THE CURRENT QUANTIZED APPROACH FOR ASSESSMENT AND THE COMPUTER MANAGEMENTS SYSTEM

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ABSTRACT

Using the Fuzzy Mathematics theory, this thesis studied a new assessment appronch--the quantized one. And on this base it designed Fuzzy weighting approach suitable to many kinds of types of marking data, i.e. the quantized Management system which can be used in all kinds of assessment.

PREFACE

"Assessment" is a practical issue in management work. for example, in order to commend the advanced indivituals and units. to set up models we need it; it is also needed in such cases : that post engagement of workers of science and technowledge; selection of heads of every rank; assessing the grades and awards of the staff; assessing of synthetic benefits of a business; and assessing of each work result, etc. While the standard of assessment is not easy to fix properly, for the level of people's consciessness varies, especially for there are so many elements to consider . The way of voting premorily taken hardly satisfies people. The result of voting was usually different with the true case and made the assessment couldn't get the result expected . Therefore it's very necessary to re-study the assessment approach and make it concrete and quantized. This thesis studied a new approach of assessment ---the quantized one utilizing the theory of fuzzy mathematics as well as the basic way for the decision of modern management. And on this base it worked out a fuzzy weighting approach usable in varied types of comment data--the Current Quantized Management System, which can be used in varied assessments. The result of it proved better in the practice. And the feasibility of this approach is greatly strenghened by computers handling a series of data.

I. THE SYNTHETIC ASSESSMENT CARDS AND QUALITATIVE ASSESSMENT

In assessment, the given property of the object is usually a dim concept with no clear extension. As for this kind of assessment, we cannot use simply the traditional two-value logic of maths but should consider the intermediate state between 0 and 1. The basic method to solve such kind of problem is to divde the given fuzzy concept into several bronch ones according to the assessment purpose and the real situation of the surrounding

environment and the limits. Then we can evaluate every branch concept and handle them with weighting approach to fulfil the task of accurately handling the fuzzy concepts

The process of conducting some assessment is that, firstly related unit collectively works to determine the assessment condition sets A and comment degree Sets S. Suppose they respectively are:

$A=\{cond.1,\ cond.2,\ \cdots,\ cond.t\}$ (cond=condition)

$S=\{deg.1,\ deg.2,\ \cdots,\ deg.F\}$ (deg=degree)

Among them, the conditions are limitted according to the specific demands of different units (the nature of different jobs) and different degrees in the same job; the degrees according to the practical needs. It is obvious that the proportion of each condition in the condition sets are not completly the same in general assessments. These proportions can be fixed by related experts and experienced and prestigious managers considering in an all-round way in line with practical needs (the purpose of the assessment). Suppose the weight vector relative to A is

$A=\{a'_1, a'_2, \cdots, a'_t\}$. and $a'_1+a'_2+a'_3+\cdots+a'_t=100$

For practical use, we can fill in a table with the assessment conditions and the relative proportions in the general assessment as well as the comment degrees, then a synthetic assessment (s.a.) card arises as following:

S.A.Cards

Name of the assessed_____ Department_____

cond. / deg. proportion	deg.1 $[100, a_1]$	deg.2 $(a_1, a_2]$	...	deg. F $(a_{2(F-1)}, 0]$	remarks
cond.1 (a'_1)					
cond.2 (a'_2)					
... ...					
cond.T (a'_t)					

Unit of the assessed_____

The assessor should mark "√" in the relative colums in accordance with his own knowledge about the state of the assessed (i.e. to mark "√" in the column which suggests some certain condition belonging to the coment of some related certain degree.) If lacking knowledge about some certain condition and hardly assessing, the assessor can mark "*" in the remark column. It would be considered abstention in the statistics.

After counting up all the assessment cards (of the same assessed) with computers and arranging them, we can get comment statistics table B :

$B=(b_{ij})_{T\times F}$ $\quad i=1,2,\cdots,T;\ j=1,2,\cdots,F$

Among them b is the frequency of condition i being assessed as comment J. All the elements in B divided by the number of the assessors M, are the comment matrx R :

$$R=B/M=(b_{ij}/M)_{T\times F}=(r_{ij})_{T\times F}$$

Therefore, the result of relative synthetic assessment s.a ; can be got in the way below:

$$A*B=(c1,c2,\ldots\ldots,cF)=C$$

Among them, $c_j=(\vee(r_{ij}\wedge a_i)+\Sigma a_i * r_{ij})/2$ $\quad i=1,2,\ldots\ldots,T;\ J=1,2,\ldots,F$

After standardised handling of C , we can see the assessment vector is S=(s1,s2,..., sF) Among them $Sj=c_j/\Sigma c_k$ $\quad (k=1,2,\ldots,F)$ suggesting the subodinate degree of the assessed towards comment j. According to the hapital fraction of the comment degree in the hundred-mark system we can get the percentage form of the assessment vector:

$$S=\sum_{i=1}^{F} s_i \times a_k$$

in whichakis the upper mark of the mark section of the comment degree i. If

the value of S falls into the mark area of comment K, then the result of the synthetic assessment is comment K.

The above method of filling in tables and handling marks is called "Qualitative assessment" method.

II. QUANTITATIVE ASSESSMENT METHOD

The above qualitative assessment method is comparatively rough. The primitive data gotten through this way doesn't differenciate the different marks in mark areas relative to the comment. So the result of comment can hardly be shown in the hundred-mark system. The qualitative comment can be got through calculation only according to the mark area relative to each comment and in the principle of " biggest belonging". While the quantitative assessment is a more meticulous way for assessment. The primitive data provided by this method have differenciated twice the different values in the comment mark areas.

Suppose the comment degrees and relative mark areas are:

deg.1	deg.2	deg.3	.....	deg.F
$[a_1, a_2]$	$[a_3, a_4]$	$[a_5, a_6]$	.....	$[a_{2F-1}\ a_{2F}]$

In order to assure the assessment result more accurate, reflecting the true condition of the assessed person Ai, we can divide futher area of comment mark into 10 parts. If the assessor regards that Ai should be given the highest mark in some comment mark area according to the given conditions, he(or she) can fill the relative comment column with mark1. otherwise mark r,

$$r \in \{0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9\}$$

The Way of giving mark can be shown in the table below:

deg. / cond. proportion	deg.1 [100,90]	deg.2 [90,74]	deg.3 [74,60]	deg.4 [60,30]
cond.1 (a_1)	0.6			
cond.2 (a_2)		0.8		
....				
cond.T (a_T)				0.4

The given mark to condition 1 shows the score in the 1st con dition is

$$90+0.6\times(100-90)=96$$

The given mark to condition 2 shows the score in the second condition is

$$74+0.8\times(90-74)=88.4$$

The given mark to condition T shows the score in condition T is

$$30+0.4\times(60-30)=42$$

To make it convenient in practical assessment,now we are to set up a parameter list for value transformation which is relevant to the comment collection. Suppose the mark area of comment i is $[a_{i-1}\ a_i]$, take the length of each proportion of Vi as $\overline{V}_i=(a_{i-1}-a_i)/10$, obevously, each smaller value area can be shown by two points, then can use some certain value instead of its belonging parameter? The answer is positive, because so long as our way to take this value is simflar with the way to take values in each smaller area of every comment mark area , we can make that the standards are unified in transfering the assessment result of all the assessed to the hundred-mark system. On the base of experiments of many assessments, the parameter of each smaller area in area V: $(a_{i-1}\ a_i)$ is like that: $V_i^{10}=a_i+10\times\overline{V}_i$, $V_i^{9}=a+9\times\overline{V}_i$, $V_i^{8}=a_i+8\times\overline{V}_i$,....., $V_i^{1}=a_i+\overline{V}_i$ Through this way we can divide the relevant areas of all the comment areas V1, V2, ...,Vk into 10 smaller areas, and show them with relevant parameters, then the parameters' list relevant to the comment collection V appears

$$V=\begin{bmatrix} V_1^1 & V_2^1 & \dots & V_F^1 \\ V_1^2 & V_2^2 & \dots & V_F^2 \\ \vdots & \vdots & \vdots & \vdots \\ V_1^{10} & V_2^{10} & \dots & V_F^{10} \end{bmatrix}$$

The statistics of quantitative assessment cards is based on the statistics of the comment value list 1, and 2 and the number of assessors. Suppose the number of assessors is W, we can get :

comment value list 1, $B=(b_{ij})_{T\times F}$ in which b_{ij} expresses

comment value list 2, $K=(k_{ij})_{T\times F}$ in Which k_{ij} expresses

the number of the assessors who give marks in comment mark area j by condition i, Through B and K we can get the synthetic assessment list like following:

$B'=(b_{ij}/k_{ij})_{T\times F}=(b'_{ij})_{T\times F}$

Further we can get the synthetic assessment quantity list

$$V^*=\begin{bmatrix} V_{11}^{Y_{11}} & V_{12}^{Y_{12}} & \dots & V_{1F}^{Y_{1F}} \\ V_{21}^{Y_{21}} & V_{22}^{Y_{22}} & \dots & V_{2F}^{Y_{2F}} \\ \vdots & \vdots & \vdots & \vdots \\ V_{T1}^{Y_{T1}} & V_{T2}^{Y_{T2}} & \dots & V_{TF}^{Y_{TF}} \end{bmatrix}$$

among them $r_{ij}=(\beta_{ij}^{\xi})$, $\beta_{ij}^{\xi}=\mathrm{INT}(b_{ij}\times 10+0.5)$, $V_{ij}^{Y_{ij}}=V_{ij}^{Y_{ij}}$ By comment quantity list 2 we can get the matrix of comment coefficient $B^*=(k_{ij}/W)_{T\times F}=(\tilde{b}_{ij}^*)_{T\times F}$

By standard handling them line by line we get: $(b_{ij}^*)_{T\times F}=B^*$ in which $b_{ij}^*=\tilde{b}_{ij}^*/\sum_{j=1}^{F}\tilde{b}_{ij}^*$ Then the synthetic vector of assessment can be got by the formula bellow

$$R=B^*\circ V^*=\begin{bmatrix} \sum_{j=1}^{F} V_{1j}^{Y_{1j}}\cdot b_{1j}^* \\ \sum_{j=1}^{F} V_{2j}^{Y_{2j}}\cdot b_{2j}^* \\ \vdots \\ \sum_{j=1}^{F} V_{Tj}^{Y_{Tj}}\cdot b_{Tj}^* \end{bmatrix}=\begin{bmatrix} r_1 \\ r_2 \\ \vdots \\ r_T \end{bmatrix}$$

Suppose A=(a1, a2, ...,aT) is the proportion matrix and $\sum a_i=1$ the expression of the synthetic vector in the hundred mark system is $S=A\times R=\sum_{i=1}^{T} a_i\cdot r_i$

(Thefeasibility of the assessment approach is ommitted)

III. MANY-TIMES SYNTHETIC ASSESSMENT

In practice, many assessments of objects usoally need assessors of different sides to be involved in. For example, assessing the achievements of mork of an engineer needs fellows of the same trade, the relative leaders and the masses who know him , etc.while the knowledge and understanding of all the three degrees of persons are evidently different in comprehensiveness,accuracy and profoundness. So the assessment result of the three sides have to be re-synthetic-assessed, which is called the "second-level synthetic assessment". From this we have "three-level", "four-level" ones. Here we only study the "secon --level one , whose principle cae shifted into the other many degrees synthetic assessments.

1).THE SYNTHETIC ASSESSMENT OF TYPE PD(1,t)

The so-called "S.A." PD(1,t) is a kind of S.A. conducted by the same assessors (whose comment-weight-proportions are similar) who use t kinds of assessment cards. In the "second level S.A." the determining of weight at the 1 1st and 2nd level is respectively called the 1st-level weight distribution and the 2nd-level one. Suppose the weights relevant to the seven cards are respectively t1, t2, ..., tt. The weighted vector of cardi is

Ti=(ti1, ti2,...,tir) among which r is the amount of conditions, and $\sum_{j=1}^{Y} t_{ij}=1$

As for the qualitative assessment, according to the statistics method of cards introduced in"I" we can get the relative comment matrix Bi (i=1,...,t) , then the synthetic comment vector can be gotten by the formula below:

$$S^{*}=\begin{bmatrix} t_1 \\ t_2 \\ \vdots \\ t_t \end{bmatrix} \circ \begin{bmatrix} T_1 \times B_1 \\ T_2 \times B_2 \\ \vdots \\ T_t \times B_t \end{bmatrix} = (c_1, c_2, \ldots, c_F)$$

Among then the way to get C is aimilar with the one introduced in section 1. After that, with the transform way of value in "I", we transform S to the form of one-hundred-system to expres S, and combining the mark areas of each comment we can fix the relative S.C. (synthetic comment). We can change S^{*} into the form of one-hundred-mark system to express S according to the method of value transform in "I",combining the mark area relative to each comment, and it is S that determines the synthetic comments

As for the quantitative one, according to the method of cards counting and value transform introduced in "II", we can get the value of the S.C.(in form of percentage)of different cards (corresponding to their own weight matrix), the result of the general assessment is:

$$S=(t_1, t_2, \ldots, t_t) \circ \begin{bmatrix} s_1 \\ s_2 \\ \vdots \\ s_t \end{bmatrix} = \sum_{i=1}^{t} t_i \cdot s_i$$

2), THE GENERAL ASSESSMENT (G.A.) OF TYPE PD(t,1)

PD(t,1) G.A. is a kind of assessment conducted by kinds t of assessors (t>1) using a same kind of S.A. . The basic way to conduct S.A. of PD(t,1) type is to combine the "fusing" of weight matrix and the "piling" of fuzzy relation matrix to a one-degree synthetic assessment.

Suppose the weight matrix corresponding to each kind of assessors is

T={a_1 (1st'kind of a.), a_2(2nd ones),...,a_t(the t th ones)} (a=assessor)

Among them $\sum a_i = 1$ The cards' proportion matrix is A=(A1,A2,...,Ar) ; r is the number of conditions, $\sum_{i=1}^{r} Ai = 1$ If the result of the comment catatistics of kind i of the assessors is Bi, (i=1,2,...,t)and the synthetic vector of assessment PD(t,1) is

$$S=(a1,a2,\ldots,a) \circ \begin{bmatrix} B1 \\ B2 \\ \vdots \\ Bt \end{bmatrix}$$

In case of the quantitative assessment, in the above formula, Bi (i=1,2,...,t) is a quantity value otherwise it is a two-dimensional quantity table. In qualitative assessment, we have to determine S.C. in the way introduced in "I".

3). THE SYNTHETIC ASSESSMENT PD(t,M)

The S .A . PD(t,M) means a process of S.A. conducted by t different assessors using M kinds of the assessing cards (yet the number of cards used by each kind of assessers and the corresponding conditions can be different).

Such a kind of assessment might be changed into one-stage S.A., namely, supplying the formuld used in direct statistics by computers.

Suppose the weight vector of each kind of assessors is

T=(a1(№1a.),a2(№2a.),...,a (№ta.)) (a.=assessors)

Among them $\sum_{i=1}^{t} a_i = 1$ and the synthetic comment vector is $S=\sum_{i=1}^{t} a_i \cdot s_i$. Here, Si is the result of S.A. of kind i of assessors, and

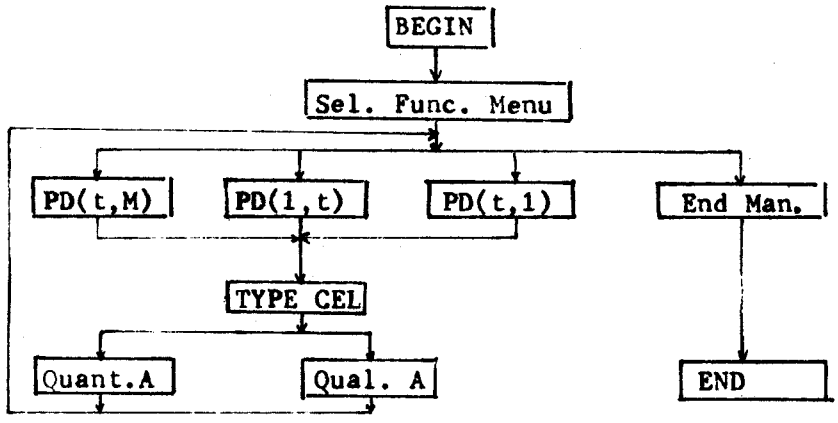
$$Si=Ti \circ \begin{bmatrix} A1 \times B1 \\ A2 \times B2 \\ \vdots \\ Ad \times Bd \end{bmatrix}$$

Among them d is the number of cards used by the assessors of kind i, while Ak=(a1,a2,...,a_e) is the weight vector of card k, e is the number of conditions of the card. $\sum_{i=1}^{e} a_i = 1$, Ti=(t1,t2,...,t_d) is the proportion vector correspording to

D cards used by the assessors of kind i. Among them the calculating method of A1×B1 is synthetically handled according to the statistics method in "I" or "II", on the basis of requiments of qualitative or quantitative assessment.

IV. THE BRIEF INTRODUCTION OF THE COMPUTER MANAGEMENT SYSTEM

1). THE FLOW CHART OF THE GENERAL ASSESSMENT SYSTEM



(Sel.=Selection; Func.=Function ;Quant.A=Quantitative Assessment;Qual.A=Qualitative;Man.=Management)

2). DIRECTION FOR USING THIS SYSTEM

The system is compiled in IBM BASIC language. It prompts the users to operate by form of talking. This system is suitable to all the types of IBM computers. With help of IBM computer and its softwares, people can rapidly handle the data of type PD(t,1) (when t=1, it's one-stage assessment), type PD(1,T) and PD(t,M) of S.A.

(1). A.A. PD(1.t)

• When the computer is in "OK" (basic state), we insert the softplate containing "The Current Synthetic Assessment System" into driver A. and adjust the course into the inner store and input the key of RUN, then there would appear a sentence saying "The C.A.S. SERVES YOU", then the selection menu of assessment pattern the screen.

The Selectivity of Assessment pattern

1. Ending Assessment System 2.pD(1,t)
3.PD(t,1) 4.PD(t,M)

Please Select 1 - 4

If you select PD(1,t), input key2, there appears on the screen:

The Selectivity of Assessment Type
0. returning to the selectivity of assessment pattern
1. Qual.A. 2. Quant. A

1°. Qual. A

If you select Qual.A., input key "1",the screen would prompt the number of cards type you will input and use. After the user input the number of cards type T, the computer will begin to count up multiply every cards type. First of all it will prompt inputting the nume of the assessed. The process counting cards i (i=1,2,...,t)is : (1). to prompt the user to input the name of cards i and their relative card proportion. (2). to input the number of conditions of these cards and the corresponding proportion . (3). to promput the user to input the comments of these cards, and after eveny card is input , the sereen would pnompt the user whether the inputting result is right ; if right, the user can continue to input the cards, other wise the screen would prompt to input the above card again , until the user finishes to input all the comments . Then the computer will immediately stamp the synthetic comments out and finally the result of the general assessment of PD(1,t).

2°. The Quant.A.

The condueting process is similar with that in 1°. In counting the cards, the cards , the sereea will show the promptness:

The code name of the comments--- BEST(1). BETTER(2). MIDDLE(3). POOR(4). Please input code name "K" and the relative quantity value "R". The user should input the code name of the comments and the relative quantity value at the same time (being separated wth ","). For example , the result of some comment is that score 0.9 in the relevant column "BETTER", then the user can input the key 2, 0.9

(2).S.A. PD(t,1)

To select "2" in the FUNCTION MENU, the user can conduct the S.A. of the same kind of cards used by different kinds of assessors. The qualitative and quantitative assessments can respectively be condueted.

(3). S.A. PD(t,M)

To select "3" in the FUNCTION MENU , the user can conduct the S.A. in which several kinds assessors are involved , and in which the number of card kinds used by the assessors and the conditions are not completely in common . According to the need of the practical assessment the user can uonduct the qualitative or quantitative one.

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