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Folk custom sports culture inheritance and development prospect research under variational method model

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ABSTRACT

Folk custom sports culture is an indivisible part of Chinese culture, it reflects Chinese culture long history and era features. Nowadays, material culture is rapidly developing, protects these folk custom sports culture, let old generation culture to continue to spread, and is an inescapable mission of new generation youth. The paper researches on folk custom sports culture inheritance and development prospect. Firstly, utilize statistical Figure and mathematics curve fitting method, it makes comprehensive analysis of folk custom sports investment status and masses familiar extent with folk custom sports events. Secondly, utilize Variational method extremum principle; it studies folk custom sports events participants' amount theoretical maximum value. And then it gets conclusion: masses familiar extent on rubber band skipping, rope skipping, shuttlecock kicking, dragon-boat racing, lion dancing, kite flying and other public events are higher, while on spinning top beating, iron-hoop rolling, swinging are lower, folk custom sports investment and inheritance problems are still problems to be solved at present. On condition that people' s living standard and folk custom sports facilities construction investment permit, theoretically folk custom sports events participants amount percentage can arrive at 69.8% as the largest. To further propel to folk custom sports development, it should positive encourage masses to participate in folk custom sports events, and give masses effects into play.

KEYWORDS

Folk custom sports; Cultural inheritance; Curve fitting method; Variational method.



INTRODUCTION

As one part of Chinese sports, folk custom sports culture gets closest to masses life, is one kid of sports events with most national characteristics. But due to the development of era, lots of folk custom events has nearly lost, many youth knows little about Chinese folk custom sports culture.

Yan Wei in the article “Century Chinese folk custom sports research review and outlook”, he found that current society Chinese folk custom sports from starting to preliminary development, it went though tortuous process, spiral climbed and finally realized comprehensive development. The paper viewed in currently fast pace of lifestyle, researched current environment Chinese folk custom sports development trend, and carried out practical investigation, data handling, finally got the result: in order to strengthen folk custom sports construction, it must focus on different folk custom sports cases researching, continue to grasp and solve issues that hinder folk custom sports development, on this basis, it put forward folk custom sports future development trend to provide important theoretical references for Chinese folk custom sports development.

Zhang Zhi-Cheng in the article “Chinese folk custom sports development status analysis”, analyzed Chinese folk custom sports status advantages, disadvantages, opportunities and problems to be confronted, studied and pointed out corresponding solutions. The paper through interviewing schools, collected urban and rural residents satisfaction on current stage folk custom sports and nation attentions on folk custom sports, finally got conclusion: folk custom sports basically met public demands, it possessed 5000 years cultural deposits, but some public still lacked of recognition on folk custom sports, and nation investment on urban and rural sports was imbalanced. It suggested spreading folk custom sports culture through modern media especially by network.

Zhang Guo-Dong in the article “Chinese folk custom sports development status and countermeasures research”, under the social environment of urban and rural construction harmonious and steadily development, researched on economy and folk custom sports culture harmonious and sustainable development. The paper through utilizing investigation and researching methods, analyzed contemporary folk custom sports was one kind of vivid characteristic, plentiful and various compositions folk custom sports activity, and then put forward it should gradually establish folk custom sports system, strengthen national administrative management on folks custom sports and arrive at realistic folk custom sports culture and economy integration.

The paper starts from folk custom sports culture inheritance and development prospect, utilizes curve fitting method and variational method extremum principle, makes quantitative analysis of folk custom sports culture status, and studies folk custom sports culture participants’ amount maximum value in the perspective of theory to make theoretical contributions to folk custom sports culture development and inheritance.

CURVE FITTING MODEL-BASED FOLK CUSTOM SPORTS INVESTMENT STATUS

With the development of economy and advancement of times, more and more folk custom sports events have lost. Up to now, folk custom sports that still exist are mainly spinning top beating, rubber band skipping, rope skipping, shuttlecock kicking, earthbags flinging, iron-hoop rolling, dragon-boat racing, lion dancing, kite flying, swinging and so on. Folk custom sports is an important part of Chinese sports, its development has important significances in Chinese rural sports and urban and rural development. For folk custom sports development, its investment is a main factor that affects its development. Government investment is crucial to folk custom sports infrastructure, field construction.

Below TABLE 1 is Chinese folk custom sports investment status in year 2007~2012, data is from general administration of sport of China, China’s statistical yearbook, internet relative investigation report.

TABLE 1 : Folk custom sports investment status

Year	2007	2008	2009	2010	2011	2012
Folk custom sports investment/ ten thousand Yuan	69.32	72.45	65.17	73.68	78	72.14

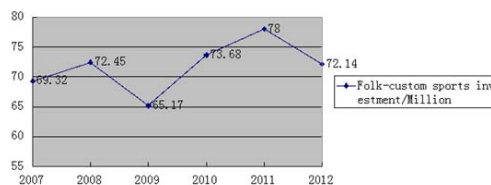


Figure 1 : Folk-custom sports investment

Now by curve fitting method, it analyzes above data and then further analyzes Chinese folk custom sports investment change status as Figure 1.

Known a group of data (two dimensions), that plane n pieces of points $(x_i, y_i), i = 1, 2, 3, \dots, n, x_i$ are different from each other, assume there is a curve function $y = f(x)$, let $f(x)$ to get closer to known all original data's data Figure points positions in one relation criterion, so that it can get curve fitting goodness. In general, we use polynomial function by least square method to solve the fitting function.

Data processing

Utilize SPSS software, process with above TABLE 1 original data, and then get folk custom sports investment fitting curve, as following Figure 2 shows:

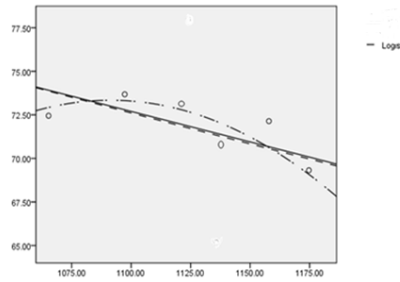


Figure 2 : Changes in folk-custom sports investment

From above Figure 2, it is clear that present Chinese folk custom sports investment lingers, folk custom sports inheritance is still by far a problem to be solved. Presently, folk custom sports development among masses life is not so extensive, many folk custom sports events have lost, folk custom sports position in people's mind is still not going well, and then also restricts folk custom sports culture inheritance to certain extent.

Folk custom sports events satisfaction analysis

Folk custom sports mainly spinning top beating, rubber band skipping, rope skipping, shuttlecock kicking, earth bags flinging, iron-hoop rolling, dragon-boat racing, lion dancing, kite flying, swinging and so on. It has various forms and abundant in contents, gets closer to masses life and is loved by masses. But in recent years, with constant advancement of times, some folk custom sports events have gradually been forgotten by people, iron-hoop rolling, lion dancing, spinning top beating and other events have become memory of the old, even some youth know little about them.

Below TABLE 2 is Chinese masses' familiar extent on above several kinds of folk custom sports events, and the data is from relative literatures information and internet investigation report.

TABLE 2 : Familiar extent

	Spinning top beating,	Rubber band skipping, rope skipping, shuttlecock kicking,	Earthbags flinging	Iron-hoop rolling	Dragon-boat racing	Lion dancing	Kite flying	Swinging
Familiar extent%	0.15	0.38	0.22	0.20	0.57	0.48	0.62	0.21

Draw above TABLE into statistical Figure, as following Figure 3:

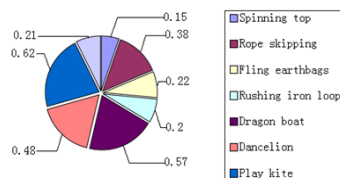


Figure 3 : The picture of familiar extent

By above pie Figure, it is clear that in spinning top beating, rubber band skipping, rope skipping, shuttlecock kicking, earthbags flinging, iron-hoop rolling, dragon-boat racing, lion dancing, kite flying, swinging and other folk custom sports activities, rubber band skipping, rope skipping, shuttlecock kicking, dragon-boat racing, lion dancing, and kite flying masses familiar extent is higher, they are relative completely preserved, while spinning top beating, iron-hoop rolling,

swinging familiar extent is lower, which also shows these kinds of activities inheritance has suffered influence, most of people don't know more about them.

VARIATIONAL METHOD-BASED FOLK CUSTOM SPORTS EVENTS AND PARTICIPANTS AMOUNT MAXIMIZATION RESEARCH

In order to study Chinese folk custom sports culture inheritance, and masses development prospect in participating in folk custom sports events, now utilize variational method to study them, establish mathematical model, and then get folk custom sports events participants maximum value under the circumstance of current existing economic conditions and construction base.

Variational method guiding thought

Variational method is a kind of classic mathematical method in studying functional and extremum problems, it has widely applications in different fields.

Functional extremum can use distance $d(x_0(t))$, $x_0(t) < \varepsilon$ to measure, and distance definition is :

$$d(x_0(t), x_0(t)) = \max_{t_1 \leq t \leq t_2} \{|x(t) - x_0(t)|, |x'(t) - x_0'(t)|\}$$

Functional maximum value can be similarly defined. $x_0(t)$ is called functional mechanism function or extremum curve.

Functional variation: As differential of function is incremental linear principal part, functional variation is functional incremental linear principal part. As functional independent variable, function $x(t)$ increment in $x_0(t)$ is recorded as:

$$\delta x(t) = x(t) - x_0(t)$$

It also calls function variation. It generated functional increment is recorded as:

$$\Delta J = J(x_0(t) + \delta x(t)) - J(x_0(t))$$

If ΔJ can be expressed as:

$$\Delta J = L(x_0(t), \delta x(t)) + r(x_0(t), \delta x(t))$$

Functional variation one important form is:

$$\delta J(x(t)) = \frac{\partial}{\partial \alpha} J(x(t) + \alpha \delta x(t)) \Big|_{\alpha=0}$$

It is because when variance exists, increment:

$$\Delta J = J(x(t) + \alpha \delta x) - J(x(t)) = L(x(t) + \alpha \delta x) + r(x(t), \alpha \delta x)$$

According to L and r properties, it has:

$$L(x(t) + \alpha \delta x) = \alpha L(x(t), \delta x)$$

$$\lim_{\alpha \rightarrow 0} \frac{r(x(t), \alpha \delta x)}{\alpha} = \lim_{\alpha \rightarrow 0} \frac{r(x(t), \alpha \delta x)}{\alpha \delta x} \delta x = 0$$

So:

$$\begin{aligned} \frac{\partial}{\partial \alpha} J(x + \alpha \delta x) \Big|_{\alpha=0} &= \lim_{\alpha \rightarrow 0} \frac{J(x + \alpha \delta x) - J(x)}{\alpha} \\ &= \lim_{\alpha \rightarrow 0} \frac{L(x, \alpha \delta x) + r(x, \alpha \delta x)}{\alpha} = L(x, \delta x) = \delta J(x) \end{aligned}$$

Extremum and variation

Utilize variation formula's expression, it can get functional extremum and variation relationship:

If $J(x(t))$ arrives at extremum (maximum or minimum) in $x_0(t)$, then:

$$\delta J(x_0(t)) = 0$$

According to function requirement, it is clear:

$$\frac{\partial}{\partial \alpha} J(x(t) + \alpha \delta x) \Big|_{\alpha=0} = 0$$

Variational method fundamental lemma

Lemma: $\varphi(x) \in C[x_1, x_2], \forall \eta \in C^1[x_1, x_2], \eta(x_1) = \eta(x_2) = 0$, it has: $\int_{x_1}^{x_2} \varphi(x)\eta(x)dx \equiv 0$

then $\varphi(x) \equiv 0, x \in [x_1, x_2]$.

Variational method fundamental lemma

Solve functional: $J = \int_{t_0}^{t_f} F(t, x(t), x'(t))dt$

Extremum, in general, is looking for a curve $x(t)$, generally the curve is extremum curve, it is recorded as $x^*(t)$.

Maximum (minimum) value principle

If controlled system: $\dot{x} = f(t, x, u), x(t_0) = x_0$

If control strategy $u(t)$ entirely constitutes bounded set U , solve $u(t) \in U$, let performance indicator:

$$J(u(t)) = \varphi(t_f, x(t_f)) + \int_{t_0}^{t_f} F(t, x, u)dt$$

To arrive at maximum (minimum) value.

Maximum (minimum) value principle : $f(t, x, u), \varphi(t_f, x(t_f)), F(t, x, u)$, all are continuously differentiable,

$u^*(t)$ and corresponding $x^*(t)$ are up to following requirements.

(i) Optimal path $x^*(t)$, co-state vector $\lambda^*(t)$ are up to following requirements:

$$\frac{dx}{dt} = f(t, x, u), u(t) \in U,$$

$$\frac{d\lambda}{dt} = -\frac{\partial H}{\partial x}$$

(ii) Hamilton function

$$H(t, x^*, u, \lambda^*) = F(t, x^*, u) + \lambda^{*T}(t)f(t, x^*, u)$$

As $u(t)$ function, optimal strategy $u^*(t)$ must let:

$$H(t, x^*, u, \lambda^*) = \max_{u \in U} H(t, x^*, u, \lambda^*)$$

Or let:

$$H(t, x^*, u, \lambda^*) = \min_{u \in U} H(t, x^*, u, \lambda^*) \text{ (principle of minimum)}$$

(iii) Meet corresponding boundary conditions

If two endpoints are fixed, then canonical equation boundary condition is:

$$x(0) = x_0, x(t_f) = x_f$$

If start terminal t_f are fixed, and $x(t_f)$ is free, then canonical equation boundary condition is:

$$x(0) = x_0, \lambda(t_f) = \varphi_{x(t_f)}(t_f, x(t_f))$$

If start is fixed, terminal $t_f, x(t_f)$ are free, then canonical equation boundary condition is:

$$x(0) = x_0, \lambda(t_f) = \varphi_{x(t_f)}(t_f, x(t_f)),$$

$$H(t_f, x(t_f), u(t_f), \lambda(t_f)) + \varphi_{x(t_f)}(t_f, x(t_f)) = 0$$

Variational method model establishment and solution

Problems analysis and hypothesis:

(i) Folk custom sports events participants amount percentage is function of time t , it records as $x(t)$. The size of $x(t)$ is closely linked to people's living standard, sports facilities construction extent. Record initial participants amount as $x(0) = x_0$.

(ii) As time goes on, people's living standards are getting better and better. t moment people's living standards can use t moment national sports events participants percentage to sketch, living standards get higher, people pursue the spiritual life becomes more and more strong, and then number of people that participate in folk custom sports events also increase, record its change function as $m(t)$.

(iii) Sports facilities construction directly affects people's enthusiasm in participating in folk custom sports. If $u(t)$ is annual average sports facilities investment expense, $g(t)$ is t moment construction speed rate coefficient, then annual average folk custom sports facilities construction efficiency is $g(t)u(t)$. In addition, annual average folk custom sports facilities investment will not so big, its function is bounded function W , then $u(t) \in W$.

(iv) Set annual average facilities construction extent and folk custom sports events participants amount percentage ratio is p , then $px(t)$ represents t moment annual average facilities construction that t moment folk custom sports facilities perfection extent.

(v) Both $x(t)$ and $u(t)$ are continuous function of time t . If discount factor is δ , then it has

$$\begin{cases} \frac{dx(t_1)}{dt_1} = \delta x(t_1) \\ x(t) = 1 \end{cases}$$

$$\text{It solves: } x(t_1) = e^{-\delta(t-t_1)}$$

Let $t_1 = 0$, it gets t moment annual average sports facilities input discount is $e^{-\delta t}$. Therefore, t moment folk custom sports events participants amount percentage $x(t)$ discount is $x(t)e^{-\delta t}$, $u(t)$ discount is $u(t)e^{-\delta t}$, annual average sports facilities construction discount is $p x(t)e^{-\delta t}$.

(vi) To define time t_f and number of participants percentage $x(t_f)$ are free.

Model construction and solution

According to above problems hypothesis, it can get in case that allowed by people's living standards and folk custom sports facilities construction investment, number of participant maximization state equation:

$$\begin{cases} \frac{dx(t_1)}{dt_1} = -m(t) + g(t)u(t) \\ x(0) = x_0 \end{cases}$$

In above state equation, among satisfied $0 \leq u(t) \leq U$ function set W , look for optimal control strategy $u^*(t)$.

Firstly write problems' Hamilton function:

$$H[px(t) - u(t)]e^{-\delta t} + \lambda[-m(t) + g(t)u(t)]$$

Then by co-state equation and boundary conditions, it solves $\lambda(t)$, that is by:

$$\begin{cases} \frac{d\lambda(t)}{dt} = -H_x = -pe^{-\delta t} \\ \lambda(t_f) = \varphi_{x(t_f)} = e^{-\delta t_f} \end{cases}$$

It solves: $\lambda(t) = (1 - \frac{p}{\delta})e^{-\delta t_f} + \frac{p}{\delta}e^{-\delta t}$

In the following, utilize maximum value principle to solve $u^*(t)$.

For:

$$H = px(t)e^{-\delta t} - \lambda m(t) + [\lambda g(t) - e^{-\delta t}]u(t)$$

Obviously, H is linear function of u , therefore it can get:

$$u^*(t) = \begin{cases} U, & \lambda g(t) - e^{-\delta t} > 0 \\ 0, & \lambda g(t) - e^{-\delta t} < 0 \end{cases}$$

Or

$$u^*(t) = \begin{cases} U, & [(1 - \frac{p}{\delta})e^{-\delta t_f} + \frac{p}{\delta}e^{-\delta t}]g(t) - e^{-\delta t} > 0 \\ 0, & [(1 - \frac{p}{\delta})e^{-\delta t_f} + \frac{p}{\delta}e^{-\delta t}]g(t) - e^{-\delta t} < 0 \end{cases}$$

For transformation point t_s , it should meet:

$$[(1 - \frac{p}{\delta})e^{-\delta t_f} + \frac{p}{\delta}e^{-\delta t}]g(t) - e^{-\delta t} = 0$$

That:

$$[\frac{p}{\delta} - (\frac{p}{\delta} - 1)e^{-\delta t_f}]g(t) - 1 = 0$$

Therefore, it can solve t_s .

In the topic, set: $x(0) = 0.48, U = 1, m(t) = 2, p = 0.1, \delta = 0.05, g(t) = \frac{2}{(1+t)^{\frac{1}{2}}}$

Therefore, it can get t_s formula is $(1+t_s)^{\frac{1}{2}} = 4 - 2e^{0.05(t_s - t_f)}$.

When $t < t_s$, $u^*(t) = U = 1$, now state equation is: $\frac{dx}{dt} = -2 + \frac{2}{(1+t)^{\frac{1}{2}}}$

When $t < t_s$, $u^*(t) = 0$, now state equation is: $\frac{dx}{dt} = -2$

Then when $t > t_s$, it has: $\int_0^{t_s} \frac{dx}{dt} = \int_0^{t_s} [-2 + \frac{2}{(1+t)^{\frac{1}{2}}}]dt + \int_{t_s}^t (-2)dt$

It solves: $x(t) = 4(1+t_s)^{\frac{1}{2}} + 96 - 2t, t_f = 2(1+t_s)^{\frac{1}{2}} + 28$

Get: $t_s = 10.6, t_f = 69.8$

Then get optimal control strategy as: $u^*(t) = \begin{cases} 1, & 0 \leq t \leq 10.6 \\ 0, & 10.6 \leq t \leq 69.8 \end{cases}$

Result evaluation

By above variational method analysis, it is clear that allowed by people's living standards and folk custom sports facilities construction investment, number of participants in folk custom events percentage maximum value is 69.8%. In spinning top beating, rubber band skipping, rope skipping, shuttlecock kicking, earthbags flinging, iron-hoop rolling, dragon-boat racing, lion dancing, kite flying, swinging numerous events, masses participation is basic impetus to preserve and inherit folk custom sports culture, only national consciousness promotes, they focus on protection of folk custom sports culture, then can fundamentally carry forward folk custom sports events.

CONCLUSION

The paper firstly makes comprehensive analysis of folk custom sports investment status, starts from statistical Figure and mathematics curve fitting two methods, learns that presently Chinese folk custom sports investment lingers, and on this basis, it studies masses familiar extent on folk custom sports. It puts forward that folk custom sports investment and inheritance problems are by far the problems to be solved, masses familiar extent on rubber band skipping, rope skipping, shuttlecock kicking, dragon-boat racing, lion dancing, kite flying and other public events are higher, while on spinning top beating, iron-hoop rolling, swinging are lower.

The paper bases on comprehensive analysis of folk custom sports inheritance and development status, utilizes variational method's extremum principle, studies on folk custom sports events and participants maximization on the condition that people's living standards and folk custom sports facilities construction investment permit, and gets conclusions: on the limited conditions, folk custom sports events participants amount percentage maximum value can arrive at 69.8%. The masses are carriers of folk custom sports culture inheritance, only masses promote consciousness of protecting culture, strengthening folk custom sports culture inheritance, then it can let existing folk custom sports culture to continue to preserve so as not to lose.

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