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SPSS-based tennis consumption influence factor variance analysis

Chunjie Du

School of vocational education, South China Normal University, FoShan 528225, Guangdong, (CHINA)

ABSTRACT

Since Olympic Games succeeded hosting in 2008, sports events popularization range in China has become more and more widely. Sports have gradually become a kind of industry that is received by people. Sports consumption status attracts more attentions form investors and consumers. Thereupon, the paper takes Beijing Tennis consumption status as an example, researches sports consumption main influence factors. Utilize factor analysis method, by analyzing consumption possibility and consumers' age, sex, income and education background relative data, and then get conclusion. Conclusion shows consumers' income is the largest influence factor, age and education background impacts degrees are equal and also the larger influence factors and sex becomes smallest influence factor. Above conclusion have important significances in investors' judgment investment and future earnings status. And meanwhile it has guidance in national economic development direction.

KEYWORDS

Sports consumption; Tennis; Factor analysis; Influence factor.



INTRODUCTION

With people's material living standard improvements, people also require more in spiritual life. Sports are important parts to meet people spiritual life that belongs to the tertiary industry. Sports events can let people to master more sports common senses and exercise techniques. In order to let physique to be robust and body shape to be elegant, more and more people hope that can scientific carry out physical exercises. Entertainment sports events and competitive sports can let people to be satisfied in spirit. Sports enrich masses life, is beneficial to physical and psychological health development. Just because this, sports as the tertiary industry has been constantly developed. It is sought after as a whole social consumption and investment hotspot. Sports industry gradually shows better and better prospects. If it wants to take sports industry as key development industry to carry out, then sports consumption problem research takes main position beyond dispute.

In varieties of sports events, tennis, badminton, table tennis and other ball type events are always favored by people. And tennis occupies larger proportions in consumptive sports events. Modern tennis is originated from Britain, it appeared in Athens' hosted modern first session Olympic Games in 1896, tennis men's single and double were listed as formal competition events. Tennis motion is elegant; it integrates entertainment, appreciation and fitness. It not only can improve people physical quality but also can improve people psychological quality. Tennis adaptive population range is wide; it is convenient for strengthening communication, increasing friends exchanging, which conforms to numerous sports enthusiasts requirements. Due to tennis participated number of people is more, industry is big, tennis is a kind of sports event with multiple values.

As early as 1999, Tan Yue-Jie pointed out tennis was a kind of high consumption sports when analyzed Chinese tennis development influence factors. In 2000, when Zhong Tian-Lang investigated Shanghai citizen sports consumption level, he found tennis consumption occupied proportion was relative small. Therefore, tennis consumption reflected sports consumption status to certain extent. Beijing as Chinese capital, national political, cultural heart, internationally compatible pivot, its economic impact lays the top in international. Beijing citizen daily living standard is universally higher that arrives at well-off standard. No matter from consumption thought or consumption ability, it lies in advanced national level. Therefore, the paper takes Beijing Tennis consumption levels as research objects, analyzes sports consumption level influence factors.

MODEL ESTABLISHMENT

Recently, tennis is popular in the world; tennis consumption status has certain impacts on world economy, Figure 1. Due to people's emphasis improving, research on tennis consumption level problem turns to be very important.



Figure 1 : Schematic tennis

Data processing

The paper used data is from "Beijing tennis consumers and their consumption behaviors analysis". Tennis consumption level influence factors include sex, age, education background, profession, income; in general, a people's income is up to one's profession. Thereupon, the paper

considers four influence factors that are respectively sex, age, education background, income. Make data-driven on influence factors, schematic is as following TABLE 1.

TABLE 1 : Influence factor data-driven schematic table

Sex	Age	Education Background	Income
1 Women	1 Youth (Below 35 years old)	1 Below high school	1 Low income (Within 10 ten thousand Yuan)
	2 Mid-aged (36-55 years old)	2 Junior college	2 Medium income (10-50 ten thousand Yuan)
2 Men	3 Old (Above 56 years old)	3 Regular college	3 High income (Above 50 ten thousand)
		4 Above master	

After data driving influence factors, and extract original data, it gets data TABLE 2.

TABLE 2 : Each factor consumption possibility after data-driven original data Table

Sex	Percentage 1	Age from low to high	Percentage 2	Education percentage from low to high	Percentage 3	Income from low to high	Percentage 4
1	32.6	1	61.76	1	3.4	1	33.06
2	67.4	2	34.39	2	10.6	2	65.56
		3	3.85	3	56.8	3	1.36
				4	29.2		

Handle with data in TABLE 2, it gets each group of people consumption possibility status, in order to easy to compare, expand 10000 times of consumption possibility, as following TABLE 3.

Factor analysis

Factor analysis is integrating variables with intricate relations into some factors with fewer quantities. When carry out multiple analysis, it is also a kind of statistical method to make dimensionality reduction.

Factor analysis concept

Factor analysis is also called element analysis, is established and developed during research psychology process. It can be supposed that psychology unique contribution on natural science is factor analysis method. With people constant deepen researching for years; the analysis method has been gradually tended to be perfect in theory. Not only just its usage in psychology intelligent and character researching, it also applied into attitude, learning and other aspects' researching. It is also promoted to non-psychology field, as geography, geology and biology as well as other researches. It is a kind of effective mathematical model to explain relations among matters.

Factor analysis (*R* type) mathematical model: set $x_i (i = 1, 2, \dots, p)$ *p* pieces of variables, if it expresses as:

$$X_i = a_{i1}F_1 + a_{i2}F_2 + \dots + a_{i3}F_3 + \epsilon_i \quad (m \leq p) \tag{1}$$

That $X = AF + \epsilon, F_1, F_2, \dots, F_m$ is called common factor, is unobservable variable, $A = (a_{ij})_{p \times m}$ is called factor loading matrix, a_{ij} represents the *i* variable loading in the *j* factor, ϵ_i is special factor that cannot be contained by previous *m* pieces of common factors and meets $Cov(F, \epsilon) = 0, F, \epsilon$ are uncorrelated.

Factor analysis analyzed and solved three basic questions:(1) Estimate factor loading matrix *A*;(2) In case that factor is not easy to be explained, to get reasonable explanation, carry out orthogonal transformation on factor loading matrix; (3) Provide every variable (or samples) regarding *m* pieces of

common factors scores, generally it represents as original variable linear combination to reasonable estimate common factors.

TABLE 3: Data result table after handling

Consumption possibility	Sex	Age	Education background	Income	Consumption possibility	Sex	Age	Education background	Income
22.63	32.60	61.76	3.40	33.06	46.79	67.40	61.76	3.40	33.06
44.88	32.60	61.76	3.40	65.56	92.79	67.40	61.76	3.40	65.56
1.12	32.60	61.76	3.40	1.63	2.31	67.40	61.76	3.40	1.63
70.56	32.60	61.76	10.60	33.06	145.87	67.40	61.76	10.60	33.06
139.92	32.60	61.76	10.60	65.56	289.28	67.40	61.76	10.60	65.56
3.48	32.60	61.76	10.60	1.63	7.19	67.40	61.76	10.60	1.63
378.07	32.60	61.76	56.80	33.06	781.66	67.40	61.76	56.80	33.06
749.74	32.60	61.76	56.80	65.56	1550.08	67.40	61.76	56.80	65.56
18.64	32.60	61.76	56.80	1.63	38.54	67.40	61.76	56.80	1.63
194.36	32.60	61.76	29.20	33.06	401.84	67.40	61.76	29.20	33.06
385.43	32.60	61.76	29.20	65.56	796.87	67.40	61.76	29.20	65.56
9.58	32.60	61.76	29.20	1.63	19.81	67.40	61.76	29.20	1.63
12.60	32.60	34.39	3.40	33.06	26.05	67.40	34.39	3.40	33.06
24.99	32.60	34.39	3.40	65.56	51.67	67.40	34.39	3.40	65.56
0.62	32.60	34.39	3.40	1.63	1.28	67.40	34.39	3.40	1.63
39.29	32.60	34.39	10.60	33.06	81.23	67.40	34.39	10.60	33.06
77.91	32.60	34.39	10.60	65.56	161.08	67.40	34.39	10.60	65.56
1.94	32.60	34.39	10.60	1.63	4.00	67.40	34.39	10.60	1.63
210.52	32.60	34.39	56.80	33.06	435.25	67.40	34.39	56.80	33.06
417.48	32.60	34.39	56.80	65.56	863.14	67.40	34.39	56.80	65.56
10.38	32.60	34.39	56.80	1.63	21.46	67.40	34.39	56.80	1.63
108.23	32.60	34.39	29.20	33.06	223.76	67.40	34.39	29.20	33.06
214.62	32.60	34.39	29.20	65.56	443.72	67.40	34.39	29.20	65.56
5.34	32.60	34.39	29.20	1.63	11.03	67.40	34.39	29.20	1.63
1.41	32.60	3.85	3.40	33.06	2.92	67.40	3.85	3.40	33.06
2.80	32.60	3.85	3.40	65.56	5.78	67.40	3.85	3.40	65.56
0.07	32.60	3.85	3.40	1.63	0.14	67.40	3.85	3.40	1.63
4.40	32.60	3.85	10.60	33.06	9.09	67.40	3.85	10.60	33.06
8.72	32.60	3.85	10.60	65.56	18.03	67.40	3.85	10.60	65.56
0.22	32.60	3.85	10.60	1.63	0.45	67.40	3.85	10.60	1.63
23.57	32.60	3.85	56.80	33.06	48.73	67.40	3.85	56.80	33.06
46.74	32.60	3.85	56.80	65.56	96.63	67.40	3.85	56.80	65.56
1.16	32.60	3.85	56.80	1.63	2.40	67.40	3.85	56.80	1.63
12.12	32.60	3.85	29.20	33.06	25.05	67.40	3.85	29.20	33.06
24.03	32.60	3.85	29.20	65.56	49.68	67.40	3.85	29.20	65.56
0.60	32.60	3.85	29.20	1.63					

Factor analysis general steps

(1) Similar to principal component analysis, calculate \bar{x}_k and $s_k(k, j = 1, 2, \dots, m)$, establish basic equation set.

(2) Use principal component analysis method to define factor loading matrix A .

Factor analysis basic model is as following:

$$\begin{cases} X_1 = a_{11}F_1 + a_{12}F_2 + \dots + a_{1p}F_p + \epsilon_1 \\ X_2 = a_{21}F_1 + a_{22}F_2 + \dots + a_{2p}F_p + \epsilon_2 \\ \dots \\ X_m = a_{m1}F_1 + a_{m2}F_2 + \dots + a_{mp}F_p + \epsilon_m \end{cases} \tag{2}$$

Among them, $X_1, X_2 \dots X_m$ are original variables, $F_1, F_2 \dots F_p$ are common factors, it expresses as matrix form :

$$\underset{(m \times 1)}{X} = \underset{(m \times p)}{A} \cdot \underset{(p \times 1)}{F} + \underset{(m \times m)}{C} \cdot \underset{(m \times 1)}{U} \tag{3}$$

X is factor loading matrix, estimate factor loading matrix method includes principal component method, image factor method, weighting least square method, maximum likelihood method and others.

(3) Variance maximum orthogonal rotation, make extreme of variable coefficient (try to tend to 0 or 1)

The purpose of establishing factor analysis mathematical model not only is to find out common factor and group variables, but also it should make clear every common factor significance so that scientific analyze practical problems. When factor loading matrix X structure is not convenient for explaining main factors, it can use an orthogonal matrix post multiplication A (that is to implement a orthogonal transformation on A). By linear algebra knowledge, make an orthogonal transformation on A , corresponding coordinate system has a rotation so that can make explanation on factor significances.

(4) Get factor score function, calculate samples factor scores.

Use common factor to express cause variable linear combination, and further get factor score function. By factor score functions, it calculates and observes scores recorded in each common factor; therefore it solves common factors unobservable problems.

Analyze SPSS computational result

Utilize SPSS to make factor analysis of TABLE 3 data, result is as following TABLE 4:

TABLE 4 : KOM and Bartlett test result

Sampling enough degree Kaiser-Meyer-Olkin measurement		.322
	Approximate to Chi square	52.862
Bartlett sphericity degree test	df	10
	Sig.	.000

From KOM and Bartlett test result, it can get KOM value is 0.322, it shows is relative fit for factor analysis. Bartlett sphericity test null hypothesis is correlation coefficient matrix that is unit matrix, Sig value is 0.000 that is less than significance level 0.05, therefore it refuses null hypothesis, shows variables have correlations, is fit for factor analysis.

TABLE 5 : Common factor variance table

	Initial	Extract
Gender 1	1.000	.755
Age 1	1.000	.822
Degree 1	1.000	.803
Income 1	1.000	.672

TABLE 5 provides every variable communalities results. Data table left side every variable is variance that can be explained by all factors, right side represents variables communalities. From the

table, it can get that factor analysis variable communalities are very high, shows that most information in variables can be extracted by factors, which shows factor analysis result is effective. Result obtained from SPSS is scree plot; figure is as following Figure 2.

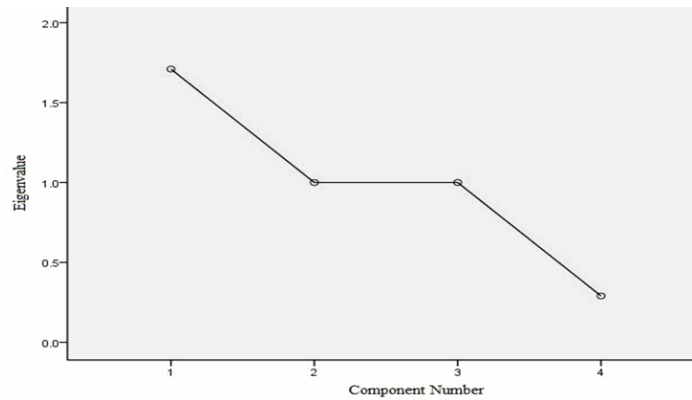


Figure 2 : Scree Plot

From Scree plot Figure 2, it gets slope (that is also gradient) gets bigger, shows the factor and other rest factors differences get high. From scree plot, it is clear that factor 1(income) uniquely is a factor, 2(age), 3(education background)can be combines as a factor, 4(sex) can uniquely concluded as a factor. By above conclusion, it draws out four factors weight pie Figure 3 as following.

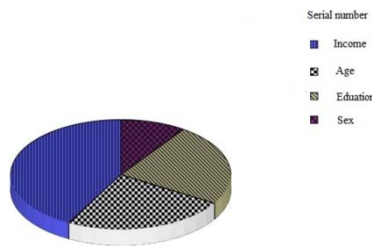


Figure 3 : Pie of weights

MODEL EVALUATION

Factor analysis advantages

Factor analysis maximum advantage is each comprehensive factor weight is not given according to subjective wishes but objective defined according to respective variance contribution rate size. Variable variance gets bigger, then the variable will get more important, therefore possessed weights gets larger; on the contrary, variable variance gets smaller, its corresponding weight will get smaller. It is not accepting or rejecting original variable, but make recombination according to original variables data information, find out main factors that affect variables, simplify data, and further avoid subjective weight defining randomness. Unique evaluation result is relative objective, reasonable. Besides, the factor analysis method whole process is applying computer software SPSS to simple and fast carry out, it has stronger operability. Therefore, compare with other analysis method, the factor analysis method is a kind of reasonable, simple, strong practicability comprehensive evaluation method.

Factor analysis disadvantages

To partial macro factors and special cases, factor analysis cannot consider them in any time, which has certain limitations. Of course factor analysis self-work load is larger, when analyze, it analyzes overall, it has very high requirements on basic data accuracy, in analyzing, once data occurs mistakes, it is not easy to discover, which requires users must pay attention to previous and post data

checking and repeatedly deduce and check on data when use the analysis method. Therefore, factor analysis should also comprehensive consider each aspect problems when uses.

CONCLUSION

Factor analysis is a mathematical tool that looks for main factors under numerous factors influence, it can help us objective look for main factors from numerous factors. The model applied fields are very broad, such as performance problem, satisfaction degree evaluation problem, technical innovative ability evaluation problem and other aspects analysis problems.

The paper applies factor analysis method into sports consumption field tennis consumption, and by drawing weight pie chart, obtained each factor weight accuracy id high, rationality is strong. By the paper established model, it is clear that tennis consumption most important influence factor is consumers' income status. It is worth noting that the factor analysis used data is from Beijing that economy is relative developed, cultural degree is relative higher. When it has regional differences, main influence factors may change. Thereupon, in future invest tennis sports event process; it has important guiding effects on adjusting investment direction.

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