THE QUANTITATIVE EVALUATION ON SCIENTISTS AND TECHNICIANS BY MEANS OF THE FUZZY SETS AND COMPUTER TREATMENT

Wang Aimin
Department of Mathematics,
Anyang Teacher's College,
Anyang, Henan Province
China

ABSTRACT

It's an effective method to evaluate scientists and technicians quantitatively. the process is, however, extremely complicated. In this essay, a general mathematical model is built to evaluate scientists and technicians with numbers, by Fuzzy sets assembly theory, and the BASIC process is supplied which is fit for such computers, IBMpc-xt, JB-3000, SHARP pc-1500, APPLE II and so on. It provides an easy, scientific and all-sided method to select and evaluate any scientists and techcians. (of talent)

I. INTRODUCTION

It's a serious task in face of us how to make good technicians stand out, how to arouse their enthusiasm and impel them to work hard and to put forward new ideas, thus to raise working efficiency on system. The key to solve these problems is to select able persons. They can only be selected and the most important way of selecting is to make checking method unite with checking contents. In the past, one was always checked by impression in which the human factor was always involved, especi ally when uncommen feelings existed between the checker and the checked. But by Fuzzy sets we can make up the shortcomings. of course, the history of the quantum judgement is very short compared with traditional checking methods. So it is used limitedly.

II. MATHS MODEL

Scientists and technician can't be measured with exact size like the parts produced in factories. It is difficult to evaluate by a forum or by votes. The standard is difficult to hold because it has a fuzzy character and many other factors. Sometimes, manfeeling acts a lot. In order to deal better with the fuzzy phenomenon in the evaluation and reflect the real level of a scientist or a technician as exactly as possible, the Fuzzy Sets theory is used. A general maths model is set up. It is also suitable for the evaluation on all-classes of eadres and the works of everymanagement.

First, the evaluating condition set A and the grade set S are decided. Supposing they:

A=(condition 1, condition 2, ... , condition T)

S=(grade 1, grad2, ... , grad F) In which, the condition is limited on each pratical demand of different classes. And the grade is decided by practical case. second, different importance of each condition in the general comment should be judged by experts and experienced, well-known managers. Then the condition prortion matrix corresponding to A can be obtained: A=(a1, a2 , ... , aT) In which $\Sigma a(i)=1$ (ie. 100 marks) In order to make use of it easily, the evaluation card is designed.

The Quantity Comment Card

Name———— Unit————

Cond. & proportion	Grade 1	Grade 2	...	Grade F	remarks
(a1) cond. 2					
(a2) cond. 2					
... ...					
(aT) cond. T					

Checker's U nit————

Note: The checker's fill in the column with "0" according to show their opinions in accordance with what they have known. If they don't know about some columns, they can mark "*" which are treated as abstent-

ion in calculation. The checkers in the work should compise upper and juior cadres and his colleagues who have a direct work connected with the checked. the process is: First the checked gives an account of his own work according to the evaluation conditions. second, the checkers put forward some questions according to evaluation conditions, the facts ther have known andwhat the checked reported. then the checked answers or explains the questions on the spot. Third, the checkers have a discussion, and fill in the card. Finally computers are used to deal with the data. After the statistics of the evaluation cards with computers by corresponding arrangement of conditional position. The table is obtained.

$$\begin{bmatrix} b(11) & b(12) & \dots & b(1F) \\ b(21) & b(22) & \dots & b(2F) \\ \dots & \dots & \dots & \dots \\ b(T1) & b(T2) & \dots & b(TF) \end{bmatrix} = B \quad B^* \frac{1}{W} \longrightarrow \begin{bmatrix} r(11) & r(12) & \dots & r(1F) \\ r(21) & r(22) & \dots & r(2F) \\ \dots & \dots & \dots & \dots \\ r(T1) & r(T2) & \dots & r(TF) \end{bmatrix} = R$$

In which b(ij) is the information of i-kind comment according to i-condition. Table B is called card Statistic Matrix. To make the calculation easy, let every elemeet in B be divided by W, the figures checked (see the second formula above) In it $0 \leq r(ij) \leq 1$

The datum information of synthetical evaluation can be given by the following formula

$$A \xrightarrow{W} R=(C_1\ C_2\ \dots\ C_F) \qquad \text{In which:}$$

$C_j = \dfrac{\bigcup_{i=1}^{T}(r_{ij} \wedge a_i) + \sum_{i=1}^{T} a_i r_{ij}}{2}$ (The reliable evidences are omitted) j=1,2, ..., F. In order to show objectively, the result is delt with by standardization:

$S=(C_1 + \frac{C_1 * Y}{\sum C_i}, C_2 + \frac{C_2 * Y}{\sum C_i} \dots C_F + \frac{C_F * Y}{\sum C_i})$, $Y=1-\sum_{i=1}^{F} C$, Si show the degree of the checked to i-kind comment.in percentage. T

It can be presented with hundred-mark by the following formula according to the habitual formula value of each grade presented by percen-

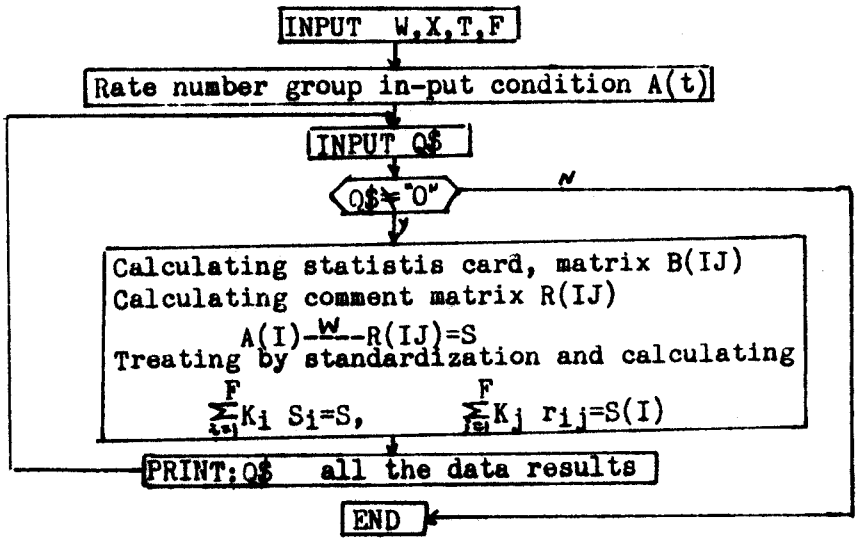
age in the comment.

$S=\sum_{i=1}^{F} K_i \cdot S_i$ In which K_i stands for the habitual formula value of i-kind comment in percentage. To make problems be found easily, the evaluation informations of i-condition can be also presented with hundred-mark S(I)

$$S(I)=\sum_{j=1}^{F} K_j \cdot r_{ij}$$

III. COMPUTER MANAGEMENT

Corresponding with the synthetice evaluation built above, we make a process fit for the computers IBM pc-XT, JB-3000, SHARP pc1500, Apple II and so on. Considering the length of the essay, only the frame is provided



In which, W= the number of people attending to the checking. X= the numbers. F= comment grades numbers. QS= the name of the people checked.

Inorder to make the calculation easy, ti's assingged that 1,2,3, ... F stands for gradel, grade2, grade3 ... grade F. The next step is to input T F and conditional proportion matrix A. (only once is enough for all the cards on A by the assigned. code number, the computer will immediately show all the data informations of A's synthetic evaluation. Take wang for example, here is the evaluation result of wang's, the general engineer:

$$\begin{pmatrix} 0.72 & 0.71 & 0.11 & 0 & 0 \\ 0.61 & 0.33 & 0.06 & 0 & 0 \\ 0 & 0.76 & 0.22 & 0 & 0 \\ 0.06 & 0.89 & 0.06 & 0 & 0 \end{pmatrix}$$

$$A^* \begin{bmatrix} 0.56 & 0.44 & 0 & 0 & 0 \\ 0.06 & 0.78 & 0.17 & 0 & 0 \\ 0 & 0.78 & 0.22 & 0 & 0 \\ 0.56 & 0.33 & 0.11 & 0 & 0 \\ 0.61 & 0.33 & 0.06 & 0 & 0 \end{bmatrix} = (0.36,\ 0.52,\ 0.12,\ 0,\ 0) \qquad S=93.32$$

S(1)=95.55, S(2)=95.24, S(3)=90.46, S(4)=92.86, S(5)=95.06, S(6)=92.09, S(7)=90.46, S(8)=94.59, S(9)=95.24

IV. SUPPLIED EXAMPLES

We checked all the technicians of Anyang Machine Tool Factory, the heavy Industry Bureau, and the Iron and steel Company respectively and achieved a good result. It supplied an important evidence for some units to choose talented people scientifically. the process is as following. The card for general engineer, director engineer and common engineer are designed by experts, experienced and highly respected cadres and some scientists and technicians, after repeated study, the direction of these cards is same with that of general evaluation card mentioned before. There're 6 grades--super best, best, better, good, worse--for all these three kinds of engineers. The condition and proportion for general engineers are: carrying out policies 15%, taking corrrect suggestion 8%, reforming and creative 7%, plan and arrabgement 7%, organizing ability8% ability of decision 10%, raising correct technical views5%, wide arrange of knowledge 10%, study and progress 5%, information idea 10%, good health 10%, young and capable 5%. Those for director engineers are: practical and honest 8%, serious and responsible 9%, uniting with colleagues 5%, technical arrangement 5%,work plan 7%, abilityof scientific research and organization 8%, ablity of judgement and synthetical analyze 10%, study and progress 5%, be patient to teach 5%, good health 5%, young and capable 5%. Those for common engineers are: professional morality 15%, union 5%, working actively 10%, applying professional knowledge 5%, work effeciemcy 10%, ability of technical organization 7%, ability of doing creative work 8%, expressing ability 5%, good health 15%,young and capable 5%.

In checking, every checker fills in the cards objectively according to what they have known, then computers calculate synthetically. In order to make the work simple, it is assigned that the numbers 1,2,3,4,5,6 stand for the "super best" "best" "better" "good" "bad" "worse". "0" is used instead of code names of abstentions.

Taking the card of an engineer as an example. If the comments of condition, 1-12 are respectively "best" "better" "better" "best" "good" "best" "better" "good" "worse" "better" "better" "best". Now input the data: 2,3,3,2,4,2,3,4,5,3,3,2 inorder. Meantime the computer will finish calculating. Then input all the comment cards for the person in the same way. After the calculating treatment, the computer shows the quantative evaluation result for him.

V.CONCLUSION

Scientists and technicians are evalued or selected quantatively by Fuzzy sets with computer solves not only the problems of speed and precision, but also has two special functions.

First, it can judge the qualities of the checked by computers according to the comment data the Matrix R and make clear where exist the strong points and weak points and how to improve the coming work.

Secondly according to all the data comments of the checked in every Comment Matrix R, we use computers to analyze comprehensively and obtain the comprehensive quantity comment of the same kind of technicians, and take it as the important basis to improve our work and choose talented people.

REFERENCES

1. L.A.Zadeh, "A Fuzzy Set Theoretical Interpretation of Hedges", Electronics Research Lab, Memo M-335 Berkeley (1972)
2. Wang Peizhuang, "Fuzzy Sets Theory and Usage", shanghai Scientific Publishing House (1983)
3. wang Aimin,"the computer Evaluation of Fuzzy Equotion"LTJ" 2,(1986)