Research on women's career choice based on MADM with IFS

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Abstract. Role positioning of women is an important research topic, which seriously affects women's life path. This paper constructs three-way decision models based on intuitive multi-attribute decision making method (MA DM) to help women choose roles. First, by analysing the factors that affect the role positioning of modern women, the decision-making evaluation system is constructed. Second, decision attribute values for every female are given by intuitionistic fuzzy sets (IFS). Third, the conditional possibilities of becoming a professional female is computed combined with the attribute weights. Finally, each female's role is defined by comparing conditional probabilities and decision initial values computed by loss functions.

1. Introduction
With the extensive application of internet technology, the traditional barriers to male and female employment beak gradually. Women have more and more opportunities to show themselves and gradually enhance their status in society. However, because women limited by the traditional female role for a long time, it is difficult for them to grasp the opportunity in time. Equality between men and women is an essential symbol of social civilization and progress. People will not be limited by gender, but choose their own life paths according to their own conditions. How to eliminate the limitation of women's role and give full attention to women's potential of human resources is a crucial subject to liberate productive forces.

Women mainly play the roles of daughters, wives, mothers and employees in their lives. Most of them have to go to school, be employed, get married, born children, retire and other significant events. Due to different family situations, social environments and individual role consciousness, women have different roles, especially as they grow older and encounter different role conflicts at different stages, which seriously affect their life paths. Role conflict \cite{1,2} is mainly reflected in the conflict between family roles and work roles. Lu yingying \cite{3} seemed women as work roles and family roles, constructed a two-dimensional female character type model, then divided women into the career-driven type, home-based endowment type, both sides type and chaos type.

In this paper, we divide women into three categories: career-oriented, family-oriented and mixed-oriented. Career type refers to those who have strong achievement motivation and high sense of self-efficacy, strive to pursue personal value and career success, have strong working ability, and devote most of their energy to work. Family type refers to those who have a strong sense of identity and responsibility for the family, have strong confidence in the construction of a right family, can find their value in housework, and devote most of their energy to handle family affairs. The integrative type
refers those who are successful in both career and family or neither is good. A three-way decision approach [4-9] is proposed to help women to select their types. The multi-attribute decision making method (MADM) [10-13] is used to calculate the conditional probability of becoming a career-driven woman. In addition to career and family choices, a three-way decision model is proposed to set mixed options for women who cannot make a decision immediately and require further analysis before making a decision. Compared with the existing decision models, three-way decision model does not simply add a category, but transform dichotomy problem into poly classification problem.

2. Factor analysis of women's career motivation choice

American career theorist Farmer believed that the reason that women lag behind men in terms of career achievements is their career motivation. Then she proposed a career motivation model based on the social learning theory. The career motivation of women is mainly from three aspects: career expectation, motivation of mastery and professional investment, which is shown in Table 1.

| career motivation | career expectation | motivation of mastery | professional investment |
|-------------------|--------------------|-----------------------|-------------------------|
|                   | tend to show value in one's career (100%) | tend to take on the challenges of career (100%) | work-centered attitude (100%) |
| Career-driven     | 80% | 80% | 80% |
| Family-type       | 20% | 20% | 20% |
| Mixed-type        | 50% | 50% | 50% |

| influence factor  | personal factors | background factors | environmental factors |
|-------------------|-------------------|--------------------|-----------------------|
| Career-driven     | 80% | 80% | 80% |
| Family-type       | 20% | 20% | 20% |
| Mixed-type        | 50% | 50% | 50% |

Career motivation includes career expectation that is one's ambition for self-expression and one's willingness to accept challenges and career commitment that is an individual's work-centered attitude toward life. She believes that personal factors, background factors and environmental factors affect women's career motivation, and career motivation interacts with these factors to affect women's career achievement and career development. The detail of these factors are as follows:

Personal factors: individual background and individual self-efficacy, in which individual background includes individual gender, education background, skills and social status.

Background factors: social status, school location, ethnicity, and mathematical language ability.
Environmental factors: supportive attitude of parents, teachers and individuals.

3. The decision model

3.1. IFS

Some basic concepts and related theories of intuition fuzzy set (IFS) [14-16] are introduced in this section. In practical application, due to the imprecision and error of data, information is often lacking. Thus, we can use different uncertain numbers to express the decision information. Studies on uncertain problems based on IFS theory can supply an essential practical apply background.

The following is a brief introduction to the basic concepts of IFS.

Definition 1

Let \( X = \{x_1, x_2, \cdots, x_n\} \) be a universe of discourse. Then IFS \( \tilde{\rho} \) on \( X \) is given by \( \tilde{\rho} = \{<x, u_x(x), v_x(x) > | x \in X\} \), where \( u_x(x) \) denotes interval-valued membership degree and \( v_x(x) \) denotes the non-membership degree of \( x \) to \( \tilde{\rho} \), respectively. For \( \forall x \in X \), \( u_x(x) \subseteq [0,1] \), \( v_x(x) \subseteq [0,1] \) and \( 0 \leq \text{sup}(u_x(x)) + \text{sup}(v_x(x)) \leq 1 \).

Definition 2

Suppose that \( \tilde{\rho} = \{\tilde{\rho}_1, \tilde{\rho}_2, \cdots, \tilde{\rho}_m\} \) is a collection of IFS, where \( \tilde{\rho}_i = (u_i, v_i) \), \( (i = 1, 2, \cdots, m) \). Let \( \omega = (\omega_1, \omega_2, \cdots, \omega_m) \) be the weight vector for \( \tilde{\rho}_i \) with \( \omega_i \geq 0 \) and \( \sum_{i=1}^{m} \omega_i = 1 \). Then the weighted operator is a mapping \( \text{IFWA}: \Omega^m \rightarrow \Omega \) according to

\[
\tilde{\rho} = \text{IFWA}(\tilde{\rho}_1, \tilde{\rho}_2, \cdots, \tilde{\rho}_m) = \omega_1 \tilde{\rho}_1 + \omega_2 \tilde{\rho}_2 + \cdots + \omega_m \tilde{\rho}_m \\
= \left( \sum_{j=1}^{m} \omega_j u_j, \sum_{j=1}^{m} \omega_j v_j \right)
\]

Definition 3

Suppose that \( \tilde{\rho} = (u, v) \) is an IFS, the precise score of \( \tilde{\rho} \) is defined by

\[
S(\tilde{\rho}) = u - v
\]

This new ranking procedure can rank arbitrary IFS and improve the practicality and accuracy of decision. According to this function, the comparison and ranking of two IFS is obtained.

3.2. Three-way decision model based on MADM

In the process of decision, it is difficult for us to carry out accurate testing and calculation of data to select the particular type of women, but experts can perceive the conditional possibility that women can become a professional female or not by the factors given in section 2. In this section, a three-way decision model based on MADM is proposed.

Let \( X = \{x_1, x_2, \cdots, x_n\} \) be the set of women, \( C = \{c_1, c_2, \cdots, c_m\} \) be the set of all attributes and \( \omega_j \) denote the weight of attribute \( c_j \), where \( \sum_{j=1}^{m} \omega_j = 1 \), \( \omega_j \geq 0 \). Suppose that the IFS decision matrix is \( \tilde{\rho} = (\tilde{\rho}_j)_{n \times m} \), where \( \tilde{\rho}_j = (u_j, v_j) \) is a given IFS decision value of female \( x_i \) with respect to attribute \( c_j \), \( u_j \) and \( v_j \) denotes the satisfaction judgment and the dissatisfaction judgment of female \( x_i \) performance under decision attributes \( c_j \), respectively. Let \( \Omega = \{A, \sim A\} \) be the state sets of choices, which means a female belongs to \( A \) or not, in which \( A \) denotes career-driven type and \( \sim A \) denotes family-driven type.
type. Let \([x_i]\) denote the equivalence class containing \(x_i \in X\) under an equivalence relation. Suppose that \(A = \{a_p, a_s, a_x\}\) is an action set, where \(a_p\), \(a_s\), \(a_x\) denote \(x_i \in POS(A)\), \(x_i \in BND(A)\) and \(x_i \in NEG(A)\), respectively. Finally, when a woman belongs to \(A\), let \(\lambda_{ip}^i\), \(\lambda_{ip}^x\) and \(\lambda_{ip}^s\) represent the loss functions incurred for choosing actions \(a_p\), \(a_s\) and \(a_x\), respectively. When a woman belongs to \(\neg A\), let \(\lambda_{im}^i\), \(\lambda_{im}^x\) and \(\lambda_{im}^s\) represent the loss functions incurred for choosing actions \(a_p\), \(a_s\) and \(a_x\), respectively.

Now, we give the three-way decision model based on MADM as follows:

Step 1. For \(\forall x_i \in X\), according to formula (1), calculate the comprehensive evaluation value \(\tilde{p}_i = (u_i, v_i)\) by:

\[
\tilde{p}_i = IFWA(\tilde{p}_{i1}, \tilde{p}_{i2}, \ldots, \tilde{p}_{in})
= \omega_1\tilde{p}_{i1} + \omega_2\tilde{p}_{i2} + \cdots + \omega_m\tilde{p}_{in}
= (\sum_{j=1}^{m} \omega_j u_j, \sum_{j=1}^{m} \omega_j v_j)
\]

(3)

Step 2. Based on formula (2), compute the conditional probability \(Pr(A | x_i)\) of choosing a career-driven type as:

\[
Pr(A | x_i) = S(\tilde{p}_i)
= u_i - v_i
= \sum_{j=1}^{m} \omega_j u_j - \sum_{j=1}^{m} \omega_j v_j
\]

(4)

Step 3. Calculate the parameters associated with the classification for \(\forall x_i \in X\) are as follows:

\[
\alpha_i = \frac{\lambda_{ip}^i - \lambda_{ip}^x}{(\lambda_{ip}^i - \lambda_{ip}^s) + (\lambda_{ip}^x - \lambda_{ip}^s)}
\]

(5)

\[
\beta_i = \frac{\lambda_{ip}^x - \lambda_{ip}^s}{(\lambda_{ip}^x - \lambda_{ip}^x) + (\lambda_{ip}^s - \lambda_{ip}^s)}
\]

(6)

Step 4. For \(\forall x_i \in X\), compare conditional possibility that she can choose a career-driven type with decision initial values. Then, according to three-way decision method, we can divide \(X\) as follows:

(P) If \(Pr(A | x_i) \geq \alpha_i\), then \(x_i \in POS(A)\), that is, \(x_i\) should choose career-driven type;

(B) If \(\beta_i < Pr(A | x_i) < \alpha_i\), then \(x_i \in BND(A)\), that is, \(x_i\) should choose mixed-type;

(N) If \(Pr(A | x_i) \leq \beta_i\), then \(x_i \in NEG(A)\), that is, \(x_i\) should choose family-type.

4. Conclusion
In conclusion, this study presents a novel three-way decision model combined on MADM to help women to choose a career path. Compared to the traditional method, the given method have scientific nature and can deal with uncertain information. It is an emerging research topic to study three-way decision making by MADM. In the future research, we can study loss functions by other types of information value.

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