

Research on research performance evaluation based on Particle swarm

TOPSIS Altmetrics method

LiJing ^{1,a}, SunJianming ^{2,b}

Harbin University of Commerce, Harbin, China

^b b sjm@hrbcu.edu.cn

Keyword: Altmetrics; TOPSIS; Particle swarm; performance appraisal

Abstract: In this paper, the particle swarm optimization algorithm and the improved TOPSIS method are combined to construct a model of the particle swarm TOPSIS alternative econometric method, which is used in the research of scientific research performance. Particle swarm optimization is introduced to determine the weights of scientific research personnel. The research achievements of H University researchers are evaluated. The experiments were compared longitudinally, horizontally, and comprehensively.

1 Introduction

Scientific research performance evaluation means making qualitative or quantitative analysis on scientific research personnel, scientific research activities or scientific research projects in a specific time period, using scientific evaluation methods to make a qualitative or quantitative analysis on scientific research personnel, scientific research activities or scientific research projects in a specific time period, and make a comprehensive evaluation of accurate, objective and fair. The evaluation of scientific research performance plays a vital role in the scientific research management of universities and scientific research institutions. The rationality and scientificity of the evaluation methods will directly affect the enthusiasm of scientific researchers and the development orientation of various scientific research institutions. The main realization process is to select evaluation object, select evaluation index, construct evaluation index system, select evaluation method, collect and process data, carry on Evaluation Analysis and provide feedback. Online scientific research environment is quietly bringing a revolution to scientific communication, corresponding to bibliometrics in the traditional scientific communication environment. Online scientific research has led to the emergence of Altmetrics. Nowadays, alternative econometrics has deeply influenced publishing, foundations, scientists and research institutions, and library as a scientific exchange. To be part of it, we must be involved in this wave of innovation. Librarians have always been in the key position of knowledge service. It is necessary to take the initiative to learn the research results of alternative metrology, to help the researchers to understand the new trend of the present human art and scientific influence, and to use the alternative measurement tools to carry out the literature service, and to occupy the leader's position in this revolution.

Altmetrics is a new metrology discipline with the emergence of the network of academic achievements. It provides a multidimensional and comprehensive evaluation perspective on the basis of the traditional evaluation methods and comprehensively measures the comprehensive impact of different forms of research results on the multi platform. It is not the original traditional evaluation method, but instead of the original evaluation method, but instead of its single perspective, inherit and supplement, and provide a multi angle evaluation scheme for the evaluation

of scientific research performance.

2 Bibliometrics index theory of scientific research performance evaluation

2.1 The concept of Bibliometrics

Bibliometrics refers to the study of the distribution structure, quantitative relation, change law and quantitative management of literature and information with the measurement methods of literature system and bibliometrics, using mathematical and statistical methods, and then to explore some disciplines of the structure, characteristics and laws of science and technology.

2.2 Applicability and limitations of bibliometrics in performance evaluation of scientific research

The use of the indicators in bibliometrics to quantify the quantitative evaluation of scientific research performance is a common phenomenon that the data in the Bibliometrics come from the authority, so it does have objectivity, impartiality and scientificity, but the main target is the source index, and the index system is not rich and comprehensive, and can not be omnidirectional. To reflect the situation of the object being evaluated. The premise of correctly giving full play to the functions of bibliometrics is that it needs to be fully aware of its own defects and organically combine, but even if so, there are still limitations. In the macro evaluation of countries and regions, the bibliometrics methods and indicators should be taken as the main evaluation means and the qualitative analysis of experts as auxiliary means. In the micro evaluation of the individual of scientific research personnel, the method of bibliometrics and indexes should be used as the auxiliary means.

The limitations of bibliometric indicators for scientific research performance evaluation are reflected in the following aspects:

2.2.1 Time-delay

Since most of the indicators are based on the citation analysis, a article from which it is published to its reference has led to at least 2-3 years of time, which leads to the inaccurate and immediate assessment of the influence of the researchers, especially for young scholars;

2.2.2 One-sidedness

With the development of the network, scientific research results are no longer limited to the form of paper, software, audio, video, data and other forms of research results are beginning to appear, and the current method based on citation analysis can not measure these forms of research results, leading to a comprehensive evaluation of the scientific research personnel;

2.2.3 Reference motivation cannot be automatically identified

As a result of the importance of the number of quotations, scientific researchers and Periodical Publishers in order to improve their own influence, there will be self citation of scientific researchers and the documents published by the publishers of periodical publishers to improve the various kinds of fraudulent phenomena in the frequency of citation, resulting in the deviation of the results of performance evaluation.

2.2.4 Commonly used Bibliometrics index

(1)H index

Concept: quantitative research on the number and quality of the results of the researchers, mainly through the number of papers and the number of papers cited, H value indicates that the researcher has been quoted in the H article at least h times.

Advantages: the concept is easy to understand, easy to calculate, and comprehensive measure the quantity and quality of results, reflecting long-term research performance, and is more robust.

Disadvantages: it does not apply to cross disciplinary comparisons, and can only grow or remain

unchanged in terms of career time.

(2) Impact Factor

Concept: the relative statistical value of the total number of papers published in the first two years of a journal in addition to the total number of papers published in the previous two years. The greater the impact factor of the journal, the greater its academic influence or academic function.

Advantages: easy to understand, simple and highly applicable.

Disadvantages: fixed calculation method, short time span, easy to be influenced by subjective and objective factors such as subject, source database and author itself.

3 The establishment of the evaluation model of particle swarm optimization

Particle swarm optimization, also known as Particle Swarm Optimization (PSO), is an evolutionary computing technology developed by J. Kennedy and R. C. Eberhart equal to 1995, derived from a simplified social model, based on a study of birds' search for habitat, which comes from artificial life. And evolutionary computation theory . Because PSO algorithm is quite simple and has the incomparable advantages compared with other genetic algorithms, it has attracted the attention of many foreign scholars. Since it was proposed, it has been gradually used to solve integer programming, nonlinear programming, multi-objective optimization, traveling salesman problem and other fields. In this paper, a nonlinear programming problem about weight is established by the minimum sum of the best and worst objects, and its mathematical programming model is given. The weight of the evaluation index is solved by using the particle swarm optimization algorithm.

The research performance of scientific research personnel B ranked sixth in 2011, rose steadily in 2011-2015 years and dropped sharply in 2016, ranking seventh. The main reason is that most of the indicators under the personal influence, social impact and scientific research impact of the researcher B reached the minimum value in this year. The fundamental reason is that the number of scientific research results has been reduced continuously since 2016, and the average value of the scientific research results in 2014-2016 years is only 1/3 of the average value of scientific research results in the first 3 years, which has also led to the disadvantages of the other three aspects. The scientific research performance of C has maintained a healthy and stable growth trend year by year in 2011-2016 years, from fifth in 2011 to first in 2016, mainly due to the "number of results" and "H index" in the dimension of scientific research output, the "subscription" index of the social impact dimension, and the influence dimension of scientific research. The data of most indexes such as "citation number" index are increasing year by year, especially in 2016, the "H index" index of scientific research output dimension of scientific research personnel, "Html browsing number" of individual influence dimension, and the maximum value of "the number of push text" and "the number of quotations" of the influence dimension of scientific research. The four dimensions of A of scientific research personnel have relative advantages compared with other scientific research, and the indicators of social dimension and scientific research dimension have obvious advantages.

4 Conclusion

In this paper, a research performance evaluation model based on particle swarm optimization (PSO) TOPSIS substitution method is constructed by combining particle swarm optimization (PSO) and TOPSIS method, which is used in the research of performance evaluation of scientific researchers. The weight of the performance evaluation index of PSO algorithm is determined. On this basis, by introducing the concept of connection vector distance, and based on the idea of set

pair analysis and connection degree, an improved TOPSIS evaluation model is constructed. The ideal point and the negative ideal point are considered as the set of opposites in the uncertain system, and the existence of the set of opposites is fully considered when examining the relationship between the alternatives and the ideal point or the negative ideal point, so the optimal scheme is not only close to the ideal point but also away from the negative ideal point, thus overcoming the transmission to a certain extent. The deficiency of the TOPSIS method. The rationality and effectiveness of the method are verified by examples, making the decision-making process more scientific, reasonable and effective.

Acknowledgements

This work was supported by Heilongjiang philosophy and Social Sciences project(Grant Nos. 17TQD215), Heilongjiang philosophy and Social Sciences project(Grant Nos. 18GLB029)and Harbin University of Commerce youth innovative talents support project(Grant Nos. 2016QN050) .

References

- [1] Jiang, Chen Zhao, and Z. Yan. "Application of TOPSIS analysis method based on AHP in bid evaluation of power equipment." *IEEE International Conference on Information and Financial Engineering IEEE*, 2010:193-196.
- [2] Hammarfelt, Björn. "Using altmetrics for assessing research impact in the humanities." *Scientometrics* 101.2(2014):1419-1430.
- [3] Bornmann, Lutz. "Do altmetrics point to the broader impact of research? An overview of benefits and disadvantages of altmetrics." *Journal of Informetrics* 8.4(2014):895-903.
- [4] Zahedi, Zohreh, R. Costas, and P. Wouters. "How well developed are altmetrics? A cross-disciplinary analysis of the presence of `alternative metrics' in scientific publications." *Scientometrics* 101.2(2014):1491-1513.