APPLICATION OF ANALYTIC HIERARCHY PROCESS ON CALCULATING THE WEIGHTS OF ECONOMIC MODEL EVALUATION

Dai Wang, Dan Chang, Na Luo and Jingyi Xu
School of Economics and Management, Beijing Jiaotong University, No.3 Shangyuancun, Beijing, China

Keywords: Weight, Evaluation system, AHP, Adjust.

Abstract: With the combination of teaching resources and IT technology being more and more close, it has attracted more attention on the issue of how to manage the quality of online teaching resources. This thesis has constructed an evaluation system for the model library of the Economic Model Resource Platform, and adjusted the weighted scales and the corresponding calculations based on both of the theory of the Analytic Hierarchy Process (AHP to be brief) and the characteristics of the Economic Model Resource Platform during the process of determining the weights of the evaluation system in order to make the final weights more suitable for practical applications. This study helps achieve the purposes of monitoring the quality of the economic models and promoting the optimization of the models. On the other hand, the calculation method of determining the weights has provided a reference for the application of AHP.

1 INTRODUCTION

With the rapid development of information technology, network technology gradually penetrated into the educational applications. However, with the rapid increase of the amount of teaching resources on the Internet, how to effectively improve the quality of teaching resources has gotten more and more concentration. The foundation of this thesis is the Economic Model Resource Platform. This platform which works as a library of the economic models based on the internet technology contains 170 models up to now. And the platform is an important teaching resource with the goals of training the scientific and engineering thoughts of the economics and management students and training them to be the compound and creative talents. With the increasing number of the models on the platform, the quality of the models varies greatly, and needs improving continuously. Therefore, the management of the models on the platform is particularly important.

Analytic Hierarchy Process (AHP to be brief) has the characters of clear, simply, and with strong systematicness (XIANG Qing, 1997). In recent years, this method has been widely applied to analyze and evaluate in many territories such as social science, economy, education and others. The examples of the applications come as the constructing of the analysis method of meandering river underground reservoir (Yue Dali *et al.*, 2010), the constructing of the evaluation system of the emergency logistics plan(MA Li, 2010) , the constructing of the quality evaluation system in the hospital work (ZENG Wenting *et al.*, 2010), analyzing the leading industries in direct foreign investments (Zhao Fu-hou, 2010), etc.

This thesis is based on AHP. The first step is to construct the index system of model library evaluation system, and the second step is to determine the weights. In the process of the second step, there is a combination of the theory of AHP and the characteristics of the application of the evaluation system. The method of constructing the judgment matrixes has been adjusted, making it more suitable with the actual situation. And it proves to be correct by the validation afterwards.

2 CONSTRUCT THE INDEX SYSTEM OF ECONOMIC MODELS

This thesis uses the AHP method to construct the index system of the economic model evaluation

Wang D., Chang D., Luo N. and Xu J..
APPLICATION OF ANALYTIC HIERARCHY PROCESS ON CALCULATING THE WEIGHTS OF ECONOMIC MODEL EVALUATION.
DOI: 10.5220/0003549201080116
In *Proceedings of the 13th International Conference on Enterprise Information Systems* (ICEIS-2011), pages 108-116
ISBN: 978-989-8425-55-3

system (Rong RUAN *et al.*, 2011). Based on the basic principles of AHP, the index system is divided into three levels, namely, the target layer, rule layer and project layer. By consulting criteria of teaching resources and combining the features of the economic models, the target layer is divided into content, technical, effectiveness and application. Those are the first-level indexes. Then get the target level indexes in the same way. After this, there are 11 indexes of the criterion level and 24 indexes in the program level finally.

The index system is shown in Table 6.

3 DETERMINE THE INITIAL WEIGHTS USING AHP

3.1 Theory and Characteristics of AHP

AHP is proposed by the U.S. operations researcher T.L Saaty (1980), which is a multi-objective decision analysis method combined with qualitative and quantitative analysis. It suits for the problem that has complex structure and many decision criteria that are difficult to quantify. The basic idea of AHP is that the system is decomposed into different elements according to the nature, decision-making or evaluation of goals of the object. Then different elements are arranged from high to low by the linkages between elements.

AHP is not only a simple method for making quantitative analysis by non-quantitative systems in engineering event, but also an effective method to make subjective judgments on the objective description.

3.2 The Implementation Steps of AHP

The general process of AHP is, shown in Figure 1.

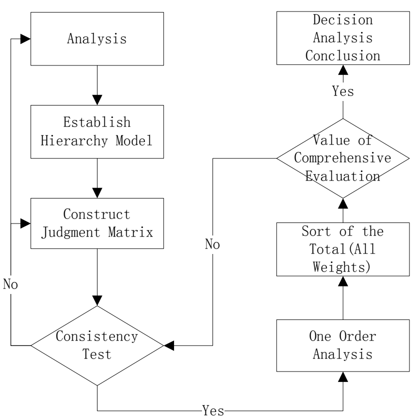

Figure 1: The general process of AHP.

1. Analyze the research questions.
2. Establish the hierarchy models based on the results of the research questions.
3. Construct the judgment matrix.
4. Conduct consistency test, if the test failed, re-analyze the problem or construct a new judgment matrix, else make the single-pass order analysis.
5. Make the total sequencing analysis of all weights.
6. Test the value of comprehensive evaluation, if the decision can be accepted, draw conclusions, or re-test the consistency.

3.3 Application of AHP to Get the Weights of the Economic Model Evaluation System

3.3.1 Construct Variables

The economic model evaluation system is divided into three levels based on the target layer, rule layer and project layer. Level one indexes include content, technical, effectiveness and application; the secondary indexes include integrity, accuracy and ease of understanding and so on. Indexes have been shown in Table 6.

Level one indexes will be set respectively as A_1 、 A_2 、 A_3 、 A_4 . The secondary indexes corresponding to level one indexes will be set respectively as B_{1m} 、 B_{2n} 、 B_{3k} (m 、 n 、 k are natural numbers）, so do the third level indexes.

Assume that the weights of the level one indicators as ω_1 、 ω_2 、 ω_3 、 ω_4 , and then:

$$\begin{cases} 0 \le \omega_i \le 1 \quad (i = 1,2,3) & (1) \\ \sum_{i=1}^{4} \omega_i = 1 & (2) \end{cases}$$

Assume that the weights for the secondary indicators are $\omega_{ij} \quad (i = 1,2,3; j = 1,2,...,\max(m,n,k))$, and then:

$$\begin{cases} 0 \le \omega_{ij} \le 1 \quad (i = 1,2,3) & (3) \\ \sum_{j=1}^{\max(m,n,k)} \omega_{ij} = 1 & (4) \\ \sum_{i=1}^{3} \sum_{j=1}^{\max(m,n,k)} \omega_i \omega_{ij} = 1 & (5) \end{cases}$$

3.3.2 Determine the Weights of Evaluation Indexes

(1) Construct judgment matrixes. On the same level, the result of pair wise comparison can be generally described by using "important", "slightly important", "relatively important" and "very important". In AHP, using $f(x,y)$ to express whether factors x is more important than factor y . If $f(x,y)>1$, it indicates that x is more important than y . If $f(x,y)<1$, it indicates that x is less important than y . Only when $f(x,y)=1$, it indicates that x and y are equally important. And it is commonly agreed that $f(x,y)=\frac{1}{f(y,x)}$.

Numbers 1 to 9 are used to indicate the level of importance of the indexes. The meanings of the scales are in Table 1.

Table 1: The meaning of each scale in AHP.

Scale f(x,y)	Definition	Instructions
1	Equally important	i is equally important with j
3	Somewhat important	i is somewhat more important than j
5	Relatively important	i is relatively more important than j
7	Very important	i is more important than j
9	Absolutely important	i is absolutely more important than j
2 4 6 8	Between	Between the two states

(2) Expert opinion to construct the Matrix method. In the scoring process, the experts determine the relative importance ratio of the indicators in the same level based on their experience. The form of collecting the data is questionnaire.

According to the evaluation system, we invited 55 experts to rate indexes in order to create a judgment matrix by questionnaires. The experts are from three research areas namely Department of Economics, Department of Logistics and Department of Information System. After the research, 50 questionnaires were recovered, and the recovery was 90.9%. Because each expert has a certain understanding of bias and errors, we removed some radical elements and do descriptive statistics when using the original data. At last, we received 13 comparison matrixes.

Take the secondary indicators 'integrity' for example. Its third-level indexes' judgment matrix is in Table 2.

(3) Calculating the weights and the maximum eigenvalue of the third-level indexes of 'integrity'. Determine the matrix data (Row 2-5, Table 2) in accordance with the instructions given afterwards. The following is the calculation of the maximum eigenvalue of the indexes; the results are in Table 3.

Calculation descriptions:

M_i :

$$M_i=\left(\prod_{j}^{n} b_{ij}\right)^{1/n} \tag{6}$$

Table 2: Judgment matrix of the level 3 indexes of 'Integrality'.

Integrality	Theoretical source	Assumptions	Theory to explain	Analysis
Theoretical source	1	2	2	1
Assumptions	1/2	1	2	2
Theory to explain	1/2	1/2	1	1
Analysis	1	1/2	1	1

Table 3: Calculate the index weights and the maximum eigenvalue of the third-level indexes of 'integrity'.

Scales	A	B	C	D	Mi	Wi	(AW)i	The largest eigenvalue	Weights
A	1.00	2.00	2.00	1.00	1.414214	0.340657	2.043945	0.69628508	0.505198
B	0.50	1.00	2.00	2.00	1.189207	0.286458	1.575517	0.45131891	0.32746
C	0.50	0.50	1.00	1.00	0.707107	0.170329	0.510986	0.08703563	0.06315
D	1.00	0.50	1.00	1.00	0.840896	0.202556	0.708947	0.14360147	0.104192
Total					4.151424	1		1.3782411	

In this case n = 4.

W_i :

$$W_i = M_i / \sum_{i}^{n} M_i \quad (7)$$

In this case n = 4.

A is comprehensive judgment matrix. Each number in the number i line in A multiplied by each number of the corresponding values in the W_i column, and the summation of all products is $(AW)_i$.

The calculation of the maximum eigenvalue:

$$\lambda_{\max} = \left(AW\right)_i / n \times W_i \quad (8)$$

In this case, the maximum eigenvalue is equal to 1.3782411.

(4) Consistency Test. Because the matrix structure made by the experts do not necessarily meets the matrix consistency. Judge the matrix consistency test in order to limit this kind of error. Take the largest eigenvalue and n's relative error as the consistency indicator of matrix. Denoted by:

$$CI = \frac{\lambda_{\max} - n}{n-1} \quad (9)$$

(n equals to the order of matrix, also the number of indexes in matrix.)

If $n \le 2$,the matrix is always exactly the same, it means $CI = 0$ 。And when $n > 2$,the ratio of the matrix's consistency index and the average random consistency index is random consistency ratio which is denoted as CR .

If $CR<0.1$, the judgment matrix has satisfactory consistency and the calculated feature vector is reliable. Otherwise the matrix the experts constructed has larger error and is out of range. The matrix needs to be re-adjusted until it gets the satisfactory consistency.

After calculation, all comparison matrixes are consistent, and the results are credible.

(5) Calculation of the total weight. The index system is composed of the first-level indicators and secondary indicators. Each first-level indicator contains numbers of secondary-level indexes. As described above, we calculate four first-level indicators' weights, and analyze the consistency of its matrix. And it is the same to the secondary-level indexes.

Supposing that the indicator i 's weight is equal to a_i ,its j secondary-level indicator's relative weight is b_j .Then this secondary-level indicator's total weight is $a_i \times b_j$.

In order to verify whether the total weight also has the satisfaction of consistency, we need to calculate the total random consistency index, the indicator is calculated as:

$$CR = \frac{\sum_{i=1}^{n} a_i CI_i}{\sum_{i=1}^{n} a_i RI_i} \quad (10)$$

While:

a_i : the number i first-level indicator's weight.

CI_i : the number i first-level indicator's consistency index value.

RI_i : the number i first-level indicator's average random consistency index values.

The final overall consistency test result is 0.028312 which is far less than 0.1.So it is consistent with consistency. Evaluation indexes’ weights are in Table 6, the unadjusted weights.

3.4 Existing Problems in Weights

According to the analysis of the system above, the following questions are found:

1) There are nine scales 1 to 9 which bring heavy interference to define the actual level of importance. According to the statistics, in the valid questionnaires, 89.93 percent of the scores are between 1 and 4, and this is not accord with the actual. And a few high points such as score nine or eight will cause big effect to the result of the data. The reason lies in that nine scales range too wide, and in the economic model evaluation system, the differences of importance between indexes of the same layer do not need so big a range. At the same time, because the differences between the graders own subjective thoughts, the specific meanings of 1 to 9 are difficult to be defined.

2) Traditional AHP method is applicable to the systems with fewer indexes, and when they are used to the economic model evaluation system, the big workload will make raters be confused with the concepts of indexes gradually.

3) Due to current mindset, in 90.1% of the recovered questionnaires, the top right corner data of judgment matrix are greater than 1. When some experts do the rating, they default that the front index is more important than the afterward indexes. This kind of mindset leads to an obvious weight stressed phenomenon in the same layer indexes, namely the index Content’s weight is greater than 80%, which causes the weight of index Application

can be ignored, or even the indexes of the secondary layer and the third layer. The phenomenon does not match the facts.

4 ADJUST THE WEIGHTS OF THE EVALUATION SYSTEM

4.1 Adjustments

It has shown that the direct application of AHP does not match the evaluation system exactly based on the analysis of the evaluation system above. Because of this, it is needed to adjust the ways of calculating the weights based on the characteristics and the actual applications of the Economic Model Resource Platform and re-calculate them.

The specific adjustments of the application of AHP are as follows.

1) Narrow the scope of the scales to three numbers. Narrowing the scope of the scales is more suitable for this study compared to the initial nine numbers.

2) Set the scales to -1, 0 and 1(YE Jun, WANG Lei, 2010). -1 is introduced into the process in order to express the degree of the importance of the indexes and reduce the fatigue caused by the large amount of work.

The meaning of each scale is shown in Table 4.

Table 4: The meaning of each adjusted scale.

Scale f(x,y)	Definition	Interpretation
-1	To be less important	i is less important than j
0	To be equally important	i is equally important with j
1	To be more important	i is more important than j

3) Using the adjusted questionnaires to obtain new data from the same respondents.

4.2 Calculating Weights

(1) Structure the Judgment Matrixes. A judgment matrix is based on the relative importance of each index, denoted by C. Still take the level three indexes of the secondary index 'Integrality' for example. The experts assess the relative importance of the indexes as 'Theory to explain' > 'Assumptions' = 'Theoretical source' > 'Analysis'. And the initial judgment matrix is shown in Table 5.

Thereupon,

$$C = \begin{bmatrix} 0 & 0 & -1 & 1 \\ 0 & 0 & -1 & -1 \\ 1 & 1 & 0 & 0 \\ -1 & 1 & 0 & 0 \end{bmatrix} \quad (11)$$

(2) Calculate the optimal transfer matrix. Optimal transfer matrix is set to be O. According to

$$O_{ij} = \frac{1}{n}\sum_{k=1}^{n}(c_{ik} + c_{kj}) \quad (12)$$

Get the optimal matrix as follows:

$$O = \begin{bmatrix} 0 & 0.50 & -0.50 & 0 \\ -0.50 & 0 & -1.00 & -0.50 \\ 0.50 & 1.00 & 0 & 0.50 \\ 0 & 0.50 & -0.50 & 0 \end{bmatrix} \quad (13)$$

(3) Get the consistent matrix. Set the consistent matrix as K. According to $k_{ij} = \exp(o_{ij})$ to get the consistent matrix as follows:

$$K = \begin{bmatrix} 1.00 & 1.65 & 0.61 & 1.00 \\ 0.61 & 1.00 & 0.37 & 0.61 \\ 1.65 & 2.72 & 1.00 & 1.65 \\ 1.00 & 1.65 & 0.61 & 1.00 \end{bmatrix} \quad (14)$$

(4) Get the weights. Make use of the eigenvector to get the weights. Set the weight matrix as P_T. Then

$$p_{Ti} = \frac{p_i}{\sum_{i=1}^{4} p_i} = \frac{\sqrt[4]{\prod_{j=1}^{4} o_{ij}}}{\sum_{i=1}^{4} p_i} \quad (15)$$

Table 5: Adjusted judgment matrix of the level 3 indexes of 'Integrality'.

Integrality	Theoretical source	Assumptions	Theory to explain	Analysis
Theoretical source	0	0	-1	1
Assumptions	0	0	-1	-1
Theory to explain	1	1	0	0
Analysis	-1	1	0	0

And the weight matrix is

$$P_T = \begin{bmatrix} 0.235 & 0.143 & 0.387 & 0.235 \end{bmatrix} \quad (16)$$

(5) Complete the calculation of the weights in the evaluation system. Complete the calculation of the

Table 6: Economical model evaluation system and the weights.

A Target layer	Unadjusted weights	Adjusted weights	B Rule layer	Unadjusted weights	Adjusted weights	C Project layer	Unadjusted weights	Adjusted weights
1 Content	0.870	0.276	11 Integrity	0.503	0.124	111 Theoretical source	0.234	0.029
						112 Assumptions	0.244	0.017
						113 Theory to explain	0.009	0.048
						114 Analysis	0.016	0.047
			12 Accuracy	0.238	0.089	121 Interpretation accuracy	0.073	0.038
						122 The accuracy of understanding	0.033	0.018
						123 Whether to seize the essence	0.132	0.027
			13 Understand-ability	0.125	0.063	131 Example	0.046	0.018
						132 Analogy to explain	0.075	0.009
						133 Whether has interpretation of the academic term	0.004	0.036
2 Technical	0.080	0.455	21 Operability	0.077	0.256	211 Whether the output of experimental operation	0.068	0.148
						212 Whether the result is that the process	0.005	0.053
						213 Whether has input data validation	0.004	0.053
			22 Friendly interface	0.002	0.067	221 Tips range of input data	0.002	0.028
						222 Sample data	0	0.016
						223 The reasonable of the control	0	0.022
			23 Experiment to explain	0.002	0.131	231 Experiment description	0.002	0.041
						232 Interpretation of results	0	0.057
						233 Whether is the steps to explain logical	0	0.030
3 Effectiveness	0.030	0.102	31 Intuitive	0.025	0.027	311 Text	0	0.015
						312 Graphic description	0.016	0.008
						313 Other visual presentation methods	0.008	0.004
			32 Data Validation	0.075	0.075	321 The length of time to get result	0	0.054
						322 Error rate	0.001	0.018
4 Application	0.030	0.167	41 Case relevance	0.025	0.096		0.025	0.096
			42 Case Study	0.001	0.035		0.001	0.035
			43 Questions	0	0.035		0	0.035

entire weights in the evaluation system according to the methods above. Set the weight of index i as a_i, its secondary index j's weight as b_j, and the final weight of the secondary weight is $a_i \times b_j$.

4.3 The Evaluation System and the Weights after the Adjustments

According to the methods above, the economical model evaluation system and the weights are in the table 6, the adjusted weights.

5 VALIDATION OF THE EVALUATION INDEXES

5.1 The Basis of the Validation

To verify that the adjusted index's weights are more suitable for the economic model evaluation system, it is needed to test the two sets of weights.

According to the experience of statistics, when the size of the sample is not less than 30，it is large sample, and the samples' average can eliminate personal biases and errors. In this case, 60 users of the Economic Model Resource Platform were selected for the investigation. And they were randomly divided into group A and group B, 30 people in each group to make the results of the validation more general and reliable (E.L.Lehman, 2010).

5.2 The Process of the Validation

1) Sampling. Randomly select 20 models from the 170 models in the model library of the Economic Model Resource Platform, number them 1-20.

2) Select the respondents. Select 60 users of the Economic Model Resource Platform randomly and divided them into group A and group B, according to the methods above.

3) Rating. Let the users of group A rate the models 0-20 according to the practical usage of the models with 10 being the highest and 0 being the lowest. In this case, it has been the rules that the scores of 8-10 are level A, 5-8 are level B, and the rest are level C.

4) Scoring. Request the users of group B score the indexes of the 20 models.

5) Data analysis.

Firstly, the data of Group A were statistically analyzed. Work out the average score of each model and rate the models in the method above.

Secondly, put the scores of each index from group B into the two sets of the index systems to get two total scores for each model. And take the average scores of all the raters as the final scores of the models using two evaluation systems.

Finally, compare the three sets of data, as shown in Table 7.

Notes:

Horizontal axis: Model Numbers.

Vertical axis: Scores.

Grey areas: Levels from Group A.

Triangle marks: Model scores rated by Group B using the evaluation system unadjusted.

Quadrate markers: Model scores rated by Group B using the evaluation system after adjusted.

Table 7: The results of the validation.

Model Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Rating by Group A	A	B	B	C	C	A	C	B	B	C
Scoring by Group B(unadjusted)	9.82	2.85	9.43	0.78	7.99	9.58	7.78	9.65	8.87	8.96
Scoring by Group B(adjusted)	9.76	5.48	6.42	0.61	2.97	8.90	2.44	7.87	7.54	3.54
Model Number	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Rating by Group A	C	C	B	C	A	A	B	C	B	C
Scoring by Group B(unadjusted)	1.54	8.99	2.01	7.45	9.46	9.67	9.06	8.79	1.13	7.06
Scoring by Group B(adjusted)	1.08	3.25	8.50	2.48	9.08	8.16	6.35	4.70	6.78	2.35

The results of the matching are shown in Figure 2.

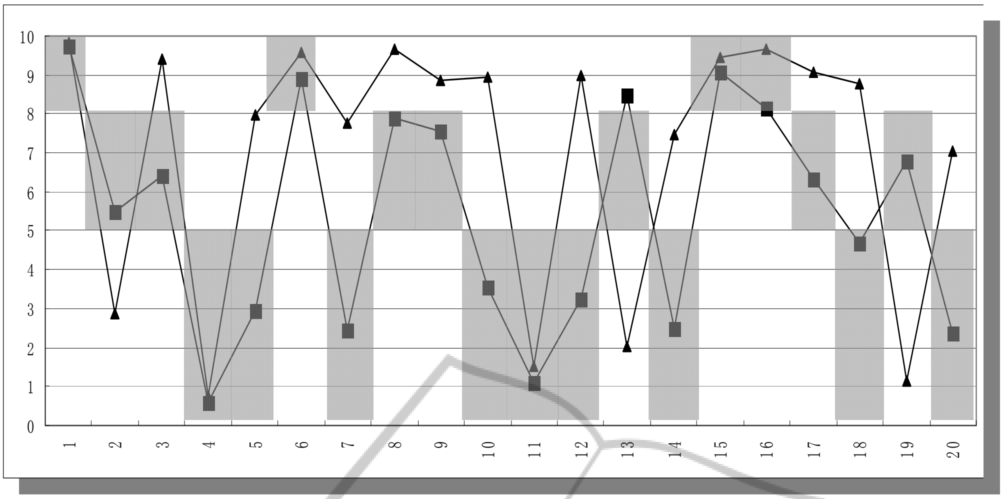

Figure 2: The matching Results of the Validation.

5.3 Analysis of the Validation

As is shown above, the number of matched models between the rating from group A and the scores gotten by the evaluation system unadjusted is 6 (respectively, model 1, model 4, model 6, model 11, model 15 and model 16), 30% of the total number of the samples. According to the data, the scores from the unadjusted evaluation system are extreme, and most of them are between 7-10 points. Observe the weight of each index, it can be find that “Theoretical source”, “Assumptions”,” Interpretation accuracy ”,“Whether to seize the essence ”,“Whether the output of experimental operation” and “Analogy to explain” occupy the larger share, weighing 82.6% in the whole evaluation. So they have too much excessive traction to the final score, resulting in relatively extreme scores of models.

However, the number of matched models between the rating from group A and the scores made by the evaluation system adjusted is 19, 95% of the total number of the samples. Therefore, the weights made by the adjusted evaluation system are more applicable and objective, mainly embodied in the following three aspects.

Firstly, they solve the unsuitable problem of the weights made by the unadjusted evaluation system. Reduce the scales to - 1, 0 and 1 can indicate the level of importance among indexes more clearly. Meanwhile, the reduction of the number of scales eases the workload of respondents and alleviates the scoring fatigue, thus enhancing the effectiveness of the initial matrixes. In addition, adjusting scales solutes the difficulty of discriminating the large amount of scales.

Secondly, accord with the actual importance of the indexes. By the weights of the final indexes, "Experimental operation is output or not" occupies the largest share, as 14.8%. Followed is "Case correlation" which occupies as 9.6%. The Economic Model Resource Platform takes IT as the core, and focuses on the applications of the models, so the maneuverability and correlation of the cases indeed weigh a larger proportion in evaluating the quality of the models. And the weights of other indexes are also accord with the actual situation.

Thirdly, be helpful with practical applications. This economic model evaluation system can show clearly the total scores of the models and typically each score of the indexes. It not only evaluates the models, but also indicates the low grade models’ weak more intuitively, which helps build a clear target for the administrator to improve the quality of the models.

6 CONCLUSIONS

There are numerals ways to get the weights of indexes in an evaluation system. And this thesis gets the weights by adjusting the process of AHP based on the theory of AHP and the characteristics of the Economic Model Resource Platform. This method not only makes the meaning of the scales more directly which results in reducing the workload of scoring and relieving the fatigue of scoring, but also gets a result more suitable to the practical applications. The method in this thesis can be used not only on the Economic Model Resource Platform, but also provides some references to other similar studies.

However, although the way of getting the weights is adjusted, it is unavoidable that the data from the experts are some kind of subjective. Therefore, it is important to choose the proper experts, both from the experts of the corresponding subjects and the users of the Economic Model Resource Platform in order to make the weights of the indexes more reasonable and practicable. The users of the Economic Model Resource Platform can rate the models according to this evaluation, and when the number of the raters is large enough, we can get the evaluation of the models.

REFERENCES

Emshoff, J. R.; Saaty, T. L.(1980). Application of the Analytic Hierarchy Process to Long Range Planning Processes. *European Journal of Operational Research*, 10(2),131-143.

Hambali, A., & Sapuan, S. M., & Ismail, N. & Nukman, Y. (2010). Material election of polymeric composite automotive bumper beam using analytical hierarchy process. *Journal of Central South University of Technology*, 17 (2), 244-256.

Lehman, E. L. (2010). Elements of Large-Sample Theory. In*: Springer New York*, New York.

Li, M. (2010). Based on rough sets and AHP evaluation of emergency logistics plan. *China Logistics and Purchasing*, 15, 66-67.

Ruan R., & Zhang Z. J., & Meng J. J., & Liu Z. C. (2011). The construction of economic model evaluation system. In: *R. T. Zhang, ed. 13th International Conference on Enterprise Information Systems, Beijing* 8-11 June 2011.

Xiang, Q. (1997). "Social Evaluation of Projects" *Review. Dialectics of Nature*, 13, 24-26.

Ye, J. & Wang, L. (2010). Research on comprehensive evaluation method based on rough set and AHP. *Computer Applications*, 7, 2486-2488.

Yue, D. L. & Wang J. & Wang Y. Z. & Wu S. H. & Liu J. M. & Shu Q. L. (2010). Hierarchy analysis in paleochannel reservoir architecture: A case study of meandering river reservoir of Guantao Formation. *Gudao Oilfield. Geological Sciences*, 3, 832-843.

Zhao, F. H. (2010). The Leading Industry Analysis in the Foreign Direct Investment Industries by Using Analytic Hierarchy Process. *Industrial Engineering*, 13, 91-95.

Zeng, W. T. & Shi L. & Zhao W. L. (2010). The application of AHP in the five top-three hospitals in Chongqing City. *China Health Statistics,* 4, 406-408.