A Study on Online Resource Acquisition Decision for University Libraries under Mixed Information

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Abstract: [Objective/Significance] To promote the rational allocation of online resource procurement funds for university libraries and improve the efficiency and scientificity of online resource procurement. [Methodology/Process] Based on the influencing factors related to online resource procurement in university libraries, we established a decision-making index system for online resource procurement in university libraries, based on which, we introduced the concept of fuzzy number, proposed an extended TOPSIS multi-indicator decision-making model for fuzzy and accurate mixed information, and validated the model through empirical evidence. [Results/Conclusions] The results show that the research content of this paper has a positive effect on promoting the science of online resource procurement in university libraries and the high quality development of university library collection resources.

Keywords: university libraries; online resources; hybrid information; TOPSIS; acquisition decisions

1 Introduction

As an auxiliary institution of university education and teaching, university library, together with university education and teaching, scientific research and innovation, constitutes the three pillars of university development. With the further popularization of Internet technology, the role played by online resources has become more and more important, which puts forward higher requirements for the selection of high-quality online resources in libraries, and in order to guarantee the quality of online resources from the source, a breakthrough must be made in the procurement of online resources. In order to ensure the quality of online resources at source, a breakthrough must be made in the procurement of online resources. Universities must develop a practical decision-making method to select the most suitable objects from numerous databases.

Online resource procurement of university libraries must be based on the university's own professional settings, discipline construction, scientific research activities, reading needs of teachers and students, and the future discipline development of the university[9], the common phenomenon in the face of online resource procurement in China's universities is that the procurement work is made by library-related experts according to their personal subjective judgment, and the results lack scientificity, and for this problem, different scholars have explored from different perspectives. Qi Yue et al.[6-7] used the Delphi method to establish an online resource procurement evaluation index system, based on the procurement budget, price and user evaluation, and used dynamic planning techniques to achieve the optimal decision of

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resource procurement. Xiaoping Zhou[11] established a multi-objective decision-making model for online resource procurement in universities with the help of gray correlation analysis technique, and provided an efficient dynamic quantitative analysis method for the selection of online resource suppliers in universities by establishing a multi-objective evaluation index system. Besides, some scholars take practical problems as the guide, and in order to cope with the problems in the process of online resource procurement, Dong Yaqian[2] selected numerous online resource evaluation indexes with reference to previous research results, and combined with questionnaire and hierarchical analysis to determine the weight of each index, and established the online resource evaluation index system accordingly. Wenjia Zhao[10] established an online resource procurement decision model based on gray theory, collected relevant factors affecting online resource procurement and established an online resource procurement evaluation index system based on this.

In summary, although the existing research results have conducted profound and pioneering studies on the online resource acquisition decision problem of university libraries, most of them are limited only for the cases where single information exists or where multiple types of information must be equipped with multiple methods. To cope with this problem and realize the vision of using a single method to deal with mixed information, this paper proposes an extended TOPSIS method for exact and fuzzy mixed decision information based on the classical TOPSIS method to solve the online resource acquisition decision problem of multi-indicator college libraries.

2 Preparatory knowledge

2.1 Fuzzy numbers

Definition 1[3]: Fuzzy number $\tilde{F}$ is an arbitrary fuzzy subset with affiliation function $\mu_{\tilde{F}}$ of any fuzzy subset on the real numbers R, usually denoted by $(f_l, f_m, f_q, f_r; 1)$ denoted by the affiliation function of the following form.

$$\mu_{\tilde{F}} = \begin{cases} \mu_{\tilde{F}}^{L}, & f_l \leq x \leq f_m, \\ 1, & f_m \leq x \leq f_q, \\ \mu_{\tilde{F}}^{R}, & f_q \leq x \leq f_r, \\ 0, & \text{Other} \end{cases} \tag{1}$$

where $\mu_{\tilde{F}}$ can be considered as a map from the real numbers R to the interval $[0,1]$ A continuous map on the interval $[f_l, f_m]$ strictly increasing on the interval and strictly decreasing on the interval $[f_q, f_r]$ strictly decreasing on the interval. $\mu_{\tilde{F}}^{L}$: The $[f_l, f_m] \rightarrow [0,1]$, and $\mu_{\tilde{F}}^{R}$: $[f_q, f_r] \rightarrow [0,1]$ are respectively the $\tilde{F}$ the left affiliation function and the right affiliation function.

Definition 4[4]**:** Triangular fuzzy number $\tilde{F}$ is the segmented linear affiliation function defined by $\mu_{\tilde{F}}$ The fuzzy number defined by

$$\mu_{\tilde{F}} = \begin{cases} 0, & x < f_l, \\ \frac{x-f_l}{f_m-f_l}, & f_l \le x \le f_m, \\ \frac{f_r-x}{f_r-f_m}, & f_m \le x \le f_r, \\ 0, & f_r < x, \end{cases} \tag{2}$$

Trigonometric fuzzy numbers $\tilde{F}$ is represented by the triple (f_l, f_m, f_r) to represent, can be considered as fuzzy numbers $(f_l, f_m, f_q, f_r; 1)$ when $f_m = f_q$ the case where $f_l < f_m < f_r$ and all are real numbers.

2.2 Fuzzy semantic information

Table 1 Fuzzy semantic information and triangular fuzzy number

Indicator Importance Assessment	Triangular fuzzy number	Assessment of Indicator Attributes	Triangular fuzzy number
Very low (VL)	(0,0,0.1)	Very poor (VP)	(0,0,1)
Low (L)	(0,0.1,0.3)	Difference (P)	(0,1,3)
Lower (ML)	(0.1,0.3,0.5)	Poorer (MP)	(1,3,5)
Medium (M)	(0.3,0.5,0.7)	Medium (F)	(3,5,7)
Higher (MH)	(0.5,0.7,0.9)	Better (MG)	(5,7,9)
High (H)	(0.7,0.9,1)	Good (G)	(7,9,10)
Very high (VH)	(0.9,1,1)	Very good (VG)	(9,10,10)

2.3 Defuzzification

Definition 6[1]: for triangular fuzzy numbers $\tilde{F} = (f_l, f_m, f_r)$, it is defuzzified by its gradient-averaged integral with the following equation.

$$P(\tilde{F}) = \frac{1}{6}(f_l + 4 \times f_m + f_r) \tag{3}$$

3 Construction of online resource acquisition decision index system for university libraries under mixed information

According to the characteristics of the research object itself, from the actual situation of resource utilization, teaching support functions and construction of supporting software and hardware facilities in the target libraries, the Guidelines for Centralized Literature Procurement in General Higher Education Libraries formulated by the Steering Committee for Library and Information Work of Higher Education Institutions of the Ministry of Education is used as a guide, and the research results of previous research in recent years are drawn from[2, 7] on the basis of the principles of global, scientific, easy-to-operate and independence. Based on the principles of global, scientific, easy-to-operate and independence, the decision indicators of online resource procurement in university libraries are divided into four major categories: technical level of online resources, matching degree of online resources, function of online resource system and cost of online resources, which are further divided into 19 decision indicators, mainly including the number of retrievals, matching degree of user needs and data update cycle. The information reflected by each index is divided into two types of precise information and fuzzy information according to the different ways of representation, and the specific information types and content descriptions of each index are shown in Table 2.

Table 2 Decision index system of online resource acquisition for university libraries under mixed information

Tier 1 Indicators	Secondary indicators	Message Type	Description of indicator content
Online resource technology levelA_1	Number of searchesA_{11}	Precise Information	Average number of searches per month for users during the trial period
	DownloadsA_{12}	Precise Information	Average number of documents downloaded by users in a single month during the trial period
	Literature QualityA_{13}	Fuzzy information	Quality, scholarship and authority of the literature
	Types of included documentsA_{14}	Precise Information	Types of documents available for searching in the database
	Search Data ExperienceA_{15}	Fuzzy information	The user experiences the data retrieval process as fast, Comprehensiveness of results, online readability and downloadability
Online Resource MatchingA_2	User Needs MatchingA_{21}	Fuzzy information	The degree of matching between search results and user needs
	Match with major disciplinesA_{22}	Fuzzy information	The degree of matching of database resources with the main disciplines of universities
	Fit with the library's strategic positioningA_{24}	Fuzzy information	The degree of matching database resources with the strategic positioning of university libraries
	Matching with original resourcesA_{25}	Fuzzy information	Degree of complementarity and coordination with original resources
Online resource system functionsA_3	Data update cycleA_{31}	Precise Information	Reflect the timeliness of database information
	Search InterfaceA_{32}	Fuzzy information	Easy to interpret search interface, information integrity, etc.
	System FeaturesA_{33}	Fuzzy information	Data service capabilities unique to the database as perceived by the user
	Search functionA_{34}	Fuzzy information	Ability to retrieve word classes, language, and modality

	Free trial timeA_{35}	Precise Information	Number of months of free use from the database provider
	Information statistics functionA_{36}	Fuzzy information	The function of statistical data resource usage
	Personalized FeaturesA_{37}	Fuzzy interest	Ability to provide personalized services according to user needs
Online resource costsA_4	Software and hardware acquisition costsA_{41}	Precise Information	Investment in procurement database software and hardware
	Cost per articleA_{42}	Precise Information	Ratio of input cost to total number of views
	System data maintenance costsA_{43}	Precise Information	Input for regular system updates and maintenance

4 Construction of Extended TOPSIS Multi-Indicator Decision Model with Mixed Information

4.1 Description of the decision problem

Let there exist a multi-indicator decision problem.$C = \{C_i | i = 1,2,\cdots,m\}$ denote the set of indicators that reflect the desirability of the scenarios, and$S = \{S_j | j = 1,2,\cdots,n\}$ denotes the set of options, and$E = \{E_k | k = 1,2,\cdots,K\}$ is the set of experts, and the corresponding weights of each expert satisfy$q^k \in [0,1]$ and$\sum_{k=1}^{K} q_k = 1$.

4.2 Decision-making process

(1) Establishing a decision matrix$D$

Assuming that the program is represented byx_{ij} indicates the programS_j in the indicatorC_i information values under, then the decision matrix$D = [x_{ij}]_{m\times n}$ has the following specific form.

$$D = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \tag{4}$$

set $\widetilde{\omega}_i^k = (f_{li}^k, f_{mi}^k, f_{ri}^k)$ indicates that the expert E_k the index given by C_i of the fuzzy importance result, then according to equation (9) we have$P(\widetilde{\omega}_i^k) = \frac{1}{6}(f_{li}^k + 4 \times f_{mi}^k + f_{ri}^k)$, set each indicatorC_i the initial weight of$\omega_{0i}(i = 1,2,\cdots,m)$, then we have$\omega_{0i} = \sum_{k=1}^{K} P(\widetilde{\omega}_i^k) q^k$; thus, the indicatorC_i the weights of$\omega_i = \frac{\omega_{0i}}{\sum_{i=1}^{m}\omega_{0i}}$ and satisfies$\omega_i \epsilon [0,1]$, and$\sum_{i=1}^{m}\omega_i = 1$.

(2) Matrix normalization

In order to eliminate the effect of differences in the magnitudes of different indicators, it is usually necessary to normalize the initial decision matrix$D$ normalize the initial decision matrix, so that$D' = [x'_{ij}]_{m\times n}$ denotes the result matrix after normalization.

Usually, there are two types of indicators: benefit-based and cost-based. For benefit-based indicators, the larger the value, the better the effect; cost-based is the opposite.

Fuzzy information: when $x_{ij} = (f_{lij}, f_{mij}, f_{rij})$

The benefit-based normalization equation is.

$$f'_{lij} = \frac{f_{lij}}{\sqrt{\sum_{j=1}^{n}(f_{rij})^2}}, \quad f'_{mij} = \frac{f_{mij}}{\sqrt{\sum_{j=1}^{n}(f_{mij})^2}}, \quad f'_{rij} = \frac{f_{rij}}{\sqrt{\sum_{j=1}^{n}(f_{lij})^2}} \tag{5}$$

The cost-based normalization equation is.

$$f'_{lij} = \frac{1/f_{rij}}{\sqrt{\sum_{j=1}^{n}(1/f_{lij})^2}}, \quad f'_{mij} = \frac{1/f_{mij}}{\sqrt{\sum_{j=1}^{n}(1/f_{mij})^2}},, \quad f'_{rij} = \frac{1/f_{lij}}{\sqrt{\sum_{j=1}^{n}(1/f_{rij})^2}} \tag{6}$$

Precise information.

The benefit-based normalization equation is.

$$x'_{ij} = \frac{x_{ij} - minx_i}{maxx_i - minx_i} \tag{7}$$

The cost-based normalization equation is.

$$x'_{ij} = \frac{maxx_i - x_{ij}}{maxx_i - minx_i} \tag{8}$$

It can be seen that the normalization matrix under fuzzy information D' The value corresponding to the triangular fuzzy number in the normalized matrix is still the triangular fuzzy number, and is denoted by $x'_{ij} = (f'_{lij}, f'_{mij}, f'_{rij})$ denotes the normalized triangular fuzzy number.

(3) Determine the positive and negative ideal solutions

According to the normalized matrix $D' = [x'_{ij}]_{m\times n}$, the positive ideal solution x'^{+} and the negative ideal solution x'^{-} the results are

$$x'^{+} = (x_1'^{+}, x_2'^{+} x_3'^{+}, \cdots, x_m'^{+}) \tag{9}$$

$$x'^{-} = (x_1'^{-}, x_2'^{-} x_3'^{-}, \cdots, x_m'^{-}) \tag{10}$$

where, for fuzzy information, its positive ideal solution $x_i'^{+} = (f_{li}'^{+}, f_{mi}'^{+}, f_{ri}'^{+}) = (1,1,1)$, the negative ideal solution $x_i'^{-} = (f_{li}'^{-}, f_{mi}'^{-}, f_{ri}'^{-}) = (0,0,0)$; for exact information, the positive ideal solution $x_i'^{+} = 1$, the negative ideal solution $x_i'^{-} = 0$.

(4) Calculate the positive and negative separation

set d_{ij}^{+} , d_{ij}^{-} be the positive and negative separation of each normalized index value from the positive and negative ideal solution, respectively.

When the index values are fuzzy information, the positive and negative separation of each normalized index is

$$\mathrm{d}_{ij}^{+} = \sqrt{\frac{1}{3}[(f'_{lij} - f'^{+}_{li})^2 + (f'_{mij} - f'^{+}_{mi})^2 + (f'_{rij} - f'^{+}_{ri})^2]} \quad (11)$$

$$\mathrm{d}_{ij}^{-} = \sqrt{\frac{1}{3}[(f'_{lij} - f'^{-}_{li})^2 + (f'_{mij} - f'^{-}_{mi})^2 + (f'_{rij} - f'^{-}_{ri})^2]} \quad (12)$$

When the indicator values are exact information, the positive and negative separation of each normalized indicator is

$$\mathrm{d}_{ij}^{+} = \sqrt{(x'_{ij} - x'^{+}_{i})^2} \quad (13)$$

$$\mathrm{d}_{ij}^{-} = \sqrt{(x'_{ij} - x'^{-}_{i})^2} \quad (14)$$

On the basis of equations (11), (12), (13), and (14), by operating $\otimes$ The positive and negative separations of each normalized index are aggregated, so as to calculate the positive and negative separations of each scheme d_j^{+} and d_j^{-} : The

$$\mathrm{d}_j^{+} = \mathrm{d}_{1j}^{+} \otimes \mathrm{d}_{2j}^{+} \otimes \cdots \otimes \mathrm{d}_{mj}^{+} \quad (15)$$

$$\mathrm{d}_j^{-} = \mathrm{d}_{1j}^{-} \otimes \mathrm{d}_{2j}^{-} \otimes \cdots \otimes \mathrm{d}_{mj}^{-} \quad (16)$$

Operation $\otimes$ can be a variety of operations, here the weighted average of all normalized index separations is taken to obtain the positive and negative separations of the scheme d_j^{+} and d_j^{-} : The

$$\mathrm{d}_j^{+} = \frac{\sum_{i=1}^{m}\left[\omega_i \cdot \mathrm{d}_{ij}^{+}\right]}{\sum_{i=1}^{m}\omega_i} \quad (17)$$

$$\mathrm{d}_j^{-} = \frac{\sum_{i=1}^{m}\left[\omega_i \cdot \mathrm{d}_{ij}^{-}\right]}{\sum_{i=1}^{m}\omega_i} \quad (18)$$

Calculate for each scheme S_j under the positive separation d_j^{+} and negative separation d_j^{-} , the smaller the positive separation d_j^{+} is smaller, the better the scheme S_j is better; while the negative separation d_j^{-} is larger, the better the solution S_j the better the solution.

(5) Calculation of closeness

Usually, the closeness is used to determine the ranking of the schemes, such that ψ_j is the closeness, then the closeness of scheme S_j of closeness is calculated as follows.

$$\psi_j = \frac{\mathrm{d}_j^{-}}{\mathrm{d}_j^{-} + \mathrm{d}_j^{+}} \quad (19)$$

From equation (18), it is easy to see that when ψ_j is close to 1, the solution S_j is closer to the positive ideal solution PIS and farther from the negative ideal solution NIS, therefore, the ranking of the schemes can be obtained by applying this principle.

5 Empirical analysis

This paper takes the acquisition of online resources in a university library as a starting point to verify the effectiveness of the decision model under mixed information in this paper. With the development of Internet technology and mobile reading terminals, users' reading media began to gradually transition from offline to online, and in order to accommodate more users' needs, the library continuously increased its investment in online resource procurement, with online resource acquisition costs exceeding 1.2 million yuan in the past three years, and even reaching more than 2.06 million yuan in 2018. In order to ensure the full utilization of online resource acquisition costs in subsequent years to the Library 2020S_1 , theS_2 andS_3 3 databases as the objects of acquisition decision, the index importance results were obtained by the evaluation team composed of library management specialists and users with the help of fuzzy semantic information assessment; the precise information value was determined by referring to the information disclosed in the backend statistics of library online resource management and acquisition cost report forms; the fuzzy information value was also determined by expert fuzzy semantic information assessment. The importance of the indicators determined by referring to the seven granularity of fuzzy semantic information in Table 1 and the results of the indicator attribute values for each database are shown in Table 3 and Table 4.

Table 3 Fuzzy semantic information of indicator importance

		E_1	E_2	E_3
A_1	A_{11}	MH	M	ML
	A_{12}	H	MH	MH
	A_{13}	VH	H	H
	A_{14}	M	M	MH
	A_{15}	MH	MH	H
A_2	A_{21}	M	H	H
	A_{22}	H	VH	H
	A_{24}	MH	H	MH
	A_{25}	ML	M	M
A_3	A_{31}	M	ML	M
	A_{32}	ML	ML	ML
	A_{33}	MH	M	MH
	A_{34}	H	MH	M
	A_{35}	MH	M	M
	A_{36}	ML	ML	ML
	A_{37}	MH	H	H
A_4	A_{41}	VH	VH	VH
	A_{42}	M	ML	M
	A_{43}	MH	H	MH

Table 4 Attribute values of exact and fuzzy mixed information of indicators

		S_1	S_2	S_3
A_1	A_{11}	2069	1154	1119
	A_{12}	4305	2421	2388
	A_{13}	G	MG	MG
	A_{14}	26	37	10
	A_{15}	VG	G	G
A_2	A_{21}	G	MG	G
	A_{22}	VG	G	G
	A_{24}	G	F	MG
	A_{25}	MG	MP	F
A_3	A_{31}	0.5	1	1
	A_{32}	VG	MP	G
	A_{33}	VG	VG	G
	A_{34}	VG	MG	G
	A_{35}	4	15	2
	A_{36}	F	MP	MP
	A_{37}	G	G	F
A_4	A_{41}	733900	286700	186600
	A_{42}	0.17	1.36	1.34
	A_{43}	12000	18000	9000

5.1 Matrix normalization and index weights

According to the process of matrix normalization in the extended TOPSIS multiple indicator decision model under mixed information, the benefit-based indicators under fuzzy information and the benefit-based and cost-based indicators under accurate information are normalized according to equations (5), (7) and (8), respectively.

Referring to the correspondence between the results of index importance assessment and the triangular fuzzy number in Table 1, the experts in Table 3E_k importance of indicatorsC_i in Table 3 is converted into the corresponding triangular fuzzy number$\widetilde{\omega}_i^k$ and use equation (3) to defuzzify the corresponding triangular fuzzy numbers, based on which the above weight calculation formula is used to calculate the initial weights of each indexω_{0i} and the final weightsω_i The initial and final weights of each index are calculated using the above formula. In summary, the results of matrix normalization and index weights are shown in Table 5.

Table 5 Normalization matrix and index weights

		S_1	S_2	S_3	ω_i
A_1	A_{11}	1	0.037	0	0.044
	A_{12}	1	0.017	0	0.063

	A_{13}	(0.218,0.300,0.397)	(0.181,0.300,0.507)	(0.168,0.276,0.472)	0.075
	A_{14}	0.593	1	0	0.044
	A_{15}	(0.280,0.334,0.397)	(0.253,0.334,0.563)	(0.235,0.355,0.525)	0.060
	A_{21}	(0.218,0.300,0.397)	(0.181,0.300,0.507)	(0.235,0.355,0.525)	0.058
	A_{22}	(0.280,0.334,0.397)	(0.253,0.334,0.563)	(0.235,0.355,0.525)	0.074
A_2	A_{24}	(0.218,0.300,0.397)	(0.108,0.300,0.394)	(0.168,0.276,0.472)	0.062
	A_{25}	(0.156,0.234,0.357)	(0.036,0.234,0.282)	(0.101,0.197,0.367)	0.033
	A_{31}	1	0	0	0.035
	A_{32}	(0.280,0.334,0.397)	(0.036,0.334,0.282)	(0.235,0.355,0.525)	0.024
	A_{33}	(0.280,0.334,0.397)	(0.325,0.334,0.563)	(0.235,0.355,0.525)	0.052
A_3	A_{34}	(0.280,0.334,0.397)	(0.181,0.334,0.507)	(0.235,0.355,0.525)	0.060
	A_{35}	0.154	1	0	0.048
	A_{36}	(0.093,0.167,0.278)	(0.036,0.167,0.282)	(0.034,0.118,0.262)	0.024
	A_{37}	(0.218,0.300,0.397)	(0.253,0.300,0.563)	(0.101,0.197,0.367)	0.065
	A_{41}	0	0.820	1	0.080
A_4	A_{42}	1	0	0.017	0.035
	A_{43}	0.667	0	1	0.062

5.2 Separation and closeness of the schemes and their ranking

Under the condition that the positive and negative ideal solutions are known, the positive and negative separations of each normalized index are determined according to the calculation steps of Eqs. (11) to (14).

Based on the positive and negative separation degrees of each normalized index, firstly, the positive and negative separation degrees of each scheme are calculated by using Eqs. (15) to (18), and generally when the positive separation degree is smaller and the negative separation degree is larger, the corresponding scheme is more superior. Finally, the closeness values of each scheme are determined by equation (19), and the schemes are ranked according to the order of the closeness values from largest to smallest, and the larger the value is, the better the scheme is. The specific results are shown in Table 6.

Table 6 Positive and negative separation and closeness of each scheme and their ranking

S_1		S_2		S_3	
d_1^+	d_1^-	d_2^+	d_2^-	d_3^+	d_3^-
0.565	0.439	0.652	0.367	0.673	0.344
ψ_1		ψ_2		ψ_3	
0.437		0.360		0.338	
1		2		3	

From the data in the table, it can be seen that the positive separation of the schemes in descending order is $d_3^+ > d_2^+ > d_1^+$ and the negative separation is ranked from largest to smallest as $d_1^- > d_2^- > d_3^-$ According to the principle of classical TOPSIS method, when the positive separation is smaller and the negative separation is larger, the corresponding scheme is better.S_1 The positive separation of the database is the smallest, 0.565, and the negative separation is the largest, 0.439, and its corresponding closeness value is the largest, 0.437. Combined with the results of data analysis and decision making, the procurement priority of each database should be$S_1 > S_2 > S_3$.

5.3 Analysis of results

(1) Analyzed from the perspective of the contribution of the first-level indicators, the contribution of four first-level indicators, namely, online resource technology level, online resource matching degree, online resource system function and online resource cost, to the purchasing decision is 28.6%, 22.7%, 30.8% and 17.7%, respectively, among which the contribution of online resource technology level and online resource system function are higher than the average contribution of 25%, indicating that both have a The influence of both on purchasing decision is particularly significant, and it also indicates that the degree of online resource matching and online resource cost have limited influence on purchasing decision. The reason for this is that the existing databases are more cross-compatible in terms of content coverage, and users tend to pay more attention to the convenience of the technical level of the retrieval process and whether the system functions are powerful enough in the process of using them, while their concern for resource matching and cost is weaker than before.

(2) Analyzed from the perspective of contribution of secondary indicators, the contribution of the first series of indicators of download volume (0.063), document quality (0.075) and search data experience (0.060) to the acquisition decision is more significant, all higher than the average contribution of 0.053, reflecting the key role of the performance of these three aspects of the database on the acquisition decision; the second series of indicators of user needs matching (0.058), matching with the main subjects (0.074) and matching with the strategic positioning of the library (0.062) have a more significant impact on the acquisition decision; the third series of indicators only the search function (0.06) and personalization function (0.06) have a more significant impact on the acquisition decision. The second series of indicators, user needs matching (0.058), matching with major disciplines (0.074) and matching with the strategic positioning of the library (0.062), have a significant impact on the acquisition decision; the third series of indicators, only the search function (0.06) and personalization function (0.065), have a more prominent contribution to the acquisition decision, indicating that users pay more attention to information retrieval and personalized needs satisfaction; the fourth series of indicators, only the single article cost (0.035) contributes poorly to purchasing decisions.

6 Conclusions and Recommendations

In this paper, the concept of fuzzy number is introduced to address the problem of online resource procurement for university libraries in a mixed information environment in order to build a bridge between fuzzy semantics and quantitative data and to transform semantic information into a form that can be utilized by quantitative decision models. Using the classical TOPSIS principle, an extended TOPSIS multi-indicator decision model covering mixed fuzzy and precise information is proposed, and the model is validated with the empirical evidence of online resource procurement in university libraries. The results show that the research content of this paper can provide some reference for online resource procurement in libraries and make the whole procurement decision more scientific and feasible. In addition, university libraries should target their procurement at databases with high academic value and authority, and should match with the characteristics of university disciplines to avoid blindly following the trend of procurement without basis, and gradually improve the richness of online resources and teaching and research services.

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