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The evaluation for the performance of supply chain information sharing based on bijective fuzzy soft set

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ABSTRACT

The disclosure of government financial information has always been the weak line in the disclosure of financial information, thus have an impact on the quality of government financial information. It's urgent to accurately reflect the status of our government accounting information, establish a transparent government and enhance the transparency of government financial information. This article examines the problem of China local government financial information disclosures. According to the research, the results show that the government financial conditions, degree of punishment a series of other factors are significantly positively related with its disclosures. It is hoped that the research can provide an excellent practice guide to the online disclosure of government financial information.

KEYWORDS

Supply chain information sharing; Evaluation; Bijective fuzzy soft set.

INTRODUCTION

With the globalization of world economy and the rise of the knowledge-based economy, the operating environment of enterprises has become more complex. So the managers need to re-examine their running mode, and make the optimal allocation of resources and production strategy decisions in the larger space of thinking. Considering the production and business activities of enterprises from the perspective of the supply chain is very important to improve the competitiveness of the enterprises. With the increasingly close relationship between the enterprises of the supply chain, information sharing among enterprises is particularly important. In order to promote the flow of information. The supply chain must be built on the base of information sharing. Supply chain information sharing is the upstream and downstream enterprises in the supply chain sharing information with each other in order to achieve the coordination of the entire supply chain and achieve the efficiency of the entire supply chain optimization. Information sharing is an important components of every supply chain management system. There is a general belief that sharing information is the key to improve supply chain performance. The information technology has a significant influence on the supply chain information sharing. Because the lack of a quantitative model,so it's difficult to find out the impact factors when the level of the information sharing become lower. Therefore, the evaluation of supply chain information sharing has important practical and theoretical significance. The scholars have proposed a number of different research methods, Martı´nez-Olvera[1] proposed an entropy-based model which considered the uncertainty characteristics of supply chain to assess the supply chain information sharing methods. Tpking[2]used the Choquet utility theory to study the supply chain cost sharing information. Shore[3]used Hierarchical analysis method (AHP) and fuzzy logic method to evaluate the supply chain partnership information sharing ability. Yu etc[4] proposed a model based on Data Envelopment Analysis (DEA), and the simulation model was validated.

When we evaluate the supply chain information sharing, because of the complexity of the supply chain itself has, led to the establishment of evaluation index is very complicated, and contain some redundant indicators. which not only increase the amount of computation and may weaken other important indicators affect the calculation accuracy. Soft Set Theory[5] is a new kind of math tool dealing with uncertain problem tool. The method describing the object of Soft set is very flexible, it can be initially described according to approximate characteristic of the object, without any restrictions, it can use the word, sentence, logical expression and other parameters, so it is very convenient to use. In recent years, the applications of soft sets theory were also extended to data analysis under incomplete information[6], combined forecasts[7], decision making problems[8], normal parameter reduction[9], demand analysis[10]. But in real life many problems are imprecise in nature. Classical soft set theory is not capable to deal with such problems. Maji et al.[11] prosed the concept of fuzzy soft sets. In recent years, many researchers have studied on this fields. Fuzzy soft set theory has been used to deal with imprecision[12-15].

Through reducing the parameters of bijective fuzzy soft sets corresponding to max-value bijective fuzzy soft set,we can find out the key factors that affect the decision variables. This paper through calculate the membership value of original data values corresponding to the indicators of these supply chain information sharing programs to construct fuzzy bijective soft set at first. And then reduce the parameters of bijectivesoft sets corresponding to max-value bijective fuzzy soft set to identify the key factors that affect the supply chain information sharing, and the significance of soft sets are calculated to quantify the importance of each parameter, so that to propose new evaluation method of the supply chain information sharing.

PRELIMINARY

Membership function

The core application of the fuzzy set theory is to determine the membership function reasonably. Because the practical engineering problems often lack information and collection is difficult, it's very difficult to determine the membership function, therefore the trapezoidal or triangular membership function of the membership function is widely used. It's simple in form, an have the advantages of low requirement for data information. The the form of this membership functions of is usually as follows:

Let U be a common universe, $U=[x_1, x_n]$,high,low,med are three fuzzy sets over U.denoted by A,B,C,a,b,d are four nodes,where $x_1 < a < b < c < d < x_n$.

$$\mu A(x)=\begin{cases}0 & x_1 \le x < c \\ \dfrac{x-c}{d-c} & c \le x < d \\ 1 & d \le x \le x_n\end{cases} \quad \textbf{(1)}$$

$$\mu B(x)=\begin{cases}0 & x_1 \le x < a \\ \dfrac{x-a}{b-a} & a \le x < b \\ 1 & b \le x < c \\ \dfrac{d-x}{d-c} & c \le x < d \\ 0 & d \le x \le x_n\end{cases} \quad \textbf{(2)}$$

$$\mu C(x)=\begin{cases}1 & x_1 \le x < a \\ \dfrac{b-x}{b-a} & a \le x < b \\ 0 & b \le x \le x_n\end{cases} \quad \textbf{(3)}$$

There are many ways to determine the nodes. This paper uses the distance divided interval. Five intervals were divided by the same distance. the interval is $\dfrac{x_n - x_1}{5}$.

The concept of fuzzy bijective soft set

Let U be a common universe and let E be a set of parameters.

Definition 1(see[5]) (soft set). A pair (F,E) is called a soft set (over U) if and only if F is a mapping of E into the set of all subsets of the set U, where F is a mapping given by $F: E \to P(U)$.

In other words, the soft set is a parameterized family of subsets of the set U. Every set $F(e)(e \in E)$, from this family may be considered the set of e-elements of the soft sets (F,E), or as the set of e-approximate elements of the soft set.

Let U be a common universe and let E be a set of parameters.

Definition 2 (see[8])(Fuzzy soft set) Suppose $A \subset E$. Let $\tilde{P}(U)$ be the set of all fuzzy subsets in U. A pair $(\tilde{F}, A)$ is called a fuzzy soft set over U, where $\tilde{F}$ is a mapping given by $\tilde{F}: A \to \tilde{P}(U)$

Definition 3 (see [16]) (bijective soft set)Let (F,B) be a soft set over a common universe U, where F is a mapping $F: B \to P(U)$ and B is nonempty parameter set. We say that (F,B) is a bijective soft set, if (F,B) such that

$\bigcup_{e \in B} F(e) = U$.

For any two parameters $e_i, e_j \in B, e_i \neq e_j$, $F(e_i) \cap F(e_j) = \emptyset$.

Definition 4 Let $(\tilde{F}, E)$ be a fuzzy soft set over universe U, $x_i, (i = 1, 2.., n)$ be an element of U and e be a parameter of E. $\xi_{x_{\max}}(e)$ denotes the characteristic function of the max-value soft set of the fuzzy soft set $(\tilde{F}, E)$, defined by

$$\xi_{x_{\max}}(e) = \begin{cases} 1 & \text{if } \mu_{\tilde{F}(e)}(x) = \max\{\mu_{\tilde{F}(e)}(x_i)\} \\ 0 & else \end{cases}, where\, i = 1, 2...., n, \mu_{\tilde{F}(e)}(x), \lambda \in [0,1].$$

Definition 5 Let (F, B) be the a max-value soft set of a fuzzy soft set $(\tilde{F}, B)$ over a common universe U, B is a nonempty parameter set. We say that $(\tilde{F}, B)$ is a max-value bijective fuzzy soft set, if and only if (F, B) is a bijective soft set.

Obviously, a bijective soft set is a special interval-valued bijective fuzzy soft set, where $\lambda = 1$.

The reduction of the bijective soft

Definition 6 (see[16])(restricted AND operation on a bijective soft set and a subset of universe) Let $U = \{x_1, x_2, ..., x_n\}$ be a common universe, X be a subset of U, and (F, E) be a bijective soft set over U. The operation of "(F, E) restricted AND X" denoted by $(F, E) \tilde{\wedge} X$ is defined by $\bigcup_{e \in E}\{F(e) : F(e) \subseteq X\}$.

Definition 7(see[16]) (dependency of two bijective soft set) suppose that $(F, E), (D, C)$ are two bijective soft sets over a common universe U, where $E \cap C = \emptyset$. (F, E) is said to depend on (D, C) to a degree $k (0 \le k \le 1)$, denoted $(F, E) \tilde{\Rightarrow}_k (D, C)$, if

$$k = \gamma((F, E), (D, C)) = \frac{|\bigcup_{e \in C}(F, E) \tilde{\wedge} D(e)|}{|U|},$$

where $|\bullet|$ is the cardinal number of a set.

The concept of dependency is to describe a degree of bijective soft set in classifying the other one.

If $k = 1$ we say (F, E) is full depended on (D, C).

If $k = 0$ we say (F, E) is not depended on (D, C).

Definition 8(see[16]) (bijective soft decision system) Let $((F, E), (G, B), U)$ be a soft decision system, where $(F, E) = \tilde{\cup}_{i=1}^{n}(F_i, E_i)$ and (F_i, E_i) is bijective soft set. (F, E) are called condition soft set. The soft dependency between $(F_1, E_1) \wedge (F_2, E_2) \wedge ... \wedge (F_n, E_n)$ and (G, B) is called soft decision system dependency of $((F, E), (G, B), U)$, denoted κ and defined by

$$k = \gamma(\wedge_{i=1}^{n}(F_i, E_i), (G, B))$$

Definition 9(see[16]) (bijective soft decision system dependency) Let $((F, E), (G, B), U)$ be a soft decision system, where $(F, E) = \tilde{\cup}_{i=1}^{n}(F_i, E_i)$ and (F_i, E_i) is bijective soft set. (F, E) are called condition soft set. The soft dependency between $(F_1, E_1) \wedge (F_2, E_2) \wedge ... \wedge (F_n, E_n)$ and (G, B) is called soft decision system dependency of $((F, E), (G, B), U)$, denoted κ and defined by

$$\kappa = \gamma(\wedge_{i=1}^{n}(F_i, E_i), (G, B))$$

Definition 10(see[16])Let $((F,E),(G,B),U)$ be a bijective soft decision system, where $(F,E) = \tilde{\cup}_{i=1}^{m}(F_i,E_i)$ and (F_i,E_i) is bijective soft set, $\cup_{i=1}^{m}(F_i,E_i) \subseteq (F,E)$. k is the bijective soft decision system dependency of $((F,E),(G,B),U)$. If $g(\tilde{\cup}_{i=1}^{m}(F_i,E_i),(G,B)) = k$ we say $\cup_{i=1}^{m}(F_i,E_i)$ is a reduct of bijective soft decision system $((F,E),(G,B),U)$.

Algorithm proposed

On the base of above,let us consider the following algorithm:

Step1. Calculate the membership value of each indicator and construct fuzzy soft set $(\tilde{F}, A)$.

Step2. Find out the bijective soft set (F, E) corresponding to bijective fuzzy soft set $(\tilde{F}, A)$.

Step3. Construct bijective soft decision system $(\tilde{\cup}_{i=1}^{n}(F_i, E_i),(G,B),U)$.

Step4. Calculate each dependency between $\wedge(F_j, E_j)$ and (G,B), where $0 < j \le n$.

Step5. Calculate bijective soft decision system dependency of $(\tilde{\cup}_{i=1}^{n}(F_i, E_i),(G,B),U)$.

Step6. Find the reduction of bijective soft sets with respect to bijective soft decision system $(\tilde{\cup}_{i=1}^{n}(F_i, E_i),(G,B),U)$.

Step7. Calculate the significance of each bijective soft set to decision bijective soft set in the reduct bijective soft sets.

EVALUATION MODEL OF SUPPLY CHAIN INFORMATION SHARING BASED ON BIJECTIVE SOFT SET

Building bijective soft set of supply chain information sharing decision system

The literature[17] established eight programs of supply chain information sharing,including suppliers, general contractors, subcontractors. The third type of program is all of the capacity, demand, and inventory information sharing. The model use the Rockwell Software Arenav5.0 (production system planning simulation software) as a simulation tool,and calculate results of four energy parameters of eight kinds of programs after run the simulation. The scores 8 programs are ranked by Data Envelopment Analysis (DEA).

Suppose $x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8$ eight programs of supply chain information sharing, We can get the bijective soft set (F,E)corresponding to bijective fuzzy soft set $(\tilde{F}, A)$ as following:

TABLE 1 : The tabular representation of the soft set (F,E)corresponding to bijective fuzzy soft set $(\tilde{F}, A)$

	E_1		E_2			E_3			E_4			D		
	e_1	e_2	e_3	e_4	e_5	e_6	e_7	e_8	e_9	e_{10}	e_{11}	e_{12}	e_{13}	e_{14}
x_1	0	1	0	0	1	0	0	1	1	0	0	0	1	0
x_2	1	0	1	0	0	0	1	0	0	0	1	1	0	0
x_3	0	1	1	0	0	1	0	0	0	0	1	0	0	1
x_4	0	1	0	1	0	0	1	0	0	1	0	1	0	0
x_5	1	0	1	0	0	1	0	0	0	0	1	0	0	1
x_6	0	1	1	0	0	0	1	0	0	0	1	0	1	0
x_7	1	0	0	1	0	1	0	0	0	1	0	1	0	0
x_8	1	0	1	0	0	1	0	0	0	0	1	0	0	1

Calculate bijective soft decision system dependency and find out reduction of the bijective soft sets

In the Step 3 and Step 4 the following results were obtained:

$\gamma((F_1,E_1),(F_5,D_5))=0$ $\gamma((F_2,E_2),(F_5,D_5))=3/8$

$\gamma((F_3,E_3),(F_5,D_5))=1/8$ $\gamma((F_4,E_4),(F_5,D_5))=3/8$

$\gamma((F_1,E_1)\wedge(F_2,E_2),(F_5,D_5))=3/8$ $\gamma((F_2,E_2)\wedge(F_3,E_3),(F_5,D_5))=3/4$ $\gamma((F_3,E_3)\wedge(F_4,E_4),(F_5,D_5))=3/4$

$\gamma((F_1,E_1)\wedge(F_3,E_3),(F_5,D_5))=3/8$

$\gamma((F_1,E_1)\wedge(F_4,E_4),(F_5,D_5))=3/8$ $\gamma((F_2,E_2)\wedge(F_4,E_4),(F_5,D_5))=3/8$

$\gamma((F_1,E_1)\wedge(F_2,E_2)\wedge(F_3,E_3),(F_5,D_5))=1$ $\gamma((F_2,E_2)\wedge(F_3,E_3)\wedge(F_4,E_4),(F_5,D_5))=3/4$

$\gamma((F_1,E_1)\wedge(F_3,E_3)\wedge(F_4,E_4),(F_5,D_5))=1$ $\gamma((F_1,E_1)\wedge(F_2,E_2)\wedge(F_4,E_4),(F_5,D_5))=3/8$

In the *step 5*, we can obtain the information sharing decision system dependency $\kappa=1$.

In the *step6,*we can obtain:

$\gamma((F_1,E_1)\wedge(F_2,E_2)\wedge(F_3,E_3),(F_5,D_5))=1$, and $\gamma((F_1,E_1)\wedge(F_3,E_3)\wedge(F_4,E_4),(F_5,D_5))=1$

They are both equal to κ.

By definition 10,we know that reduction of the supply chain information sharing decision system are:

$(F_1,E_1)\tilde{\cup}(F_2,E_2)\tilde{\cup}(F_3,E_3)$ and $(F_1,E_1)\tilde{\cup}(F_3,E_3)\tilde{\cup}(F_4,E_4)$.

In the Step 7,we can quantify the significance of each factors which affect the supply chain information sharing as follows. The significance describes the changes in the dependency of bijective soft set decision system when a bijective soft set remove.

$$\begin{aligned} &s((F_1,E_1),\wedge_{i=1}^{4}(F_i,E_i),(F_5,D_5)) \\ &=\kappa-\gamma((F_2,E_2)\wedge(F_3,E_3)\wedge(F_4,E_4)) \\ &=1-3/4=1/4 \end{aligned}$$

$$\begin{aligned} &s((F_2,E_2),\wedge_{i=1}^{4}(F_i,E_i),(F_5,D_5)) \\ &=\kappa-\gamma((F_1,E_1)\wedge(F_3,E_3)\wedge(F_4,E_4)) \\ &=1-1=0 \end{aligned}$$

$$\begin{aligned} &s((F_3,E_3),\wedge_{i=1}^{4}(F_i,E_i),(F_5,D_5)) \\ &=\kappa-\gamma((F_1,E_1)\wedge(F_2,E_2)\wedge(F_4,E_4)) \\ &=1-3/8=5/8 \end{aligned}$$

$$\begin{aligned} &s((F_4,F_4),\wedge_{i=1}^{4}(F_i,E_i),(F_5,D_5)) \\ &=\kappa-\gamma((F_1,E_1)\wedge(F_2,E_2)\wedge(F_3,E_3)) \\ &=1-1=0 \end{aligned}$$

Analysis of Results

We can see from the results that significance of "Compliance rate "order cycle "are all 0, thus one of them alone can determine the success or failure of supplychain information sharing individually. They need to be combined with the customer "cost "and"service level ",to determine the level of entire supply chain information sharing,Such as {" compliance rate "," Cost" " Service Level "} or {" costs "," Service Level "," the ordering cycle "}. Thus it can be seen that the "customer service level "and" Cost" is the core of the supply chain information sharing decision system.

CONCLUSION

This paper proposed a supply chain information sharing decision system evaluation model based on bijective soft set. By calculating its reduction to identify which is the factors that has a greater impact on the the shared overall performance of the supply chain, and calculate the significance of each factor.

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