Research on evaluation method of periodical influence based on subdivision field

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Abstract. As an important part of the science and technology evaluation system, evaluations theory and method of journal influence need targeted research and improvement. Based on the analysis of traditional journal evaluation methods, this paper put forward an evaluation index of the core journals in the field-R_f index, and constructed the influence evaluation model of academic journals in subdivided fields. Finally, through empirical research, it is proved that R_f index can accurately find high-quality journals in subdivided fields, which is beneficial to enrich and improve the journal evaluation system.

1 Introduction

Academic journal is an important platform for scholars to conduct academic research and exchange, as well as an important tool to evaluate academic achievements. With the deepening of the various areas of academic research, the research direction is more and more refined. It is hard to make an objective and impartial evaluation of professional journals in subdivided fields, which is also go against for researchers to lucubrate through the journal platform, if we just evaluate them comprehensively.

In order to deal with this problem, this paper puts forward a classification evaluation method of journal oriented to subdivision fields, so as to reduce the limitations of traditional methods and make more objective evaluation of journals and researchers' work.

2 Construction of evaluation methods

2.1 Indicator selection

At present, there are many indexes to evaluate the influence of journals. Based on the objectivity principle, we selected the following four indexes to construct the journal evaluation model in the subdivision field.

(1) Published by high-influence authors

The author is direct participant of a paper, and the reputation of the author reflects the academic quality of the paper to some extent [1].Authors with high academic level often initiate new research directions and even propose subversive technologies, thus forming high

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academic influence. Therefore, the author's academic influence cannot be ignored when evaluating the influence of journals. In the collected data, the number of papers published by high-influence authors in the field was counted as the publication-index Ta of the j journal:

$$Ta = \sum_{i=1}^{n_j} p_i , p_i = 1 \; or \; p_i = 0 \tag{1}$$

Among the equation, i stands for the i'th article in journal, n_j stands for the number of article in the journal, $p_i = 1$ stands that the article is published by the author with high influence in the field, $p_i = 0$ stands that the article is not published by the author with high influence in the field.

(2) Cited by high-influence authors

Journal citation index mainly shows the extent to which the journal is used and valued by scholars, and authors tend to cite high-quality research results that are helpful to their research. In the collected data, the number of times that a journal was cited by influential authors in the field was counted as the citation-index Tb of the journal.

$$\mathrm{Tb} = \sum_{\mathrm{i}=1}^{\mathrm{n_j}} \mathrm{q_i} \; , \mathrm{q_i} = 1 \text{ or } \mathrm{q_i} = 0 \tag{2}$$

Among the equation, $q_i = 1$ stands that the article has been cited by high-influence authors in the field, $q_i = 0$ stands that the article has not been cited by high-influence authors in the field.

(3) Citation frequency of a single paper

Citation frequency represents the degree that a paper's point of view is recognized by the academic circle which can reflect the quality of the paper [2].The higher the citation frequency of papers in the journal, the higher influence of the journal in the subdivision field.

(4) Publish time of paper

As the citation frequency index of papers has problems of time delay [3] and half-life[4], therefore ,not only citation frequency but also publication time should be considered in journal quality evaluation. According to the distribution rule of citation time, creating the index of citation-frequency p:

$$p = \sum_{i=1}^{n_j} \frac{1}{Y - t_i} x_i \tag{3}$$

Among the equation, $\boldsymbol{Y}$ stands for the current year, $\boldsymbol{t_i}$ stands for the publication time of the paper $\boldsymbol{i}$, $\boldsymbol{x_i}$ stands for the citation amount of the paper $\boldsymbol{i}$.

2.2 Standardized processing

In order to eliminate the dimensional relationship between variables Ta, Tb and p to make the data comparable, a standardized approach is used here to make the values of different varying ranges mapped to a fixed range.

The influence of a journal in a particular field is proportional to the number of papers published in that field. ∂ denotes as the ratio of the number of articles published journal j to the total data set. N stands for the total number of collected papers in this field.

$$\partial = \frac{n_j}{N} \tag{4}$$

The higher the citation frequency of a journal's papers in this field, the higher the journal's influence. ε denotes as the ratio of the number of citation frequency of papers published journal j to the total data set.

$$\varepsilon = \frac{\sum_{i=1}^{n_j} x_i}{N} \tag{5}$$

2.3 Model Construction

According to the above index system and standardized processing method, the evaluation model of periodical influence based on subdivision field is constructed.

$$R_f = (c_1 * p + c_2 * T_a + c_3 * T_b) * \partial * \varepsilon \tag{6}$$

Among the equation, c_1, c_2 and c_3 are index weight, the calculation method will be given in Section 2.4.

2.4 Index weighting

The indicator difficulty weighting method is a new method proposed by Professor L.Yu [5] for the objective weighting of academic journal evaluation. Compared with the traditional objective weighting method, the indicator difficulty weighting method has better differentiation and is very suitable for the evaluation of academic journals. The basic idea is that the more difficult it is to improve the value of an evaluation index, the more weight should be given to the index. Its calculation formula is as follows:

$$Z_j = \frac{max(x_{ij}) - x_j}{\delta_j} \tag{7}$$

Among the equation, $max(x_{ij})$ stands for the maximum of a certain index value, x_j is the average value, δ_j is the standard deviation. The difficulty weight c_j will be obtained after Z_j standardization.

3 Empirical research

The paper data in *Natural Language Processing*, *Computer Vision* and *Machine Learning* in the field of *Artificial Intelligence* in the last ten years were selected as the research object. The data in *Natural Language Processing* was the experimental group, and the data in *Computer Vision* and *Machine Learning* was the control group.

We calculate the R_f values and ranking of journals in each of the three segments, and then, we compared them with the *Impact Factor* of traditional evaluation method, in order to understand the evaluation effect of R_f index objectively and accurately.

3.1 Data acquisition

Using domain terms as keywords to search the papers which published in the field of *Natural Language Processing*, *Computer Vision* and *Machine Learning* in the "*VIP Chinese Journal Service Platform*" database respectively in the last ten years, as shown in Table 1.

We use self-compiled python software to extract the name of journal, publication date, citation frequency, author, keywords and so on of a paper in these fields.

Natural Language Processing, *Computer Vision* and *Machine Learning* are all belong to the technical layer in the field of *Artificial Intelligence*. It is more beneficial to verify whether the same journal has different influence in different fields by calculating the influence rankings of the journals in these three fields. The keywords selected in these fields are all

cutting-edge hot spots, which are representative in the research of journals influence in subdivided fields.

Table 1. Domain keyword search table.

Domain	Search keywords
Natural Language Processing	Natural language processing, Automatic Speech Recognition, Machine translation, Information extraction, Sentiment analysis, Syntactic analysis
Computer Vision	Computer vision, Image recognition, Video recognition, Face identification
Machine Learning	Machine learning, In-depth learning, Transfer learning, Against learning, Paired-associate learning, Distributed learning, Meta learning

To avoid database updates, all data were extracted within one day. Finally, 6652 papers in the field of *Natural Language Processing* were obtained, involving 1459 journals.10110 papers in the field of *Computer Vision*, involving 1734 journals; 9940 papers in the field of *Machine Learning*, involving 1617 journals.

Table 2. Index weight distribution table.

Ariate	Natural language processing	Machine learning	Computer vision
c_1	0.284	0.267	0.242
c_2	0.474	0.366	0.388
c_3	0.242	0.367	0.370

Table 3. Ranking of journals in various fields.

Journal	Natural language processing		Machine learning		Computer vision		Impact Factor	
	R_f-Value	Ranking	R_f-Value	Ranking	R_f-Value	Ranking	Value	ranking
Journal of Chinese Information Processing	8.629	1	1.396	10	—	—	1.097	8
Journal of Software	2.600	2	7.534	2	1.612	6	2.537	3
Chinese Journal of Computers	2.520	3	9.333	1	2.126	3	3.802	1
Journal of Computer Research and Development	2.367	4	5.961	3	2.523	2	2.058	4
Computer Science	0.988	5	4.177	5	1.728	5	0.93	10
Computer Engineering and Applications	0.964	6	3.501	7	3.981	1	1.1	7
Application Research of Computers	0.891	7	3.985	6	0.825	/	1.188	6
Computer Engineering	0.684	8	1.505	9	1.012	9	1.018	9
Acta Automatica Sinica	0.586	9	5.087	4	2.002	4	2.762	2
Journal of Computer Applications	0.501	10	3.162	8	0.831	10	1.351	5

3.2 R_f index calculation

According to the index difficulty weighting method described in Section 3.4, the weight

distribution of each index in the three fields are calculated, as shown in Table 2. By substituting the weights into the model in Section 2.3, we calculate the R_f index of the journals involved in the three field. Due to space limitations, table 3 lists the ranking of the top 10 R_f journals in each field. Where, "/" indicates that the journal is not in the top 10 R_f index in this field;"—" indicates that the journal has not published papers in this field.

3.3 Result analysis

The results showed that the top 10 journals in the field of *Machine Learning* and *Natural Language Processing* are exactly the same, with only internal rankings changing, and only 2 journals in *Computer Vision* is differ from the experimental group. It shows that R_f can screen out the leading journals in the field of *Artificial Intelligence*, but the ranking order of the journals will change in each subdivision.

In addition, the result of R_f index that the top 3 journals are recognized as important academic journals in the field of *Natural Language Processing*, which indicate that the algorithm has a certain accuracy and can identify the core journals in the subdivision field.

Finally, we compared R_f index and traditional evaluation methods-*Impact Factors*, published by CNKI database platform. The results showed that "*Journal of Chinese Information Science*" ranked 8th among the 10 journals listed. However, the journal is recognized as the excellent core journal in the field of *Natural Language Processing*, so the *Impact Factors* is not enough to explain the quality of a journal in different subdivisions. R_f index can be used as a supplementary reference to help researchers find high-quality journals and scientific achievements in this field faster.

4 Conclusion

In order to improve the science and technology evaluation system, aims at the problem that some characteristic journals are in a disadvantageous position in the ranking of field journals, this paper proposes an evaluation index of journal influence, R_f index. After empirical research, the results show that R_f index has rationality and applicability in the evaluation of journal influence in subdivision fields, which can better reflect the different status of the same journal in different research fields. Therefore, the influence of the same journal in different research fields cannot be generalized. Based on this, when conducting scientific research evaluation, managers of scientific research evaluation should make a specific analysis for each field and develop a set of scientific and reasonable scientific research evaluation methods.

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