mathrm{M} \\ T_{i1} & T_{i2} & \mathrm{L} & T_{ij} \end{pmatrix} \quad \textbf{(2)}$$

K_{ij} represents indicator i and indicator j importance degree value with respect to target (U), paired judgment matrix is $T=(T_{ij})_{n\times n}$, $T_{ij}=\dfrac{1}{T_{ji}};(i\neq j;i,j=1,2,3,\cdots,n)$ and $T_{ij}>0$

TABLE 2: Indicator paired judgment matrix

U_k	T_1	T_2	T_3	$\cdots$	T_n
T_1	T_{11}	T_{12}	T_{13}	$\cdots$	T_{1n}
T_2	T_{21}	T_{22}	T_{23}	$\cdots$	T_{2n}
T_3	T_{31}	T_{32}	T_{33}	$\cdots$	T_{3n}
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\cdots$	$\vdots$
T_n	T_{n1}	T_{n2}	T_{n3}	$\cdots$	T_{nn}

Use Figure 1—9 to express, figure representative definition is as following TABLE 3 shows :

TABLE 3 : 1—9 scale definition

Scale	Definition
1	Indicates two factors have equal importance by comparing
3	Indicates the former is slightly more important than the later by comparing two factors
5	Indicates the former is more important than the later by comparing two factors
7	Indicates the former is relatively more important than the later by comparing two factors
9	Indicates the former is extremely more important than the later by comparing two factors
Even number	Represents importance is between two odd numbers
Reciprocal	Represents factors positive and negative comparison order

Weight vector and maximum feature calculation

According to first grade indicator's judgment matrix vector, carry out normalization with it; solve the sum and then make normalization, then it can get weight vector. According to feature value and feature vector relations, it can solve feature value; its implementation method is as following:
Firstly, normalize judgment matrix every column, its result is:

$$U_{ij}=U_{ij}/\sum_{k=1}^{n}U_{kj}(i,j=1,2,\mathrm{L}\ ,n) \quad \textbf{(3)}$$

Then solve the sum by lines on judgment matrix that makes normalization by column, it can get:

$$\overline{\xi_i}=\sum_{j=1}^{n}U_{ij}(i=1,2,\mathrm{L}\ ,n) \quad \textbf{(4)}$$

Above vector $\overline{\xi}=\left[\overline{\xi_1},\overline{\xi_2},\mathrm{L}\ ,\overline{\xi_n}\right]^T$ proceeds with normalization processing:

$$\overline{\xi_i} = \frac{\overline{\xi_i}}{\sum_{j=1}^{n} \overline{\xi_j}} (i = 1, 2, \mathrm{L}\ , n) \quad \textbf{(5)}$$

Then: $\xi = [\xi_1\ ,\ \xi_2\ ,\ldots\ ,\ \xi_n]^{\mathrm{T}}$ is solved feature vector.
In addition, calculate maximum feature root,the process is:

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{(U\xi)_i}{n\xi_i} \quad \textbf{(6)}$$

In above formula $(U\xi)_i$ represents vector $(U\xi)$ the i component.

According to above formula, we can respectively solve national traditional sports events system comprehensive assessment analysis first grade indicator, second grade indicator to first grade indicator weight and maximum feature value.

Consistency test

To matrix $A = \left(a_{ij}\right)_{n*n}$, if matrix element meets $a_{ij}a_{jk} = a_{ik}$,then matrix is consistent matrix. Among them, $a_{ij} > 0$, $a_{ij} = 1/a_{ji}$. In order to use it to calculate factor weight, it requires that matrix inconsistency only under acceptable conditions. When problems are relative complicated, we cannot take all factors into account, which causes paired comparison construct judgment matrix instant, judgment matrix cannot arrive at ideal state consistency.

Judgment matrix consistency indicator CI , and judgment matrix consistency ratio CR, its computational method is as following formula show.

$$CI = \frac{\lambda_{\max} - n}{n-1} \quad \textbf{(7)}$$

Among them, n represent order number of judgment matrix that is also the number of compared factors.

$$CR = \frac{CI}{RI} \quad \textbf{(8)}$$

Among them, *RI* represents Random Consistency Index value,as following TABLE 4show.

TABLE 4 : RI value table

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

When $CR \geq 0.1$,it is thought that judgment matrix occurs inconsistency that needs to make adjustment on judgment matrix again. When $CR < 0.1$, judgment matrix inconsistency is within acceptable range.

Single hierarchy judgment matrix conforms to consistency requirements by consistency testing; it can be thought that calculated weight is reasonable. Next step is doing combination consistency testing. Assume that in one layer, m pieces of factors weight calculation result is α_m, corresponding consistency indicator value respectively is CI_m, combination consistency test consistency ratio is

$$CR = \frac{\sum_{j=1}^{m} \alpha_j CI_j}{\sum_{j=1}^{m} \alpha_j RI_j} \quad \textbf{(9)}$$

By calculating, combination consistency ratio calculated value is:

$CR < 0.1$

So hierarchical total arrangement's consistency testing meets consistency requirement. It can be thought that national traditional sports' event system analysis's each indicator weight calculation result is reasonable.

The paper makes analysis and judgment on second grade indicators' innovation operation ability by applying software, as following TABLE 5 shows:

TABLE 5 : Innovation operation ability second grade indicators judgment

A2	U4	U5	U6	U7
U4	1	1/4	1/4	1/4
U5	4	1	3	3
U6	4	1/3	1	1/2
U7	4	1/3	2	1

According to former description, it has:

$$\prod_{j=1}^{4} T_{1j} = 1 \times \frac{1}{4} \times \frac{1}{4} \times \frac{1}{4} = \frac{1}{64}$$

$$\overline{W_1} = \sqrt[4]{\prod_{j=1}^{4} T_{1j}} = \sqrt[4]{\frac{1}{64}} = 0.354$$

Similarly, it calculates that A1, A3, A4's $\overline{W_i}$ are respectively $\overline{W_2} = 2.4600$, $\overline{W_3} = 0.9125$, $\overline{W_4} = 1.065$

$$W_1 = \frac{\overline{W_i}}{\sum_{i=1}^{n} \overline{W_i}} = \frac{0.3540}{2.4600 + 0.9125 + 1.065} = 0.0542$$

$$M = \begin{bmatrix} 1 & 1/4 & 1/4 & 1/4 \\ 4 & 1 & 3 & 3 \\ 4 & 1/3 & 1 & 1/2 \\ 4 & 1/3 & 2 & 1 \end{bmatrix} \begin{bmatrix} 0.0065 \\ 40 \\ 0.7523 \\ 3.5666 \end{bmatrix}$$

Then calculate M_i fourth root:

$$\overline{W} = \begin{bmatrix} 0.3540 \\ 2.4600 \\ 0.9125 \\ 1.0650 \end{bmatrix}$$

Carry on normalization processing with calculated $\overline{W} = 90.3540, 2.4600, 0.9125, 1.0650)^T$,and get feature vector:

$$W = \begin{bmatrix} 0.0542 \\ 0.4568 \\ 0.1645 \\ 0.2487 \end{bmatrix}$$

After that, calculate maximum feature root $\lambda_{\max}$

TABLE 6 : Each grade indicator weight summary sheet

Target layer	Criterion layer	Scheme layer	*Comprehensive weight*
A1(0.2776)	U1(0.1960)	T11(0.3125)	0.0235
		T12(0.2573)	0.0140
		T13(0.4302)	0.0170
	U2(0.2486)	T21(0.3141)	.0262
		T22(0.3072)	0.0212
		T23(0.3787)	0.02170
	U3(0.5550)	T31(0.3103)	0.0585
		T32(0.3109)	0.0480
		T33(0.3789)	0.0479
A2(0.3767)	U4(0.2645)	T41(0.2874)	0.0163
		T42(0.2793)	0.0421
		T43(0.4307)	0.0246
	U5(0.3133)	T51(0.4009)	0.0314
		T52(0.4293)	0.0276
		T53(0.3739)	0.0323
	U6(0.2400)	T61(0.3441)	0.0380
		T62(0.3018)	0.0349
		T63(0.3541)	0.0354
	U7(0.1823)	T71(0.1966)	0.0228
		T72(0.508)	0.0176
		T73(0.2962)	0.0181
A3(0.3456)	U8(0.14446)	T81(0.3341)	0.0295
		T82(0.3285)	0.026
		T83(0.3375)	0.0222
	U9(0.3135)	T91(0.5839)	0.0188
		T92(0.4161)	0.0180
		T93(0.1166)	0.0178
	U10(0.3358)	T101(0.2361)	0.0025
		T102(0.2412)	0.0049
		T103(0.242)	0.069
	U11(0.2062)	T111(0.286)	0.0426
		T112(0.3348)	0.0415
		T113(0.3792)	0.0422

Do weighted processing with above solved results, from which each indicator f_i powers continued product powers roots geometric mean corresponding formula is as following shows :

$$G = \sum_{i=-1}^{n} f_i \sqrt{\prod_{i=1}^{n} X_i^{f_i}} = (f_1+f_2+\Lambda+f_n)\sqrt{X_1^{f_1} \times X_2^{f_2} \times \Lambda \times X_n^{f_n}} \quad \textbf{(10)}$$

By above process, we can respectively get each grade indicator corresponding weights and comprehensive weights, as following TABLE 6 shows:

Above table corresponding comprehensive weight is as following Figure shows:

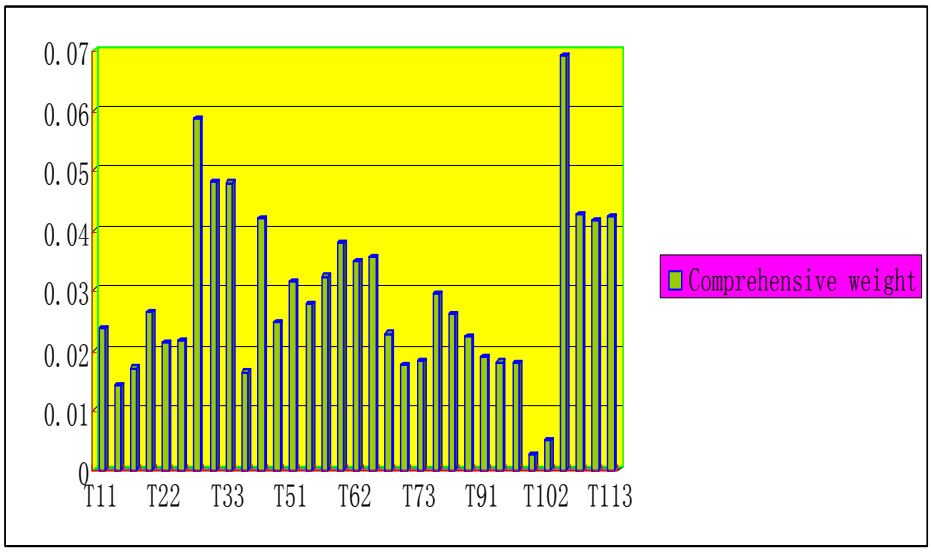

Figure 2 : Figure comprehensive weight summary

By above process and figure, we can clearly see each indicator weight size.

CONCLUSION

The paper analyzes national traditional sports events system, respectively analyzes from national traditional sports events spirits, national traditional sports events system layer, as well as national traditional sports events material layer three main directions, by applying analytic hierarchy process method, finally it gets that in national traditional sports events system, season requirements and location requirements occupied proportions are minimum, while apparatus requirements, event activities forms, organization structure analytic forms as well as activities forms comprehensive proportions are maximum,the research has certain promotion to future such field development.

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