A KIND OF COORDINATED MODEL FOR SOCIAL SYSTEM

Yue Luzhi (shenyang Institute of Chemistry Technology)
Liang Baoguo (Shenyang University of Technology)
Li Zhengping (Shenyang Institute of Aviation Technology)

ABSTRACT

In this paper we discussed how we coordinate a kind of conflict in social system.

In group decisions a decision method has been completed by XU SHUBO in [2] when goals of decisionmakers are unanimous. On this basis we discuss a kind of decision method when goals of decisionmakers are not unanimous. First a function of satisfied degree is established. On the basis of the function the concepts that goal A and B are reconcilable or irreconcilable are given. Then to find coordinated point and region we introduce normal equallbrilum point and obtain rough algorithem for calculation of the equalibrium point. Finally in order to achieve ensemble coordination we give the algorithem for ensemble coordination at the base of bilateral coordination.

In fact we fourd the solution to the following model

$$\begin{aligned} &\text{Find} && A \\ &\text{S.T} && AU + (E-A)V = W \\ & && \text{MAX } \; Y=H(W) \end{aligned}$$

Here U, V are known as matrices, E is a matrix in the elements of which are all 1. We had also transfered the model into following

$$\begin{aligned} &\text{Find} \quad W(i,j) \\ &\text{S.T} \quad \begin{cases} W(i,j) \;\triangle\in\; C(i,j) \\ \Sigma_j W(i,j) = a(i) \quad i=1,2,\ldots,n \\ \Sigma_i W(i,j) = b(j) \quad j=1,2,\ldots,m \end{cases} \end{aligned}$$

The paper explores how the problems in action and thinking be quavtitatinely dealt with using AHP.

INTRUDUCTION

In order to solve the problem conflicts in supply and demand, we discuss a kind of coordinated model of social system.

Let us choose this following goal system which is used in supply and demand

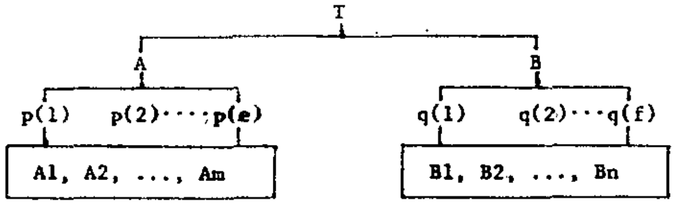

Fig.1

here T is coordinated structure at the centre
A B are goals in supply and demand separately
p(i) (i=1,2...) is the goals of supply subsystem
q(j) (j=1,2...) is the goals of demand subsystem
Ai (i=1,2...m) is the decisionmaker of supply side
Bj (j=1,2...n) is the decisionmaker of demand side

By using AHP we can obtain weighted value u(i,j) which is A(i) with respect B(j) (i=1,2,...,m, j=1,2,...,n). The weighted value is ratio between number distributed by A(i) among B(j) and amount of A(i) in practice. Thus we can obtain one side selected supply matrix U(i,j). Then we standardize the metrix and still use the sign of the matrix U(i,j). Similarly can define one-side selective demand matrix V(i,j). By using the coordinated algoritem we can better solve conflict

FUNCTION OF SATISFIED DEGREE

Let U(i,j) represent the weighed value of A(i) with respect B(j), V(i,j) represent the weighted value of B(j) with respect A(i).

DIFINATION 1: The function of satisfied degree is simply a mapping form weighed value x to satisfied degree y and denoted y=H(x)
Here x is the weighed value obtained by AHP.
y is the satisfied degree of decisionmaker, y=0 when the welghed value voilates with the profit of decisionmaker, as the satisfied degree of decisionmaker increase y increases, y=1 when decisionmakers very satisfy PROPERTY

If y=H(x) is the function of satisfied degree of A(i) with respect B(j), it has one greatest value when x=U(i,j), and satisfied degree of decisionmakers is bigger near by U(i,j).

By the satisfied degree we classlfy the weighted value into 4 part. They are

r1=arcH(y), (0.8<y<=1). r2=arcH(y), (0.5<y<=0.8)
r3=arcH(y), (0.3<y<=0.5). r4=arcH(y), (0<=y<0.3)

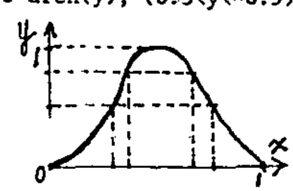

Fig.2

DIFINATION 2: r_1, r_2 are said to be excitant region, satisfactory region separately: r3 and r4 are said to be pessimistic region and noted r0. To coordinate A(i), B(j) we discuss coordinated method which is based on function of satisfied degree.

If y=H(x) and y=L(x) are functions of satisfied degree of supply and demand separately. (see Fig.3)

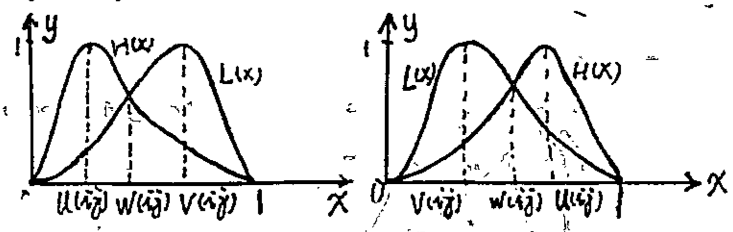

Fig.3

As the figure show: y=H(x) and y=L(x) have greatest value when x=U(i,j) and x=V(i,j) separately and if curves intersect when x=W(i,j) then by the figure we can obtain the following information

(1). Curve y=H(x) is a increasing function and curve is a decreasing function in interval [V(i,j), U(i,j)] or curve y=H(x) is a decreasing function and curve y=L(x) is a increasing function in the interval [U(i,j), V(i,j)].

(2). functions y=H(x) and y=L(x) may be roughly considered as continuative function.

(3). Because two curves intersect at A, both sides of supply and demand have same satisfied degree in x=W(i,j). The simplifed W(i,j) is called equalibrium point.

(4). Because the satisfied degrees of both sides of supply and demand is of little difference nearby x=W(i,j), we call nearby x=W(i,j) as equalibrium region and note this region by letter G. It is obvious that point in region G can be considered as approximate equalibrium point.

DIFINATION 3: If C=(r1(a)Vr2(A))V(r1(B)Vr2(B))≠ϕ, then A and B are considered as reconcilable and any a∈C is called coordinated point and C called coordinated region. Otherwise A and B are irreconcilable.

The result is equivalent to following represent.

If there is a equalibrium region in which satisfied degree of every point is bigger than 0.5 then A, B are reconcilable

COORDINATION THEOREM AND METHOD

This excerpt has three problems

(1). Calculation of equalibrium point.

(2). Discussion of two-sides stisfied degrees in the equalibrium point.

(3). Determination of reconcilable property.

The three proplems are discussed in the following steps.

(1). Under normal condition discussion of equalitrium point.

Now we only know the point in which $y=H(x)$ has maximum value and know it's monotony. In order to be convenient, we assume that curves of $y=H(x)$ and $y=L(x)$ are broken line and $y=H(x)$ and $y=L(x)$ pass through (u,1), (1,0) and (0,0), (v,1) separately. Their equations are:

$$H:\ \frac{x-1}{y}=\frac{u-1}{1} \qquad L:\ \frac{x}{y}=\frac{v}{1}$$

Finally we may write

$$H:\ y=\frac{1}{u-1}(x-1) \qquad L:\ y=\frac{1}{v}x$$

thus H and L will intersect when $x=v/(1+v-u)$, the x being denoted w0

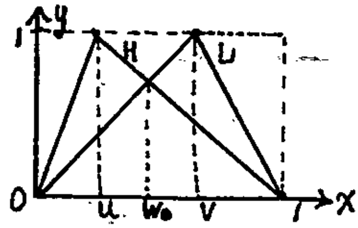

Fig.4

DIFINATION 4: The abscissa w0 is called normal equalibrium point when broken lines H and L intersect.

In general coodinated problet $w=U+(1-\lambda)V$ is to choose λ. which makes twosides satisfied degree at the point w bigger.

PROPOSITION: according to that above normal condition $w0=v/(1+v-u)$, and $\lambda.=v/(1+v-u)$. Under the coordinate transformation $x=x'$ $y=ky$ the above result do not change.

PROVE: Under the normal condition substituting $w0=v/(1+v-u)$ into $w0=U+(1-\lambda)V$ and reducing it there is $\lambda=v/(1+v-u)$, the result is independent of y.

Let us discuss the meaning of the proposion:
Considering that

$$\lambda=\frac{v}{1+v-u}=\frac{1/|u+1|}{(1/v)+(1/|u-1|)}\ ,\quad 1-\lambda=1-\frac{v}{1+v-u}=\frac{1/v}{(1/v)+(1/|u+1|)}$$

and it is fact that $1/|u-1|$, $1/v$ (they are rate of change of line H and L in the interval [u,v]) express sensitivity to change of weighted value. It is reasonable to structure weighted coefficient with sensibility. In general $|H'(x)|$, $|L'(x)|$ reflect the sensitivity of satisfied degree to weighted value, however the sensitivity can be reflected by length r1 of excitant region of decisionmakers (see Fig.5)

As shown in the Fig.5 r1(A)<r2(B). It can be seen that the sensitivity

of A is bigger than B. By the stability theorem we can obtain determination based on which normal equalibrium approves equalibrium point.

If there are two functions of satisfied degree in supply and demand, the one with higher sensitivity is a decreasing function and the other is an increasing function, when $|w-v|>|w-u|$.

Otherwise the one with higher sensitivity is an increasing function and the other is a decreasing function, when $|w-v|<|w-u|$. Under above conditions the normal equalibrium point move to equalibrium point and gredually stablize. (see Fig.6,7)

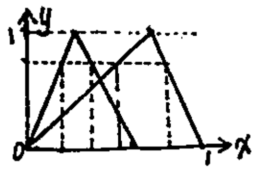

Fig.5

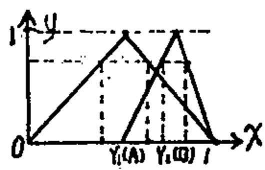

Fig.6

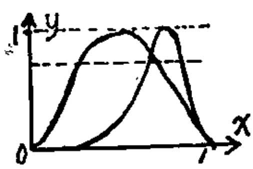

Fig.7

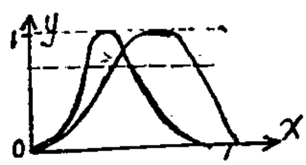

Fig.8

Normal equalibrium point controled by satisfied degree function moves to equalibrium point, and each moving point can be seen apporximation value of equalibtium point. If two-sided satisfied degree is higher in this point, this point is thought to be coordinated point.

(2) In the region with higher satisfied degree, the equalibrium point in (1) can be assumed in form as coordinated point, but it can't reflect the coordinated property. So we improve the coordinating method, that is, change the coordination at points u and v into that in small regions Δu and Δv which include u, v respectively.

If A, B are decitionmakers in supply and demand separately, by AHP we can determine r1(A), r2(B), by talking we can determine r2(A), r2(B). For convenience we will use note $r(A)=r1(A)\cup r2(A)$, $r(B)=r1(B)\cup r2(B)$. It is apparent that r(A), r(B) are closed intervals.

DIFINATION 5: $d(A,B) = \inf\{|u(i)-v(j)|\ u(i)\in r(A), V(j)\in r(B)\}$

It is obvious that (1) $d(A,B)>=0$

(2) $d(A,B)=0 \Leftrightarrow r(A)\cap r(B)=\phi$,

that is, A, B are reconcilable

To handle some of irreconcilable problems we give, out the difinations.

DIFINATION 6: If ε is preassigned positive number, the A and B are said to be of coordination, when $0<d(A,B)<\varepsilon$. Othervise it is ε-irreconcilable. According to above method we can decide coordinated property of A and B. If A and B are reconcilable we suggeste that the following formulas be med to calculate coordinated point and coordinated region

$$w = \frac{1/\Delta 1}{(1/\Delta 1)+(1/\Delta 2)} U + \frac{1/\Delta 2}{(1/\Delta 1)+(1/\Delta 2)} V. \quad C = r(A) \cap r(B) \quad (*)$$

Here 1, 2 are interval length of r1(A) and r2(B) separately

U is weighted value of A with respect B.

V is weighted value of B with respect A.

(3). Ensemble coordination

By the above analysis the coordinated results of Ai and Bj can be parted in following cases

(1) Ai and Bj are reconcilable, that is $d[(A), B(j)]=0$

(2) Ai and Bj are irreconcilable that is $d(Ai,Bj)>0$. It includes the following two cases

1) Ai, Bj are ε-reconcilable that is $0<d(Ai,Bj)<\varepsilon$.

2) Ai, Bj are ε-irreconcilable that is $d(Ai, Bj)>=\varepsilon$.

(Here ε is preassigned positive number).

Now the thing is to coordinate more Ai and Bi in the permissible range, that is $d(Ai,Bj)>0$, so we use a variety methods on all kinds of above situations.

1. On guaranteed condition that Ai and Bj in above (1) are reconcilable remained weighted value move (2)1).

2. Case (2)2) is not coordinated and it is noted $W(i,j)=0$

Concrete method is to find out solution satisfing following relation

$$W_{ij} \in \widetilde{\Delta_{ij}}, \text{ and } W_{ij}>0$$

$$\sum_j W_{in} = \overline{n_i}/N$$

$$\sum_i W_{ij} = n_{ij}/N$$

Here ni is the number of Ai

nij is distributed number to Bj by Ai

N is the total number

The any above solution can be adopted by decitionmakers

SIMPLE EXAMPLE

To explain the above method we give out the following simple example. The example is to program the distribution of graduates.

The goal system is

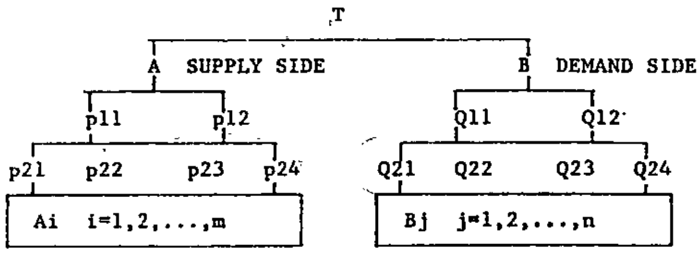

Fig.9

Here p11, Q11: in accord with scientific principles
p12, Q12: in accord with social need
p21, Q21: Geography condition
p23: layout of specialty and tendency of the developing industry
p24: future of graduates and fame of univerity
Q23: specialty need
Q24: famous degree of univasity

In the problem there are 2000 specialties and 6000 enterprises. Using AHP we can obtain one-side selective supply matrix U and the one the sids selective demand matrix V. They are multidimension matrixes, which many element are zero.

Using a transformation of line and row we can obtain some independent subsystem. (see Fig.10)

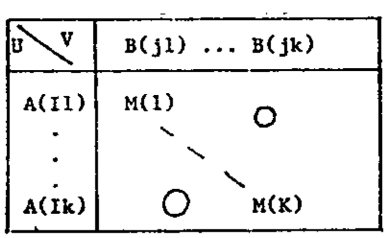

Fig.10

Here M(i) = (u(i), v(i)) i=1,2,...,k

Dimension of each subsystem is less than 200. We only need coordinate each subsystem.

EXAMPLE

If A1 represents SHENYING UNIVERSITY OF TECHNOLOGY, B2 represents a AUTOACCRSSORRY PLANT. According to AHP and the results of goal decision we have got weighted value uij of Ai with respect Bj, weighted value vij of Bij with respect Ai, and a series of excieant region r1(Ai) and r1(Bj). There u11=0.45, v12=0.75, r1(A1)=[0.4, 0.5], r1(B2)=[0.6, 0.9]. By talking we can obtain that r2(A1)=[0.5, 0.55], r2(B2)=[0.45, 0.6].

As shown in the Fig.11, two curve represent functions of two-side satisfied degree in the excitant region and two line segments represent approximate function of two-side satisfied degree in the satisfactory region.

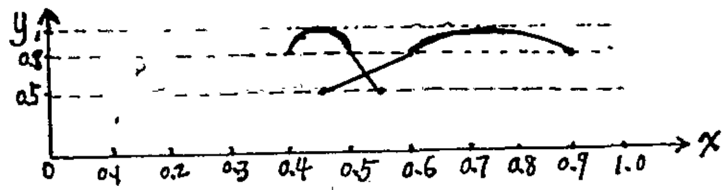

Fig.11

Thus acoording to the above conditions and famula (*) we get

$$w12 = \frac{0.3}{0.3+0.1} \times 0.45 + \frac{0.1}{0.3+0.1} \times 0.75 = \frac{21}{40}$$

$$\Delta c12 = [0.4,\ 0.55] \cap [0.45,\ 0.9] = [0.45,\ 0.55]$$

Similarly we can also get all coordinated value and region.

On condition that restriction be satisfied the coordinated structure T at the centre can choose a better result and be regarded as program for distribution.

REFERENCES

Saaty T.L. 1980 The Analytic Hierarchy Process
Shubo Xu, The Principle of The Anolytic Hierrarchy Process, Tianjin Univ. Press, 1988