Model for Risk Assessment of Project Cost with Interval-valued Intuitionistic Fuzzy Information

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Abstract

The project is in the complicated natural and social environment, which is filled with a lot of uncertainty and the resulting risk often affects the smooth implementation of the project, project urgent need to strengthen risk management. Despite the current domestic and overseas engineering project Risk management theory research has quite high level, project risk analysis and evaluation method has a lot of, but because of the risk analysis technology of the actual application of the system not to summary, so in the face of specific project risk, often choose not appropriate Analysis technology to implement risk analysis and evaluation. The end result is to project risk analysis and understand enough, increase the difficulty of the risk management, a direct impact on the construction of engineering quality, schedule and cost objectives, damage the benefit of the project. In this paper, we used induced interval-valued intuitionistic fuzzy Einstein ordered weighted average (I-IVIFEOWA) operator for multiple attribute decision making problems to deal with the risk assessment of project cost with incompletely known weights information. We developed a multiple attribute decision making method to projects in uncertain linguistic setting, by which the attribute weights can be determined. We utilize the I-IVIFEOWA operator to aggregate the interval-valued intuitionistic fuzzy information corresponding to each alternative, and then rank the alternatives. Finally, an example with the risk assessment of project cost is given.

Keywords

Multiple attribute decision making; interval-valued Intuitionistic fuzzy number; I-IVIFEOWA operator; Weight information; risk assessment.

1. Introduction

Atanassov [1,2] introduced the concept of intuitionistic fuzzy set(IFS) characterized by a membership function and a non-membership function, which is a generalization of the concept of fuzzy set [3] whose basic component is only a membership function. Xu [4] developed some arithmetic aggregation operators, such as the intuitionistic fuzzy arithmetic averaging (IFAA) operator and the intuitionistic fuzzy weighted averaging (IFWA) operator. Furthermore, Xu[5] developed the intuitionistic fuzzy ordered weighted averaging (IFOWA) operator, and the intuitionistic fuzzy hybrid aggregation (IFHA) operator. Later, Atanassov and Gargov[6-7] further introduced the interval-valued intuitionistic fuzzy set (IVIFS), which is a generalization of the IFS. The fundamental characteristic of the IVIFS is that the values of its membership function and non-membership function are intervals rather than exact numbers. Xu[8] proposed the interval-valued intuitionistic fuzzy weighted averaging (IVIFWA) operator, the interval-valued intuitionistic fuzzy ordered weighted averaging (IVIFOWA) operator and the interval-valued intuitionistic fuzzy hybrid aggregation (IVIFHA) operator and gave an application of the IVIFHA operator to multiple attribute group decision making with interval-valued intuitionistic fuzzy information. Xu and Yager [9] investigated the dynamic intuitionistic fuzzy multiple attribute decision making problems and developed some aggregation operators such as the dynamic intuitionistic fuzzy weighted averaging (DIFWA) operator and uncertain dynamic intuitionistic fuzzy weighted averaging (UDIFWA) operator to aggregate dynamic or uncertain dynamic intuitionistic fuzzy information. Wei and Zhao[10]investigated some multiple attribute group decision making (MAGDM) problems based on the induced intuitionistic fuzzy correlated averaging (I-IFCA) operator. Then, we extend the developed models and procedures to the interval-valued intuitionistic fuzzy environment. All the above operators are based on the algebraic operational laws of IVIFSs for carrying the combination process and are not consistent with the limiting case of ordinary fuzzy sets [11]. Recently, Wang and Liu[12] treated the intuitionistic fuzzy aggregation operators with the help of Einstein operations.

In this paper, we used induced interval-valued intuitionistic fuzzy Einstein ordered weighted average (I-IVIFEOWA) operator for multiple attribute decision making problems to deal with the risk assessment of project cost with incompletely known weights information. We developed a multiple attribute decision making method to projects in uncertain linguistic setting, by which the attribute weights can be determined. We utilize the I-IVIFEOWA operator to aggregate the interval-valued intuitionistic fuzzy information corresponding to each alternative, and then rank the alternatives. Finally, an example with the risk assessment of project cost is given.

2. Preliminaries

2.1 Interval-valued intuitionistic fuzzy set

Atanassov and Gargov[6-7] further introduced the interval-valued intuitionistic fuzzy set (IVIFS), which is a generalization of the IFS. The fundamental characteristic of the IVIFS is that the values of its membership function and non-membership function are intervals rather than exact numbers.

Definition 1[6-7]. Let X be a universe of discourse, An IVIFS $\tilde{A}$ over X is an object having the form:

$$\tilde{A}=\left\{\left\langle x,\tilde{\mu}_A(x),\tilde{\nu}_A(x)\right\rangle \middle| x\in X\right\} \tag{1}$$

where $\tilde{\mu}_A(x)\subset[0,1]$ and $\tilde{\nu}_A(x)\subset[0,1]$ are interval numbers, and $0\le \sup(\tilde{\mu}_A(x))+\sup(\tilde{\nu}_A(x))\le 1$, $\forall\, x\in X$.

For convenience, let $\tilde{\mu}_A(x)=[a,b],\tilde{\nu}_A(x)=[c,d]$, so $\tilde{A}=([a,b],[c,d])$.

Definition 2. Let $\tilde{a}=([a,b],[c,d])$ be an interval-valued intuitionistic fuzzy number, a score function S of an interval-valued intuitionistic fuzzy value can be represented as follows [8]:

$$S(\tilde{a})=\frac{a-c+b-d}{2},\quad S(\tilde{a})\in[-1,1]. \tag{2}$$

Definition 3. Let $\tilde{a}=([a,b],[c,d])$ be an interval-valued intuitionistic fuzzy number, a accuracy function H of an interval-valued intuitionistic fuzzy value can be represented as follows [8]:

$$H(\tilde{a})=\frac{a+b+c+d}{2},\quad H(\tilde{a})\in[0,1]. \tag{3}$$

to evaluate the degree of accuracy of the interval-valued intuitionistic fuzzy value $\tilde{a}=([a,b],[c,d])$, where $H(\tilde{a})\in[0,1]$. The larger the value of $H(\tilde{a})$, the more the degree of accuracy of the interval-valued intuitionistic fuzzy value $\tilde{a}$.

Based on the score function and degree of accuracy, Xu [7-8] give an order relation between two interval-valued intuitionistic fuzzy values.

2.2 Einstein operations of interval-valued intuitionistic fuzzy set

In this section, we shall introduce the Einstein operations[13] on interval-valued intuitionistic fuzzy sets and analyze some desirable properties of these operations. Let the t-norm T and t-conorm S be Einstein product T" and Einstein sum S" respectively, then the generalised intersection and union on two IVIFSs A and B become the Einstein product (denoted by $\tilde{a}_1 \otimes_\varepsilon \tilde{a}_2$) and Einstein sum (denoted by $\tilde{a}_1 \oplus_\varepsilon \tilde{a}_2$) on two IVIFSs $\tilde{a}_1$ and $\tilde{a}_2$, respectively, as follows[14].

$$\tilde{a}_1 \oplus_\varepsilon \tilde{a}_2\left(\left[\frac{a_1+a_2}{1+a_1a_2},\frac{b_1+b_2}{1+b_1b_2}\right],\left[\frac{c_1c_2}{1+(1-c_1)(1-c_2)},\frac{d_1d_2}{1+(1-d_1)(1-d_2)}\right]\right);$$

$$\lambda\tilde{a}_1=\left(\left[\frac{(1+a_1)^\lambda-(1-a_1)^\lambda}{(1+a_1)^\lambda+(1-a_1)^\lambda},\frac{(1+b_1)^\lambda-(1-b_1)^\lambda}{(1+b_1)^\lambda+(1-b_1)^\lambda}\right],\left[\frac{2c_1^\lambda}{(2-c_1)^\lambda+c_1^\lambda},\frac{2d_1^\lambda}{(2-d_1)^\lambda+d_1^\lambda}\right]\right),\lambda>0.$$

In the section, we shall introduce the interval-valued intuitionistic fuzzy arithmetic aggregation operators with the help of the Einstein operations.

Definition 4[14]. Let $\tilde{a}_j=\left([a_j,b_j],[c_j,d_j]\right)$ $(j=1,2,\cdots,n)$ be a collection of interval-valued intuitionistic fuzzy values, and let IVIFEWA: $Q^n \to Q$, if

$$\text{IVIFEWA}_\omega(\tilde{a}_1,\tilde{a}_2,\cdots,\tilde{a}_n)=\mathop{\oplus_\varepsilon}_{j=1}^{n}(\omega_j\tilde{a}_j)$$

$$=\left(\left[\frac{\prod_{j=1}^n(1+a_j)^{\omega_j}-\prod_{j=1}^n(1-a_j)^{\omega_j}}{\prod_{j=1}^n(1+a_j)^{\omega_j}+\prod_{j=1}^n(1-a_j)^{\omega_j}},\frac{\prod_{j=1}^n(1+b_j)^{\omega_j}-\prod_{j=1}^n(1-b_j)^{\omega_j}}{\prod_{j=1}^n(1+b_j)^{\omega_j}+\prod_{j=1}^n(1-b_j)^{\omega_j}}\right],\right.$$

$$\left.\left[\frac{2\prod_{j=1}^n d_j^{\ \omega_j}}{\prod_{j=1}^n(2-d_j)^{\omega_j}+\prod_{j=1}^n d_j^{\ \omega_j}},\frac{2\prod_{j=1}^n d_{\sigma(j)}^{\ w_j}}{\prod_{j=1}^n(2-d_{\sigma(j)})^{w_j}+\prod_{j=1}^n d_{\sigma(j)}^{\ w_j}}\right]\right) \tag{4}$$

where $\omega=(\omega_1,\omega_2,\cdots,\omega_n)^T$ be the weight vector of $\tilde{a}_j\ (j=1,2,\cdots,n)$, and $\omega_j>0$, $\sum_{j=1}^n\omega_j=1$, then IVIFEWG is called the interval-valued intuitionistic fuzzy Einstein weighted average (IVIFEWA) operator.

Furthermore, we shall introduce the interval-valued intuitionistic fuzzy Einstein ordered weighted average (IVIFEOWA) operator[14].

Definition 5[14]. Let $\tilde{a}_j=\left([a_j,b_j],[c_j,d_j]\right)$ $(j=1,2,\cdots,n)$ be a collection of interval-valued intuitionistic fuzzy numbers. An interval-valued intuitionistic fuzzy Einstein ordered weighted average (IVIFEOWA) operator of dimension n is a mapping IVIFEOWA: $Q^n \to Q$, that has an associated vector $w=(w_1,w_2,\cdots,w_n)^T$ such that $w_j>0$ and $\sum_{j=1}^n w_j=1$. Furthermore,

$$\text{IVIFEOWA}_w(\tilde{a}_1,\tilde{a}_2,\cdots,\tilde{a}_n)=\mathop{\oplus_\varepsilon}_{j=1}^{n}(w_j\tilde{a}_{\sigma(j)})$$

$$=\left(\left[\frac{\prod_{j=1}^n(1+a_{\sigma(j)})^{w_j}-\prod_{j=1}^n(1-a_{\sigma(j)})^{w_j}}{\prod_{j=1}^n(1+a_{\sigma(j)})^{w_j}+\prod_{j=1}^n(1-a_{\sigma(j)})^{w_j}},\frac{\prod_{j=1}^n(1+b_{\sigma(j)})^{w_j}-\prod_{j=1}^n(1-b_{\sigma(j)})^{w_j}}{\prod_{j=1}^n(1+b_{\sigma(j)})^{w_j}+\prod_{j=1}^n(1-b_{\sigma(j)})^{w_j}}\right],\right.$$

$$\left.\left[\frac{2\prod_{j=1}^n c_{\sigma(j)}^{\ w_j}}{\prod_{j=1}^n(2-c_{\sigma(j)})^{w_j}+\prod_{j=1}^n c_{\sigma(j)}^{\ w_j}},\frac{2\prod_{j=1}^n d_{\sigma(j)}^{\ w_j}}{\prod_{j=1}^n(2-d_{\sigma(j)})^{w_j}+\prod_{j=1}^n d_{\sigma(j)}^{\ w_j}}\right]\right) \tag{5}$$

where $(\sigma(1),\sigma(2),\cdots,\sigma(n))$ is a permutation of $(1,2,\cdots,n)$, such that $\tilde{\alpha}_{\sigma(j-1)} \geq \tilde{\alpha}_{\sigma(j)}$ for all $j=2,\cdots,n$.

In the following, Cai & Han developed the induced interval-valued intuitionistic fuzzy Einstein ordered weighted averaging (I-IVIFEOWA) operator which is an extension of induced ordered weighted averaging (IOWA) operator proposed by Yager and Filev [15].

Definition 7[16]. Let $\langle u_j,\tilde{a}_j\rangle (j=1,2,\cdots,n)$ be a collection of 2-tuples, then we define the induced interval-valued intuitionistic fuzzy Einstein ordered weighted average (I-IVIFEOWA) operator as follows:

$$\begin{aligned}
&\text{I-IVIFEOWA}_w\left(\langle u_1,\tilde{a}_1\rangle,\langle u_2,\tilde{a}_2\rangle,\cdots,\langle u_n,\tilde{a}_n\rangle\right)\\
&=\mathop{\oplus_{\varepsilon}}_{j=1}^{n}\left(w_j\tilde{a}_{\sigma(j)}\right)\\
&=\left(\left[\frac{\prod_{j=1}^{n}\left(1+a_{\sigma(j)}\right)^{w_j}-\prod_{j=1}^{n}\left(1-a_{\sigma(j)}\right)^{w_j}}{\prod_{j=1}^{n}\left(1+a_{\sigma(j)}\right)^{w_j}+\prod_{j=1}^{n}\left(1-a_{\sigma(j)}\right)^{w_j}},\frac{\prod_{j=1}^{n}\left(1+b_{\sigma(j)}\right)^{w_j}-\prod_{j=1}^{n}\left(1-b_{\sigma(j)}\right)^{w_j}}{\prod_{j=1}^{n}\left(1+b_{\sigma(j)}\right)^{w_j}+\prod_{j=1}^{n}\left(1-b_{\sigma(j)}\right)^{w_j}}\right],\right.\\
&\qquad\left.\left[\frac{2\prod_{j=1}^{n}c_{\sigma(j)}{}^{w_j}}{\prod_{j=1}^{n}\left(2-c_{\sigma(j)}\right)^{w_j}+\prod_{j=1}^{n}c_{\sigma(j)}{}^{w_j}},\frac{2\prod_{j=1}^{n}d_{\sigma(j)}{}^{w_j}}{\prod_{j=1}^{n}\left(2-d_{\sigma(j)}\right)^{w_j}+\prod_{j=1}^{n}d_{\sigma(j)}{}^{w_j}}\right]\right)
\end{aligned}\tag{6}$$

where $w=(w_1,w_2,\cdots,w_n)^T$ is a weighting vector, such that $w_j>0$, $\sum_{j=1}^{n}w_j=1$, $j=1,2,\cdots,n$, $\tilde{a}_{\sigma(j)}$ is the $\tilde{a}_j$ value of the IVIFEOWA pair $\langle u_i,\tilde{a}_i\rangle$ having the jth largest $u_i\left(u_i\in[0,1]\right)$,and u_i in $\langle u_i,\tilde{a}_i\rangle$ is referred to as the order inducing variable and a_i as the hesitant fuzzy linguistic arguments.

3. Model for Multiple Attribute Decision Making with Interval-valued Intuitionistic Fuzzy Information

In this section, we shall apply I-IVIFEOWA operator to the multiple attribute decision making (MADM) problems based on the data mining with interval-valued intuitionistic fuzzy numbers. 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. The information about attribute weights is completely known. Let $w=(w_1,w_2,\cdots,w_n)\in H$ be the weight vector of attributes, where $w_j\geq 0$, $j=1,2,\cdots,n$, $\sum_{j=1}^{n}w_j=1$. Suppose that $\tilde{R}=\left(\tilde{r}_{ij}\right)_{m\times n}=\left(\left[a_{ij},b_{ij}\right],\left[c_{ij},d_{ij}\right]\right)_{m\times n}$ is the interval-valued intuitionistic fuzzy decision matrix, $\left[a_{ij},b_{ij}\right]\subset[0,1]$, $\left[c_{ij},d_{ij}\right]\subset[0,1]$, $b_{ij}+d_{ij}\leq 1$, $i=1,2,\cdots,m$, $j=1,2,\cdots,n$.

In the following, we apply the I-IVIFEOWA operator based on the data mining to multiple attribute decision making with interval-valued intuitionistic fuzzy information. The method involves the following steps:

Step 1. Utilize the decision information given in matrix $\tilde{R}$, and the I-IVIFEOWA operator

$$\begin{aligned}
\tilde{r}_i &= \left(\left[a_i, b_i\right], \left[c_i, d_i\right]\right) \\
&= \text{I-IVIFEOWA}_w\left(\langle u_{i1}, \tilde{r}_{i1}\rangle, \langle u_{i2}, \tilde{r}_{i2}\rangle, \cdots, \langle u_{in}, \tilde{r}_{in}\rangle\right) \\
&= \mathop{\oplus_{\varepsilon}}_{j=1}^{n}\left(w_j \tilde{a}_{\sigma(ij)}\right) \\
&= \left(\left[\frac{\prod_{j=1}^{n}\left(1+a_{\sigma(ij)}\right)^{w_j} - \prod_{j=1}^{n}\left(1-a_{\sigma(ij)}\right)^{w_j}}{\prod_{j=1}^{n}\left(1+a_{\sigma(ij)}\right)^{w_j} + \prod_{j=1}^{n}\left(1-a_{\sigma(ij)}\right)^{w_j}}, \frac{\prod_{j=1}^{n}\left(1+b_{\sigma(ij)}\right)^{w_j} - \prod_{j=1}^{n}\left(1-b_{\sigma(ij)}\right)^{w_j}}{\prod_{j=1}^{n}\left(1+b_{\sigma(ij)}\right)^{w_j} + \prod_{j=1}^{n}\left(1-b_{\sigma(ij)}\right)^{w_j}}\right],\right. \\
&\quad \left.\left[\frac{2\prod_{j=1}^{n} c_{\sigma(ij)}^{\;w_j}}{\prod_{j=1}^{n}\left(2-c_{\sigma(ij)}\right)^{w_j} + \prod_{j=1}^{n} c_{\sigma(ij)}^{\;w_j}}, \frac{2\prod_{j=1}^{n} d_{\sigma(ij)}^{\;w_j}}{\prod_{j=1}^{n}\left(2-d_{\sigma(ij)}\right)^{w_j} + \prod_{j=1}^{n} d_{\sigma(ij)}^{\;w_j}}\right]\right)
\end{aligned} \tag{7}$$

to derive the collective overall preference values $\tilde{r}_i\left(i=1,2,\cdots,m\right)$ of the alternative A_i ,where $w=\left(w_1, w_2, \cdots, w_n\right)^T$ is the associated vector of the I-IVIFEOWA operator, such that $w_j > 0$ and $\sum_{j=1}^{n} w_j = 1$.

Step 2. Calculate the scores $S\left(\tilde{r}_i\right)\left(i=1,2,\cdots,m\right)$ of the collective overall values $\tilde{r}_i\ \left(i=1,2,\cdots,m\right)$ to rank all the alternatives $A_i\left(i=1,2,\cdots,m\right)$ and then to select the best one(s).

Step 3. Rank all the alternatives $A_i\left(i=1,2,\cdots,m\right)$ and select the best one(s) in accordance with $S\left(\tilde{r}_i\right)$ and $H\left(\tilde{r}_i\right)\left(i=1,2,\cdots,m\right)$.

Step 4. End.

4. Numerical example

Along with the project scale and the increasing and the improvement of technology complexity, all kinds of risk are obvious increasingly complicated and mutual relationship, project the risks has become a noticeable problem. Any project there are risks, however, how effectively to evaluate risk. It is a realistic problem to be solved. This paper through the project risk analysis and assessment, and constructs a relatively perfect engineering project risk evaluation system. Purpose is to seek for measuring project risk effective methods, in order to project risk management play a certain reference. Suppose there is a MADM problem to deal with the risk assessment of project cost with interval-valued intuitionistic fuzzy information. There are five projects $A_i\left(i=1,2,3,4,5\right)$ for four attributes $G_j\left(j=1,2,3,4\right)$. The four attributes include their own project property $\left(G_1\right)$, external environment condition of the project $\left(G_2\right)$, the internal environment condition of the project $\left(G_3\right)$ and the main project party $\left(G_4\right)$. The five projects $A_i\left(i=1,2,\cdots,5\right)$ are to be evaluated using the interval-valued intuitionistic fuzzy by the decision maker under the above four attributes, as listed as follows:

$$\tilde{R}=\begin{bmatrix} ([0.2,0.5],[0.3,0.4]) & ([0.4,0.5],[0.1,0.2]) & ([0.3,0.6],[0.2,0.3]) & ([0.3,0.7],[0.1,0.3]) \\ ([0.2,0.7],[0.2,0.3]) & ([0.3,0.6],[0.2,0.4]) & ([0.4,0.7],[0.1,0.2]) & ([0.5,0.8],[0.1,0.2]) \\ ([0.1,0.6],[0.3,0.4]) & ([0.1,0.4],[0.3,0.5]) & ([0.2,0.6],[0.2,0.3]) & ([0.2,0.4],[0.1,0.5]) \\ ([0.3,0.6],[0.2,0.4]) & ([0.4,0.6],[0.2,0.3]) & ([0.1,0.4],[0.3,0.6]) & ([0.3,0.7],[0.1,0.2]) \\ ([0.4,0.7],[0.1,0.3]) & ([0.5,0.6],[0.3,0.4]) & ([0.2,0.5],[0.3,0.4]) & ([0.5,0.6],[0.2,0.4]) \end{bmatrix}$$

In the following, we apply the I-IVIFEOWA operator to multiple attribute decision making for selecting project with interval-valued intuitionistic fuzzy information. The method involves the following steps:

Step 1. If we apply the I-IVIFEOWA operator to decision making with interval-valued intuitionistic fuzzy information, we suppose that the weight of I-IVIFEOWA operator is: $w=(0.20,0.30,0.40,0.10)$.

Step 2. The experts use order-inducing variables to represent the attitudinal character involving the opinion of different members of the board of directors. The results are shown in Table 2.

Table 2. Inducing variables

	G_1	G_2	G_3	G_4
A_1	11	14	13	18
A_2	26	20	17	21
A_3	21	13	28	18
A_4	24	25	21	19
A_5	19	22	20	13

Step 3. Utilize the decision information given in matrix $\tilde{R}$, and the I-IVIFEOWA operator which has associated weighting vector $w=(0.20,0.30,0.40,0.10)$, we obtain the overall preference values $\tilde{r}_i$ of the projects $A_i\,(i=1,2,\cdots,5)$.

$$\tilde{r}_1=([0.3412,0.4388],[0.0616,0.1236]),\tilde{r}_2=([0.4754,0.6143],[0.0471,0.0956])$$
$$\tilde{r}_3=([0.2367,0.4132],[0.1021,0.1598]),\tilde{r}_4=([0.3432,0.6165],[0.0342,0.0767])$$
$$\tilde{r}_5=([0.4865,0.6174],[0.0225,0.0633])$$

Step 4. Calculate the scores $S(\tilde{r}_i)\,(i=1,2,\cdots,5)$ of the overall interval-valued intuitionistic fuzzy preference values $\tilde{r}_i\,(i=1,2,\cdots,5)$

$$S(\tilde{r}_1)=0.3026,S(\tilde{r}_2)=0.4654S(\tilde{r}_3)=0.1943$$
$$S(\tilde{r}_4)=0.4189,S(\tilde{r}_5)=0.5021$$

Step 5. Rank all the projects $A_i\left(i=1,2,3,4,5\right)$ in accordance with the scores $S\left(\tilde{r}_i\right)$ $\left(i=1,2,\cdots,5\right)$ of the overall preference values $\tilde{r}_i\left(i=1,2,\cdots,5\right)$: $A_5 \succ A_2 \succ A_4 \succ A_1 \succ A_3$, and thus the most desirable project is A_5.

5. Conclusion

Project construction and operation stages tend to use a lot of energy and resources, and even harm the behavior of the natural environment, thus leading to the project environment risk. In the pursuit of sustainable development and construction of two type society today, project managers have to face the influence of environmental risk to the project. Although the project managers to take various measures to meet the supervision department of the requirements of the project environment risk, however, these measures have no inner driving force, and not radically reduce environmental risk of the project, its essence is still "weight management, light efficiency". How to improve the project environmental risk management efficiency, how to reasonably evaluate the supervision department of environmental risk management performance is the urgent problem to be solved. Therefore, it is necessary to explore the efficiency of environmental risk management mechanism, it is necessary to further research project environment risk management performance evaluation method for project risk management, and provide theoretical support and scientific decision-making. In this paper, we used induced interval-valued intuitionistic fuzzy Einstein ordered weighted average (I-IVIFEOWA) operator for multiple attribute decision making problems to deal with the risk assessment of project cost with incompletely known weights information. We developed a multiple attribute decision making method to projects in uncertain linguistic setting, by which the attribute weights can be determined. We utilize the I-IVIFEOWA operator to aggregate the interval-valued intuitionistic fuzzy information corresponding to each alternative, and then rank the alternatives. Finally, an example with the risk assessment of project cost is given.

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