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Model for evaluating the quality for distance education based on the intelligent computing with intuitionistic fuzzy information

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ABSTRACT

In this paper, we investigate the multiple attribute decision making problems for evaluating the quality of Distance education based on the intelligent computing with intuitionistic fuzzy information. We utilize the intuitionistic fuzzy Einstein weighted average (IFEWA) operator to aggregate the intuitionistic fuzzy information corresponding to each alternative and get the overall value of the alternatives, then rank the alternatives and select the most desirable one (s) according to the score function and accuracy function. Finally, an illustrative example for evaluating the quality of Distance education based on the intelligent computing with intuitionistic fuzzy information is given.

KEYWORDS

Multiple attribute decision-making (MADM); Intuitionistic fuzzy numbers; Intuitionistic fuzzy einstein weighted average (IFEWA) operator; Distance education.

INTRODUCTION

With the rapid development of global service industry, especially under the historic background of greatly promoting modern service industry in China, distance education is paying more and more attention to service gradually. Distance education possesses the feature of "industrialization", and it is accompanied with offering and using visible product, such as textbook; but its fundamental product is still education service and its core value derives from a series of activities among the servant (including teacher and manager) and customer (student) of e-learning school and study center. Therefore, distance education belongs to service industry, complying with basic rule of service industry, and service is the industry essence of distance education[1-5]. From the perspective of service, the thesis syllogistically applies some relevant theory of service industry to distance education field, which have been test the case study and action study, and constructs a theoretical system framework of distance education service preliminary with service view of "quasi-public product" of distance education as recognition foundation and with system view, quality view, efficiency view of distance education as the core. View on the product of distance education service. The product of distance education service is "quasi-public product", which has the characteristics of both public product and private product. In addition to teaching service, the product of distance education service abundantly contains the service of management, the service of facilities, the service of campus culture, and the service for special students, which are provided for the purpose of improving the quality of teaching services. Each of above mentioned services composes of four parts: explicit services, implicit services, facilitating goods and environment, which construct the service package of distance education in organic integrity. View on the system of distance education service[6-9]. The system of distance education service includes four elements: "staff", "customers", "service interaction"," equipment and environment", which carries out distance education service and creates the service package of distance education together. Service staff and customers are the provider and consumer of distance education service respectively, equipment and environment is necessary condition of the service, and service interaction is the core of the system, Sometimes, equipment interacts with customers directly and form service interaction. View on the quality of distance education service[10-12]. The quality of distance education service indicates the degrees how distance education organizations satisfy the needs of their customers, such as students, families, enterprises, societies, etc[13].

In this paper, we investigate the multiple attribute decision making problems for evaluating the quality of Distance education based on the intelligent computing with intuitionistic fuzzy information. We utilize the intuitionistic fuzzy Einstein weighted average (IFEWA) operator to aggregate the intuitionistic fuzzy information corresponding to each alternative and rank the alternatives and select the most desirable one (s) according to the score function. The remainder of this paper is set out as follows. In the next section, we introduce some basic concepts related to intuitionistic fuzzy sets. In Section 3 we introduce the MADM problem deal with evaluating quality for Distance education based on the intelligent computing with intuitionistic fuzzy information. In Section 4, an illustrative example is pointed out. In Section 5 we conclude the paper and give some remarks.

PRELIMINARIES

In the following, we introduce some basic concepts related to IFS.

Definition 1. An IFS A in X is given by

$$A=\left\{\left\langle x,\mu_A(x),\nu_A(x)\right\rangle\middle|x\in X\right\} \quad (1)$$

where $\mu_A: X\to[0,1]$ and $\nu_A: X\to[0,1]$, with the condition $0\le\mu_A(x)+\nu_A(x)\le 1,\ \forall x\in X$. The numbers $\mu_A(x)$ and $\nu_A(x)$ represent, respectively, the membership degree and non- membership degree of the element x to the set A [14-15].

Definition 2. Let $\tilde{a}=(\mu,\nu)$ be an intuitionistic fuzzy number, a score function S of an intuitionistic fuzzy value can be represented as follows[16]:

$$S(\tilde{a})=\mu-\nu,\quad S(\tilde{a})\in[-1,1]. \quad (2)$$

Definition 3. Let $\tilde{a}=(\mu,\nu)$ be an intuitionistic fuzzy number, a accuracy function H of an intuitionistic fuzzy value can be represented as follows[17]:

$$H(\tilde{a})=\mu+\nu,\quad H(\tilde{a})\in[0,1]. \quad (3)$$

to evaluate the degree of accuracy of the intuitionistic fuzzy value $\tilde{a}=(\mu,\nu)$, where $H(\tilde{a})\in[0,1]$. The larger the value of $H(\tilde{a})$, the more the degree of accuracy of the intuitionistic fuzzy value $\tilde{a}$.

Definition 4. Let $\tilde{a}_1=(\mu_1,\nu_1)$ and $\tilde{a}_2=(\mu_2,\nu_2)$ be two intuitionistic fuzzy values, $s(\tilde{a}_1)=\mu_1-\nu_1$ and $s(\tilde{a}_2)=\mu_2-\nu_2$ be the scores of $\tilde{a}$ and $\tilde{b}$, respectively, and let $H(\tilde{a}_1)=\mu_1+\nu_1$ and $H(\tilde{a}_2)=\mu_2+\nu_2$ be the accuracy degrees of $\tilde{a}$ and $\tilde{b}$, respectively, then if $S(\tilde{a})<S(\tilde{b})$, then $\tilde{a}$ is smaller than $\tilde{b}$, denoted by $\tilde{a}<\tilde{b}$; if $S(\tilde{a})=S(\tilde{b})$, then, (1) if $H(\tilde{a})=H(\tilde{b})$, then $\tilde{a}$ and $\tilde{b}$ represent the same information, denoted by $\tilde{a}=\tilde{b}$; (2) if $H(\tilde{a})<H(\tilde{b})$, $\tilde{a}$ is smaller than $\tilde{b}$, denoted by $\tilde{a}<\tilde{b}$ [18].

In the following, we shall introduce the Einstein operations on intuitionistic fuzzy sets and analyze some desirable properties of these operations.

Definition 5.[19] Let $\tilde{a}_j=(\mu_j,\nu_j)(j=1,2,\cdots,n)$ be a collection of intuitionistic fuzzy values, and let IFEWA: $Q^n\to Q$, if

$$\begin{aligned}&\mathrm{IFEWA}_\omega(\tilde{a}_1,\tilde{a}_2,\cdots,\tilde{a}_n)\\&=\oplus_{j=1}^{n}{}_{\varepsilon}\left(\omega_j\tilde{a}_j\right)\\&=\left(\frac{\prod_{j=1}^{n}(1+\mu_j)^{\omega_j}-\prod_{j=1}^{n}(1-\mu_j)^{\omega_j}}{\prod_{j=1}^{n}(1+\mu_j)^{\omega_j}+\prod_{j=1}^{n}(1-\mu_j)^{\omega_j}},\frac{2\prod_{j=1}^{n}\nu_j{}^{\omega_j}}{\prod_{j=1}^{n}(2-\nu_j)^{\omega_j}+\prod_{j=1}^{n}\nu_j{}^{\omega_j}}\right)\end{aligned}\qquad\textbf{(4)}$$

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 IFEWA is called the intuitionistic fuzzy Einstein weighted averaging (IFEWA) operator.

MODEL FOR EVALUATING THE QUALITY FOR DISTANCE EDUCATION BASED ON THE INTELLIGENT COMPUTING WITH INTUITIONISTIC FUZZY INFORMATION

The essence of the distance education is that the teachers and learners separate, the teaching quality caused in order to remedy teachers and students to separate dopes, have offered service of standing in numerous study for learners, the distance education can make learners be able to study whenever and wherever possible, but through literature research of modern distance education learners and document of distance education, and find that it is more important to utilize new technology and network advantage establish teaching model suited to distance adult learners and guaranteeing teaching quality. We first limited the distance education, blended learning and teaching model respectively through the theory research, then we designed the teaching model of distance education based the theory of distance education, blended learning and transmission though many research method, at last we brought forward a new teaching model--blended learning model in distance education. In this paper, we investigate the multiple attribute decision making problems for evaluating the quality of Distance education based on the intelligent computing with intuitionistic fuzzy information. Let $T=\{S_1,S_2,\cdots,S_m\}$ be a discrete set of schools. Let $G=\{G_1,G_2,\cdots,G_n\}$ be a set of attributes. The information about attribute weights is completely known. Let $\omega=(\omega_1,\omega_2,\cdots,\omega_n)$ be the weight vector of attributes, where $\omega_j\geq 0$, $j=1,2,\cdots,n$. Suppose that $\tilde{R}=(\tilde{r}_{ij})_{n\times m}=(\mu_{ij},\nu_{ij})_{n\times m}$ is the intuitionistic fuzzy decision matrix, where μ_{ij} indicates the degree that the alternative A_i satisfies the attribute G_j given by the decision maker, ν_{ij} indicates the degree that the alternative A_i doesn't satisfy the attribute G_j given by the decision maker D_k, $\mu_{ij}\subset[0,1]$, $\nu_{ij}\subset[0,1]$, $\mu_{ij}+\nu_{ij}\leq 1$, $i=1,2,\cdots,m$, $j=1,2,\cdots,n$, $k=1,2,\cdots,t$.

In the following, we apply the IFEWA operator to evaluate the quality for Distance education with intuitionistic fuzzy information.

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

$$\tilde{r}_i=\left(\mu_i,\nu_i\right)=\text{IFEWA}_{\omega}\left(\tilde{r}_{i1},\tilde{r}_{i2},\cdots,\tilde{r}_{in}\right),\ i=1,2,\cdots,m. \quad \textbf{(5)}$$

to derive the values $\tilde{r}_i\left(i=1,2,\cdots,m\right)$ of the alternative S_i.

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

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

NUMERICAL EXAMPLE

Since the middle of 19th century, the mode of distance education has greatly changed with the development of communication technology. At present, based on the development and application of information technology, distance education experts divide the developing process of distance education into three phases: correspondence education from the middle of 19th century to the middle of 20th century, multimedia-aided distance education from the middle of 20th century to the end of 1980s and Web-based distance learning since 1990s. The change of teaching mode always brings a series of problems which we can not avoid. In the late of 1990s, two-way video conferencing system based on satellite and Internet technology were employed by Radio and Television Universities at all levels across China. Since 1998, more and more universities have started to offer distance education courses. And by the end of 2003, the number of universities which implement trial Web-based instruction has amounted to 68, including the Central Radio and Television University. However, the rapid expansion of scale and the lack of experiences have resulted in various problems, the reduction of teaching quality and social trust. The main problems are as follows: no complete quality guarantee system, no unified quality standards, no forceful supervision of the teaching process, low efficiency of net learning, the lack of systematic teaching support and service, the lack of practical technique training for farmers and the combination of school and enterprise. Faced with the current situation of modern distance education, educators should analyze these problems carefully, find out the causes and come up with reasonable suggestions so as to keep distance education growing steadily. The following thesis is an attempt to explore series of existing problems based on the research which has been done both at home and abroad with regard to the mode of distance education and the writer will, in terms of the social demand and the practical problems of web–based instruction, raise some measures to be taken and suggestions to further perfect distance education. This section presents a numerical example to illustrate the method proposed in this paper. There is a panel with five possible Distance education schools $A_i\left(i=1,2,3,4,5\right)$ to select. The experts select four attribute to evaluate the five Distance education schools: ①G_1 is the environment of teaching and studying; ②G_2 is the management of teaching information; ③G_3 is the curriculum design and target; ④G_4 is the empathy and the teaching practice. The five possible Distance education schools $A_i\left(i=1,2,3,4,5\right)$ are to be evaluated using the intuitionistic fuzzy information by the decision maker under the above four attributes whose weighting vector $\omega=\left(0.30,0.10,0.40,0.20\right)^T$), as listed in the following matrix.

$$\tilde{\boldsymbol{A}}=\begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \\ A_4 \\ A_5 \end{array}\begin{array}{c} \begin{array}{cccc} G_1 & G_2 & G_3 & G_4 \end{array} \\ \begin{bmatrix} (0.4,0.6) & (0.3,0.5) & (0.7,0.3) & (0.3,0.4) \\ (0.5,0.4) & (0.6,0.2) & (0.2,0.2) & (0.6,0.2) \\ (0.5,0.3) & (0.5,0.2) & (0.6,0.4) & (0.6,0.1) \\ (0.2,0.3) & (0.8,0.2) & (0.5,0.2) & (0.5,0.4) \\ (0.6,0.46) & (0.6,0.1) & (0.4,0.4) & (0.7,0.2) \end{bmatrix} \end{array}$$

Then, we utilize the approach developed to evaluate quality of Distance education in order to select the best Distance education schools.

Step 1. Utilize the IFEWA operator, we obtain the preference values $\tilde{r}_i$ of the Distance education schools $A_i\left(i=1,2,3,4,5\right)$.

$\tilde{r}_1=\left(0.47,0.22\right),\tilde{r}_2=\left(0.65,0.31\right),\tilde{r}_3=\left(0.54,0.21\right)$
$\tilde{r}_4=\left(0.59,0.14\right),\tilde{r}_5=\left(0.76,0.12\right)$

Step 2. Calculate the scores $S\left(\tilde{r}_i\right)\left(i=1,2,3,4,5\right)$ of the intuitionistic fuzzy values $\tilde{r}_i\left(i=1,2,3,4,5\right)$

$S\left(\tilde{r}_1\right)=0.25,S\left(\tilde{r}_2\right)=0.34,S\left(\tilde{r}_3\right)=0.33$
$S\left(\tilde{r}_4\right)=0.45,S\left(\tilde{r}_5\right)=0.64$

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

CONCLUSION

In this paper, we investigate the multiple attribute decision making problems for evaluating the quality of Distance education based on the intelligent computing with intuitionistic fuzzy information. We utilize the intuitionistic fuzzy Einstein weighted average (IFEWA) operator to aggregate the intuitionistic fuzzy information corresponding to each alternative and get the overall value of the alternatives, then rank the alternatives and select the most desirable one (s) according to the score function and accuracy function. Finally, an illustrative example for evaluating the quality of Distance education based on the intelligent computing with intuitionistic fuzzy information is given.

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