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An approach to evaluating the enterprises organizational performance with 2-tuple linguistic information

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ABSTRACT

In this paper, we investigate the multiple attribute group decision making problems for evaluating the enterprises organizational performance with 2-tuple linguistic information. Then, a model based on the 2-tuple weighted geometric operator to evaluate the enterprises organizational performance is presented. In this model, alternative appraisal values are calculated by the aggregation of 2-tuple linguistic information. Thus, the ranking of alternative or selection of the most desirable trip (s) is obtained by the comparison of 2-tuple linguistic information. Finally, an illustrative example for evaluating the enterprises organizational performance is given to verify the developed approach and to demonstrate its practicality and effectiveness.

KEYWORDS

Comprehensive evaluating; 2-tuple linguistic variables; 2-tuple weighted geometric operator; Enterprises organizational performance.

INTRODUCTION

Enterprise performance evaluation has been the unsolved question that modern management theory and practice have been exploring. One of reasons lies in varied and hierarchical features of performance evaluation. Day after day market competition being more fierce, and the environment of business rapid change. Aimed to achieve organization's strategic target and meet all important benefit counterparts' needs, enterprise's operators more and more rely on science and reasonable performance evaluation system. Interior organization unit is fundamental unit of the enterprise strategy implementation. Enterprise performance establish in different and hierarchical interior organization units' performance. Based on this thought, this existed papers stands in enterprise operator's point paying attention to enterprises' interior performance evaluation. By studying literature and making comprehensive utilization of management science, economic, finance and accounting theories, the other authors had summarized and used research cream of the region of enterprise performance evaluation from since more than one centuries in Western, and proposed the system construction flexible mechanism: the system establishment environment and system construction. By analyzing the key organization background variable which influence interior organization units' performance evaluation system, and in view of different interior organization units' responsibility goal, integrating actual situation of finance basic data, ma-king analysis of complexity, multiplicity and uncertainty factors influence to interior organization units performance evaluation, the other authors devised the interior organization units' performance evaluation system, including four essential elements: evaluation goal, evaluation indicator, evaluation criteria and evaluation method. By dividing interior organization units division, the performance of interior organization units contained in the enterprise overall performance, and enterprise's overall performance originate from the interior organization units performance organic conformity. The other authors constructed the multi-level performance evaluation indicator system, and the content of study used into the oil field company's interior organization units' performance evaluation, and provides the valuable reference to theory exchange, scholar research and practice development of enterprise performance evaluation.

The problem of evaluating the enterprises organizational performance with 2-tuple linguistic information is the multiple attribute group decision making problems[1-10]. In this paper, we investigate the multiple attribute group decision making problems for evaluating the enterprises organizational performance with 2-tuple linguistic information. Then, a model based on the 2-tuple weighted geometric (TWG) operator to evaluate the enterprises organizational performance is presented. In this model, alternative appraisal values are calculated by the aggregation of 2-tuple linguistic information. Thus, the ranking of alternative or selection of the most desirable trip (s) is obtained by the comparison of 2-tuple linguistic information. Finally, an illustrative example for evaluating the enterprises organizational performance is given to verify the developed approach and to demonstrate its practicality and effectiveness.

PRELIMINARIES

Let $S = \{ s_i \mid i = 1, 2, \cdots, t \}$ be a linguistic term set with odd cardinality. Any label, s_i represents a possible value for a linguistic variable, and it should satisfy the following characteristics[11-14]:

(1) The set is ordered: $s_i > s_j$, if $i > j$; (2) Max operator: $\max\left(s_i, s_j\right) = s_i$, if $s_i \geq s_j$; (3) Min operator: $\min\left(s_i, s_j\right) = s_i$, if $s_i \leq s_j$. For example, S can be defined as

$$S = \{ s_1 = extremely\ poor, s_2 = very\ poor, s_3 = poor, s_4 = medium, \\ s_5 = good, s_6 = very\ good, s_7 = extremely\ good \}$$

Definition 1[11-14]. Let $S=\{s_1,s_2,\cdots,s_t\}$ be a linguistic term set and $\beta\in[1,t]$ be a value representing the result of a symbolic aggregation operation; then 2-tuple that expresses the equivalent information to β is obtained with the following function:

$$\Delta\ [1,t]\rightarrow S\times[-0.5,0.5) \quad \textbf{(1)}$$

$$\Delta(\beta)=\begin{cases} s_i\ ,i=round(\beta) \\ \alpha=\beta-i\ ,\ \alpha\in[-0.5,0.5) \end{cases} \quad \textbf{(2)}$$

where round (.) is the usual round operation, s_i has the closest index label to β and α is the value of the symbolic translation.

Definition 2[11-14]. Let $S=\{s_1,s_2,\cdots,s_t\}$ be a linguistic term set and (s_i,α_i) be a 2-tuple; a function Δ^{-1} can be defined, such that, from a 2-tuple (s_i,α_i) it return its equivalent numerical value $\beta\in[1,t]\subset R$, which is obtained with the following function:

$$\Delta^{-1}:\ S\times[-0.5,0.5)\rightarrow[1,t] \quad \textbf{(3)}$$

$$\Delta^{-1}(s_i,\alpha)=i+\alpha=\beta \quad \textbf{(4)}$$

Definition 3[15]. Let $x=\{(r_1,a_1),(r_2,a_2),\ldots,(r_n,a_n)\}$ be a set of 2-tuple and $\omega=(\omega_1,\omega_2,\cdots,\omega_n)^T$ be the weighting vector of 2-tuple (r_j,a_j) $(j=1,2,\cdots,n)$ and $\omega_j\in[0,1]$, $\sum_{j=1}^{n}\omega_j=1$, The 2-tuple weighted geometric operator is

$$(\tilde{r},\tilde{a})=TWG_{\omega}((r_1,a_1),(r_2,a_2),\ldots,(r_n,a_n))=\Delta\left(\prod_{j=1}^{n}\left(\Delta^{-1}(r_j,a_j)\right)^{\omega_j}\right)$$

$$\tilde{r}\in S,\tilde{a}\in[-0.5,0.5) \quad \textbf{(5)}$$

AN APPROACH TO EVALUATING THE ENTERPRISES ORGANIZATIONAL PERFORMANCE WITH 2-TUPLE LINGUISTIC INFORMATION

In this section, we shall develop the multiple attribute group decision making problems for evaluating the enterprises organizational performance with 2-tuple linguistic information as follows.

Let $A=\{A_1,A_2,\cdots,A_m\}$ be a discrete set of alternatives, and $G=\{G_1,G_2,\cdots,G_n\}$ be the set of attributes, $\omega=(\omega_1,\omega_2,\cdots,\omega_n)$ is the weighting vector of the attributes G_j $(j=1,2,\cdots,n)$, where $\omega_j\geq 0$, $j=1,2,\cdots,n$, $\sum_{j=1}^{n}\omega_j=1$. Let $D=\{D_1,D_2,\cdots,D_t\}$ be the set of decision makers. Suppose that $\tilde{R}_k=\left(\tilde{r}_{ij}^{(k)}\right)_{m\times n}$ is the decision matrix, where $\tilde{r}_{ij}^{(k)}\in\tilde{S}$ is a preference value, which takes the form of linguistic variables, given by the decision maker $D_k \in D$, for the alternative $A_i \in A$ with respect to the attribute $G_j \in G$. Let $A = \{A_1, A_2, \cdots, A_m\}$ be a discrete set of alternatives.

In this paper, we investigate the multiple attribute group decision making (MAGDM) problems for evaluating the enterprises organizational performance with 2-tuple linguistic information.

Step 1. Transforming linguistic decision matrix $R_k = \left(r_{ij}^{(k)}\right)_{m\times n}$ into 2-tuple linguistic decision matrix $R_k = \left(r_{ij}^{(k)}, 0\right)_{m\times n}$.

Step 2. Utilize the decision information given in matrix R_k, and the TWG operator

$$z_i^{(k)} = \left(r_i^{(k)}, a_i^{(k)}\right) = \Delta\left(\prod_{j=1}^{n}\left(\Delta^{-1}\left(r_{ij}^{(k)}, 0\right)\right)^{\omega_j}\right), r_i^{(k)} \in S, a_i^{(k)} \in [-0.5, 0.5) \quad \textbf{(6)}$$

to derive the individual overall preference value $\tilde{r}_i^{(k)}$ of the alternative A_i.

Step 3. Utilize the TWG operator:

$$z_i = \left(r_i, a_i\right) = \Delta\left(\prod_{k=1}^{t}\left(\Delta^{-1}\left(r_i^{(k)}, a_i^{(k)}\right)\right)^{v_k}\right), r_i \in S, a_i \in [-0.5, 0.5) \quad \textbf{(7)}$$

to derive the collective overall preference values $z_i = \left(r_i, a_i\right)\left(i = 1, 2, \cdots, m\right)$ of the alternative A_i,.

Step 4. Rank all the alternatives $A_i\left(i = 1, 2, \cdots, m\right)$ and select the best one (s) in accordance with $z_i\left(i = 1, 2, \cdots, m\right)$. If any alternative has the highest z_i value, then, it is the most important alternative.

ILLUSTRATIVE EXAMPLE

The properties of the importance of the organizational learning in corporate is obvious, especially the adjustment role of institutional quality, from Adam Smith to David? Ricardo then Cairns, professor at the American University of Manchester Blanket operations research theory, Taylor’s Scientific Management Theory, Fayal’s process management theory, Hawthorne’s behavioral science theory, all reflect the importance of organizational learning. Institutional quality as the adjustment variable of organizational learning and corporate performance, have a significant role in the regulation of the improvement of enterprise performance. Therefore, make a full review is needed, that is a major issue for business management studies can’t be avoided. In China, the organizational learning as an emerging enterprise management theory, has become one of the most important theoretical branch enterprise management theory, plays an important role in enterprise management and performance analysis. If we miss organizational learning, our enterprise is doomed to have no profitability. We make an enterprises questionnaire with 500 enterprises, try to understand the condition and capabilities of different types of enterprises about organizational learning. In this section, we shall present a numerical example for evaluating the enterprises organizational performance to illustrate the method proposed. There is a panel with four possible enterprises $A_i\left(i = 1, 2, 3, 4\right)$ to select. The expert teams selects five attribute to evaluate the four possible enterprises: ①G_1 is the enterprise development support ability; ②G_2 is the enterprise value creation ability; ③G_3 is the enterprise operation ability; ④G_4 is the customer service ability; ⑤G_5 is the enterprise marketing ability. The four possible enterprises $A_i\left(i = 1, 2, 3, 4\right)$ are to be evaluated by using the linguistic term set

$$S = \{s_1 = extremely\ poor, s_2 = very\ poor, s_3 = poor, s_4 = medium,$$
$$s_5 = good, s_6 = very\ good, s_7 = extremely\ good\}$$

by the three decision makers $D_k\left(k=1,2,3\right)$ under the above five attributes whose weighting vector $\omega=\left(0.20,0.10,0.30,0.25,0.15\right)^T$), and construct, respectively, the decision matrices as follows $\tilde{R}_k=\left(\tilde{r}_{ij}^{(k)}\right)_{4\times5}\left(k=1,2,3\right)$:

$$\tilde{R}_1=\begin{matrix}A_1\\A_2\\A_3\\A_4\end{matrix}\begin{pmatrix}s_2 & s_6 & s_5 & s_4 & s_6\\ s_7 & s_2 & s_1 & s_1 & s_5\\ s_4 & s_4 & s_7 & s_5 & s_2\\ s_5 & s_1 & s_3 & s_2 & s_4\end{pmatrix}$$

$$\tilde{R}_2=\begin{matrix}T_1\\T_2\\T_3\\T_4\end{matrix}\begin{pmatrix}s_4 & s_6 & s_6 & s_5 & s_5\\ s_2 & s_5 & s_3 & s_2 & s_1\\ s_4 & s_3 & s_4 & s_3 & s_4\\ s_3 & s_4 & s_6 & s_4 & s_7\end{pmatrix}$$

$$\tilde{R}_3=\begin{matrix}T_1\\T_2\\T_3\\T_4\end{matrix}\begin{pmatrix}s_2 & s_4 & s_3 & s_5 & s_6\\ s_4 & s_6 & s_5 & s_2 & s_1\\ s_2 & s_7 & s_3 & s_4 & s_5\\ s_4 & s_2 & s_2 & s_4 & s_4\end{pmatrix}$$

In the following, we shall utilize the proposed approach in this paper getting the most desirable enterprises with best organizational performance:

Step 1. Transforming linguistic decision matrix $R_k=\left(r_{ij}^{(k)}\right)_{m\times n}$ into 2-tuple linguistic decision matrix $R_k=\left(r_{ij}^{(k)},0\right)_{m\times n}$ as follows

$$\tilde{R}_1=\begin{pmatrix}(s_2,0) & (s_6,0) & (s_5,0) & (s_4,0) & (s_6,0)\\ (s_7,0) & (s_2,0) & (s_1,0) & (s_1,0) & (s_5,0)\\ (s_5,0) & (s_4,0) & (s_7,0) & (s_5,0) & (s_2,0)\\ (s_4,0) & (s_1,0) & (s_3,0) & (s_2,0) & (s_4,0)\end{pmatrix}$$

$$\tilde{R}_2=\begin{pmatrix}(s_4,0) & (s_6,0) & (s_6,0) & (s_5,0) & (s_5,0)\\ (s_2,0) & (s_5,0) & (s_3,0) & (s_2,0) & (s_1,0)\\ (s_4,0) & (s_3,0) & (s_4,0) & (s_3,0) & (s_4,0)\\ (s_3,0) & (s_4,0) & (s_6,0) & (s_4,0) & (s_7,0)\end{pmatrix}$$

$$\tilde{R}_3=\begin{pmatrix}(s_2,0) & (s_4,0) & (s_3,0) & (s_5,0) & (s_6,0)\\ (s_4,0) & (s_6,0) & (s_5,0) & (s_2,0) & (s_1,0)\\ (s_2,0) & (s_7,0) & (s_3,0) & (s_4,0) & (s_5,0)\\ (s_4,0) & (s_2,0) & (s_2,0) & (s_4,0) & (s_4,0)\end{pmatrix}$$

Step 2. Utilize the decision information given in matrix $\tilde{R}_k$, and the TWG operator to derive the individual overall preference value $z_i^{(k)} = \left(r_i^{(k)}, a_i^{(k)}\right)$ of the enterprises A_i.

$$z_1^{(1)} = (s_2, 0.23), z_2^{(1)} = (s_4, 0.42), z_3^{(1)} = (s_5, -0.17), z_4^{(1)} = (s_4, 0.38)$$
$$z_1^{(2)} = (s_4, -0.36), z_2^{(2)} = (s_2, 0.21), z_3^{(2)} = (s_5, 0.39), z_4^{(2)} = (s_2, 0.19)$$
$$z_1^{(3)} = (s_4, -0.26), z_2^{(3)} = (s_3, 0.-31), z_3^{(3)} = (s_4, 0.34), z_4^{(3)} = (s_5, 0.07)$$

Step 3. Utilize the TWG operator to derive the collective overall preference values $z_i = (r_i, a_i)(i = 1,2,3,4)$ of the enterprises A_i, $w = (0.35, 0.30, 0.35)$ is the weighting vector of the TWG operator.

$$z_1 = (s_4, 0.13), z_2 = (s_2, -0.32), z_3 = (s_6, 0.26), z_4 = (s_5, -0.45)$$

Step 4. Ranking all the enterprises organizational performance $T_i\left(i = 1,2,3,4\right)$ in accordance with the $z_i\left(i = 1,2,3,4\right)$: $A_3 \succ A_4 \succ A_1 \succ A_2$, and thus the most desirable enterprise with best organizational performance is A_3.

CONCLUSION

In this paper, we investigate the multiple attribute group decision making problems for evaluating the enterprises organizational performance with 2-tuple linguistic information. Then, a model based on the 2-tuple weighted geometric (TWG) operator to evaluate the enterprises organizational performance is presented. In this model, alternative appraisal values are calculated by the aggregation of 2-tuple linguistic information. Thus, the ranking of alternative or selection of the most desirable trip (s) is obtained by the comparison of 2-tuple linguistic information. Finally, an illustrative example for evaluating the enterprises organizational performance is given to verify the developed approach and to demonstrate its practicality and effectiveness.

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