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The Identification of Core Periodicals by Fuzzy Order-optimum Theory

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Abstract: To make the fuzzy mathematics get wider application in books and information fields, this research investigates the status quo of Yanshan University library and applies the fuzzy order-optimum theory to select the core periodicals of mathematics and physics in "The main contents for Chinese Core Periodicals".

Key words: Fuzzy order-optimum, core periodicals, selection

INTRODUCTION

With the increasing number of scientific and technological periodicals, it seems essentially important to identify core periodicals in a variety of concerned fields. The identification of core periodicals is a dynamic and random process. To avoid limitations and incompleteness, this paper applies the theory of fuzziness to get a fuzzy order of technological periodicals. The result is rather practical, thus it should be possible to identify core periodicals in a library as well as improve technicians' academic performance.

FUZZY ORDER-OPTIMUM THEORY AND CORE PERIODICALS

Fuzzy mathematics is an effective tool to do research and deal with fuzzy phenomena. Fuzzy order-optimum Theory is to apply similarity priority formula to measure the fuzziness distance between actual samples and desired samples. In this way, those of greater similarity will be selected (Zhongxiong, 1999). This is a step-by-step process of calculation and comparison.

Suppose there are m core periodicals in the whole system and n relatively selected participants to appraise the system. Consequently, the system index feature value matrix is (Shouyu, 2002):

$$X_{m\times n}=\begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1n} \\ X_{21} & X_{22} & \cdots & X_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ X_{m1} & X_{m2} & \cdots & X_{mn} \end{bmatrix}=X_{ij}$$

i = 1, 2, 3,...m. j = 1, 2, 3,...,n
Of them, X_{ij} is the feature value of object i and index j.

As for the most desired samples, their n index value is the highest. What is more, compared with the degree of similarity of each element in the desired samples in set m, we can get a relative fuzziness matrix. The sample selecting is based on their degree of similarity, that is, the similarity between any sample from set m and desired samples.

Suppose X_i and X_j are two samples selected at random. In order to compare the degree of similarity between them and the desired sample X_R, we can calculate the Haming Distance d_i and d_j of X_i, X_j and X_R:

$$d_i = |X_R - X_i| \quad d_j = |X_R - X_j|$$

Then we can get priority selection proportion:

$$r_{ij}=\frac{d_{Ri}}{d_{Rj}+d_{Ri}} \quad r_{ji}=1-r_{ij} \tag{1}$$

After getting fuzzy relative matrix (1) we select λ value according to the number, λϵ[0,1]. Those λ--cut matrixes whose diagonal lines are 1 enjoy most resemblance with desired samples. We mark their consequence number 1. Then we delete its whole row and the line whose row number is the same. The next step is to lower the λ value and to get their respective consequence number. Their number can be marker with number 2,3.... The smaller the number is, the greater the degree of resemblance is. Another way to examine this is to add all the numbers. The smaller the added number is, the greater the degree of resemblance is. If we grant all indexes weights, the result will be more accurate. If a is weight, $a_1+a_2+...a_n = 1 = W$. Through the formula $X \cdot W = Y$, we can get Y, that is, the comment set.

APPLIED EXAMPLES

This research studies the core periodicals of mathematics and physics in "The main contents for Chinese Core Periodicals" (Shoujing, 2002). Thirteen kinds of physics periodicals are retrieved, their number being

Table 1: Finding of mathematics core periodicals

CCP	The name of issue	Four variables			
		Referred time C_1	Circulation time C_2	Issue quality C_3	Staff's comment C_4
A_1	Journal on Numerical Methods and Computer Application	42	31	9.5	9.5
A_2	China University Teaching	26	17	8.5	9.0
A_3	Acta Mathematica Sinica	14	21	9.0	9.5
A_4	Advances in Mathematics	18	12	8.5	9.0
A_5	Chinese Journal of Computational Mathematics	2	5	8.0	8.5
A_6	Journal of Systems Science and Mathematical Sciences	6	11	8.5	8.5
A_7	Mathematics in Practice and Theory	3	6	9.0	9.0
A_8	Statistical Research	19	2	9.0	9.0
A_9	Application of Statistics and Management	12	8	9.5	9.0
A_{10}	Chinese Journal of Applied Probabilityand Statistics	33	30	9.0	9.0
A*	Journal of Yanshan Universiti	75	38	10.0	10.0

Table 2: Finding of physics core periodicals

CCP	The name of issue	Four variables			
		Referred time C_1	Circulation time C_2	Issue quality C_3	Staff's comment C_4
A_1	Acta Acustica	9	21	9.5	9.5
A_2	Chinese Journal of Scientific Instrument	17	17	9.5	9.5
A_3	Chinese Journal of Computational Physics	19	16	9.0	8.5
A_4	Physics	16	10	8.5	9.0
A_5	Recent Developments in Science and Technology Abroad	13	29	9.0	9.5
A_6	Optical Technique	10	14	8.5	9.0
A_7	College Physics	11	15	8.5	8.5
A_8	Chinese Journal of Lasers	13	13	9.0	9.0
A_9	Infrared	10	19	8.5	9.0
A_{10}	Communication Today	19	23	8.5	8.5
A_{11}	Journal of Infrared and Millimeter Waves	12	26	9.0	9.0
A_{12}	Applied Laser	8	14	9.0	8.5
A_{13}	Journal of Opcoelec	6	9	8.5	9.0
A*	Journal of Yanshan Universiti	75	38	10.0	10.0

Notes: 1) CCP refers the consequence number in "The main contents for Chinese Core Periodicals"; 2) A* refers the journal published by the work unit for which the author works

Table 3: Finding of physics core periodicals and order

CCP	C_1	C_2	C_3	C_4	The sum of order	Ordering
A_1	4	6	1	1	12	4
A_2	4	7	1	1	13	5
A_3	5	5	2	3	15	7
A_4	1	10	3	2	16	8
A_5	3	1	2	1	7	1
A_6	4	4	3	2	13	6
A_7	2	8	3	3	16	9
A_8	3	9	2	2	16	10
A_9	4	4	3	2	17	11
A_{10}	1	2	3	3	9	2
A_{11}	3	3	2	3	11	3
A_{12}	4	11	2	2	19	12
A_{13}	5	12	3	3	23	13

marker A_1~A_{13}. The consequence is like Table 1 Mathematics periodicals are altogether 10 issues, marked from A_1' to A_{10}'. Its consequence is like Table 2. Suppose the most desired sample is Journal of Yanshan University, marked with A*. Four variables are selected to do the research:

- The index of circulation rate-the lending statistics of technological periodical library within a limited period;
- The index of referred thesis-a statistics of references in "Journal of Yanshan University" and postgraduate thesis within the recent 4 years;

Table 4: Finding of mathematics core periodicals and order

CCP	C_1	C_2	C_3	C_4	Numbering	Ordering
A_1	2	2	1	1	6	1
A_2	3	5	2	1	11	4
A_3	4	3	1	1	9	3
A_4	6	9	2	1	18	7
A_5	8	9	1	1	19	8
A_6	10	7	2	2	21	9
A_7	9	11	2	1	23	10
A_8	2	8	2	2	14	5
A_9	5	7	1	2	15	6
A_{10}	2	2	2	2	8	2

- The index of issue quality-professors from mathematics department and physics department are invited to evaluate two core periodicals;
- The index of library staff-purchasers and issue librarians are invited to evaluate the aforementioned two periodicals. The full mark is 10.

The statistical finding is shown in Table 1 and 2:

According to Formula of Fuzzy Similarity Priority (1), taking C_1 in Table 1 as an example, we can obtain the to the similar priority select proportion between A_1\A_2 and A*:

$$r_{A_1A_2} = \frac{|75-17|}{|75-9|+|75-17|} = 0.47 \qquad (2)$$

$$r_{A_2A_1} = 1-0.47 = 0.53$$

Table 5: Priority results sort for the mathematical and physical journal

Ordering	Physics	CCp	Mathematics	CCp
1	Acta Acustica	A_1	Journal on Numerical Methods and Computer Application	A_1
2	Chinese Journal of Scientific Instrument	A_2	China University Teaching	A_2
3	Chinese Journal of Computational Physics	A_3	Acta Mathematica Sinica	A_3
4	Physics	A_4	Advances in Mathematics	A_4
5	Recent Developments in Science and Technology Abroad	A_5	Chinese Journal of Computational Mathematics	A_5
6	Optical Technique	A_6	Journal of Systems Science and Mathematical Sciences	A_6
7	College Physics	A_7	Mathematics in Practice and Theory	A_7
8	Chinese Journal of Lasers	A_8	Statistical Research	A_8
9	Infrared	A_9	Application of Statistics and Management	A_9
10	Communication Today	A_{10}	Chinese Journal of Applied Probability and Statistics	A_{10}
11	Journal of Infrared and Millimeter Waves	A_{11}		
12	Applied Laser	A_{12}		
13	Journal of Opcoelec	A_{13}		

As is shown in (2): A_2 is more likely to be resemble with A* than A_1. Likewise, we can obtain all r_{ij} and r_{ji} (i, j = 1, 2, 3,...,13). When i = j, $r_{ij} = r_{ji} = 0$

In a similar way, the fuzzy relative matrix of C_i is $R^{<1>}$ (i = 1, 2, 3, 4).

We can conclude that the fuzzy relative matrix of C_1 is $R^{<1>}$ ($R^{<1>}$ is the fuzzy relative matrix of referred time of physics periodicals); the fuzzy relative matrix of C_2 (the circulation time) is $R^{<2>}$; the fuzzy relative matrix of C_3 (issue quality) is $R^{<3>}$; the fuzzy relative matrix of C_4 (staff comment) is $R^{<4>}$. Here, we only demonstrate the matrix of physics periodicals $R^{<1>}$:

$R^{<1>} =$

													The sum of row
0	0.47	0.46	0.47	0.48	0.50	0.49	0.48	0.50	0.46	0.49	0.50	0.51	5.81
0.53	0	0.51	0.50	0.48	0.47	0.48	0.48	0.47	0.51	0.48	0.46	0.46	5.83
0.54	0.49	0	0.49	0.47	0.46	0.47	0.47	0.46	0.50	0.47	0.46	0.44	5.72
0.53	0.50	0.51	0	0.51	0.52	0.52	0.51	0.52	0.49	0.52	0.53	0.54	6.20
0.52	0.52	0.53	0.49	0	0.51	0.51	0.50	0.51	0.47	0.50	0.52	0.53	6.11
0.53	0.53	0.54	0.48	0.49	0	0.50	0.49	0.50	0.46	0.49	0.54	0.51	6.03
0.51	0.52	0.53	0.48	0.49	0.50	0	0.49	0.50	0.51	0.50	0.51	0.52	6.06
0.52	0.52	0.53	0.49	0.50	0.51	0.51	0	0.51	0.47	0.50	0.52	0.53	6.11
0.50	0.53	0.54	0.48	0.49	0.50	0.50	0.49	0	0.46	0.49	0.51	0.52	6.21
0.54	0.49	0.50	0.51	0.53	0.54	0.49	0.53	0.54	0	0.53	0.54	0.55	6.33
0.51	0.52	0.53	0.48	0.50	0.51	0.50	0.50	0.51	0.47	0	0.52	0.52	6.06
0.50	0.54	0.54	0.47	0.48	0.46	0.49	0.48	0.49	0.46	0.48	0	0.51	5.90
0.49	0.54	0.56	0.46	0.47	0.49	0.48	0.47	0.48	0.45	0.48	0.49	0	5.86

Select λ value from the bigger to smaller in various matrixes R. In matrix $R^{<1>}$, when $\lambda = 0.49$, A_{10} and A_4 are the first two to reach the point λ 1. Therefore we define the consequence numbers of A_{10} and A_4 are 1. Meantime, we delete row 10 and row 4, line 10 and line 4. Then we devalue λ one by one and decode the matrix. Likewise, we can also decode matrixes $R^{<2>}R^{<3>}R^{<4>}$ and obtain Table 3. The consequence number in Table 4 stands for the degree of similarity between individual index of core periodicals and desired samples and the added consequence number stands for the degree of similarity between the whole four indexes and the desired samples. The smaller the added consequence number is, the greater degree of similarity it will be.

The same calculative method can be used to calculate the fuzzy relative matrixes of mathematics periodicals $R^{<1>'}, R^{<2>'}, R^{<3>'}, R^{<4>'}$. After decoding them, we can get Table 5, which shows the consequence of mathematics and physics core periodicals.

CONCLUSIONS

The situation of periodicals varies from library to library. The applications of the Fuzzy Order-Optimum theory helps a lot to easily and accurately identify the core periodicals in a specific library. Thus this provides evidence to purchase new periodicals for the library, as well as reference for readers. It is also conducive to the quantitative management of periodicals.

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