# Research on the Multi-attribute Decision Making Model Based on the Possible Regret Degree of the Policy-maker

Peng Weibing
Law School of Central South University, Changsha, Hunan, China
Huaihua Intermediate People's Court, Huaihua, Hunan, China
Email: hpengweibing@163.com

Zhou Qihai
Information Technology Application Research Institute, Southwestern University Of Finance and Economics, Chengdu, Sichuan, China;
School of Economic Information Engineering, Southwestern University Of Finance and Economics, Chengdu, Sichuan, China
Email: zhouqihai@gmail.com

Li Yan
Information Technology Application Research Institute, Southwestern University Of Finance and Economics, Chengdu, Sichuan, China;
School of Economic Information Engineering, Southwestern University Of Finance and Economics, Chengdu, Sichuan, China
Email: Liyan77@163.com

*Abstract*—the non-definite multi-attribute decision making problem is the further expansion of research to the traditional multi-attribute decision making problem. In the actual decision-making, because of policy-making question's complexity, decision-making information acquisition costs and other reasons, the decision information which the policy-maker can obtain are mostly ambiguous, so in the real life, many of decision-making problems are the non-definite multi-attribute decision making problems. In the non-definite multi-attribute decision-making process, as decision-making information is non-definite, therefore the policy-maker, when carries on the decision-making, faced with the following difficult position: decision-makers making decision with the non-definite decision-making information most likely will regret. This article will conduct the research to this question, in order to portray the decision-makers dilemma in the decision-making process under the uncertain condition; this paper defines the following concept: policy-makers plus regret degree, policy-makers negative regret degree and policy-makers weighted combination regret degree. According to the different thresholds of policy-makers plus regret degree, policy-makers negative regret degree and policy-makers weighted combination regret degree, respectively determine the best plan and construct the optimal decision results table, policy-makers according to their preference situation can query this table and select the most excellent plan suited to their own situation.

## I. INTRODUCTION

Multi-attribute decision making problem is the hot spots in the policy science, systems engineering, management science and other research field, also has widespread and the important utilization in the real life. The multi-objective decision making question, in which the policy-making attribute took the single real value, has studied quite thoroughly. However, in practice, because of the incompleteness of information, the characteristics of policy-attributes and other reasons, people often encounter multi-attribute decision making problems in which the property value is fuzzy value. This kind of policy-making question is called non-definite multi-attribute question or risk multi-attribute decision making problems. For practical decision-making needs, this kind of multi-objective decision making question recent year gradually receives some scholar's attention. Generally speaking, the non-definite multi-objective decision making question mainly conducts the research to the following question: the attribute value take the fuzzy language value, the attribute value take the interval value, and the attribute weight value is partly unknown or completely unknown.

In the non-definite multi-attribute decision-making process, because the decision-making information is non-definite, so policy-makers select the best plan needing to face the following dilemma: Suppose there are two alternatives A and B to be available for policy-makers choose, policy-makers choose A and give up B, as decision-making information with non-definite, it actually may be that the B plan is better than A plan. In other words, policy makers in decision-making process with non-definite decision-making information most likely will regret. Existing research about the non-definite multi-attribute decision making problems is rarely related to this question, and this issue is root causes disturbed the policy-maker when caring on policy-making under the non-definite condition. This article will conduct the research to this question, in order to portray the decision-makers dilemma in the decision-making process under the uncertain condition; this paper defines the following concept: policy-makers plus regret degree, policy-makers negative regret degree and policy-makers weighted combination regret degree. According to the different thresholds of policy-makers plus regret degree, policy-makers negative regret degree and policy-makers weighted combination regret degree, respectively determine the best plan and construct the optimal decision results table, policy-makers according to their preference situation can query this table and select the most excellent plan suited to their own situation.

## II. LITERATURE REVIEW

Literature [1]-[14] has conducted the research to the fuzzy language multi-objective decision making question: In literature [1], the linguistic variable of the evaluation value and weight vectors is modeled by the normal fuzzy number, and the decision making framework based on the linguistic operator is established by the weighted mean method. The linguistic operator based on normal fuzzy numbers is given, and the calculating method for the cuts of the comprehensive evaluation value is put forward. The fuzzy number of evaluation is expressed by discrete cuts, and the normal fuzzy number is aggregated. In literature [2], defines the following concept: the expectation level of alternative, the uncertain linguistic negative point, the achievement scale, the alternative comprehensive scale under uncertain linguistic environment. Based on these concepts, some linear programming models are established, through which the decision maker interacts with the analyst. In literature [3], A TOPSIS method is proposed to deal with multiple attribute decision-making [MADM] problems with attribute weights unknown completely and the attribute values taken the form of uncertain linguistic variables. In literature [4], with respect to multiple-attribute decision-making (MADM) problems with uncertain linguistic information, a decision analysis method based on linguistic probability is proposed. The concept to uncertain linguistic variable is introduced and linguistic probabilistic ordered weighted averaging (LPOWA) operator is proposed. In literature [5], study the multiple attribute decision making problems, in which the

information about attribute weights is completely unknown and the attribute values take the form of uncertain linguistic variables. In literature [7], a simple and explicit formula for obtaining the attribute weights is given by the concept of range extremity difference. In literature [8], a new decision making approach based on D-S theory is proposed for the multi-attribute group decision making problem with incomplete linguistic assessment information. Literature [15]-[21] has conducted the research to the sector multi-objective decision making question: In literature [15], studies a kind of multi-attribute decision-making problem in which the preference information on alternatives and the attribute values are described by interval-valued intuitionist fuzzy numbers, and proposes a new method. In literature [16], for precisely quantify uncertainty, according to the isomorphic fundamental principles and the relative theories and the thought of the similar science, a new algorithm based on an isomorphism multi-objective decision-making new method was proposed. In literature [17], based on the connection number theory of Set Pair Analysis, find the interaction point of certainty and uncertainty, it shows the size of the interaction point". In literature [18], based on the concept of negative ideal point by considering the vector projection, the close-degree of the ideal pointed the negative close to the ideal point is comprehensively analyzed. In literature [19], the concepts of interval ideal point and inclination of each alternative on the interval ideal point are defined. The method uses the inclination to define the relative closeness between decision alternative and ideal point. In literature [21], a new possibility degree for comparing two projects is defined. A new method is proposed for inter-valuation-attribute decision-making, in which the attribute values are in the form of interval numbers. Literature [22]-[26] has conducted the research to the multi-attribute decision making question in which the value of attribute weight is partly unknown or completely unknown: In literature [22], the definition of deviation degree between two interval grey numbers is given from the essence of interval grey numbers as well as the concepts and formulas for individual imagined optimum vector and degree of group integrated grey incidence. Therefore the incidence degree coefficient formula is constructed from an analytical technique based on deviation degree for interval grey numbers and a minima regret-based approach is proposed to compare and rank this interval integrated grey incidence degree. In literature [23], with respect to multiple attribute group decision making problems with linguistic assessment information, a new method based on maximizing deviation and two-tupelo is proposed. In literature [24], some operational laws of interval-valued intuitionist fuzzy numbers, score function and accuracy function of interval-valued intuitionist fuzzy numbers were introduced. In literature [25], a multi-objective decision model is built, one objective is to maximize matching degree and the other is to maximize trading capitals, then according to the characteristic of the model which belongs to a type of mixed 0-1 integer quadratic programming model. In

literature [26], based on grey system theory, the grey attribute group decision-making problem is discussed, in which the attribute values are interval grey numbers and the attribute weights and authoritative weights are unknown.

### III. BASIC CONCEPT SYNOPSIS

This article discusses attribute type, either type of cost attribute (the value of this type attribute is more small, the plan is more good), or the efficiency attribute (the value of this type attribute is more small, the plan is more bad). Moreover, suppose the decision information table to undergo standardized processing in this paper.

Supposes $A = \{A_1, A_2, \cdots, A_n\}$ as the pre-set, $U = \{u_1, u_2, \cdots, u_m\}$ as the attribute set. $\tilde{v}_{ki}$ Expresses a sector value $[v_{ki}^L, v_{ki}^R]$ obtained by caring on appraising the plan $A_k$ ( $k = 1, 2, \cdots, n$) under the attribute $u_i$ ($i = 1, 2, \cdots, m$), then may get sector number decision-making matrix $\tilde{V} = [\tilde{v}_{ki}]_{n \times m}$. Supposes the attribute $u_1, u_2, \cdots, u_m$ expert weight value respectively is $\omega_1, \omega_2, \cdots, \omega_m$, where $\omega_i \geq 0$ ($i = 1, 2, \cdots, m$), and $\omega_1 + \omega_2 + \cdots + \omega_m = 1$.

**Definition 1.** The policy-maker carries on the decision-making under the condition that the attribute value takes the sector value $\tilde{v}_{ki}$, caring on evaluation to plan $A_k$ ( $k = 1, 2, \cdots, n$) under the attribute $u_i$ ($i = 1, 2, \cdots, m$) obtains the evaluation value $v_{kij}$. When the attribute $u_i$ is an efficient attribute, the policy-maker negative regret degree equals with $\dfrac{v_{kij} - v_{ki}^L}{v_{ki}^R - v_{ki}^L}$, records as $h_{kij}^-$. When the attribute $u_i$ is a cost attribute, the policy-maker negative regret degree equal with $\dfrac{v_{ki}^R - v_{kij}}{v_{ki}^R - v_{ki}^L}$, records as $h_{kij}^-$.

**Definition 2.** The policy-maker carries on the decision-making under the condition that the attribute value takes the sector value $\tilde{v}_{ki}$, caring on evaluation to plan $A_k$ ( $k = 1, 2, \cdots, n$) under the attribute $u_i$ ($i = 1, 2, \cdots, m$) obtains the evaluation value $v_{kij}$. When the attribute $u_i$ is an efficient attribute, the policy-maker plus regret degree equals with $\dfrac{v_{ki}^R - v_{kij}}{v_{ki}^R - v_{ki}^L}$, records as $h_{kij}^+$. When the attribute $u_i$ is a cost attribute,

the policy-maker plus regret degree equals with $\dfrac{v_{kij} - v_{ki}^L}{v_{ki}^R - v_{ki}^L}$, records as $h_{kij}^+$.

Obviously, $0 \leq h_{kij}^- \leq 1$, as the attribute $u_i$ is an efficient attribute, $h_{kij}^-$ and $v_{kij}$ are concurrently changing; When the attribute $u_i$ is a cost attribute, $h_{kij}^-$ and $v_{kij}$ are reversely changing. $0 \leq h_{kij}^+ \leq 1$, as the attribute $u_i$ is an efficient attribute, $h_{kij}^+$ and $v_{kij}$ are reversely changing, When the attribute $u_i$ is a cost attribute, $h_{kij}^+$ and $v_{kij}$ are concurrently changing.

**Definition 3.** If the policy-makers selects their own negative regret withstanding degree as $h_{kij}^-$, when the attribute $u_i$ is an efficient attribute, call $v_{ki}^L + h_{kij}^- \times (v_{ki}^R - v_{ki}^L)$ as the best value to $A_k$ ( $k = 1, 2, \cdots, n$) under the condition that the policy-maker withstanding negative regret degree value take $h_{kij}^-$. When the attribute $u_i$ is a cost attribute, call $v_{ki}^R - h_{kij}^- \times (v_{ki}^R - v_{ki}^L)$ as the best value to $A_k$ ( $k = 1, 2, \cdots, n$) under the condition that the policy-maker withstanding negative regret degree value take $h_{kij}^-$, record as $v_{kij}^-$.

**Definition 4.** If the policy-makers selects their own plus regret withstanding degree as $h_{kij}^+$, When the attribute $u_i$ is an efficient attribute, call $v_{ki}^R - h_{kij}^- \times (v_{ki}^R - v_{ki}^L)$ as the worst value to $A_k$ ( $k = 1, 2, \cdots, n$) under the condition that the policy-maker withstanding plus regret degree value take $h_{kij}^+$. When the attribute $u_i$ is a cost attribute, call $v_{ki}^L + h_{kij}^- \times (v_{ki}^R - v_{ki}^L)$ as the worst value to $A_k$ ( $k = 1, 2, \cdots, n$) under the condition that the policy-maker withstanding plus regret degree value take $h_{kij}^+$, record as $v_{kij}^+$.

Defined by the definition 3 and definition 4 we can known, when the policy-makers simultaneously considering the plus regret degree $h_{kij}^+$ and the negative regret degree $h_{kij}^-$, to make existing attribute evaluation in the interval evaluation value $[v_{ki}^L, v_{ki}^R]$ to satisfy the plus regret degree $h_{kij}^+$ and the negative regret degree $h_{kij}^-$, the following inequality $h_{kij}^+ + h_{kij}^- \geq 1$ must

establish. When $h_{kij}^{+} + h_{kij}^{-} = 1$, have only one feasible value. When $h_{kij}^{+} + h_{kij}^{-} > 1$, feasible values constitute a sector.

**Definition 5.** If the policy-makers selects their own plus regret withstanding degree as $h_{kij}^{+}$ and negative regret withstanding degree as $h_{kij}^{-}$, When the attribute $u_i$ is an efficient attribute, call the sector $[v_{kij}^{+}, v_{kij}^{-}]$ as feasible evaluation value region of the plan $A_k$ ( $k = 1,2, \cdots, n$) under the attribute $u_i$ ($i = 1,2, \cdots, m$). When the attribute $u_i$ is a cost attribute, call the sector $[v_{kij}^{-}, v_{kij}^{+}]$ as feasible evaluation value region of the plan $A_k$ ( $k = 1,2, \cdots, n$) under the attribute $u_i$ ($i = 1,2, \cdots, m$).

**Definition 6.** When the policy-makers selects their own plus regret withstanding degree as $h_{kij}^{+}$ and negative regret withstanding degree as $h_{kij}^{-}$, call $w_1 \times h_{kij}^{+} + w_2 \times h_{kij}^{-}$ as the policy-maker weighted combination regret degree, records as $h_{kij}$. Where, $0 \leq w_1, w_2 \leq 1$ and $w_1 + w_2 = 1$.

## Ⅳ. Constructing Policy-making algorithm

### Policy-making algorithm

Input:

(1) Decision information table.

(2) The attribute $u_1, u_2, \cdots, u_m$ expert weight value $\omega_1, \omega_2, \cdots, \omega_m$

(3) The policy-maker acceptable plus (negative) regret degree value.

Output: Policy-making result table

Begin:

The first step: Extracts each set $\tilde{v}_{1i} \cup \tilde{v}_{2i} \cup \cdots \cup \tilde{v}_{ni}$ the right endpoint value $v_i^{R}$ and left endpoint value $v_i^{L}$, ($i = 1,2, \cdots, n$).

The second step: When the attribute $u_i$ is an efficient attribute, extracting the value $v_{kij}^{+}$ to each regret degree value according to the formula $v_{ki}^{R} - h_{kij}^{-} \times (v_{ki}^{R} - v_{ki}^{L})$. When the attribute $u_i$ is a cost attribute, extracting the value $v_{kij}^{+}$ to each regret degree value according to the formula $v_{ki}^{L} + h_{kij}^{-} \times (v_{ki}^{R} - v_{ki}^{L})$.

The third step: When the attribute $u_i$ is an efficient attribute, extracting the value $v_{kij}^{-}$ to each regret degree

value according to the formula $v_{ki}^{L} + h_{kij}^{-} \times (v_{ki}^{R} - v_{ki}^{L})$. When the attribute $u_i$ is a cost attribute, extracting the value $v_{kij}^{-}$ to each regret degree value according to the formula $v_{ki}^{R} - h_{kij}^{-} \times (v_{ki}^{R} - v_{ki}^{L})$.

The fourth step: Takes the sector $[v_{kij}^{-}, v_{kij}^{+}]$ mid-point value.

The fifth step: Using the average weighting operator to fuse evaluation value to each reelection plan under various attributes, then obtains the synthesis evaluation value.

End

## Ⅴ. indefinite Weight Information of Attributes Based on Region Match Degree

At present, methods to determine the weight value of attributes may divide into two categories: Subjective tax power law, objective tax power law. The subjective tax power law is that the policy-makers, according the decision-makers' subjective preferences to various attribute, determine the weight value of attributes, such as expert investigation method[27], two coefficient method[28], the link compare grading method[29] and analytic hierarchy method[8] and so on. But the objective tax power law is that the policy-makers, according to some certain rule, determine the weight value of attributes, such as principal components analytic method, information entropy technology method, mean square method [30], method based on plan matching [31] and so on.

The above methods to process the indefinite weight values' information have the following same thought: establish an optimized model based on certain criterion such as variance minimizing, take the solution of the optimized model as the attributes' weight value. This processing thought has the following flaws: (1) the issue of the reasonableness of the criterion; (2) the multiplicity of criterion, when carry on the decision making according to the different criterion, whether the policy-making result does have the uniformity; (3) when the policy-making result does not have the uniformity, need to judge the fit and unfit between various criterion; (4) the weight value obtaining by solving an optimized model is only the approximation value of the real weight value of the attributes, therefore exist some errors in general. When the synthetic decision-making results are sensitive to the weight values, easily obtain the decision-making results which deviates from the real situation. Obviously the above four questions are very difficult to solve even can not solve. In view of this fact, attempt to deal with the decision-making question, in which the weight value's information only partly may know, from an opposite perspective in this article. Firstly suppose each plan is the synergy, extract the corresponding weight value's supposition territory. Then judge match degree between each weight value's supposition territory and the weight value's objective territory, the plan owing the maximum

match degree is the optimal plan. How construct the judgment criterion to measure the spatial regional match degree is a key question to realize the above thought, the following will study this issue.

*A. Construct weight value supposition region*

Suppose $A = \{A_1, A_2, \cdots, A_n\}$ as the decision scheme set, $U = \{u_1, u_2, \cdots, u_m\}$ as the attribute collection. Carry on standardized processing to the attribute appraisal value, obtain the matrix $E_{n \times m}$, carry on the evaluation to the plan $A_i$ according to attribute $u_j$, obtain an evaluation value $e_{ij}$ is the standardized processing result of the above evaluation value. Use the linear weighted average method to fuse evaluation information on various attribute (to other fusion operator processing thought is similar). Call the region constituted by the objective weight values' information as weight values' objective region $G_0$, $g_j^0$ expresses the objective weight value of the attribute $u_j$. When supposes plan $A_i$ as the optimal plan, then obtain a weight values' region, call this region as weight values' supposition region $G_i$. $g_j^i$ Express the supposition weight value of the attribute $u_j$ under the above supposition, $i = 1, 2, \cdots, n$, $j = 1, 2, \cdots, m$.

$$G_i = \{(g_1^i, g_2^i, \cdots, g_m^i) \mid e_{i1}g_1^i + e_{i2}g_2^i + \cdots + e_{im}g_m^i \geq e_{11}g_1^i + e_{12}g_2^i + \cdots + e_{1m}g_m^i,$$
$$e_{i1}g_1^i + e_{i2}g_2^i + \cdots + e_{im}g_m^i \geq e_{21}g_1^i + e_{22}g_2^i + \cdots + e_{2m}g_m^i,$$
$$\vdots$$
$$e_{i1}g_1^i + e_{i2}g_2^i + \cdots + e_{im}g_m^i \geq e_{i-11}g_1^i + e_{i-12}g_2^i + \cdots + e_{i-1m}g_m^i,$$
$$e_{i1}g_1^i + e_{i2}g_2^i + \cdots + e_{im}g_m^i \geq e_{i+11}g_1^i + e_{i+12}g_2^i + \cdots + e_{i+1m}g_m^i,$$
$$\vdots$$
$$e_{i1}g_1^i + e_{i2}g_2^i + \cdots + e_{im}g_m^i \geq e_{n1}g_1^i + e_{n2}g_2^i + \cdots + e_{nm}g_m^i,$$
$$g_1^i + g_2^i + \cdots + g_m^i = 1,$$
$$0 \leq g_j^i \leq 1, j = 1, 2, \cdots, m\}$$
$$(i = 1, 2, \cdots, n)$$

*B. Judgment criterion for measuring match degree between spatial regions*

When describe the relations between the spatial regions in the spatial geometry, the commonly used two indicators are: The longest (or shortest) distance between

two spatial regions or the area (or volume) size of the superposition region of two spatial regions. The distance between two spatial regions is more short (or the area (or volume) of the superposition region of two spatial regions is more big), the match degree between two regions is more big. Therefore we may establish the following four criterion to judge the match degree between various weight values' supposition region $G_i$ (i=1, 2, …, n) and the weight values' objective region $G_0$. Records the most short distance between the region $G_i$ and the region $G_0$ as $r_i$, the farthest distance between the region $G_i$ and the region $G_0$ as $M_{ri}$, the area (or volume) size of the superposition region of the region $G_i$ and the region $G_0$ as $S_{i0}$, the area (or volume) size of the region $G_i$ as $S_i$.

(1) When $r_a > 0, r_b > 0$, if $r_a > r_b$, then the match degree between the region $G_a$ and the region $G_0$ is smaller than the match degree between the region $G_b$ and the region $G_0$; if $r_a = r_b$, then the match degree between the region $G_a$ and the region $G_0$ is equal to the match degree between the region $G_b$ and the region $G_0$; if $r_a > r_b$, then the match degree between the region $G_a$ and the region $G_0$ is bigger than the match degree between the region $G_b$ and the region $G_0$.

(2) If $r_a > 0, r_b = 0$, then the match degree between the region $G_a$ and the region $G_0$ is smaller than the match degree between the region $G_b$ and the region $G_0$.

(3) When $r_a = 0, r_b = 0$, if $\dfrac{S_{a0}}{S_a} > \dfrac{S_{b0}}{S_b}$, then the match degree between the region $G_a$ and the region $G_0$ is bigger than the match degree between the region $G_b$ and the region $G_0$; if $\dfrac{S_{a0}}{S_a} = \dfrac{S_{b0}}{S_b}$, then the match degree between the region $G_a$ and the region $G_0$ is equal to the match degree between the region $G_a$ and the region $G_0$; if $\dfrac{S_{a0}}{S_a} < \dfrac{S_{b0}}{S_b}$, then the match degree between the region $G_a$ and the region $G_0$ is smaller than the match degree between the region $G_b$ and the region $G_0$.

(4) Suppose set $G$ is a non-empty set, then the match degree between the region $\Phi$ and the region $G_0$ is smaller than the match degree between the region $G$ and the region $G_0$.

In the criterion 3 involve in computing multiple integrals, when the information fusing method is a nonlinear method. Multiple integral's computations will possibly be

very complex. In this case, we can use the following criterion $3'$ to substitute the criterion 3.

（ $3'$ ） When $r_a = 0, r_b = 0$ , if $Mr_a > Mr_b$ , then the match degree between the region $G_a$ and the region $G_0$ is smaller than the match degree between the region $G_b$ and the region $G_0$ ; if $Mr_a = Mr_b$ , then the match degree between the region $G_a$ and the region $G_0$ is equal to the match degree between the region $G_b$ and the region $G_0$ ; if $Mr_a < Mr_b$ , then the match degree between the region $G_a$ and the region $G_0$ is bigger than the match degree between the region $G_b$ and the region $G_0$ .

Obviously the criterion 3 is clearly superior criterion $3'$ , therefore in the practical application we should select appropriate criterion to compare match degree between the spatial regions according to the policy-making subjective and objective environment.

## VI. EXAMPLE ANALYSIS

Selecting the good moral and talented person to important position is quite representative multi-factor decision-making question. Suppose a typical unit HR personnel selection process cases as follows:

(1) Formulate six inspection targets (efficiency attributes): moral character ( $u_1$ ), work attitude ( $u_2$ ), style of work ( $u_3$ ), educational level and knowledge structure ( $u_4$ ), leadership ( $u_5$ ), develop capacity ( $u_6$ ).

(2) Evaluation of democracy, just recommend: the masses of the candidates (including designated and candidate choice) were the target rate (Lowest is 0 points, the perfect score is 10 points).

(3) Initial treatment evaluation statistics: using the primary method (for example: low limit of the top 5 highest scores, or high limit of the top 5 highest scores, or high and low limit of the highest mean score of the top 5), determined from the five candidates short-listed candidates $A_k$ ( $k = 1,2, \cdots ,5$ ).

(4) Select one person from five people to a new post by the Human Resources Department.

In general, because the populace inspection target value which gives to the identical candidate (attribute value, namely its score) is different, therefore after statistical primary treatment to each candidate (i.e. individual plan) under each inspection target attribute value, the evaluation values usually are give by some sector numbers [a, b], Where $0 \leqslant a \leqslant 10$, and $0 \leqslant a \leqslant 10$. Use the algorithm constructed in this paper to deal with their personnel selection question:

### TABLE I.
SECTOR NUMBER DECISION-MAKING MATRIX

|       | $u_1$  | $u_2$   | $u_3$   | $u_4$    | $u_5$  | $u_6$   |
|-------|--------|---------|---------|----------|--------|---------|
| $A_1$ | [4,9]  | [7,8]   | [4,8]   | [6,10]   | [7,9]  | [8,9]   |
| $A_2$ | [5,8]  | [9,10]  | [7,9]   | [5,8]    | [4,8]  | [8,9]   |
| $A_3$ | [3,8]  | [6,9]   | [5,9]   | [9,10]   | [6,9]  | [7,10]  |
| $A_4$ | [7,9]  | [7,8]   | [8,10]  | [6,8]    | [6,8]  | [7,9]   |
| $A_5$ | [5,9]  | [4,9]   | [5,10]  | [6,8]    | [4,8]  | [7,9]   |

Suppose policy-makers selected the following positive (negative) regret degree: $(h_{ki1}^+, h_{ki1}^-) = (0,1)$ , $(h_{ki1}^+, h_{ki1}^-) = (0.5, 0.5)$ and $(h_{ki1}^+, h_{ki1}^-) = (1,0)$ . Each attribute exporter weights values are $(\omega_1, \omega_2, \cdots , \omega_6) = (0.1, 0.2, 0.3, 0.1, 0.2, 0.1)$.

Ask the feasible evaluation sector for the plan $A_k$ ( $k = 1,2, \cdots ,n$) under the attributes $u_i$ ($i = 1,2, \cdots ,m$) , $(h_{ki1}^+, h_{ki1}^-) = (0,1)$ , $(h_{ki1}^+, h_{ki1}^-) = (0.5, 0.5)$ and $(h_{ki1}^+, h_{ki1}^-) = (1,0)$ .

### TABLE II.
FEASIBLE EVALUATION SECTOR VALUE TABLE
（ $(h_{ki1}^+, h_{ki1}^-) = (0,1)$ ）

|       | $u_1$ | $u_2$ | $u_3$ | $u_4$ | $u_5$ | $u_6$ |
|-------|-------|-------|-------|-------|-------|-------|
| $A_1$ | 9     | 8     | 8     | 10    | 9     | 9     |
| $A_2$ | 8     | 10    | 9     | 8     | 8     | 9     |
| $A_3$ | 8     | 9     | 9     | 10    | 9     | 10    |
| $A_4$ | 9     | 8     | 10    | 8     | 8     | 9     |
| $A_5$ | 9     | 9     | 10    | 8     | 8     | 9     |

### TABLE III.
FEASIBLE EVALUATION SECTOR VALUE TABLE
（ $(h_{ki1}^+, h_{ki1}^-) = (0.5, 0.5)$ ）

|       | $u_1$ | $u_2$ | $u_3$ | $u_4$ | $u_5$ | $u_6$ |
|-------|-------|-------|-------|-------|-------|-------|
| $A_1$ | 6.5   | 7.5   | 6     | 8     | 8     | 7.5   |
| $A_2$ | 6.5   | 9.5   | 8     | 6.5   | 6     | 8.5   |
| $A_3$ | 5.5   | 7.5   | 7     | 9.5   | 7.5   | 8.5   |
| $A_4$ | 8     | 7.5   | 6     | 7     | 7     | 8     |
| $A_5$ | 7     | 6.5   | 7.5   | 7     | 6     | 8     |

### TABLE IV.
FEASIBLE EVALUATION SECTOR VALUE TABLE （ $(h_{ki1}^+, h_{ki1}^-) = (1,0)$ ）

|       | $u_1$ | $u_2$ | $u_3$ | $u_4$ | $u_5$ | $u_6$ |
|-------|-------|-------|-------|-------|-------|-------|
| $A_1$ | 4     | 7     | 4     | 6     | 7     | 8     |
| $A_2$ | 5     | 9     | 7     | 5     | 4     | 8     |
| $A_3$ | 3     | 6     | 5     | 9     | 6     | 7     |
| $A_4$ | 7     | 7     | 8     | 6     | 6     | 7     |
| $A_5$ | 5     | 4     | 5     | 6     | 4     | 7     |

Using the average weighting operator to fuse evaluation value to each reelection plan under various attributes, then obtains the synthesis evaluation value, as shown in Table 5:

### TABLE V.
POLICY-MAKING RESULT TABLE

| regret degree value | (0, 1) | (0. 5, 0. 5) | (1, 0) |
|---------------------|--------|--------------|--------|

| | | | |
|---|---|---|---|
| $A_1$ | 8. 6 | 7. 1 | 5. 8 |
| $A_2$ | 8. 8 | 7. 65 | 6. 5 |
| $A_3$ | 9. 1 | 7. 45 | 5. 8 |
| $A_4$ | 9. 0 | 7. 0 | 7. 0 |
| $A_5$ | 9. 0 | 6. 95 | 5. 9 |

We can see from Table 5: When policy- makers select positive (negative) regret degrees value as $(h_{ki1}^+, h_{ki1}^-) = (0,1)$, the candidate $A_3$ is the best candidate. When policy- makers select positive (negative) regret degrees value as $(h_{ki1}^+, h_{ki1}^-) = (0.5, 0.5)$, the candidate $A_5$ is the best candidate. When policy- makers select positive (negative) regret degrees value as $(h_{ki1}^+, h_{ki1}^-) = (1,0)$, the candidate $A_4$ is the best candidate.

## VII. CONCLUSION

This article has conducted the research to the sector multi-objective decision making question, comparing to existing research to this kind of multi-objective decision making question, the innovation of this paper is: as to policy-maker, under the condition that the decision information is non-definite, possibly may regret after caring on the decision-making, define the following concept: policy-makers plus regret degree, policy-makers negative regret degree and policy-makers weighted combination regret degree. According to the different thresholds of policy-makers plus regret degree, policy-makers negative regret degree and policy-makers weighted combination regret degree, respectively determine the best plan and construct the optimal decision results table, policy-makers according to their preference situation can query this table and select the most excellent plan suited to their own situation.

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**Peng Weibing**, Ph.D., is studying at the Law School of Central South University, Changsha, Hunan. His research directions: economical legal science, countryside land circulation, etc.

**Zhou Qihai** (1947- ) is a Full Professor (from 1995), Doctor's (and Master's) tutor and a head of Information Technology Application Research Institute, School of Economic Information Engineering, Southwestern University of Finance and Economics (SWUFE), China. He graduated in 1982 from Lanzhou University, China; has been working in SWUFE since 1982, successively hold posts from teaching assistant (1982-1987), lecturer (1987-1991), vice professor (1991-1995, promoted anomaly in 1991), professor (1995-today, promoted anomaly in 1995); and got the titles of both "Outstanding experts (enjoyed government subsidies) with outstanding contributions of Sichuan province, China" (summa cum laude of Sichuan province government, 1996) and "One hundred academic and managerial leading heads of China informationalization" (summa cum laude about this domain in China, 2006). He has published 47 academic books and over 230 academic papers; and is President of **IITAA** (**I**nternational **I**nformation **T**echnology & **A**pplications **A**ssociation), Chair or Organizing Chair of some important international conferences. His research interests are in algorithm research, computational geometry, isomorphic information processing, economics & management computation, eBusiness, and so on. More (in Chinese) about Prof. Zhou Qihai is shown here:

http://www.iitaa.com/Members-zqh.asp

**LI Yan** (1983- ), Master, is studying in School of Economic Information Engineering, Southwestern University of Finance and Economics, Chengdu, Sichuan, China. He has published 13 papers. His research areas are in Non-definite decision-making, intelligence information processing.