THE ORDER OF COMPLEX FUZZY NUMBER

--THE ORDER OF CLASSICAL RATIONAL GREY NUMBER

YUE CHANG-AN

HANDAN PREFECTURE EDUCATION COLLEGE

HANDAN HEIBEI CHINA

WU HE-QIN

HEBEI COAL MINING AND CIVIL ENGINEERING COLLEGE

HANDAN HEIBEI CHINA

The definition of complex fuzzy number (or classical rational gery number) has been in article[1][2] as follows:

$$u(x)=\begin{cases}\{1\}, & x\in[a,b]\\ \{0\}, & x\notin[a,b]\end{cases}\quad a,b\in R,\ a\leq b$$

We called those grey numbers that are written in the above pattern interval-type (or hieravchy-type)grey numbers.Aan the interval-type grey numbers can be written as [a,b],in which a , b are respoctively called left,right endpoint of the interval-type grey number u(x) ,written as a=p[u(x)], b=Q[u(x)], of which the supporting set

$$E=\{X|\sup u(X)\neq 0\}=[a,b]$$

and inf u(x)=1

As follows:

$$u(x)\begin{cases}\{0,1\}, & x\in[a,b]\\ \{0\}, & x\notin[a.b]\end{cases}\quad a,b\in R,a\leq b$$

We called those gery numbers which can be written as the above pattern information-type gery numbers (or Deng's gery numbers),which can be written as [a,b], in which a,b are respectively called left ,right endpoint of information -type gery number u(x) ,written as a=p[u(x)],b=Q[u(x)],of which the supporting set

$$E=\{x|\sup u(X)\neq 0\}=[a,b],$$

and $\inf u(x)=0$

Information-type , interval-type grey numbers are called by a joint name classical rational grey number .It is obvious that the classical rational grey number becomes fuzzy number when it is interval-type grey number. therefore , classical rational grey numbers are also called complex fuzzy number[3].

The order of classical rational grey numbers (or complex fuzzy number) is very important in the research on grey limit and grey function .so it is very necessary for us to study this problem.

Definition1. Let $u_1(x), u_2(X)$ be two classical rational grey numbers (or complex fuzzy numbers) ,if

$$\frac{p[u_1(x)]+Q[u_1(x)]}{2}=\frac{p[u_2(x)]+Q[u_2(x)]}{2}$$

then we call $u_1(x)$ and $u_2(x)$ the concentric classical rational grey numbers (or concentric complex fuzzy numbers),written as $u_1 \backsim u_2$, and to any classical rational grey number $u(X)$, $\frac{p[u(X)]+Q[u(X)]}{2}$ is called by us its centre, written as Θu.

From definition 1 , we can easily draw the conelusion as follows:

Theorem 1. If $u_1 \backsim u_2$, then $u_2 \backsim u_1$.

Theorem 2. If $u_1 \backsim u_2$, $u_2 \backsim u_3$ then $u_1 \backsim u_3$.

theorem 3. For arbitrary $u(x)$ there is $u \backsim u$.

We may divid the classical retion grey numbers into the equivalent class by the same centre according to the three theorems above,so that any grey number of the same kind is concentric .

Theorem 4. If $u_1 \backsim u_2$ and $Q[u_1(x)]=Q[u_2(x)]$

then $P[u_1(x)]=P[u_2(x)]$

Proof: since $u_1 \backsim u_2$.

$$\frac{P[u_1(x)]+Q[u_1(x)]}{2} = \frac{P[u_2(x)]+Q[u_2(x)]}{2}$$

and due to $Q[u_1(X)]=Q[u_2(x)]$

$$\frac{Q[u_1(x)]}{2} = \frac{Q[u_2(x)]}{2}$$

$$\frac{P[u_1(x)]}{2} = \frac{P[u_2(x)]}{2}$$

hence $P[u_1(x)]=p[u_2(x)]$

with the same method mentioned above ,we can prove the following conclusion:

Theorem 5. If $u_1 \backsim u_2$ and $P[u_1(x)]=P[u_2(x)]$ then $Q[u_1(x)]=Q[u_2(x)]$

Theorem 4 and theorem 5 show that to the concentric classical rational grey number $u_1(x)$, $u_2(x)$, if there is a same endpoint and $\inf u_1(x)=\inf u_2(X)$ then $u_1(x)=u_2(x)$.

Definition 2.

(1) If $\theta u_1 < \theta u_2$, then we would say $u_1(x)$ is smaller then $u_2(x)$, written as $u_1 < u_2$.

(2) If $u_1 \backsim u_2$ and $Q[u_1(x)]<Q[u_2(x)]$ then we would say $u_1(x)$ is smaller then $u_2(x)$, written as $u_1 < u_2$.

(3) If $u_1 \backsim u_2$ and $Q[u_1(x)]=Q[u_2(x)]$, $\inf u_1(x) < \inf u_2(x)$, then we would say $u_1(x)$ is smaller then $u_2(x)$, written as $u_1 < u_2$.

Theorem 6 Let $u_1(x)$ and $u_2(x)$ be two arbitrary classical rational gery numbers, we have and only have one of the following three egualities holds water:

$$u_1 = u_2 \ , \ u_1 < u_2 \ , \ u_2 < u_1 \ .$$

proof:

(1) when $\theta u_1 \neq \theta u_2$

The same gery number must be the common centre, therefore $u_1 = u_2$ does not hold water.since $\theta u_1 \neq \theta u_2$,we have and only have one of $\theta u_1 < \theta u_2$ and $\theta u_2 < \theta u_1$ holds water. From definition2 , we can come to a conclusion that we have and only have one of $u_1 < u_2$ and $u_2 < u_1$ can holds water.

(2) When $u_1 \Leftrightarrow u_2$,we can discuss it in the following two cases:

(i) If $Q[u_1(X)] \neq Q[u_2(x)]$, we have and only have one of $Q[u_1(x)] < Q[u_2(x)]$ and $Q[u_2(x)] < Q[u_1(x)]$ can holds water . From definition 2 , We have and only have one of $u_1 < u_2$ and $u_2 < u_1$ holds water , but $u_1 = u_2$ does not .

(ii)If $Q[u_1(x)] = Q[u_2(x)]$ when $\inf u_1(x) \neq \inf u_2(x)$, it means we have and only have one of $\inf u_1(x) < \inf u_2(x)$ and $\inf u_2(x) < \inf u_1(x)$ holds water ,but $u_1 = u_2$ does not.when $\inf u_1(x) = \inf u_2(x)$,we have and only have $u_1 = u_2$ holds water.

Summing up what mentioned above, theorem 6 is true.

Theorem 7 if $u_1 \leqslant u_2$ and $u_2 \leqslant u_1$,then $u_1 = u_2$.

Proof:(omited)

Treorem 8 if $u_1 < u_2$ and $u_2 < u_3$,then $u_1 < u_3$.

Proof: (omited)

From such discussions,we may see we made an orderly relationship on the basic of classical rational gery number (or complex fuzzy number) So the set of classical rational gery number is a complex ordering set (or ordinal set).

Reference:

[1] Deng Julong, The gery comtrolling system.

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[2] Wang Qinyin ,Wu Heqin ,The concept of gery number and its property, Proceeding of NAFIPS'88

[3] Yue Changan ,The complex fuzzy metric space --The gery metric space , n° 38 issue 89 of BUSEFAL.