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Analysis of Electricity Marketing Risk Control of Power Supply Enterprise Based on Intelligent Algorithm

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Abstract

The technology in the power marketing risk control analysis of power supply enterprises effectively solves the proprietary method, which is suitable for the situation where the comprehensive subordination relationship collapses through the application of the handwheel. The objective weighting method can be used to obtain the data information of the relevant indicators, but the subjective weighting method can be used to obtain the data information of the relevant indicators. Other solutions for collapsed synthetic affiliation do not address proprietary methods that adapt in an effective manner. Through the improvement of traditional algorithms, it is proposed that the application of intelligent algorithms to the process of risk control analysis and evaluation can effectively improve and improve the accuracy of power supply enterprises' power marketing risk control evaluation.

Keywords: *Ahp, Intelligent Algorithm, Power Supply Enterprise, Marketing Effect, Comprehensive Evaluation;*

1. Introduction

With the deepening of the national power system reform and the power market reform, it has become an inevitable fact that power marketing goes to the market. Whether the marketing work is done in place has become one of the important conditions for the survival and development of enterprises [1-2]. The importance of electric power marketing With the continuous development of modern economy, the demand for electric energy is increasing. Electric power marketing occupies a very important position in the business of electric power enterprises, which is directly related to the survival and development of electric power enterprises. The center of power marketing is to realize the exchange of electric energy, and finally complete the use value of electric energy and obtain profits. Whether the business goals and profit goals of power companies can be achieved, whether power companies can survive and develop in a competitive market, ultimately depends on whether power consumers purchase electrical energy and increase the use of electrical energy [3-4]. Therefore, power marketing should focus on expanding market sales and increasing market customers[5-6]. It should be based on the principle of "power grid is the foundation, technology is the support, and service and management are the guarantee", and the power marketing must be legalized and commercialized. Operation, adopt a market-oriented management model, and position power marketing as the core business of power supply enterprises. Power production and operation activities should obey and serve the needs of power marketing.

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2. Electricity marketing effect evaluation index system

Due to the particularity of power products, the index system of power marketing effect is different from other commodities. According to the characteristics of power companies and the principles of establishing an index system, an index system is established from four aspects: the economic benefits of the power companies, social benefits, internal marketing awareness, and customer service satisfaction.

(1) Target level, that is, comprehensive evaluation of the marketing effect of power supply companies.

(2) The standard level is divided into 4 levels, namely the economic benefits of the enterprise, social benefits, the marketing awareness within the enterprise, and customer service satisfaction.

(3) Indicator level, that is, 22 indicators distributed on 4 levels: annual electricity sales, annual electricity sales growth rate, annual sales revenue, annual sales revenue growth rate, electricity fee recovery rate, sales profit rate, line loss rate, The unit power supply cost, the social image of the power supply company, the social contribution rate of the power supply company, the cultural quality level of the marketing department personnel, the marketing strategy level of the marketing department, the management level of the enterprise leadership, the degree of cooperation of other departments with the marketing department, the installation industry expansion efficiency, one One example for each household, inspection and maintenance efficiency, power supply reliability, customer satisfaction rate, customer complaint rate, annual power outages for urban users, and annual power outage time for urban users.

3. Evaluation model

3.1. Determination of weight

When determining the weight of an indicator?, it should include the following two parts:

(1) The subjective weight part μ_j that reflects the experience and knowledge of the expert. Generally speaking, when an expert determines the weight of an indicator, he usually considers its importance from the economic meaning (or technical meaning) of the indicator itself, so it is called subjective The weight determined by the weighting method is the value weight.

(2) Reflecting the objective? The objective weight v_j of the amount of information transmitted. Generally speaking, they determine the importance of the index according to the degree of variation of each index value or the correlation between each index, so that the weight has absolute The objectivity.

Combine the subjective weight μ_j and the objective weight v_j to get the combined weight. In combination weights, multiplicative combination is commonly used. The characteristics of multiplicative synthesis are: when any of the subjective and objective weights is small (towards 0), the combined weight will be small; when only two weights are important at the same time, the combined weight Value is important. This method has "multiplier utility", which makes the bigger the bigger and the smaller the smaller, so it is suitable for the situation where there are more indicators and the weight distribution is more even.

3.1.1. Determination of subjective weight.

The Analytic Hierarchy Process (AHP method) is an optimization method based on expert consultation. It can divide various factors in a complex system into interconnected and orderly layers, forming a multi-level analysis structure, and dividing multiple levels and multiple indicators. The weight assignment of is simplified as a pairwise comparison of the importance of each index, which makes up for the weakness of the human brain that is difficult to scan in all dimensions in more than two dimensions. The tomographic analysis method is used to determine the subjective weight of the evaluation index. The main steps are:

(1) According to the established hierarchical structure, use 1-9 and its reciprocal scale method to compare the two factors. That is, the scales 1, 3, 5, 7, and 9 respectively represent? And (compared to the

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two elements, one element is the same, slightly, obvious, strong, and extremely important than the other element, 2, 4, 6, 8, respectively The median value of two adjacent judgments, the scale of the comparison between factor i and j and the scale of comparison between j and i are the reciprocal of each other. The judgment matrix $A=\left(b_{ij}\right)_{m\times n}$ is obtained by comparing n elements in pairs.

(2) Solve the characteristic root $\lambda_{\max}$ and the characteristic vector (weight vector) U of the judgment matrix. The feature vector is the importance ranking weight of each factor in the same layer relative to a factor in the previous layer. The matrix eigenvector solution methods include power multiplication, square root method and normal column average method. The square root method is used here. After normalization, it is the ranking weight of the relative importance of the corresponding factors at the same level to a factor at the previous level.

(3) Hierarchical single sorting and checking the consistency of the judgment matrix. In order to check the consistency of the judgment matrix, the consistency index $CI=\frac{\lambda_{\max}-n}{n-1}$ and the average random variable index RI need to be calculated. When the random consistency ratio is $CR=\frac{CI}{RI}<0.1$, it is considered that the results of the analytic hierarchy process have satisfactory consistency, that is, the weight distribution is reasonable. Otherwise, the value of the element of the judgment matrix must be adjusted, that is, the value of the weight redistribution.

(4) Level total ranking and consistency test. Calculate the ranking weight of the relative importance of all factors at the same level to the overall goal, which is called the level total ranking. It uses the weights of the factors at the next level and the combined weights of the factors at the previous level to get the relative importance of the lowest level factors to the overall goal.

(5) Draw a weighting conclusion. After being scored by multiple experts, the total ranking calculation results of their respective levels are obtained. Synthesize it to get the final weight $U=\left[u_1,u_2,\cdots u_n\right]^T$ weight of each index of the evaluation index system.

3.1.2. Determination of objective weight

The entropy method is used to determine the objective weight of the evaluation index. The main steps are as follows:

(1) Construct index level matrix X, whose element xij is the level value of j index (j=1,2,...,n) of i enterprise (i=1,2,...,m).

(2) Take the optimal value x_j^* of each evaluation index. If $x_j^*:j$ is a positive indicator, the larger the better; if j is an inverse indicator, the smaller the better.

(3) Define the proximity Dij of xij to x_j^*

(4) Normalize Dij $d_{ij}=\frac{D_{ij}}{\sum_{i=1}^{m}D_{ij}}$ to make $0\le d_{ij}\le 1$ and $\sum_{i=1}^{m}d_{ij}=1$.

(5) Calculate the conditional entropy of evaluation index j

The conditional entropy of the evaluation index j indicates how much the index j reflects the system information, or the uncertainty of j. The calculation formula is:

$$H_j=-\sum_{i=1}^{m}d_{ij}\ln d_{ij} \tag{1}$$

If d_{ij} are all equal, then $H_j=\ln m=H_{\max}$

(6) Use $H_{\max}$ to normalize H_j to obtain the entropy value representing the importance of evaluation index j:

$$h_j=\frac{H_j}{\ln m} \tag{2}$$

(7) Determine the evaluation weight vj of evaluation index j by h_j as

$$v_j=\frac{1}{n-H}\left[1-h_j\right],\ j=1,2,\cdots,n \tag{3}$$

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Where $H=\sum_{j=1}^{n}h_j$ and vj satisfy $0\le v_j\le 1$ and $\sum_{j=1}^{n}v_j=1$.

3.2. Decision model

Use intelligent algorithm analysis to make decisions.

(1) Determine the analysis sequence. On the basis of qualitative analysis of the research problem, determine a dependent variable factor and multiple independent variable factors. Let the dependent variable data constitute the reference sequence X_0'. The respective variable data constitute the comparison sequence $X_0'(i=1,2,\cdots,m)$,

That is, the optimal sample $(1,1,\cdots,1)^T$, n+1 data sequences form the following matrix:

$$[X_0',\cdots X_n']=\begin{bmatrix} X_0'(1) & \cdots & X_n'(1) \\ \vdots & & \vdots \\ X_0'(m) & \cdots & X_n'(m) \end{bmatrix}_{m\times(n+1)}$$

(4)

(2) Make the variable sequence dimensionless. In general, the original variable sequence has different dimensions or orders of magnitude. In order to ensure the reliability of the analysis results, the variable sequence needs to be dimensionless. After dimensionless, each factor sequence forms the following matrix:

$$[X_0,\cdots X_n]=\begin{bmatrix} X_0(1) & \cdots & X_n(1) \\ \vdots & & \vdots \\ X_0(m) & \cdots & X_n(m) \end{bmatrix}_{m\times(n+1)}$$

(5)

(3) Find the difference sequence, the maximum difference and the minimum difference. Calculate the absolute difference between the first column of the matrix (reference sequence) and the remaining columns (comparison sequence) in the corresponding period in (2) to form the following absolute difference matrix:

$$\begin{bmatrix} \Delta_{01}(1) & \Delta_{02}(1) & \cdots & \Delta_{0n}(1) \\ \Delta_{01}(2) & \Delta_{02}(2) & \cdots & \Delta_{0n}(2) \\ \vdots & \vdots & & \vdots \\ \Delta_{01}(m) & \Delta_{02}(m) & \cdots & \Delta_{0n}(m) \end{bmatrix}_{m\times n}$$

(6)

Where $\Delta_{0j}(k)=|x_0(k)-x_j(k)|$, $j=1,2,\cdots,n$; $k=1,2,\cdots,m$. The largest and smallest numbers in the absolute difference matrix are the largest and smallest differences:

$$\max_{\substack{1\le j\le n\\1\le k\le m}}|\Delta_{0j}(k)|=\Delta(\max)$$

$$\min_{\substack{1\le j\le n\\1\le k\le m}}|\Delta_{0j}(k)|=\Delta(\min)$$

(7)

(4) Calculate the correlation coefficient. The data in the absolute difference matrix is transformed as follows:

$$\zeta_{0j}(k)=\frac{\Delta(\min)+\rho\Delta(\max)}{\Delta_{0j}(k)+\rho\Delta(\max)}$$

(8)

Get the correlation coefficient matrix

$$\begin{bmatrix} \zeta_{01}(1) & \zeta_{02}(1) & \cdots & \zeta_{0n}(1) \\ \zeta_{01}(2) & \zeta_{02}(2) & \cdots & \zeta\Delta_{0n}(2) \\ \vdots & \vdots & & \vdots \\ \zeta_{01}(m) & \zeta_{02}(m) & \cdots & \zeta_{0n}(m) \end{bmatrix}_{m\times n}$$

(9)

In the formula, the resolution coefficient ρ takes a value in (0,1), the smaller the value, the better the difference between the correlation coefficients.

(5) Calculate the degree of association. The weight vector $W=(w_1,w_2,\cdots,w_m)$ of m evaluation indicators relative to the total target, the weighted correlation degree of each evaluation object $\gamma_k=\sum_{j=1}^{m}\zeta_{0j}(k)w_j$, where $k=1,2,\cdots,n$.

(6) Sort by weighted relevance. The weighted relevance degree of each evaluation object is sorted from large to small. The larger the relevance degree, the closer the evaluation object is to the optimal value.

According to the density function graph of t, combined with business characteristics, select the model.

The marketing business service risk index I reflects the number of work orders generated at a certain moment after the marketing business is launched, and measures the size of the marketing

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business service risk.

The actual service risk index I_{Ci} of the i-th marketing business is:

$$I_{Ci} = P_i \times C$$

(10)

Where: Pi is the ratio of work orders caused by the subpoena for the i-th marketing business; C is a constant.

The i-th marketing business forecast service risk index I_{Pi} is:

$$I_{Pi} = \frac{1}{P_i(t \le T)} \times P_i \times C$$

(11)

In the formula: $P_i(t \le T)$ represents the cumulative probability of a work order T days after the start of the marketing business.

The service risk I_P of power marketing business is:

$$I_P = \sum_{i=1}^{n} (w_i \times I_{Pi})$$

(12)

Where wi is the weight of the i-th marketing business service risk.

4. Application examples

4.1. Model calculation

Taking three power supply companies A, B, and C as examples, the above-mentioned index system is used to comprehensively evaluate their marketing effects, and the index data of the three companies are processed in a dimensionless manner. The results are shown in the table 1.

Table 1. Dimensionless data of three power supply companies.

Power supply company	A	B	C
Annual electricity sales	1.1	0.96	0.88
Annual electricity sales growth rate	0.87	1.03	1.12
Annual sales revenue	1.1	0.99	0.87
Annual sales revenue growth rate	0.78	1	1.12
Electricity fee recovery rate	0.57	1.11	0.71
Ratio of income as a percentage of sales	0.63	1.11	0.76
Line loss rate	1.1	0.87	0.65
Unit power supply cost	1.1	0.73	0.6
Social Image of Power Supply Company	0.97	1.11	1.04
Social contribution rate of power supply enterprises	0.75	0.95	1.12
The cultural level of the marketing staff	1.07	1.11	0.93
Marketing strategy level of marketing department	1.1	0.94	0.91
Enterprise leadership management level	0.94	1.11	0.65
The degree of cooperation of other departments to the marketing department	0.89	1.11	0.8

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Expansion of installation efficiency	0.86	0.98	1.12
One example	1.1	1.08	1.04
Check maintenance efficiency	1.1	0.98	0.58
Power supply reliability	1.01	0.99	1.12
Customer satisfaction rate	1.08	1.11	1.09
Customer complaint rate	0.98	1.11	1.06
Annual power outages for urban users	1.02	1.04	1.12
Annual power outage time for urban users	0.86	0.93	1.12

According to the data in Table 1, evaluate it according to the following steps:

(1) Establish a hierarchical structure model, as shown in the figure!

(2) According to the opinions of experts and the subjective judgment of the analysts, the importance of each criterion layer and its index is compared with the 1-9 scale method, and the subjective weight is calculated.

(3) Calculate and determine the objective weight according to the entropy method.

(4) Calculated by the formula $w_j = u_j v_j$ and normalized to obtain the combined weight, as shown in Table 2.

Table 2. Weights of evaluation indicators for power supply companies.

Indicator name	Subjective weight uj	Objective entropy weight vj	Combination rights wj
Annual electricity sales	0.094	0.0196	0.0444
Annual electricity sales growth rate	0.094	0.0175	0.0397
Annual sales revenue	0.094	0.0207	0.047
Annual sales revenue growth rate	0.094	0.0373	0.0848
Electricity fee recovery rate	0.063	0.1585	0.2409
Ratio of income as a percentage of sales	0.063	0.1123	0.1706
Line loss rate	0.032	0.1023	0.7762
Unit power supply cost	0.032	0.1257	0.0956
Social Image of Power Supply Company	0.03	0.0052	0.0038
Social contribution rate of power supply enterprises	0.03	0.0456	0.0325
The cultural level of the marketing staff	0.055	0.0127	0.0168
Marketing strategy level of marketing department	0.055	0.0163	0.0215
Enterprise leadership management level	0.019	0.0965	0.0427
The degree of cooperation of other	0.019	0.0389	0.0173

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departments to the marketing department			
Expansion of installation efficiency	0.014	0.0191	0.006
One example	0.053	0.002	0.0025
Check maintenance efficiency	0.007	0.1432	0.0212
Power supply reliability	0.033	0.0047	0.0038
Customer satisfaction rate	0.026	0.0004	0.0003
Customer complaint rate	0.019	0.0043	0.002
Annual power outages for urban users	0.029	0.0022	0.0016
Annual power outage time for urban users	0.068	0.0195	0.0317

It can be seen from Figure 1 that from January 2013 to February 2014, the predicted service risk index is highly accurate. From February 2014 to February 2015, the predicted service risk index is higher than the actual service risk index, and the time is later. The greater the difference between the two.

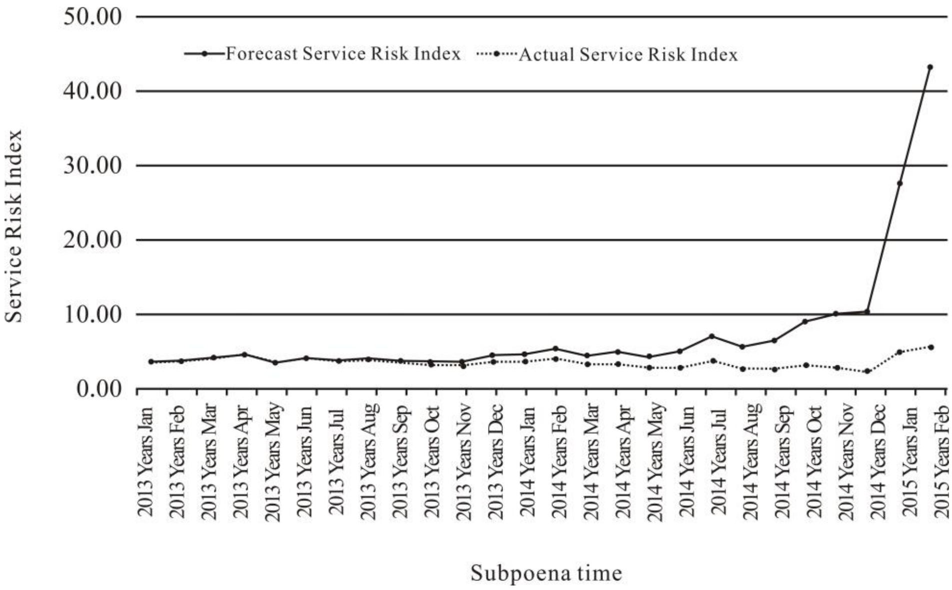

Figure 1. Electricity sales service risk index trend.

Because the deadline for the work order data is August 2015, the work order cycle caused by the batch new installation business is about 877 days. The work order triggered by the electricity sales between January and February 2013 will hardly be generated in the subsequent time, and the actual service The risk index represents all the work orders caused by electricity sales during this period. The predicted service risk index and the actual service risk index have a high degree of fit, indicating that the model has a good forecasting effect. For electricity sales after February 2014, before the work order deadline, the data time length is less than one cycle, and the work orders caused by electricity sales are not all generated. The actual risk index reflects the current work order risk, and the forecast index reflects the electricity sales of the month. All work order risks that may be triggered, so the predicted

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service risk index is higher than the actual service risk index.

(5) Calculate the weighted correlation degree K of each power supply enterprise according to the intelligent algorithm method, as shown in Table 3.

Table 3. Relevance of the three power supply companies.

Power supply company	Weighted relevance	Rank
A	0.5056	3
B	0.6225	1
C	0.5778	2

4.2. Result analysis

The result of intelligent algorithm analysis shows that B power supply company has the highest comprehensive score among the three companies. To a certain extent, it shows that B company has the best marketing effect in the three companies, followed by C company and A company. Through the analysis of the correlation coefficient, we can also understand the characteristics and problems of each company. The reason why B company has better marketing effect is because of the sales profit rate, the level of corporate leadership management, and the degree of cooperation of other departments with the marketing department. The ideal value has a higher degree of relevance, and has a higher degree of relevance in the weight of large indicators such as sales profit rate and electricity fee recovery rate.

5. Conclusion

In this paper, by applying intelligent algorithms to the analysis of the effect of power marketing risk control in power supply enterprises, it can take advantage of the advantages of intelligent algorithms without using a large amount of data analysis samples. At the same time, the selection of data is relatively simple. At the same time, in traditional risk control methods The objective weight can be fully analyzed to ensure that the evaluation results are more accurate and scientific. The use of this method makes the evaluation results more reasonable and feasible compared to the single subjective and objective evaluation, effectively exerts the advantages and disadvantages of subjective and objective analysis methods, and can make up for the disadvantages of the above two methods to a certain extent. More suitable for use in the evaluation of multiple power supply companies.

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