Construction of Off-site Pension Satisfaction Evaluation System Based on Rough Set Theory

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Abstract. Due to the aging of the population, the large number of "421" families has caused the traditional old-age care model to suffer severe impacts and new models of old-age care have emerged. First, in light of the more chaotic division of the current old-age care model, we explored the connotation of a new type of old-age care model—off-site pension, then aimed at the lack of systematization and standardized evaluation system for remote old-age care. Starting from the factors affecting the satisfaction of the off-site pension, the theory of rough sets was introduced and an intelligent evaluation model for satisfaction was established. Using the rough set method, a hierarchical calculation method was used to achieve the objective weighting of each index. Finally, through strength analysis and model earnestness, the rational validity of the rough set intelligent evaluation model was verified.

Introduction

According to the data of the White Paper on the Development of China's Pension Industry in 2016, the elderly population aged 60 or over in China had reached 222 million, accounting for 16.1% of the total population by the end of 2015. At present, there are nearly 100 million elderly people living in empty nests and solitary homes, making a huge gap in the pension industry. At the same time, due to the large number of "421" families, the traditional family pension is facing a serious impact. The intensified of the aging population and the increase of large urban population base leads to the shortage of institutional pension resources and the pressure of social pension.

As the traditional models have encountered difficulties, it is urgent to innovate the old-age support model to ease the current social pension problem.

At present, domestic scholars have a lot of researches on pensions as a whole, but there are few researches on the off-site pensions, And it mainly focuses on the determination of the connotation of off-site pensions, the feasibility of the model, and the problems that arise, lacks a deeper discussion on the system's evaluation system. This article is based on the existing research results, discusses the factors affecting the satisfaction of off-site pensions, and tries to construct an off-sex pension satisfaction evaluation model based on rough set theory and quantitatively obtaining index weights.

To achieve a quantitative and reasonable analysis of the satisfaction of this new type of old-age care model.

The Connotation of Off-site Pension

China's Existing Pension Model and Defined Standards

Due to the rapid growth of the pension market and the vigorous promotion of the government, many new models of old-age care have been proposed, such as the new model of housing pension, home-based pension, and tourism pension. However, in the classification of pension models, different opinions and different types of divisions has been made. The commonalities between different types leads to the vague concept of old-age care model, lack of ordering and integration.

Currently, several typical classification methods in the academic community are single-factor classifications, including ①from pension support perspective, divided into family pension, social
pension and self-supporting (Yan-chun Meng, 2010);②Institutional pension and home-based care (Guang-zong Mu, 2000);③ From the point of view of old-age care, it can be divided into family pension, community pension and institutional pension (Le-fei Lin, 2006).

Classification of Innovative Endowment Model—4×4 Tabular Model

Based on the unclear status of endowment classification model, before studying the new model of off-site pension, this project proposes to define a new standard for old-age care model, making the fuzzy classification clear and bounded.

By classifying the existing pension models, sorted out the two most important factors of the pension model: the main source of the old-age living environment and old-age pension funds. Based on these two variables, the “4×4” pension model classification standard was proposed. The sources of pension funds can be divided into four dimensions: individuals, families, governments, and other social charities. The living environment for the elderly can be divided into four dimensions: individual, family, institution, and community. By combining these two factors in pairs, the old-age care model can be divided into 16 categories.

Table 1. Pension mode classification.

| Pension living environment | Individual | family | Pension agency | community |
|----------------------------|------------|--------|----------------|-----------|
| Individual                 | Individual-individual | Individual family | individual - Pension agency | Individual-comm unity |
| family                     | family-individual | family - family | family - Pension agency | family-community |
| government                 | government-individual | government - family | government - Pension agency | Government-community |
| Social funds               | Social funds-individual | Social funds - family | Social funds - Pension agency | Social funds - community |

Different Definitions of Off-site Pension

Through the above 4×4 table classification, it is possible to more clearly define the off-site pension model. The off-site pension model belongs to the old-age pension mode in which the old-age living environment is a broad-based community. The source of old-age pension funds can be a new type of old-age support for individuals, families, and social and social funds. More generally, off-site pensions can be defined as: Older people leave the original place of life to live in another place for a longer period of time.

Satisfaction Evaluation Model Based on Rough Set Theory

The Construction of Indicator System

Construction Principles. The index system for the collection of off-site pension models should follow the principle of importance, measurability, and practicality. That is, the indicators of the smart pension system must be considered important by the public, which must be statistical, computational, and analytical. Meanwhile, the evaluation index system should not be too cumbersome, the evaluation method should be simple and easy to understand. And the data sources must be authentic and reliable.
The Design of Indicator System. This study mainly borrowed from Li Xiao-wen's (2015) three major factors affecting seniors' satisfaction with their care: medical care, humanistic care, and medical help. Aiming at the most important environmental requirements of the off-site pension model, a living environment index has been added. At the same time, according to Marlowe's hierarchy of needs theory, to emphasize the physiological, safety, and social needs of the elderly, and to combine the specific old-age care needs of the elderly, this study constructed three different types of first-level indicators: residential pensions, medical care, and humanistic care, and eight indicators of the secondary indicators system.

| First-level indicators | Secondary indicators | Detailed description of indicators |
|------------------------|----------------------|-----------------------------------|
| Living environment     | Air quality          | Whether the air quality of the place of residence is good or not |
|                        | Infrastructure       | Whether the entertainment and living facilities in residence are fully equipped or not |
|                        | Traffic convenience  | Whether the traffic is convenient or not |
|                        | Life safety          | Whether every old man's safety can be guaranteed or not |
| Medical care           | Professional care    | Whether the old people can be accompanied by medical professionals or not |
|                        | Emergency care       | Whether the elderly can receive timely assistance in emergencies or not |
| Humanity care          | Dating activity      | Whether the old people can have their own circle of friends or not |
|                        | Cultural training    | Whether the old people can have spiritual and cultural training or not |

The Construction of Evaluation Model

Rough set theory is a data calculation method proposed by Pawlaw (1982) which is mainly used as a tool for processing fuzzy and uncertain data. The main principle is to calculate the classification and decision rules of the problem by weight calculation on the basis of clear classification. Because the public's evaluation of the different-endowment pension model is ambiguous and predictable, this paper based on the rough set theory to reduce the fuzzy and uncertain factors in the off-site pension model, remove redundant indicators, and evaluate the objectivity satisfaction.

Build Information Tables and Decision Tables. Set up pension institutions as \( U=\{u_1,u_2,u_3,…,u_n\} \), The evaluation indicator is \( C=\{C_1,C_2,C_3,…,C_n\} \) The first-level indicator is \( C_x(x=1,2,…,n) \), and the second level indicator is \( C_x=(C_{x_1},C_{x_2},…,C_{x_n}) \). Investigate and analyze public ratings of secondary indicators and conduct preliminary processing to obtain information evaluation tables.

Discretize the original information table into a decision table \( S=(U,C,D,V,F) \).

Determination of Weights. In practical applications, the number of indicators to be evaluated is big, so the first-level indicators are divided into blocks, and the level two calculation method is used to gradually obtain the weights of the second-level indicators.

Weight value calculation procedure of each first-level indicators

In the first step, the result \( U/\text{IND}(C) \) of the object set \( U \) to be evaluated on the condition attribute set \( C \) and the result \( U/\text{IND}(C) \) on the decision attribute \( D \) are obtained. And after removing the first-level index \( C_x \) in the condition attribute set \( C \) in turn, the result of the partition \( U \ (C-C_x) \) are obtained.

In the second step, the dependency degree \( \gamma_c(D) \) of the decision attribute \( D \) on the condition attribute set \( C \) and the dependency \( \gamma_{c-cx}(D) \) on the condition attribute set \( c-c_x \) are calculated. The third step is to calculate the importance of each level of indicators.
The fourth step is to calculate the importance of the first-level indicator $C_x$.

$$\omega(C_x) = \frac{\text{SGF}(C_x)}{\sum_i \text{SGF}(C_i)}$$  \hspace{1cm} (2)

Secondary weight indicators.

In the first step, the first-level indicator $C_x$ ($x=1, 2, ..., n$), in the decision table is selected in order to obtain the result $U/\text{IND}(C_x)$ of the object set $u$ to be evaluated in the first-level index $C_x$ and the result of the partition $U/\text{IND}(D)$, $(D)$ in the decision attribute $D$, and then calculate the dependence $\gamma_{C_x}(D)$ of the decision attribute $D$ on the primary index $C_x$.

In the second step, under the selected first-level index $C_x$, the second-level index condition attribute $C_{xh}$ ($h=1, 2, ..., n$), under the first-level index is removed in order to obtain the division result and calculate the dependency $\gamma_{C_x-C_{xh}}(D)$.

The third step is to calculate the relative importance of the secondary attribute $C_{xh}$, of the secondary indicators under the primary index $C_x$.

The fourth step is to calculate the relative attribute weight value of each secondary index condition attribute $C_{xh}$, under the first-level index $C_x$.

$$\omega(C_{xh}) = \frac{\text{SGF}(C_{xh})}{\sum_i \text{SGF}(C_{xi})}$$  \hspace{1cm} (3)

Determination of final weight values

Calculate the final weight value of the condition attribute of each secondary index.

$$\bar{\omega}(C_{xh}) = \omega(C_x) \times \omega(C_{xh})$$  \hspace{1cm} (4)

The comprehensive evaluation value of the object to be evaluated.

Calculate the comprehensive evaluation value of each object to be evaluated.

$$K_i = \sum_i \sum_j \bar{\omega}(C_{xh}) \times l_{ij}$$  \hspace{1cm} (5)

$l_{ij}$ the score of the object to be measured under the secondary index conditional attribute.

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