Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 221 (2023) 565–572

Procedia Computer Science

www.elsevier.com/locate/procedia

Tenth International Conference on Information Technology and Quantitative Management

Commercial Bank Data Asset Quality Evaluation Model Based on Fermatean Fuzzy TOPSIS

Lina Dong[a, b], Mu Zhang[a, *]

[a]*School of Big Data Application and Economics, Guizhou University of Finance and Economics, Guiyang(550025), Guizhou, China*
[b]*Guizhou Institution for Technology Innovation & Entrepreneurship Investment, Guizhou University of Finance and Economics, Guiyang(550025), Guizhou, China*

Abstract

With the continuous development of informationization and digital transformation, the types of data assets owned and controlled by enterprises are increasing, the volume is increasing, and the growth rate is increasing. The value of data assets is determined by the quality of data assets, so the quality of data assets has become a problem that everyone pays attention to and is worth studying. This paper will evaluate the quality of commercial banks' data assets. This paper comprehensively considers the characteristics of data itself (accuracy, timeliness, consistency, integrity) and the characteristics of data as assets (profitability, security, risk), and builds an index evaluation system of data asset quality. The multi-criteria decision-making (MCDM) model constructed by Fermatean Fuzzy TOPSIS uses Matlab software to make quantitative evaluation and ranking of the data asset quality of 5 commercial banks. The results show that the data asset quality of S_3 of commercial bank is the best, while that of S_1 of commercial bank is the worst. Finally, the ranking results obtained by the above method are compared with the ranking results of triangular fuzzy TOPSIS. Only the ranking results of the top two commercial banks are different. The ranking results of the two methods are roughly the same. But the Fermatean Fuzzy TOPSIS evaluation scope is larger and the hesitancy of the evaluator is considered, which proves the feasibility and superiority of the method and model.

Keywords: Data Asset Quality; Multi-Criteria Decision-Making; Fermatean Fuzzy Set; TOPSIS Method;Degree of Hesitation

1. Introduction

Victor Mayer-Schönberger, the father of big data, keenly pointed out that although data assets have not yet been

* Corresponding author. Tel.:+86-0851-88510575.
*E-mail address:*zhangmu01@163.com

10.1016/j.procs.2023.08.023

included in the balance sheets of various companies, it is only a matter of time [1]. The "Data Asset Management Practice White Paper (Version 4.0)" published by the China Academy of Information and Communications Technology in 2019, starting from the definition of assets, clearly defines the concept of data assets. It states that data assets refer to data resources owned or controlled by enterprises that can bring future economic benefits to the enterprise and are recorded in physical or electronic form, such as documents, information, electronic data, etc [2].

Big data and the Internet continue to develop, and companies are undergoing continuous digital and information transformation. The digital economy has become a new growth point, and data has become a new factor of production and a strategic asset, contributing to the efficiency and effectiveness of technological innovation and industrial upgrading [3]. The Fourth Plenary Session of the 19th Central Committee of the Communist Party of China added data as a new factor of production, and the Fifth Plenary Session redefined the market position of data elements and affirmed the value created by data [4]. The Central Committee of the China Democratic League has also put forward many suggestions on data elements during the Two Sessions [5], indicating the importance attached to data elements by the people of the country.Although data is considered an asset for companies, not all data assets necessarily have value. The quality of data assets determines their value. Therefore, evaluating the quality of enterprise data assets is a worthwhile research topic. Only high-quality data assets have application value, can bring positive economic benefits to companies, and provide valuable information to data asset users for making informed decisions.

In the evaluation of data asset quality, different researchers have different considerations when constructing the data asset quality evaluation system.

Fu shan et al.(2022) [6]pointed out that the traditional view of data quality includes the "six dimensions" of completeness, uniqueness, timeliness, validity, accuracy, and consistency. Sometimes there may be slight variations in versions, with some dimensions being added, reduced, or replaced. Most existing studies use the "six dimensions" as the principles for data quality evaluation or use them to construct the data asset quality evaluation system[4][7]-[11].However, in reality, data quality is not limited to the "six dimensions". The traditional "six dimensions" only satisfy the basic requirements of data quality, and when evaluating data asset quality, factors such as industry differences should also be considered to create high-quality data asset elements and enhance the standardization level of data quality assessment.

Data asset quality includes not only the data quality characteristics described in existing research (such as data completeness, accuracy, timeliness, and security) but also the quality of data profitability and data utility as asset attributes [12]. More and more researchers are considering multiple factors and constructing more comprehensive data asset quality assessment systems. You Jianxin and Xu Tao (2021)[14]evaluated the data asset quality of commercial banks by considering not only data quality (accuracy, timeliness, consistency, completeness) but also the characteristics of data as assets (profitability, security, risk). Sun Lili and Yuan Qinjian (2019) [15]evaluated the data quality of e-commerce by combining qualitative and quantitative methods and constructed a four-level hierarchical data quality evaluation index system, including intrinsic dimensions, contextual dimensions, application dimensions, and asset dimensions. Shi Lei et al. (2023)[16], in the construction of a data asset value evaluation system, considered that the factors influencing data asset value include data asset quality value and data asset economic value.

To sum up, we should not be limited to the traditional "six characteristics". In other words, we should consider the characteristics of data quality, but also consider the characteristics of data as assets.

In terms of the data asset quality evaluation method used, Wang Yulan (2018)[1] uses the hierarchical analysis method to build the data asset evaluation model. Cheng Xiaoting (2022)[4] aims at the evaluation information of Zhongzhi information and language information respectively, and uses Zhongzhi soft set and probabilistic language term set to construct the data asset quality evaluation method of commercial banks to eliminate the preferences of decision makers. Liu Wei (2011) [7]The whole process data quality control idea, constructed the data quality control and evaluation system model. Sun Lili et al.(2017)[12] collected and processed the data combined with semi-structured interview and rooted theory. You Jianxin and Xu Tao (2021) 14]used the method based on the triangular fuzzy number TOPSIS to evaluate the data asset quality of commercial banks. Sun Lili and Yuan Qinjian (2019) [15]used the Delphi method to correct the evaluation index, and then used the hierarchical analysis method to determine the weight of each index, to construct the evaluation index system of e-commerce data quality. Shi Lei et al.(2023)[16] established the data asset value evaluation model combined with various methods such as hierarchical analysis method, cost method, market method, income method and comprehensive method, which provides reference and basis for enterprises to evaluate the value of data assets.

To sum up, the most of them use theoretical evaluation or hierarchical analysis method, triangular fuzzy number approximate ideal solution sorting method, etc. At present, no scholars have used Fermatean Fuzzy TOPSIS method to analyze and measure the evaluation information. When people evaluate a thing, they often do not use accurate data to evaluate it, but generally use language to evaluate it. The evaluation results of this language are also subjective. In the process of evaluation, people's will is often wavering, that is, there may be ambiguity and hesitation, and the fuzzy evaluation method will comprehensively consider the ambiguity and hesitation in the evaluation. In the fuzzy evaluation method, Fermatean fuzzy set compared with the intuitive fuzzy set and triangular fuzzy set, the algorithm has a larger evaluation range and considers the hesitation of the evaluator, making the quantitative results closer to the language evaluation of the evaluator. Therefore, this paper uses the Fermatean Fuzzy TOPSIS method to evaluate the quality of data assets.

Based on previous research, when constructing the data asset quality evaluation system, the entry point is to consider not only the quality of the data itself, but also the characteristics of the data as an asset, so that the data asset quality evaluation system will be more perfect. In the evaluation of data asset quality, Fermatean Fuzzy TOPSIS method is used to evaluate the data asset quality of commercial banks. The parameters of Fermatean Fuzzy objects are described by the membership, non-membership and hesitation, which is more reasonable considering the hesitation of the evaluators.

2. Research method

TOPSIS method based on Fermatean Fuzzy

The MCDM problem, also known as the multi criteria decision-making problem, is a related problem that is difficult to express evaluation results with a single attribute (indicator). TOPSIS method is a classical approach in multi-criteria decision-making.It ranks the evaluation objects by calculating their distances to both the positive ideal solution and the negative ideal solution. The best evaluation alternative is the one that is closest to the "positive ideal solution" and farthest from the "negative ideal solution", and vice versa. The advantage of TOPSIS method is that it considers different types of attributes, characterizes the superiority or inferiority of evaluation alternatives through comprehensive evaluation indices, and provides a simple and quick way to obtain the ranking results of alternatives.Fuzzy research methods have evolved from intuitionistic fuzzy sets to Pythagorean Fuzzy and then to Fermatean Fuzzy, the range of information that fuzzy research methods can contain is constantly expanding. This article will integrate the advantages of TOPSIS method and Fermatean Fuzzy to evaluate the quality of data assets using the TOPSIS method based on Fermatean Fuzzy. The specific steps are as follows:

Step 1:Establish the decision matrix.

Based on the MCDM problem using Fermatean fuzzy sets, let's assume there are m evaluation objects $S_i(i=1,2,\cdots,m)$ and n evaluation criteria $C_j(j=1,2,\cdots,n)$. We have the weight vector for each evaluation criterion $w=(w_1,w_2,\cdots w_n), 0\le w_j\le 1, \sum_{j=1}^{n} w_j=1$. We use $C_j(S_i)=(\mu_{ij},\upsilon_{ij})$ to represent the evaluation value of evaluation object S_i for evaluation criterion C_j. The Fermatean fuzzy decision matrix is represented as follows $R=(C_j(S_i))_{m\times n}$. μ_{ij},υ_{ij} respectively represent membership degree and non-membership degree, that is, the degree value of the evaluation object S_i belonging to the evaluation standard (attribute) C_j is μ_{ij}, while the degree value of the evaluation object S_i not belonging to the evaluation standard (attribute) C_j is υ_{ij}.

Step 2:Determine the positive ideal solution and negative ideal solution.

To determine the positive ideal solution and negative ideal solution, we need to use the scoring function. So, let's first introduce the definition of the scoring function.

Assuming $F=(\mu_F,\upsilon_F)$ is a Fermatean fuzzy set, the fraction function of F can be expressed as $score(F)=\mu_F^3-\upsilon_F^3$.

Following the core of the TOPSIS method, the best solution should have the shortest distance to the positive ideal solution (PIS) and the farthest distance from the negative ideal solution (NIS). Therefore, based on the scoring function, a comprehensive evaluation method is used to calculate the Fermatean Fuzzy PIS (FFPIS) and Fermatean Fuzzy NIS (FFNIS).

FFPIS are represented by S^+, which can be calculated by the following equation:

$$S^+ = \begin{cases} \max\left\langle score\left(C_j\left(S_i\right)\right)\right\rangle \middle| j = 1,2,\cdots,n\left(\text{If } C_j \text{ is a benefit indicator}\right) \\ \min\left\langle score\left(C_j\left(S_i\right)\right)\right\rangle \middle| j = 1,2,\cdots,n\left(\text{If } C_j \text{ is a cost indicator}\right) \end{cases}$$
$$= \left\{\left(\mu_1^+, \upsilon_1^+\right), \left(\mu_2^+, \upsilon_2^+\right), \cdots, \left(\mu_n^+, \upsilon_n^+\right)\right\} \tag{1}$$

FFNIS is represented by S^-, which can be calculated by the following equation:

$$S^- = \begin{cases} \min\left\langle score\left(C_j\left(S_i\right)\right)\right\rangle \middle| j = 1,2,\cdots,n\left(\text{If } C_j \text{ is a benefit indicator}\right) \\ \max\left\langle score\left(C_j\left(S_i\right)\right)\right\rangle \middle| j = 1,2,\cdots,n\left(\text{If } C_j \text{ is a cost indicator}\right) \end{cases}$$
$$= \left\{\left(\mu_1^-, \upsilon_1^-\right), \left(\mu_2^-, \upsilon_2^-\right), \cdots, \left(\mu_n^-, \upsilon_n^-\right)\right\} \tag{2}$$

Step 3:Calculate the distance between each evaluation object and the positive and negative ideal solutions

$$D\left(S_i, S^+\right) = \sum_{j=1}^{n} w_j d\left(C_j\left(S_i\right), C_j\left(S^+\right)\right)$$
$$= \frac{1}{2} \times \sum_{j=1}^{n} w_j \sqrt{\frac{1}{2} \times \left[\left(\mu_{ij}^3 - \left(\mu_j^+\right)^3\right)^2 + \left(\upsilon_{ij}^3 - \left(\upsilon_j^+\right)^3\right)^2 + \left(\pi_{ij}^3 - \left(\pi_j^+\right)^3\right)^2\right]} \tag{3}$$
$$i = 1,2,\cdots,m$$

$$D\left(S_i, S^-\right) = \sum_{j=1}^{n} w_j d\left(C_j\left(S_i\right), C_j\left(S^-\right)\right)$$
$$= \frac{1}{2} \times \sum_{j=1}^{n} w_j \sqrt{\frac{1}{2} \times \left[\left(\mu_{ij}^3 - \left(\mu_j^-\right)^3\right)^2 + \left(\upsilon_{ij}^3 - \left(\upsilon_j^-\right)^3\right)^2 + \left(\pi_{ij}^3 - \left(\pi_j^-\right)^3\right)^2\right]} \tag{4}$$
$$i = 1,2,\cdots,m$$

π_{ij} is the degree of hesitation， $\pi_{ij} = \sqrt[3]{1 - \mu_{ij}^3 - \upsilon_{ij}^3}$.

Step 4:Calculate the comprehensive evaluation index for each evaluation object.

$$\textit{Relative Closeness Index } RC\left(S_i\right) = D\left(S_i, S^-\right) / \left[D\left(S_i, S^-\right) + D\left(S_i, S^+\right)\right] \tag{5}$$

Step 5:Determine the optimal ranking of alternatives and analyze the results.

3. Example analysis

The data assets generated during the operation of commercial banks are important resources with high value. In this paper, the 5 branches of commercial banks used in the case analysis of You Jianxin and Xu Tao (2021) are taken as the evaluation object.We use the Fermatean Fuzzy TOPSIS method to evaluate the data asset quality of these branches. We analyze the evaluation results and compare them with the results obtained using the triangular fuzzy TOPSIS method used by You Jianxin and Xu Tao (2021).

3.1. Establish the index system

Data asset quality encompasses not only the characteristics of data quality as described in existing research, such as data completeness, accuracy, timeliness, and security, but also the quality of data as an asset, including data profitability and data utility (Sun Lili, Wu Jianhua, 2017). Therefore, this paper will consider from the following two aspects and build an index system to build a data asset quality evaluation system by referring to You Jianxin and Xu Tao (2021):the construction of the indicator system in this paper is summarized in Table 1.

Table 1 Index system

Dimension	Index	Indicator description	Examples
Data quality	C_1 Accuracy	Data accuracy includes both the accuracy of data content and its format, such as the accuracy of types, formats, precision, and value ranges. Data accuracy is different from data correctness, as data accuracy needs to be as precise as possible considering the desired context.	For example, if a company's total assets are described as being over 20 million, this description is correct but not precise enough.
	C_2 Timeliness	Timeliness has a dual effect on data assets. For data assets with high liquidity, their value only exists for a short period of time, and as time passes, their effectiveness decreases or even disappears. On the other hand, data assets that had low value in the past may have new significance for company decision-making after a certain period of time.	Let's say the information needs to be disclosed by the company within the period of January 1, 2020, to January 31, 2020. However, the company discloses this information on February 2, 2020, thus violating timeliness and currency.
	C_3 Consistency	Consistency refers to the consistency of related values within the same system or across different systems.	In different systems, the values of the same object should be consistent. When different users access the same data simultaneously, the values returned should be the same.
	C_4 Integrity	Completeness includes two aspects:the completeness of data form and the completeness of data content. The completeness of data form ensures that the data has the correct structure to reflect the relationships between data elements, while the completeness of data content requires that there are no empty values for essential data items.	If a particular data item in a data table is designated as the primary data item but contains empty values, it violates the requirement of completeness for data asset quality.
Data asset	C_5 Profitability	Profitability is a fundamental characteristic of assets, and data, as an asset, also needs to possess this characteristic. It means that enterprises can generate economic benefits through the ownership or control of data assets. Data assets can provide unique advantages to enterprises in business competition and lead to higher profits.	The patent rights that a company holds for a self-developed drug reflect the profitability of data assets through the economic benefits derived from the use of the drug's data.
	C_6 Security	Ensuring the security of data assets is essential.	Examples of indicators related to data protection include data backup coverage and protection coverage.
	C_7 Risk	This includes safeguarding data assets against ethical and legal risks that may arise during their operation. It is important to maintain the security of data assets and prevent potential risks from occurring.	If data assets are not adequately protected, they can be stolen by unauthorized individuals.

3.2. Commercial data asset quality evaluation

First, construct the reference table for the correspondence between indicator evaluation linguistic variables and Fermatean fuzzy numbers in Table 2:

Table 2 The relationship between linguistic variables and Fermatean fuzzy numbers was evaluated

linguistic variables							
	Benefit type indicator	Very poor	Poor	Relatively poor	General	Relatively good	Good	Very good
	Cost type indicator	Very large	Large	Relatively larger	General	Relatively small	small	Very small
Fermatean fuzzy numbers		[0, 1]	[0.17, 0.85]	[0.34, 0.68]	[0.51, 0.51]	[0.68, 0.34]	[0.85, 0.17]	[1, 0]

The objective is to evaluate the data asset quality of 5 commercial bank branches, with 5 evaluation objects and 7 evaluation criteria. Yu Jianxin and Xu Tao (2021) invited 5 experts to evaluate the indicators and calculate the optimal weights of the evaluation criteria using the Best Worst Method (BWM) procedure. The weight result is (0.089, 0.076, 0.057, 0.298, 0.297, 0.115, 0.067). According to the linguistic results of the indicator evaluation for the 5 branches by You Jianxin and Xu Tao (2021), and by referring to the relationship between the indicator evaluation linguistic variables and Fermatean fuzzy numbers in Table 2, the corresponding Fermatean fuzzy numbers are determined for the 5 branches.Next, the Fermatean Fuzzy TOPSIS method is applied using MATLAB software to evaluate the data asset quality of these 5 commercial bank branches.

Step 1:Constructing the Fermatean fuzzy decision matrix (Table 3).

Table 3 Fermatean fuzzy decision matrix

Bank\Index	C_1	C_2	C_3	C_4	C_5	C_6	C_7
S_1	(0.85, 0.25)	(0.51, 0.51)	(0.68, 0.39)	(0.68, 0.34)	(0.17, 0.85)	(0.68, 0.42)	(0.34, 0.60)
S_2	(0.85, 0.09)	(0.68, 0.42)	(0.68, 0.51)	(0.85, 0.17)	(0.34, 0.76)	(0.68, 0.42)	(0.34, 0.68)
S_3	(0.85, 0.25)	(0.51, 0.59)	(0.85, 0.17)	(0.68, 0.34)	(0.34, 0.60)	(0.68, 0.26)	(0.17, 0.85)
S_4	(0.68, 0.34)	(0.51, 0.43)	(0.68, 0.28)	(0.68, 0.42)	(0.34, 0.76)	(0.68, 0.26)	(0.34, 0.76)
S_5	(0.85, 0.09)	(0.68, 0.26)	(0.68, 0.17)	(0.68, 0.26)	(0.34, 0.68)	(0.51, 0.51)	(0.34, 0.76)

Step 2:Determining the positive ideal solution (PIS) and negative ideal solution (NIS).

First, based on the score function, the score matrix is calculated (Table 4).

Table 4 Score matrix

Bank\Index	C_1	C_2	C_3	C_4	C_5	C_6	C_7
S_1	0.5985	0	0.2551	0.2751	-0.6092	0.2403	-0.1767
S_2	0.6134	0.2403	0.1818	0.6092	-0.3997	0.2403	-0.2751
S_3	0.5985	-0.0727	0.6092	0.2751	-0.1767	0.2969	-0.6092
S_4	0.2751	0.0531	0.2925	0.2403	-0.3997	0.2969	-0.3997
S_5	0.6134	0.2969	0.3095	0.2969	-0.2751	0	-0.3997

Among the 7 evaluation criteria, except for "risk" which is a cost-type criterion (where smaller values are better), the remaining 6 criteria are benefit-type criteria (where larger values are better). Based on the score matrix, the positive ideal solution (S^+) and negative ideal solution (S^-) for each evaluation criterion are determined. The results can be seen in Table 5.

Table 5 Positive and negative ideal solutions

Solution\Index	C_1	C_2	C_3	C_4	C_5	C_6	C_7
S^+	(0.85, 0.09)	(0.68, 0.26)	(0.85, 0.17)	(0.85, 0.17)	(0.34, 0.60)	(0.68, 0.26)	(0.17, 0.85)
S^-	(0.68, 0.34)	(0.51, 0.59)	(0.68, 0.51)	(0.68, 0.42)	(0.17, 0.85)	(0.51, 0.51)	(0.34, 0.60)

The third to fifth steps involve calculating the distance between each evaluated object and the positive ideal solution, $D(S_i, S^+)$, as well as the distance between each evaluated object and the negative ideal solution, $D(S_i, S^-)$. Then, the relative closeness index (RC) for each evaluated object is calculated. Finally, the best ranking of alternative solutions is determined. The results can be seen in Table 6.

Table 6 Distance and relative proximity index and their ranking

Bank	S_1	S_2	S_3	S_4	S_5
$D(S_i, S^+)$	0.1297	0.0554	0.0500	0.1060	0.0814
$D(S_i, S^-)$	0.0321	0.0956	0.1041	0.0484	0.0813
RC	0.1985	0.6330	0.6756	0.3137	0.4996
ranking	5	2	1	4	3

3.3. Result Analysis

(1) Analysis of Data Asset Quality Evaluation Results

This study focuses on 5 branches of commercial banks as research objects. By applying the Fermatean Fuzzy TOPSIS method combined with the optimal weights calculated using the BWM method from the literature, the ranking of data asset quality for the 5 commercial bank branches is determined. From the ranking results in Table 7, it can be observed that $S_2 > S_3 > S_5 > S_4 > S_1$. The second branch has the highest data asset quality, while the first branch has the lowest data asset quality.

(2) Comparative Analysis

The results of ranking the data asset quality of these 5 commercial bank branches using the TOPSIS method based on triangular fuzzy numbers are compared with the results obtained using the Fermatean Fuzzy TOPSIS method, as shown in Table 7:

Table 7 Comparison of results of different methods for evaluating data asset quality

Method	Bank	S_1	S_2	S_3	S_4	S_5
Fermatean Fuzzy TOPSIS	RC	0.1985	0.6330	0.6756	0.3137	0.4996
	ranking	5	2	1	4	3
Triangular fuzzy number TOPSIS	D	0.23	0.76	0.59	0.48	0.53
	ranking	5	1	2	4	3

To illustrate the effectiveness and feasibility of Fermatean Fuzzy based TOPSIS method, we use this method to evaluate the data asset quality of commercial banks, and compare the same numerical example based on Fermatean Fuzzy TOPSIS method and triangle based TOPSIS method.As can be seen from Table 7, the rankings obtained using the Fermatean Fuzzy-based TOPSIS method and Yu Jianxin and Xu Tao (2021) using the TOPSIS method based on triangular fuzzy number are slightly different, but generally consistent. Such results illustrate the effectiveness and feasibility of the Fermatean Fuzzy-based TOPSIS method to some extent.

The fuzzy theory not only considers the subjective information of the evaluation subject, but also considers the hesitation degree of the subjective evaluation, and improves the reliability of the experts' data asset quality evaluation. Fermatean Fuzzy Theory is compared with the triangular fuzzy theory used by You Jianxin and Xu Tao (2021). The biggest advantage of Fermatean Fuzzy theory is that Fermatean Fuzzy theory covers a wide range of evaluation areas, that is to say, the membership degree and non-membership can be given more freely, that is, the evaluation needs of experts can be better met.

4. Conclusion

With the continuous development of information and digital transformation, more and more domestic enterprises have fully realized the importance of data assets and the importance of data asset quality to the value of data assets, and constantly hope to enhance the value of data assets through data asset management and data governance, so that more and more data assets can create value for enterprises. Only by evaluating the quality of data assets, enterprises can more quantitatively understand the advantages and disadvantages of data asset quality, so as to evaluate the value of enterprise data assets. This paper combines Fermatean Fuzzy and TOPSIS methods, and according to the constructed data asset quality evaluation system, completes the construction of MCDM framework for data asset quality evaluation, uses the research methods that have not been used before, and provides a new model reference for data asset quality evaluation. In this paper, scholars use Lingo software to calculate the optimal weight of BWM method, simple code, clear logic, can quickly calculate the optimal weight. The feasibility of the model is verified by applying the model to practical problems and the results of the model are scientifically accurate. In addition, the TOPSIS method based on Fermatean Fuzzy includes a wider range of evaluation results and involves the degree of hesitancy. Considering the situation that evaluators may hesitate in the evaluation process, it embodies the superiority of this method.

There are still many shortcomings in this paper, such as the index system is not complete, the index weight calculation method is single, the comprehensive evaluation method is single. In the future, there are many areas worth improving: 1 the evaluation objects can be more abundant, including commercial banks and more industries; 2 a more perfect index system can be established; 3 in the future, the data asset quality can be evaluated with other methods, such as the calculation method of other index weights and other comprehensive evaluation methods.

Acknowledgements

This research was funded by the Regional Project of National Natural Science Foundation of China, grant number 71861003.

References

[1] Wang Yulan. (2018) "Research on Data Asset Evaluation Model Based on Analytic Hierarchy Process." Tianjin University of Commerce.

[2] Sun Ying, Chen Sixia. (2021) "Data Assets and High-Quality Development of Technology Service Enterprises:Based on the 'Broadband China' Quasi-Natural Experiment." Journal of Wuhan University (Philosophy & Social Sciences) 74(05):132-147.

[3] Mayer-Schonberger V, Cukier K. (2013) "Big Data: A Revolution That Will Transform How We Live, Work, and Think." New York:Houghton Mifflin Harcourt.

[4] Cheng Xiaoting. (2022) "Research on the Evaluation Method of Data Asset Quality for Commercial Banks under Uncertain Environment." Shanxi University of Finance and Economics.

[5] Fan Xuehan, Wang Zhen. (2023) "'Two Sessions' Discuss Data Asset Evaluation and Transactions." First Financial Daily, 2023-03-10 (A04).

[6] Fu Shan, Deng Zhengbao, Yu Peng. (2022) "On the 'Authenticity' of Data Quality and Related Fusion Calculation Strategies." Information and Communication Technology & Policy, No. 332(02):8-15.

[7] Liu Wei. (2011) "Research on Metadata-Based Data Quality Control and Evaluation Model." Northeast Petroleum University.

[8] Lu Benxin. (2013) "Research on Data Quality Management in Data Warehousing." Dalian University of Technology.

[9] Lu Hui. (2021) "Application of Data Quality Improvement in Power Grid Informatization." Software, 42(11):119-121.

[10] Liu Boyu, Yin Hao, Yan Lijing. (2018) "Data Governance in Enterprise Big Data Applications." Electronic Technology and Software Engineering, No. 142(20):174.

[11] Guo Fengtao. (2020) "Practice Research on the Operation of Data Quality Management System in Small and Medium-Sized City Commercial Banks." Times Finance, No. 774(20):99-100.

[12] Sun Lili. (2017) "Research on Data Quality Control of B2C Enterprises from the Perspective of Data Asset Management." Nanjing University.

[13] Sun Lili, Wu Jianhua, Yuan Qinjian. (2017) "Research on Influencing Factors of Data Asset Quality in B2C Enterprises." Information Studies:Theory & Application, 40(07):99-102+98.

[14] You Jianxin, Xu Tao. (2021) "Evaluation Model of Data Asset Quality Based on Multi-Criteria Decision-Making Methods." Journal of Tongji University (Natural Science), 49(04):585-590.

[15] Sun Lili, Yuan Qinjian. (2019) "Research on the Indicator System for Evaluating Data Quality in E-commerce from the Perspective of Data Asset Management." Modern Information, 39(11):90-97.

[16] Shi Lei, He Tianxiang, Chen Duanbing. (2023) "Research on the Evaluation of Enterprise Data Asset Value." China Asset Appraisal, No. 277(04):20-30.

[17]Tapan Senapati, Ronald R. Yager. (2020) "Fermatean fuzzy sets." Journal of Ambient Intelligence and Humanized Computing11(2).