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A Research on Weighted Combinatorial Evaluation Model

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Abstract: In order to deal with the inconsistency of different evaluation conclusions, this study measures the reliability of comprehensive evaluation models by constructing reliability indicators and determines the weights of each comprehensive evaluation method on this basis, then accordingly presents a weighted combinatorial evaluation model which takes the reliability of each comprehensive evaluation model into consideration. We use weighted combinatorial evaluation model on academic research level appraisal, evaluation conclusions show that ranking results of the weighted combinatorial evaluation model is more precise than that of the general comprehensive evaluation model.

Key words: Combinatorial evaluation, reliability analysis, academic research level, ante test and expost test

INTRODUCTION

Intrusion Evaluation activity is a basis work of decision-making and its methods are increasingly complex, interdisciplinary, mathematics. At present, most research is specific to a particular model. Documents and information that study on combinatorial evaluation system model are very little.

The essence of combinatorial evaluation system is combining several evaluation methods which have the same properties(Zhang *et al*., 2012). These Combinatorial methods must meet two prerequisites in the application: First:Selected for combinations of methods are able to address the evaluation issue of dysplasia and while the evaluation findings vary when used alone, but under the condition of a certain degree of statistical confidence are compatibility.Second: The evaluation conclusion of single method should have comparable, either both sort of evaluation, either both methods of evaluation scores, not all methods can be combined (Chen *et al*., 2003).

How to validate multiple evaluation method of sort in given significantly level has consistency, this belonging to ante test, can use Kendall (Kendall) consistency coefficient test law (Gregory, 1996; Li *et al*., 2006), when given significantly level meets consistency conditions? how to calculate more reasonable combinational weight, this belonging to weight assigned value problem, how to test combinational weight is reasonable and how to select most suitable combinational weight, this belonging to ex post test, ex post test uses Spearman (Spearman) Rank. correlation coefficient tests (Wang and Yuan, 2007; Xiao, 2008). In this text, we established reliability index for measuring relative reliability of comprehensive evaluation model, according to it constructed weights for various evaluation models and then established weights of combinational evaluation model based on reliability analysis.

RELIABILITY ANALYSIS OF THE COMPERHENSIVE EVALUATION MODEL

Reliability analysis is a comprehensive evaluation system to measure whether a certain stability effective analysis methods for performance and reliability. Reliability means the results of quiz tools consistency or stability.

Reflect the true extent of measured characteristics of indicators. Reliability refers to the consistency and stability of the test results, rather than a quiz or checklist for itself. Reliability under the value refers to a specific type of consistency, than to a general consistency, reliability varies at different times, different subjects or different results between the different score;

We Reliability analysis of the comperhensive evlauation model refers to the accuracy or credibility of evaluation results, size indicates that reliability of statistics called a reliability coefficient.

Comprehensive evaluation model of integrated reliability (r) by Spearman Brown formula gives:

$$R = \frac{m\bar{r}}{1+(m-1)\bar{r}} \quad (1)$$

where, M represents the number of the comprehensive evaluation model, $\bar{r}$ represents a single evaluation model of reliability coefficient of the mean value. j is a constant, k is a variable, r_j is the reliability coefficients for the comprehensive evaluation model of j:

$$r_j = \frac{\sum_{\substack{k=1\\k>j}}^{n}(X_j - \overline{X_i})(X_k - \overline{X_i})}{\sum_{\substack{k=1\\k>j}}^{n}\frac{1}{2}[(X_j - \overline{X_i})^2 + (X_k - \overline{X_i})^2]} = \frac{\sum_{\substack{k=1\\k>j}}^{n} l_{jk}}{\sum_{\substack{k=1\\k>j}}^{n}\frac{(l_{jj} + l_{kk})}{2}} \quad (2)$$

L_{jj} is the sum of squares of X_j, l_{jj} shows the difference square of Evaluation object i which obtains between in j evaluation model and its own evaluation value, Is: $(X_j - \overline{X_i})^2$; l_{kk} s the sum of squares of X_k, l_{kk} shows the difference square of Evaluation object i which obtains between in k evaluation model and its own evaluation value, is $(X_k - \overline{X_i})^2$; l_{jk} shows that the difference of evaluation value in j evaluation model and its own evaluation value products the difference of evaluation value in k evaluation model and its own evaluation value, is:

$$(X_j - \overline{X_i})(X_k - \overline{X_i})$$

WEIGHTED COMBINATORIAL EVALUATION MODEL AND ITS ANTE AND EX POST TEST

Multiple index comprehensive evaluation, two issues need to be addressed: how a multi dimensional standardization, comparability of data. Are integrated into a unified evaluation indicator values. First standardized method, the efficiency coefficient method, method of equivalent coefficient of solution, the second question is how to scientifically determine the index weights.

Determine the weights of combinatorial evaluation model: First,Normalized reliability value of every evaluation model,then obtain the Weight of various evaluation methods, is W_j:

$$W_j = \frac{r_j}{\sum_{j=1}^{5} r_j} \quad (3)$$

And then use rang analysis concluded that the dimensionless evaluation the assessment of results X_i, makes a variety of comprehensive evaluation results can be obtained and then assume linear function method to dimensionless evaluation results are weighted combinations.Weighted combination evaluation model:

$$Y_i = \sum_{j=1}^{5} W_j X_i \quad (4)$$

Ante test and ex post test of combinatorial evaluation: Ante test of combinatorial evaluation is mainly used for testing each single method's sorting result are consistent, combinatorial evaluation is composed of these single models. In generally speaking, ante test uses kendall coefficient (C) to test:

$$X_{ij} = T_i + E_{ij} \quad (5)$$

where, M is the number of evaluation methods: n is the number of being evaluated, R_i is the sum which used m evaluation methods to assess i project, When n is greater than 7, use Chi-square test, test statistic is:

$$\chi^2 = m(n-1)C \quad (6)$$

χ^2 Subject to m distribution whose degree of freedom is n-1.Look up table to find the confidence level of $\chi^1_{n-1}(\alpha)$, $\alpha = 0.05$ or $\alpha = 0.01$.

If $\chi^2 \geq \chi^1_{n-1}(\alpha)$, then the evaluation of various evaluation methods results in statistically significant is agreeing.

Ex post test of combinatorial evaluation is mainly used for inspecting the Close degree between sorts of combinatorial evaluation and sorts of the initial method.

Ex post test of combinatorial evaluation is using Spearman rank correlation coefficient tests.When n = 10, test statistic is:

$$t_k = \rho_k \sqrt{\frac{n-2}{1-\rho^2_k}} \quad (7)$$

We selected 5 indicators of academic research level (research funding, Awards, monographs, patents, research projects), used 4 Comprehensive evaluation models (cluster analysis, factor analysis, principal component analysis, comprehensive index method) to evaluate them. first, we made inverse indicators and appropriate indicators of the original data positive, then we used range method nondimensionalize data, used 4 Comprehensive evaluation models to evaluate,Sorted the results of the 10 samples, shows as Table 1-4:

Valuation results are dimensionless by efficacy coefficient method and then calculate the reliability of a single evaluation model, R1 = 0.867, R2 = 0.891, R3 = 0.778, R4 = 0.912. According to the reliability of a single evaluation model, using Eq. 1 can be calculated four comprehensive reliability evaluation model (r) = 0.961, you can see a variety of comprehensive reliability evaluation model of reliability than a single model has markedly improved. Reliability of comprehensive evaluation on four kinds of methods for high and low order: Cluster analysis, a comprehensive index method, principal component analysis, factor analysis, determine the appropriate

Table 1: Cluster analysis results

College	Cluster analysis	Sort
1	0.591	4
2	-0.092	9
3	-0.498	10
4	1.369	1
5	0.068	6
6	0.467	5
7	0.997	2
8	0.043	7
9	0.617	3
10	-0.013	8

Table 2: Principal component analysis results

College	Principal component analysis	Sort
1	24.830	1
2	24.660	2
3	20.480	6
4	23.980	3
5	22.40	5
6	19.910	7
7	23.340	4
8	18.810	10
9	19.760	8
10	19.660	9

Table 3: Factor analysis results

College	Factor analysis	Sort
1	0.618	3
2	0.540	5
3	0.517	6
4	0.624	2
5	0.512	7
6	0.489	9
7	0.568	4
8	0.635	1
9	0.502	8
10	0.477	10

Table 4: Comprehensive index method results

College	Comprehensive index method	Sort
1	0.559	2
2	0.457	6
3	0.445	7
4	0.636	1
5	0.437	8
6	0.415	9
7	0.545	3
8	0.515	4
9	0.462	5
10	0.361	10

weight, 0.2515, 0.2584, 0.2256, 0.2645, respectively. To verify the consistency of the n Comprehensive evaluation models results,based on ante test method constructs the test statistic, under a given significance level $\alpha = 0.01$, $\chi^2 \geq \chi^2_{n-1}(\alpha)$, Therefore, in the article, Four evaluation models sort results are consistent with the significance level of $\alpha = 0.01$.

CONCLUSION

Addition we selected simple average law, AHP and weighted combination evaluation for comparison, calculated Spearman rank correlation coefficient for Calculation model and combine three of the four comprehensive evaluation model of the 3 combinatorial evaluation models and the 4 Comprehensive evaluation models, they are related coefficient, evaluation conclusions show that ranking results of the weighted combinatorial evaluation model is more precise than that of the general comprehensive evalutation model.

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