A Journal Content Quality Evaluation Model Based on Entropy Analysis

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Abstract. The quality evaluation of the content of the journal group is an important part of bibliometric research[1], which reveals the distribution of the number of subject literature in the journal through the quantitative analysis of the development law and growth trend of academic journals, and provides an important reference for optimizing the use of academic journals. At the same time, journal evaluation is also an important content in academic evaluation, which is based on certain standards and adopts certain methods to judge the role, influence or value of academic journals, which has a vital impact on the allocation of academic resources, the incentive of researchers, and the development of academic research. Therefore, on the basis of studying the content quality of many journals, this paper constructs a quality evaluation index system of journals in China based on analysis, and uses the mature entropy theory method to evaluate it, and the research results provide valuable help for improving the quality of journals and promote the smooth development and ultimate success of journal clusters in the new era.

Keywords: Electrical Journal, Quality Evaluation, Entropy Method, Information Theory.

1 Introduction

Under the new power system[2],the essence of content quality evaluation of journal groups is to make value judgments about journals[3],The process involves many factors, which requires a combination of evaluation index selection and weight determination[4]. Regarding the rational use of evaluation results, different journal evaluation systems have their own characteristics, and it is difficult to evaluate which is better or worse, and the key lies in correctly understanding the evaluation function of the core journal list[5].It is not possible to completely "use journal papers" to replace paper evaluation with journal evaluation, nor can it completely deny its role as a reference tool in academic evaluation, and should treat the use of various core journal lists correctly with a scientific attitude.

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Ref[6-7] believed that the principal component analysis method and the entropy-weighted TOPSIS method were used to construct the index system, and the fuzzy Borda method was used to calculate the journal ranking.Ref[8] believed that the principal component analysis and factor analysis methods have two major shortcomings:there is no sufficient theoretical basis for using the variance contribution rate as the weight, and the final weight of the two evaluation methods is a simple linear summary.Ref[9] noted that the principles of journal evaluation were based on accountability.Ref[10]: Bibliometric analysis of two journals published by the Institute of Forestry was performed to evaluate the journal's publishing activities based on the number of articles, references, authors, and number of journal citations.

Most of the above literature tends to use different index systems to evaluate journals, but due to the simplification of indicators and evaluation methods, the existing evaluation results lack comprehensiveness and objectivity. At the same time, most researchers only focus on the quality performance of journals at a certain point in time, and do not analyze the dynamic development of journal quality.

Therefore, on the basis of the existing research literature, this paper firstly uses factor analysis to screen the evaluation indexes, establishes the evaluation index system and model, secondly, uses the entropy method to determine the weights of different evaluation indicators, and finally, constructs the dynamic quality evaluation model of the State Grid journals by calculating the comprehensive scores of the corresponding years of the State Grid journals.

2 Experimental Models

The construction of the evaluation index system requires scientific processes and methods. Firstly, this paper establishes a preliminary evaluation index system by screening evaluation indexes, then uses the entropy method to determine the weight of the index system and comprehensively evaluates and analyzes it, and finally uses an electrical journal as a demonstration to verify the practical reliability of the model.

2.1 Establish an Index Evaluation System

The academic quality of journals is mainly reflected by the academic content of the journal and the academic influence of the journal, which are generally measured by the source (or article) index and the cited (or influenced) index respectively. The selection of evaluation indicators is an important part of the evaluation work, and the correctness of the selection of evaluation indicators directly determines whether the evaluation results can reasonably reflect the status of the State Grid journal group.

Metric Definitions

Based on the previous research results and the analysis of traditional indicators, the first step of this paper is to use the following indicators to initially screen materials:

(a) Impact factor: the frequency of citations of articles in a journal in a specific year or period is an important indicator to measure the influence of academic journals;

(b) Compound total citations: the total number of times all the cited articles published by a journal since its inception have been cited by composite statistical sources in a statistical year.

(c) Compound impact factor: the ratio of the total number of citations of the citable published by a journal in the previous two years to the total number of citable articles published by the journal in the previous two years.

(d) Composite other citation impact factor: the ratio of the total number of citations of the citable published in a journal in the previous two years by compound statistical sources outside the journal in the statistical year to the total number of citable articles published in the journal in the previous two years.

(e) Comprehensive total citations: the total number of times all the citable articles published by a journal since its inception have been cited by comprehensive statistical sources in a statistical year.

(f) Comprehensive impact factor: the ratio of the total number of citations of the citable published by a journal in the previous two years to the total number of citable articles published by the journal in the previous two years.

(g) Intra-year index: the total number of citations of papers published by a journal in a specific year, reflecting the "vitality" of the journal and the average academic impact of the journal in the year in which the articles are included.

(h) Red dot index: the proportion of papers published in the evaluated journal with keywords that coincide with the high-frequency keywords of the same discipline in the same period in the evaluation time window.

(i) Citation: The total number of cited articles published in a journal within a specified time frame.

(j) Volume: The total number of documents in various genres published in a journal within a specified time frame is equal to the sum of the number of cited articles and the number of non-cited articles.

(k) Citations ratio: the ratio of the number of cited articles published by a journal to the number of articles published within a specified time range.

(l) Ratio of funded papers: the proportion of papers funded by various funds published by a journal within a specified time frame to all available cited articles.

(m) Average citations: the average number of references published by a journal in a statistical year.

(n) Number of journals cited: the number of journals cited by a journal in a statistical year.

(o) Number of journals cited: the number of journals cited in a statistical year.

(p) Total citation ratio: the ratio of the total number of citations to the total number of citations of a journal in a statistical year by journals other than the journal.

(q) Web download rate per year: the ratio of the total number of articles published in a journal and published on CNKI in the statistical year to the total number of articles published online by the journal in the current year.

(r) Total downloads: the total number of full-text downloads of all documents published by a journal on CNKI in the statistical year.

Metric Filtering

The index journal matrix of n indicators of m journals in year T was constructed and standardized as follows:

$$r_{ij} = x_{ij} / \max\left(X_{ij}\right), \quad R = \left(r_{ij}\right)_{m\times n} \tag{1}$$

$$X^T = \begin{bmatrix} X_{(1,1)} & X_{(1,2)} & \cdots & X_{(1,1)} \\ X_{(2,1)} & X_{(2,2)} & \cdots & X_{(2,n)} \\ \cdots & \cdots & \cdots & \cdots \\ X_{(\mathrm{m},1)} & X_{(m,2)} & \cdots & X_{(m,n)} \end{bmatrix}_{m\times n} \tag{2}$$

In equation (1), the abscissa of the matrix element represents the high-quality journals of 28 national network companies such as Proceedings of the Chinese Society of Electrical Engineering and Power System Automation, and the ordinate represents several indicators that have been retained, including the impact factor, Immediacy Index, Citations ratio, Fund paper ratio and other-citation rate of other citations. For example, $X_{(1,2)}$ represents the data of the impact factor of the Proceedings of the CSEE.In equation (2), T is year, m is Journal, n is indicator.

When the KMO statistic is greater than 0.5 and the accompanying probability value corresponding to the χ^2 statistic of Bartlett test is less than 0.05, it indicates that there is a correlation between the original variables, which is suitable for factor analysis to prepare for determining the weight of the evaluation index. Finally, after screening the existing indicators according to the above methods, a new matrix is obtained after removing the unqualified indicators in equation (1).

2.2 Determine the Weight of Evaluation Indicators

The weight of the evaluation index refers to the proportion of a single index in the evaluation of multiple indicators, which reflects the importance of the index in the evaluation results. The indicators selected in the previous step all reflect the academic quality of the journal from a quantitative perspective, but the contribution to the evaluation results of the journal is different, and due to the differences between disciplines, the application value of each index in different disciplines is also inconsistent, so it is necessary to combine the subjective factors such as the evaluation purpose to analyze, give different weights to each index and fully consider the discipline factors.

Weight, also known as weight, is a quantitative allocation of the importance of something or a factor. It is often used in multi-objective decision-making, multi-indicator evaluation and forecasting. The weight not only reflects the guiding intention and values, but also has an important impact on the results of journal quality evaluation.

Entropy is derived from thermodynamics and is a measure of the uncertainty of the state of a system. The entropy method is an objective weighting method that determines the weight of the index according to the amount of information provided by the observations of each indicator. In information theory, entropy is a measure of uncertainty, the larger the amount of information, the smaller the uncertainty and the smaller the

entropy, and the smaller the amount of information, the greater the uncertainty and the greater the entropy. According to the characteristics of entropy, the randomness and disorder of a scheme can be judged by calculating the entropy value, and the dispersion degree of an index can also be judged by the entropy value. Therefore, according to the degree of variation of each index, the weight of each index can be calculated by using information entropy as a tool, which provides a basis for the comprehensive evaluation of multiple indicators. For a certain indicator, the greater the difference between its index values, the greater the role of the indicator in the comprehensive evaluation, and if all the index values of a certain indicator are equal, the indicator has no effect in the comprehensive evaluation.

The entropy value of each index is calculated. On the basis of the standardization of the data of each index, the weight of the index value of the sample of the ith journal in the j-item index is calculated, see equation (3). To calculate the entropy value of each index, see Equation (4):

$$b_{ij} = \frac{r_{ij}}{\sum_{i=1}^{m} r_{ij}} \tag{3}$$

$$e_j = -\frac{\sum_{i=1}^{m} b_{ij} \times \ln b_{ij}}{\ln m} \tag{4}$$

Among them, 1≤i≤m and 1≤j≤n are satisfied.

Calculate the coefficient of difference. See equation (5).

$$g_j = 1 - e_j \tag{5}$$

Factor Analysis. Factor analysis of the data of each journal and each year, as shown in the table below, can obtain the variance contribution rate p and the component score coefficient β, and obtain a total of y common factors extracted from the factor analysis.

Calculate the indicator weights. See equation (6).

$$w_j = \frac{p_k \times \beta_j \times g_j}{\sum_{j=1}^{7} p_k \times \beta_j \times g_j} \tag{6}$$

Among them, 1≤j≤n and 1≤k≤y are satisfied. p_k is the variance contribution rate of the k-th extracted common factor. β_j is the component score coefficient of the j-th indicator.

2.3 Journal Quality Grading Model

The main purpose of journal classification is to extract a few excellent key journals from all journals, and divide the journals according to the quality of the journals, so there are not many levels of general grading, and this paper is set to 3 levels, which are leading journals, characteristic journals, echelon journals and regional journals. The specific process is as follows.

Comprehensive scores of each journal. After the above entropy calculation, factor analysis, and weight calculation process, the weight of each index in the corresponding year is obtained, and the standardization matrix and weight matrix can be obtained, and the two indicators can be weighted to obtain $Q=(q_{ij})_{28\times7}$,where $q_{ij}=r_{ij}\times w_j$.

Journal grading. According to the comprehensive score of the journal, the ranking of each journal in the corresponding year can be obtained in Table 1.

Table 1. Journal grading.

Journal Grade	Journal score
Leading Journals	score≥1.0
Featured Journals	1.0＞score≥0.2
Regional journals	0.2＞score

3 Simulation Studies

In this paper, 28 journals of the State Grid are used to simulate and calculate the classification model of the above-mentioned periodicals, and the KMO and Bartlett spherical tests are carried out after the screening of standardized index data (the results are shown in Table 2), which meet the requirements of the model and are suitable for factor analysis.

Table 2. KMO and Bartlett spherical test results of indicator data of each year.

Project	In 2021	In 2022
The number of KMO sampling appropriateness	0.589	0.604
Approximate chi-square	71.934	63.235

The entropy value and difference coefficient of the screened journal index data were calculated (the results are shown in Table 3).

Table 3. Calculation results of entropy and coefficient of difference by year.

Journal metrics	Year	Impact factor			Immediacy Index	Citations ratio	Fund paper ratio	other-citation rate
		Composite	other-citation	Comprehensive				
Entropy	2021	0.870	0.872	0.792	0.859	0.997	0.934	0.997
	2022	0.879	0.873	0.881	0.838	0.997	0.934	0.998
Coefficient of difference	2021	0.130	0.128	0.208	0.141	0,003	0.066	0.003
	2022	0.121	0.127	0.119	0.162	0,003	0.066	0.002

The results of the factor analysis are shown in Table 4 and 5 (illustrated in 2021).

Table 4. Explanation of total variance in 2021 journal evaluation factor analysis.

Ingredients	Initial eigenvalues			Extract the sum of squares of the load			Sum of squares of rotational loads		
	Total	Variance percentage	Cumulative%	Total	Variance percentage	Cumulative%	Total	Variance percentage	Cumulative%
1	4.83	69.06	69.06	4.83	69.06	69.06	3.58	51.20	51.20
2	1.16	16.56	85.62	1.16	16.56	85.62	1.36	19.42	70.63
3	0.69	9.83	95.45						
4	0.26	3.67	99.12						
5	0.05	0.71	99.82						
6	0.01	0.14	99.96						
7	0.01	0.04	100.0						

Table 5. 2021 journal evaluation factor analysis of the component score coefficient matrix after rotation.

Evaluation factor		Composite Impact Factor	other-citation Impact Factor	Comprehensive Impact Factor	Immediacy Index	Citations ratio	Fund paper ratio	other-citation rate
Ingredient	1	0.201	0.309	0.127	0.275	0.018	0.243	0.159
	2	0.097	-0.197	0.070	-0.085	0.449	0.010	-0.749

The Table 6 shows the calculation results of indicator weights.

Table 6. Calculation results of weight coefficients for each journal.

Year	Impact factor			Immediacy Index	Citations ratio	Fund paper ratio	other-citation rate
	Composite	other-citation	Comprehensive				
2021	0.078	0.477	0.062	0.360	0.008	0.114	0.042
2022	0.270	0.378	0.256	0.203	0.003	0.158	0.049

The comprehensive scores and grading results of each year are in Table 7.

Table 7. Comprehensive score of State Grid journals in each year.

Name of the journal	Overall score			Grade
	2021	2022	Average	
Power system automation	1.112	1.168	1.140	Leading Journals
Power grid technology	1.042	1.067	1.055	
Proceedings of the CSEE	1.023	1.068	1.046	
Smart electricity	0.873	0.901	0.887	
High voltage technology	0.735	0.790	0.763	
China Power	0.743	0.765	0.754	Featured Journals
Power Grid & Clean Energy	0.725	0.639	0.682	
Global Energy Interconnection	0.725	0.612	0.669	
Power construction	0.558	0.602	0.580	

Name of the journal	Overall score			Grade
	2021	2022	Average	
Power Engineering Technology	0.567	0.559	0.563	
Power Information and Communication Technology	0.652	0.380	0.516	
Electricity demand-side management	0.494	0.536	0.515	
Electricity supply	0.552	0.451	0.502	
Zhejiang Electric Power	0.373	0.308	0.341	
Shandong Electric Power Technology	0.316	0.193	0.255	
Hubei Electric Power	0.261	0.208	0.235	
Hydropower and pumped hydro	0.174	0.159	0.167	
Hunan Electric Power	0.173	0.148	0.161	
Hebei Electric Power Technology	0.142	0.126	0.134	
Journal of Shandong Electric Power College	0.130	0.112	0.121	
Heilongjiang Electric Power	0.117	0.120	0.119	
Northeast Electric Power Technology	0.112	0.123	0.118	Regional journals
Shanxi Electric Power	0.120	0.115	0.118	
Ningxia Electric Power	0.128	0.102	0.115	
Jilin Electric Power	0.113	0.099	0.106	
Qinghai Electric Power	0.102	0.086	0.094	
Sichuan Electric Power Technology	0.087	0.074	0.081	
Jiangxi Electric Power	0.075	0.077	0.076	

It can be seen that the scores of the 28 journals vary greatly. Therefore, the evaluation of State Grid science and technology journals can not start from the perspective of volume, but should be carried out from the perspective of quality, in the selection of evaluation indicators and the design of the index system should be fully considered in the multi-dimensional evaluation of journals, more relative and objective indicators should be adopted.

4 Conclusions of the Study

Based on the entropy value method, this paper establishes a quantitative analysis model for the quality of journals based on the journal index system and mathematical analysis.

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