FUZZY MULTIFACTORIAL EVALUATION OF MEDICINAL QUALITY

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ABSTRACT

In this paper, we make use of method of multifactorial evaluation to carry on multifactorial evaluation for quality of medicine(or other products)and management of quality of products.First of all, we take the method oflinear function and trapezoidal distributive function as a bridge, basde on it, we establish membership function which is every evaluation target relative to each objict of evaluation, then carry on multifactorial evaluation. The result comforms to an objective reality by analysing.

Keyword:Medicinal Quality, Fuzzy Multifactorial Evalution

I. PREFACE

Strengthening administration of quality of medicine and heigthening the quality of medicine is important problem about the people. At present we check and control medicinal quality and we establish the standard of qualified and excellent quality according to "medicine dictionary" but we can't precisely evaluate the products that is good or bad degree,the evaluation of quality of products is especially affected by many targets of factor. In real work, the evaluation of quality of medicine is complex and difficult problem. In this paper, we make use of method of fuzzy multifactorial evaluation to carry on multifactorial evaluation for the quality of medicine.

2.THE MULTIFACTORIAL EVALUATION OF MANY PRODUCTS

It is a method which look for the better from a great number of same products.

Now taking the tablet of traditional chinese medicinal herbs for example, we establish standard basde on the item and request of examination in the dictionary of chinese medicine of Tianjin.

(1). Appearance(method of evaluation of work points or marks) : The product that is given six points is qualifier and the ten points is full marks.

(2).Limit of difference of each tablet(weight of each Tab$\leqslant$0.3g)=$\pm$ 5%.

(3).Limit of melt (sugar-coated tablet)<=100 minutes.

(4). Moisture(dry method)<=8%.

(5).Health standard:Can't have pathogenic bacteria and living germ and egg of germ; contained no-pathogenic bacteria<=10000/g; contained mould<=500/g.

Basde on above standard we take the result of three batch same products to carry on evaluation(List I).

Basde on fuzzy change axiom such as figure I, let's express each factor

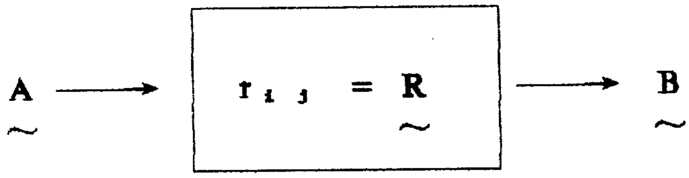

Figure .I.

LIST I

PRODUCT / ITEM	Y1 FIRST BATCH	Y2 SECOND BATCH	Y3 THIRD BATCH
U_1	7	6	8
U_2	2%	3%	4%
U_3	60	70	50
U_4	5%	4%	6%
U_5	9000	8000	7000
U_6	300	200	400

Note: U_1=appearance U_2=limit of difference of each Tab(%)
U_3=limit of melt(minute) U_4=moisture(%)
U_5=no-pathogenic bacteria(each gram) U_6=mould(each gram)

above(list I) and relations between them and each product with fuzzy vector A and fuzzy relation matrix R. First we form factor set. This is shown in vector $U=(u_1,u_2,\ldots,u_6)$. Distribution of number of weighted in the whole for all the factors, such as u_i is respectively $a_1=0.1, a_2=0.5, a_3=0.3, a_4=0.2, a_5=0.4, a_6=0.4$. This is shown in vector $A=(a_1, a_2,\ldots,a_6)$. It is fuzzy set on U. Then evaluation set is formed. There are three batch products whichis shown in Y_1,Y_2,Y_3. This is shown in vector $Y=(Y_1,Y_2,Y_3)$. It is fuzzy set on Y.

Now basde on membership function between factor set and evaluation set, we make up relation matrix R.

$$R=((U_i,Y_j,ur_{ij})/i=1,2,\ldots,6;\ j=1,2,3.)$$

Membership function is established according to the characteristic of each target factor. In order to make them simple, they all adopted linear function. If $G_i(x)$ ($i=1,2,\ldots,6.$) show respectively membership which is each factor u_i, we line up every $G_i(x)$ as follows.

$$G_1(x)=\begin{cases}1 & ,(x=10)\\ x-6/10-6 & ,(6<x<10)\\ 0 & ,(x=6)\end{cases} \qquad G_2(x)=\begin{cases}1 & ,(x=0)\\ 5-x/5 & ,(0<x<5)\\ 0 & ,(x=5)\end{cases}$$

$$G_3(x)=\begin{cases}1 & ,(x=0)\\ 100-x/100 & ,(0<x<100)\\ 0 & ,(x=100)\end{cases} \qquad G_4(X)=\begin{cases}1 & ,(x=0)\\ 8-x/8 & ,(0<x<8)\\ 0 & ,(x=8)\end{cases}$$

$$G_5(x)=\begin{cases}1 & ,(x=0)\\ 10000-x/10000 & ,(o<x<10000)\\ 0 & ,(x=1000)\end{cases} \qquad G_6(x)=\begin{cases}1 & ,(x=0)\\ 500-x/500 & ,(0<X<500)\\ 0 & ,(x=500)\end{cases}$$

For the above membership we can reckon respectively value of membership function of each target which is above three batch medicine and it is shown in matrix R.

$$\underset{\sim}{R} = \begin{bmatrix} 0.25 & 0 & 0.5 \\ 0.6 & 0.4 & 0.2 \\ 0.4 & 0.3 & 0.5 \\ 0.4 & 0.5 & 0.25 \\ 0.1 & 0.2 & 0.3 \\ 0.4 & 0.6 & 0.2 \end{bmatrix}$$

Let R fuzzy change axiom. The number of weighted A is shown in vector $A'=(o.1,0.5,0.3,0.2,0.4,0.4)$ Let $\sum_{i=1}^{6} a_i=1$ $a_i\in[0,1]$. Then we get:

$$\underset{\sim}{A}=(0.05,0.26,0.16,0.11,0.21,0.21)$$

basde on formula B=A o R, then operator "0" is calculated by adding and multiplying. We get:

$$B=(0.3185,0.3750,0.2895)$$

among them $B_{j_o}=\underset{1\leqslant j\leqslant 3}{MAX} b_j$. It is the better products. Then others are sequenced and fix on the better and morse for every product. Therefor we can now that the quality of the first batch medicine is the best, the second is better, the third is no good.

3. MULTIFACTORIAL EVALUATION OF PRODUCTS OF A KIND

It is a method of evaluation of quality grade.

We take the tablet of traditional chinese medicinal herbs to explain. First of all, we establish standard of each target factor according to the model of medicinal dictionary(list II).

Let $U=(u1,u2,...u6)$ be the set of factor. Among them distribution of number of weighted for all the factor is respectiively $A=(a1,a2,...a6)$ and let $\sum_{i=1}^{6} a_i=1$ $a_i\in[0,1]$. let $A=(0.05,0.26,0.16,0.11,0.21,0.21)$.

LIST II

class / item	V1	V2	V3	V4
U1	[6, 7]	[7, 8]	[8, 9]	[9, 10]
U2	[5, 4]	[4, 3]	[3, 2]	[2, 0]
U3	[100, 80]	[80, 60]	[60, 40]	[40, 0]
U4	[80, 65]	[65, 50]	[50, 40]	[40, 0]
U5	[10000,8000]	[8000, 6000]	[6000, 4000]	[4000, 0]
U6	[500, 400]	[400, 300]	[300, 200]	[200, 0]

Note: V1=common product V2= good product V3= better product V4= best product U1=appearance U2=limit of difference of each Tab (%) U3= limit ofmelt(minute) U4=moisture(%) U5=no-pathogenic bacteria(/g) U6=mould(/g)

Now the result of evaluation are divided into four classes(list II) V1=common product V2=good product V3=better product V4=best product so that they form evaluation set V=(v1,v2,v3,v4).

Let us establish fuzzy relation matrix R between factor set U and evaluation set V for each evaluation object.

$$R=\{(U_i,V_j,ur_{ij})/i=1,2,\ldots 6;\ j=1,2,3,4.\}$$

If R have been got we carry on operation basde on formula B=A o R. The operator "o" is calculated by adding and multiplying.

$$B = A \circ R = (a1,a2,\ldots,a6)\begin{bmatrix} r11 & r12 & r13 & r14 \\ r21 & r22 & r23 & r24 \\ \cdots & \cdots & \cdots & \cdots \\ r61 & r62 & r63 & r64 \end{bmatrix} = (b1,b2,b3,b4)$$

Among them $B_j=\sum_{k=1}^{6} a_k . r_{kj}$ (j=1,2,3,4) (3——2)

If $b_{jo}=\underset{1\leqslant j\leqslant 4}{MAX} b_j$ then the appraisal object is evaluated to get a comment V_{jo}.This is the final result of multifactorial evaluation.

Based on list II,we establish membership function which is every factor relative to each class.in order to make them simple, they full adopted trapezoidal distribution function.If $f_{ij}(x)$ (i=1,2,...,6. j=1,2, 3,4) show membership which is factor U_i relative to the grade V_j.We only line up $f_{11}(x)$,$f_{12}(x)$,$f_{13}(x)$,$f_{14}(x)$ but others $f_{ij}(x)$ are omitted.

$$f_{11}(x)=\begin{cases}1 & ,(6\leqslant x<7)\\ (10-x)/3 & ,(7\leqslant x\leqslant 10)\end{cases}\qquad f_{12}(x)=\begin{cases}x-6 & ,(6\leqslant x<7)\\ 1 & ,(7\leqslant x<8)\\ (10-x)/2 & ,(7\leqslant x<8)\end{cases}$$

$$f_{13}(x)=\begin{cases}(x-6)/2 & ,(6\leqslant x<8)\\ 1 & ,(8\leqslant x<9)\\ 10-x & ,(9\leqslant x\leqslant 10)\end{cases}\qquad f_{14}(x)=\begin{cases}(x-6)/3 & ,(6\leqslant x<9)\\ 1 & ,(9\leqslant x\leqslant 10)\end{cases}$$

... ... , ... , ...

Based on above membership function and result of sampling check of medicine, we form fuzzy relation matrix R. In list I we take the first batch products for example. Let Y1∈x relation matrix R1 is formed. About Y1 we get $f_{11}(7)=1$, $f_{12}(7)=1$, $f_{13}(7)=0.5$, $f_{14}(x)=0.33$, ... then $\underset{\sim}{R1}$ is got

$$\underset{\sim}{R1}=\begin{bmatrix}1 & 1 & 0.5 & 0.33\\ 0.5 & 0.33 & 0.5 & 1\\ 1 & 1 & 0.5 & 0.33\\ 0.77 & 1 & 1 & 0.75\\ 1 & 0.5 & 0.25 & 0.17\\ 0.75 & 1 & 1 & 0.67\end{bmatrix}$$

According to formula (3---1) and (3---2), we get

$$B=(0.7922, 0.7808, 0.6075, 0.5882)$$

therefor Y1 get comment "the common product". We can also get comment of other object Yk, k=2,3. They can omitted here.

4. CONCLUSION

In this paper, the method of multifactorial evaluation is applied to evaluation of medicine quality and other quality of products. We must point out that the method of multifactorial evaluation is applied to evaluation of quality of products. The linchpin upon which problem depends is to find a bridge in meth method. Here we establish membership function between each evaluation target and evaluation object. They full adoptred linear function and trapezoidel distributve function. We make use of method of multifactorial evaluation to carry on management for quality of products. It is just a begining and must be perfect step by step to serve managemenet of quality better.

5. REFERENCE

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