the Application of Fuzzy Mathematics to the Apprasal of the Classroom Teaching Qualities

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Appraising classroom teaching qualities is one part of the theory of educational measure.How to give an objective appraisal of the classroom teaching qualities of a teacher is an unsoved question.Usually, when we appraise classroom teaching qualities, we often use words"good","fairly good","mediocre" or "bad" , but they are all blurred. If we want to make a quantitative appraisal of teaching qualities, using fuzzy mathematics is one of the effective ways. In this article, we combine the fuzzy syntheticel judgement with the fuzzy recognition to give a way to appraise the classroom teaching qualities of a teacher.

I .Setting up an Appraisal Index System

Classroom teaching qualities are affected by many factors, such as teaching aims,teaching requirements,teaching contents,teaching methods and so on. So we must choose appraisal factors and set up an appraisal index system scientifically and reasonably if we want make an objective appraisal

of classroom teaching qualities.

We suppose that classroom teaching qualities are affected by factors as follows: u_1, u_2, ..., u_n. Let field $U=\{u_1,u_2,...,u_n\}$ be a set of appraisal index. Grade the factors that affect the teaching qualities according to their affecting extent: v_1, v_2, ...,v_m. Let $V=\{v_1,v_2,...,v_m\}$ be a set of the appraisal grade.In order to guarantee that the appraisal results tally with the actual stiuatation, and have more reference value,we invite k teaching specialists to pass a judgement of weight number respectively on each factor in field U as follow list:

u_i / weight number / specialist	u_1	u_2	...	u_n	Σ
specialist 1	a_{11}	a_{12}	...	a_{1n}	
specialist 2	a_{12}	a_{22}	...	a_{2n}	
⋮	⋮	⋮	⋮	⋮	⋮
specialist k	a_{k1}	a_{k2}	...	a_{kn}	
$\frac{1}{k}\sum_{i=1}^{k} a_{ij}=t_i$	$\frac{1}{k}a_1$	$\frac{1}{k}a_2$	...	$\frac{1}{k}a_n$	

In the list a_i (i=1, 2, . ..,n) is $\sum_{i=1}^{k} a_{ij}$, the sum of all the rows. The

weight number of a_i corresponding to index factor u_i is

$$t_i = \frac{1}{k}\sum_{i=1}^{k} a_{ij} = \frac{a_i}{k}$$

the weight number distributive set corresponding to the appaisal factor set $U=\{u_1,u_2,\ldots,u_n\}$ is

$$\underline{A}=(t_1,t_2,\ldots,t_n)$$

there $t_i \in (0,1)$ and $\sum_{i=1}^{k} t_i=1$.

Ⅱ .Synthetical Judgement of the Model

On basis of setting up the index system of appraisal, we'll pass a judgment on the model that will be appraised.

Invite k teaching specialists, adopting specialists appraising method, we get weight number distributive set $\underline{A}= \{t_1,t_2,\ldots,t_n\}$. On the other hand, we pass a judgment on each $u_i \in U, i=1,2,\ldots,n$, as follow list:

	v_1	v_2	...	v_n
u_1	x_{11}	x_{12}	...	x_{1m}
u_2	x_{21}	a_{22}	...	x_{2m}
⋮	⋮	⋮	⋮	⋮
u_n	x_{n1}	x_{n2}	...	x_{nm}

Thereupon we get the matrix of fuzzy relation,the appraisal matrix

$$\underline{R}=\begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix}$$

Adopting the set operation of fuzzy matrix $\underline{B}=\underline{A}\cdot\underline{R}$ and using operation $M(\cdot,\oplus)$,we obtain the results of synthetical judgement

$$\underline{B}=(b_1,b_2,\ldots,b_m)$$

where $b_i\in(0,1)$, and $\sum_{i=1}^{m} b_i=1$.

Example. We want to appraise classroom teaching qualities of teacher A_1, A_2, A_3 of a school.

First of all we must fix the set of appraisal factors

$$U=\{u_1,u_2,u_3,u_4,u_5,u_6,u_7,u_8\}$$

where u_1:teaching aims and requirements; u_2: teaching contents;u_3: scientificalness; u_4: basic concept, elementary knowledge; basic technique; u_5: focal point, difficult point; u_6, teaching method; u_7: teaching state, language, blackboard writing; u_8: teaching effect.

Adopt the set of appraisal grade $V=\{v_1,v_2,v_3,v_4\}$, where v_1:good,v_2: fairly good,v_3: mediocre, v_4: bad. Eight members including Headmaster,

Dean of stuies. Derector of teaching and research section and teachers with good teaching qualities make up the appraisal group. The eight people adopt specialist appraising method to get the weight number distribution set A= {1.2, 1.3, 0.9, 1.9 ,1.5, 1.15, 0.85, 2.05} and appraise teacher A_1 by passing judgments respectively on factor u_1, u_2, ..., u_8 as follows:

(0.4, 0.1, 0.2, 0.3)

(0.5, 0.2, 0.1, 0.2)

(0.3, 0.7, 0 , 0)

(0.6, 0.2, 0.1, 0.1)

(0.2, 0.4, 0.1, 0.3)

(0.3, 0.3, 0.2, 0.2)

(0.4, 0.3, 0.15, 0.15)

(0.5, 0.25, 0.2, 0.05)

then we get the appraisal matrix

$$\underline{R}_1 = \begin{array}{c} \begin{matrix} v_1 & v_2 & v_3 & v_4 \end{matrix} \\ \begin{bmatrix} 0.4 & 0.1 & 0.2 & 0.3 \\ 0.5 & 0.2 & 0.1 & 0.2 \\ 0.3 & 0.7 & 0 & 0 \\ 0.6 & 0.2 & 0.1 & 0.1 \\ 0.2 & 0.4 & 0.1 & 0.3 \\ 0.3 & 0.3 & 0.2 & 0.2 \\ 0.4 & 0.3 & 0.15 & 0.15 \\ 0.5 & 0.25 & 0.2 & 0.05 \end{bmatrix} \end{array} \begin{matrix} u_1 \\ u_2 \\ u_3 \\ u_4 \\ u_5 \\ u_6 \\ u_7 \\ u_8 \end{matrix}$$

Adopting the set operation of fuzzy matrix to give an appraisal result

to teacher A_1

$$\underline{B}_1=\underline{A}\cdot\underline{R}_1=(1.2,1.3,0.9,1.9,1.5,1.5,0.85,2.05)\cdot\begin{bmatrix}0.4, & 0.1, & 0.2, & 0.3\\ 0.5, & 0.2, & 0.1, & 0.2\\ 0.3, & 0.7, & 0, & 0\\ 0.6, & 0.2, & 0.1, & 0.1\\ 0.2, & 0.4, & 0.1, & 0.3\\ 0.3, & 0.3, & 0.2, & 0.2\\ 0.4, & 0.3, & 0.15, & 0.15\\ 0.5, & 0.25, & 0.2, & 0.05\end{bmatrix}$$

Using $M(\cdot,\oplus)$,we get

$$\underline{B}_1=\underline{A}.\underline{R}_1=(4.655,\ 3.2075,\ 1.5475,\ 1.79)$$

After normalization treatment we get

$$\underline{B}_1^*=(0.415625,\ 0.286383928,\ 0.138169642,\ 0.159821428)$$

$$=(0.41,\ 0.29,\ 0.14,\ 0.16)$$

The members of the appraisal group adopting the same method that we have used to teacher A_1, using the weight number distributive law $\underline{A}$=(1.2, 1.3, 0.9, 1.9, 1.5, 1.5, 0.85, 2.05) to give appraisal to teacher A_2, A_3 respectively and get the result of synthetical judgement.

Ⅲ · the Compair of the model's Appraisal

By the above-mentioned analisis, we can see that the classroom teaching qualities of teacher A_1, A_2, A_3 have been quantified and the proportions they hold in the apprasal grade have been fixed. But we can't show the order of teacher A_1, A_2, A_3 about their teaching qualities. We

must compair the models so that we can make out the order of the teachers about their classroom teaching qualities.

"Only by compairing can one distinguish."And we must have a criteriom when we compair. We choose an ackowledged excellent teacher with good teaching qualities as a standard model. Using fuzzy synthetical judgement we can get the appraisal result. Using fuzzy recognition, we can find the approach degree of the appraised models with the standard model. Then we can made out the order of appraised model according to their approach degrees.

Adopting the above-mentioned exapmle and same method we can find the appraisal result of the standard model $\underline{B}$ = (0.75, 0.20, 0.05, 0). Usingthe computational formula of approach degree, according to the characters of the factors that affect the teaching qualities and applacation range of all kinds of the approach degrees,we use computational formula of Hamming approach degree.

$$N_H(\underline{A}.\underline{B})=1-\frac{1}{n}d(\underline{A},\underline{B})$$

$$=1-8(\underline{A},\underline{B})$$

to find the approach degrees of $\underline{B}_1,\underline{B}_2,\underline{B}_3$ with $\underline{B}$ respectively.

$$N_H(B,B_1)=1-\frac{1}{4}(|0.75-0.41|+|0.29-0.20|+|0.05-0.14|$$

$$+|0-0.16|)$$

$$=1-\frac{1}{4}(0.34+0.09+0.09+0.16)$$

$$=1-0.17$$

$$=0.83$$

$$N_H(\underline{B},\underline{B}_2)=1-\frac{1}{4}(|\ 0.75-0.39\ |+|\ 0.31-0.20\ |+|\ 0.15-0.05\ |$$
$$+|\ 0-0.15\ |)$$
$$=1-\frac{1}{4}(0.36+0.11+0.10+0.15)$$
$$=1-0.18$$
$$=0.82$$

$$N_H(\underline{B},\underline{B}_3)=1-\frac{1}{4}(|\ 0.75-0.40\ |+|\ 0.20-0.27\ |+|\ 0.05-0.25\ |$$
$$+|\ 0-0.08\ |)$$
$$=1-\frac{1}{4}(0.35+0.07+0.20+0.08)$$
$$=1-0.175$$
$$=0.825$$

We can find from the approach degrees that the seqence of the classroom teaching qualities of the three teachers is: A_1 is the best;, A_3 is the second; A_2 is the last.

REFERNCES

[1] L.A.Zadeh(translated by Chen Guoquan),
Fuuzy Set,Language Variety and Fuzzy logic, Science Publishing House of China. 1982

[2] Wang Peizhuang, Fuzzy Set and Its Application,
Shanghai Science and Technology Publiishing House of China,1984.