Journal of Theoretical and Applied Information Technology
28th February 2013. Vol. 48 No.3

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

A MISAPPLICATION FOR WEIGHT EVALUATION DETERMINED BY THE PRINCIPAL COMPONENT ANALYSIS

RUNCHUN HAN, JIXIAN XIAO, JIE YANG, HONGWEI DU

Hebei United University

ABSTRACT

Principal component analysis is the study of how a small number of uncorrelated principal components indicate the internal structure of multiple variables. The purpose is to simplify the data, reduce the dimension of redundancies, and make the new variable uncorrelated. So it is widely utilized in multivariate statistical analysis. These years, however, some people apply the principal component analysis to determine the weight of evaluation index system, even include the method in the textbook. This paper will clarify the unscientific method of valuing the weight in four aspects.

Key words: *Principal Component Analysis, Evaluation System, Weights*

1. INTRODUCTION

Principal component analysis was firstly suggested by the U.S. psychologist Charies Spearman in 1904. The basic idea is to measure a number of indicators with a few uncorrelated principal component indicators (linear combination of original indicators), which can reflect the main message of original observational indicators. This data processing in statistical work is frequently used to remove redundant indicators, and get a more objective and scientific evaluation, however, in recent years, some people use PCA to select the weight of evaluation index system, ranges from the master's thesis, doctoral dissertation, to research papers and scientific research projects, PCA method is widely used and known as "the law of objectively valuing weights". In reference [1] , it introduces the method of how to use PCA determine the weight. The reference [2] said, "compared with subjective weight method, the objective weight method is directly based on the original information and obtain the weight, such as component analysis, factor analysis, and the details are in the reference. " According to reference [1] and other data above, the principal component analysis method is to determine the weights as follows:

Suppose there are p indicators, where $a_{ij}\,(i=1,2,\ldots,n;\ j=1,2,\ldots,n)$ means the i^{th} observation of the j^{th} indicator..

Firstly, we use standard normal method to eliminate the impact of dimension, namely, $u_{ij}=\dfrac{a_{ij}-\bar{a}_j}{\sigma_j}$, where $\bar{a}_j$ means the average of j indicator, and σ_j is the standard deviation of j indicator. $u_j=(u_{1j},u_{2j},\ldots,u_{nj})^T$

Secondly, calculate the covariance matrix W of $u_1,u_2,\ldots,u_p$ the eigenvalue $\lambda_1\ge\lambda_2\ge\ldots\ge\lambda_p$ of W, and the corresponding normalized eigenvector $\boldsymbol{e_1,e_2,\cdots,e_p}$, where $e_j=\left(e_{1j},e_{2j},\cdots,e_{pj}\right)^T\quad j=1,2,\cdots,p$

Then, using contribution rate of the eigenvalues to determine the principal components and their number

$$m=\min\left\{l:\frac{\lambda_1+\lambda_2+\cdots+\lambda_l}{\lambda_1+\lambda_2+\cdots+\lambda_p}\ge 80\%\right\}$$

$$F_k=e_{1k}u_1+e_{2k}u_2+\cdots+e_{pk}u_p\qquad k=1,2,\cdots,m$$

Then we can get the weight

$$w_k=\frac{\lambda_k}{\sum_{j=1}^{m}\lambda_j}\qquad k=1,2,\cdots,m$$

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

At last, calculate the score

$$F = w_1 F_1 + w_2 F_2 + \cdots + w_m F_m$$

As we all know, to carry out any evaluation has its specific purpose, and the index system is served for this purpose, while the weights are used to reflect the important level of each indicator by evaluators to achieve an evaluation purpose, without such purpose, the index system is worthless. It is difficult to find out what kind of purpose and background Charies Spearman had to use principal component analysis to determine the weights, and how to prove such weights is in line with the wishes of the evaluators, at least, however, now people use this method without sufficient demonstration or deduction. Therefore, I believe that the application of the method to determine weight is lack of theoretical basis.

2. WITH PRINCIPAL COMPONENT ANALYSIS METHOD TO DETERMINE THE WEIGHT THE WRONG WAY

In order to get enough sample space and pass KMO and Bartlett's test, we randomly choose 40 schools as the samples from the report about "the world university rankings 2008" published by the Times, and clarify that using principal components analysis to determine the evaluation weights is unscientific from four aspects. The original data collected as follows:

Table 1. The Original Data Table

RANK	PEER REVIEW SCORE	EMPLOYER REVIEW SCOR	STAFF/STUDENT SCORE	CITATIONS/STASS SCORE	INTERNATIONAL STAFF SCORE	INTERNATIONAL STUDENT SCORE	RANK	PEER REVIEW SCORE	EMPLOYER REVIEW SCOR	STAFF/STUDENT SCORE	CITATIONS/STASS SCORE	INTERNATIONAL STAFF SCORE	INTERNATIONAL STUDENT SCORE
1	100	98	48	100	23	36	21	73	75	36	53	100	88
2	95	97	49	63	100	78	22	71	35	47	75	63	81
3	63	71	93	77	100	100	23	60	54	51	72	92	79
4	84	54	62	99	25	36	24	80	30	30	94	24	29
5	77	76	70	87	25	45	25	77	74	23	73	34	40
6	72	78	67	69	95	60	26	79	43	64	36	42	56
7	73	94	57	65	82	72	27	63	49	67	60	61	34
8	69	97	68	60	81	72	28	66	17	89	40	24	90
9	73	59	86	57	54	77	29	79	42	47	51	52	29
10	59	95	74	62	92	99	30	49	98	46	55	92	93
11	79	54	38	94	72	33	31	59	44	74	64	20	31
12	84	46	42	96	28	26	32	76	57	19	51	93	48
13	88	43	55	71	51	21	33	59	58	47	46	70	98
14	76	53	61	79	48	36	34	37	59	63	71	77	95
15	63	90	61	61	87	83	35	65	87	18	41	88	100
16	65	73	49	80	71	88	36	63	62	19	65	50	96
17	72	98	57	50	71	64	37	62	86	24	37	99	93
18	84	58	48	79	18	18	38	62	50	46	39	71	85
19	85	47	24	98	17	19	39	81	69	21	40	26	28
20	77	82	45	55	79	34	40	52	48	57	51	68	50

2.1 For Increasing Or Decreasing The Sample, It Is Precarious To Make The Principal Component As The Evaluation Weights.

Based on the method from the reference [1], we use SPSS for a capacity of 40 schools to determine the weight and achieve integrated rank. Using principal component analysis by SPSS and get:

Table 2. KMO And Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.705
Bartlett's Test of Sphericity	Approx. Chi-Square	67.566
	df	15
	Sig.	.000

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Table 3. Component Matrix

	Component		
	1	2	3
PEER REVIEW SCORE	-.727	.450	.152
EMPLOYER REVIEW SCOR	.477	.687	.434
STAFF/STUDENT SCORE	.165	-.672	.660
CITATIONS/STASS SCORE	-.638	.099	.524
INTERNATIONAL STAFF SCORE	.839	.281	.101
INTERNATIONAL STUDENT SCORE	.886	-.069	.050

Extraction Method: Principal Component Analysis.
And

Table 4. Total Variance Explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	2.679	44.648	44.648
2	1.219	20.314	64.962
3	.935	15.583	80.546
4	.569	9.485	90.030
5	.323	5.387	95.418
6	.275	4.582	100.000

Extraction Method: Principal Component Analysis.

From Table 2, KMO =0.705> 0.7, it shows the effect of factor (principal component) analysis is accredited, and according to the probability value ($p<0.05$) of Bartiett's sphericity test, the independence of the variables assumption should be rejected, so the practicality testing of factor analysis holds.

If only test the 2 principal components, the cumulative contribution rate would be 78.64%, less than 80%, so we take 3 instead, and the cumulative contribution rate rises up to 91.41%, so taking m=3.

If we transform the coefficients of Table 3 Component Matrix into orthogonal units, then:

e1=(-0.44392, 0.291269, 0.100875, -0.39001, 0.512722, 0.541228)

e2=(0.407978, 0.621893, -0.60837, 0.090081, 0.25427, -0.06263)

e3=(0.156687, 0.449081, 0.682743, 0.542306, 0.104336, 0.051532)

So the principal components are:

$F1= - 0.44392u1+0.291269u2+0.100875u3 - 0.39001u4+0.512722u5+0.541228u6$

$F2=0.407978\ u1+0.621893\ u2 - 0.60837\ u3+0.090081\ u4+0.25427\ u5-0.06263\ u6$

$F3=0.156687\ u1+0.449081\ u2+ 0.682743\ u3+0.542306\ u4+0.104336\ u5+0.051532\ u6$

Where u1, u2, u3, u4, u5, u6 are PEER REVIEW SCORE, EMPLOYER REVIEW SCOR, STAFF / STUDENT SCORE, CITATIONS / STASS SCORE, INTERNATIONAL STAFF SCORE, INTERNATIONAL STUDENT SCORE standardized data respectively.

Calculated from Table 4, the weights of the 3 principal components are: 0.554318, 0.25221, 0.193472. So the evaluation score is:

$F= 0.554318F1+0.25221F2+0.193472F3$

Table5 Symmetric Measures

		Value	Asymp. Std. Errora	Approx. Tb	Approx. Sig.
Measure of Agreement	Kappa	132	.059	5.065	.000
N of Valid Cases		39			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

According to the formula, we get the integrated rank. Table 9 shows the ranking result of the 40 sample schools.

Now, we remove one ranking observation, such as the 28th school, and for the rest 39 samples, KMO = 0.694, similar to 0.7, which indicates the effect of factor (principal component) analysis of is accredited, and according to the probability value ($p<0.05$) of Bartiett's sphericity test, the independence of the variables assumption should be rejected, so the practicality testing of factor analysis holds. Re-use the same method to determine the weight and the integrated rank, at last get the integrated ranking samples (see Table 9, Rank 2).

Among the 40 schools, the integrated rank of the 28th school is 32. When removing it, the ranking of the first 31 schools in the rest 39-school sample

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

should be the same as in the 40-school sample, while the 33rd, 34th in the 40-school sample should be the 32nd, 33rd in the 39-school sample respectively, and so on. If we reset the 32nd rank as 33rd of the 39-school sample, then the ranking of these two sets of samples should be the same. The feature is called rank on the increase or decrease of the stability of the sample. We have seen from table 9, Rank 1 and Rank 2, except the 12th, 13th, 15th, 18th,22nd, 23rd school, the ranking of 33 schools changed, the largest difference is 8 places, the rank difference of 14 schools is no smaller than 4. The SPSS result of Kappa consistency test on Rank1 and Rank 2 is as follows in Table 5.

Since p <0.001, so we can not rule out Rank 1 and 2, which have a certain consistency. In the general view, when the Kappa Value ≥ 0.75, it shows a good consistency between the two samples; when 0.75> Kappa Value ≥ 0.4, it means the consistency is not very well; when Kappa Value <0.4, it shows the poor consistency between the two samples. [3] Because the Kappa Value = 0.132 <0.4, so the consistency is poor. This result shows that determining weight by the principal component analysis is not stable enough to increase or decrease the sample, this instability resulted in the rankings without any reference to the actual value.

2.2 The Use Of Principal Component Analysis To Evaluate The Weight Which Is Not Stable To The Changes Of Observations

As a rule, in the evaluation process, for a positive indicator, as an evaluation object of observations increases, the evaluation of the object position should move forward, when the observations decreases, the evaluation of the object position should be moved back, evaluation of other objects relative rankings should unchanged. That is, if an evaluation object ranked ith were ranked into the first j because the changing of its observations, when i> j, then the original rank kth (j ≤ k <i) school should now be (k +1)th; when i <j, then the original ranking as kth (i <k ≤ j) school should now rank (k -1)th, the rest rankings still the same. This feature is called the stability of the evaluation on observations. On the basis of the above cases, in 40-school sample, change the 2nd school's PEER REVIEW SCORE from 95 to 10, CITATIONS / STASS SCORE point from 63 to 30, then rank the 40 schools again by the principal components method to determine weight, see Table 9, Rank 3. Here are two abromal problems: first, after the change in it, its position didn't decrease, but rose up from 7th to 1st, for an evaluation method, how can we believe that the method of science. Second, even if the 2nd school from the 7th into the first one is recognized, according to the usual understanding, the original Rank 1 to 6, should in turn become paragraphs 2 to 7, other schools rank the same, see Table 9, Rank 6. According to this logic, comparing Rank 3with Rank 6, there are 33 schools have changed the order, and 15 schools' rank changed more than 4 places, the 28th school changes the largest, in 13 places. The SPSS result of Kappa consistency test on Rank3 and Rank 6 is as follows in Table 6.

Table6 Symmetric Measures

		Value	Asymp. Std. Errora	Approx. Tb	Approx. Sig.
Measure of Agreement	Kappa	.154	.062	6.076	.000
N of Valid Cases		40			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Since p <0.001, so we can not rule out Rank 1 and 2 have a certain consistency, but because Kappa Value = 0.154 <0.4, so the consistency is poor. This shows that the use of principal component analysis to evaluate the weight is not stable to the changes of observations; this instability also resulted in the rankings without any reference to the actual value.

2.3 The Non-Uniqueness Of The Eigenvectors Which Is Calculated From The Covariance Matrix And Causes The Ranking Results That Do Not Have The Unique Solution.

For any eigenvalue $\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_p$ got from the covariance matrix W, there are two opposite eigenvectors $\pm e_1, \pm e_2, \cdots, \pm e_p$, where $e_j = (e_{1j}, e_{2j}, \cdots, e_{pj})^T \quad j = 1,2,\cdots,p$, which pairwise orthogonal unit vectors. If there are k principal compnents, we can construct 2k scenarios and get 2k different evaluation results. Under an extreme case, we make $e_1^* = -e_1, e_2^* = -e_2, e_3^* = -e_3$, namely, the difference between the two principal component groups is a minus, and the result ranking is in Table 9, Rank 4, which is opposite to Rank 1. In front of such results, which one should be selected? Which one is correct? Rank 1 or Rank 4?

Journal of Theoretical and Applied Information Technology
28th February 2013. Vol. 48 No.3

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

2.4 The Contribution Or The Characteristic Value Of Principal Component Is The Inherent Characteristics Of The Data, And Can Not Reflect The Significance Of The Indicator

The reason to cause the analysis process unstable and unauthentic in part 1, which is the contribution rates (or eigenvalue) of the PCA that reflect the inherent characteristics of the sample data, and describe the degree of discrete on their eigenvector, while taking contribution rates as the weights does not reflect the evaluating standard of evaluators, even not indicate the importance of indicators.

Suppose that $X=(x_1, x_2, \cdots, x_p)$ is p-dimension variable, $X_1, X_2, \cdots, X_n$ are n samples selected from statistical population.

And suppose $A=(X_1, X_2, \cdots, X_n)^T$, the p column vectors of matrix A are $w_1, w_2, \cdots, w_p$

If $V_{P\times p}$ is the standardized covariance matrix, and the eigenvalues of $V_{P\times p}$ are $\lambda_1, \lambda_2, \cdots, \lambda_p$, so we can get

$$\Gamma^T V \Gamma = \begin{pmatrix} \lambda_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \lambda_p \end{pmatrix}$$

Or equivalently

$$\begin{cases} V\gamma_i = \lambda_i \gamma_i & i=1,2,\cdots,p \\ \gamma_i^T \gamma_j = \begin{cases} 1 & i=j \\ 0 & i\neq j \end{cases} & i,j=1,2,\cdots,p \end{cases}$$

So γ_i is the corresponding eigenvector of λ_i, and γ_1、γ_2⋯、γ_p are mutually orthogonal, and we have formula (1):

$$\begin{cases} \max\limits_{\gamma^T\gamma=1} \gamma^T \mathbf{V} \gamma = \lambda_1 = \gamma_1^T \mathbf{V} \gamma_1 \\ \max\limits_{\substack{\gamma^T\gamma=1 \\ \gamma^T\gamma_1=0}} \gamma^T \mathbf{V} \gamma = \lambda_2 = \gamma_2^T \mathbf{V} \gamma_2 \\ \cdots\cdots\cdots\cdots\cdots\cdots \\ \max\limits_{\substack{\gamma^T\gamma=1 \\ \gamma^T\gamma_i=0 \\ i=1\cdots p-1}} \gamma^T V \gamma = \lambda_p = \gamma_p^T V \gamma_p \end{cases}$$

If a and b are constant vectors, make $D(X)=V$, $y=a^T X$, $z=b^T X$, and we can get

$$D(y) = a^T V a$$
$$Cov(y,z) = a^T V b \quad (2)$$

Suppose G as the linear aggregation from $w_1, w_2, \cdots, w_p$,

$$G = \begin{Bmatrix} y \middle| y = a_1 w_1 + a_2 w_2 + \cdots + a_p w_p , \\ a_1^2 + a_2^2 + \cdots + a_p^2 = 1 \end{Bmatrix} ,$$

we set $(a_1, a_2, \cdots, a_p)^T$ as one of the direction of $w_1, w_2, \cdots, w_p$, and y is the variable or random sample of $\{w_i\}$.

Formulae (1) and (2) indicate that all sample in G, the sample variance on γ_1 is maximum, and equal to λ_1; on the orthogonal direction of γ_1, the sample variance on γ_2 is maximum, and equal to λ_2; and the rest can be deduced by analogy. The deduction above shows that the contribution rate or eigenvalue of principal components are the inherent characteristics of the data, and it only reflects the discrete degree of random sample on its eigenvactor, but not denote the importance of each indicator.

Table7 Symmetric Measures

		Value	Asymp. Std. Errora	Approx. Tb	Approx. Sig.
Measure of Agreement	Kappa	.026	.035	1.013	.311
N of Valid Cases		40			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

In fact, from Tables 1 and Table 5 (the 40–student ranking part), we can observe that the scores of number 35 student are 35 78, 57, 77, 90, 88, 88; the ones of number 34 are 87, 89, 77, 90, 88, 88, and compare the two student, number 34 has a better achievement than 35, but number 35 is the first ranking. A detailed analysis of tables 1 and 5 will be able to know the results of the evaluation it is very absurd, it does not reflect the purpose of

Journal of Theoretical and Applied Information Technology
28th February 2013. Vol. 48 No.3

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

evaluation set by the evaluators, which has no scientific support.

Table8 Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Measure of Agreement	Kappa	-.026	.	-1.013	.311
N of Valid Cases		40			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

To sum up, it is a misapplication to use the principal component analysis to determine the weight of revaluation, such method is lack of scientific basis, and can not indicate the essentiality of the evaluation indicators. The examples in this paper made KMO and Bartiett's test. According to the reference [1] viewpoint, it should be authentic for factor analysis based on these sample data above, the results, however, are totally worthless, for those general samples, the evaluation result may be more nonsensical.

Times university rankings were published by the importance of indicators, followed by 0.4, 0.1, 0.2, 0.2, 0.05, 0.05 weight coefficient, the result can be obtained by the weight in Table 9, Rank 5.

In Table 9, we compare Rank 1 with Rank 5, Rank 4 with Rank 5, the result can't be confidence by evaluating the weight which is determined by principal component. Contrast to Rank 1 and Rank 5, except two schools, the ranking of 38 schools changed, the rank difference of 30 schools is not smaller than 4, the 37th school has the largest difference, 34 places, The SPSS result of Kappa consistency test on Rank 1 and Rank 5 is shown as follows in Table 7.

Since p = 0.331> 0.05, so Rank 1 and Rank 5 do not have any consistency. While the Kappa Value = 0.026 <<0.4, it shows that the use of principal component analysis to determine the ranking of the weights and the ranking of the Times have no consistency, so Rank 1 has no reference value.

Contrast to Rank 4and Rank 5, all the ranking of 40 schools changed, the rank difference of 33 schools is no smaller than 4, the 2nd,3rd school have the largest difference, 32 places, The SPSS result of Kappa consistency test on Rank 4 and Rank 5 is shown as follows in Table 8.

Table 9. Ranking Table

index	Rank1	Rank 2	Rank3	Rank4	Rank5	Rank6	Rank7
1	27	31	36	14	1	27	1
2	7	14	1	34	2	1	40
3	6	2	2	35	3	7	2
4	36	34	33	5	4	36	3
5	26	24	28	15	5	26	4
6	13	9	12	28	6	13	5
7	10	8	11	31	7	10	6
8	8	6	7	33	8	8	7
9	21	15	13	20	9	21	8
10	2	1	3	39	10	3	9
11	28	29	31	13	11	28	10
12	38	38	38	3	12	38	11
13	35	35	34	6	13	35	12
14	30	28	29	11	14	30	13
15	5	5	6	36	15	6	14
16	15	17	18	26	16	15	15
17	11	10	14	30	17	11	16
18	37	37	37	4	18	37	17
19	39	40	40	2	19	39	18
20	18	20	23	23	20	18	19
21	9	13	15	32	21	9	20
22	23	23	24	18	22	23	21
23	16	16	16	25	23	16	22
24	40	39	39	1	24	40	23
25	25	33	32	16	25	25	24
26	29	25	25	12	26	29	25
27	24	21	21	17	27	24	26
28	32	removed	19	9	28	32	27
29	33	30	30	8	29	33	28
30	1	3	4	40	30	2	29
31	34	27	26	7	31	34	30
32	20	26	27	21	32	20	31
33	14	12	9	27	33	14	32
34	12	4	5	29	34	12	33
35	4	11	10	37	35	5	34
36	19	22	22	22	36	19	35
37	3	7	8	38	37	4	36
38	17	18	17	24	38	17	37
39	31	36	35	10	39	31	38
40	22	19	20	19	40	22	39

Note:

Rank 1 the ranking based on the weighted determined by PCA.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Rank 2 removed 28 observation, and use PCA to determine the weight and rank.

Rank 3 change PEER REVIEW SCORE AND CITATIONS/STASS SCORE of the school with index 2 to 10 and 30, use PCA to determine the weight and rank.

Rank 4 use $e_1^* = -e_1, e_2^* = -e_2, e_3^* = -e_3$ to make a new PCA ranking.

Rank 5 the Times ranking

Rank 7 the ideal ranking based on Rank 3's assumption.

Rank 7 based on Rank 3's assumption and the Times's weights to rank.

Since p = 0.331> 0.05, so the sort order 4 and 5 do not have any consistency. While because the Kappa Value = ¬ │ -0.026 │ <<0.4. This shows that the use of principal component analysis to determine the weight, the feature vector have taken a negative position vector in the Times ranking and have no consistency, so there is no reference value of Rank 4.

In summary, we say that evaluation on the weight which is determined by the principal component analysis is an error, there is no scientific evidence, and the method can not reflect the importance of evaluation as well. This example also made KMO analysis and Bartiett sphericity test, according to the refereces [1], that should be said that the sample data in this case call the shots for component analysis, the result still possess no value of reference. For the general problems, it may bring a more absurd result of evaluation.

3. CONCLUSION

As a result, we draw the following conclusions:1. Weight maked by Principal Component Analysis is instability for evaluating the change of entity, thus the instability makes the really rank is invalid; 2. Eight maked by Principal Component Analysis is instability for evaluating the change of observation, thus the instability makes the rank of weight is invalid, 3. The positive and negative of orthonormal vector make the expression of Principal Component Analysis isn't unique, that makes us cann't evaluate normally. Based on those, we think Principal Component Analysis isn't a scientific method, and we will study on the reasonable scope of the weight of Principal Component Analysis, and study on the new way of making weight.

ACKNOWLEDGEMENT

Hebei Society Science Funds：HB11GL061，Strategy of Hebei Ports' Services Industry

REFERENCES

[1] Wentong Zhang, and Wei *Dong*, *SPSS Statistical Analysis Advantage Testbook[M]*, Beijing, Higher Education Press, 2004.9, pp.227-232.

[2] Junping Jia, and Xiaoqun He. Statistics[M], Beijing, *China Renmin University Press*, 2006, pp.440.

[3] Wentong Zhang, and Jie Yan, *SPSS Statistical Analysis Basic Testbook[M]*, Beijing, Higher Education Press, 2004.9, pp.318

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195