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Research on the Correlation of Mathematical Models of "Subsistence Allowances" in Chinese Provinces

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Abstract **– "Subsistence allowances" is a kind of guarantee system for low-income families in China. Because of the different developments in various regions of China, there are differences in the "subsistence allowances" in various provinces. This paper analyzes the correlation between the "low-income standards" of each province by studying the main indicators of "subsistence allowances" and collecting and processing the indicators. This study first screened out the main indicators for calculating the "subsistence allowances". Then collect and sort out the indicators of various indicators in China's provinces from 2008 to 2016. Factor analysis and cluster analysis were carried out by SPSS software to obtain the correlation of "subsistence allowances" in Chinese provinces. This study can provide a basis for decision-making for China's provinces to determine the minimum living standards, and to some extent reflect the economic development of China's provinces.**

Keywords **– Subsistence Allowances, Provinces, Factor Analysis, Cluster Analysis.**

I. INTRODUCTION

Since the State Council issued a document in 1997 requiring the establishment of a minimum living security system in urban areas across the country, China has established a subsistence allowance system covering urban and rural areas. In the past 21 years, the subsistence allowance system has played an important role in improv--ing residents' lives, alleviating poverty and maintaining social stability. However, because China's civil affairs departments have not unified the calculation method of subsistence allowance standards, this has led to different methods adopted by various localities. The direct conse--quence is that there are many problems such as random adjustment of standards everywhere and excessive differences between the subsistence allowances. Therefore, how to establish a reasonable and efficient social security system is an urgent problem to be solved. Among them, the minimum living security system is the "last line of defense" in the social security system, and it is also a powerful guarantee for resolving social contradictions, maintaining social stability, promoting social equity, and ensuring the smooth progress of economic system reform [1].

The research collected relevant data, established a mathematical model to select the main indicators for calculating the "subsistence allowances", and analyzed the correlation between the current "subsistence allowances", which can be used for Chinese provinces. Determining the minimum living standard provides the basis for decision making.

II. MODEL INTRODUCTION

The study mainly refers to the three calculation methods given by the government and obtains corresponding indicators. Then, collect and sort out the data of various indicators from 2008 to 2016 in the provinces of the country. The average value of the indicators for each province for nine years was calculated. The factor analysis of SPSS software showed that the two principal compo--nents were called "consumption factor" and "financial factor". The factor scores of each province were calculated, and the cluster analysis was carried out by SPSS software. Finally, the provinces were divided into three categories. The "subsistence allowances" of the same provinces were highly correlated, and the correlations of different provinces were relatively weak.

A. *Introduction to Factor Analysis*

Starting from studying the internal dependence of the original variable correlation matrix or the covariance matrix, some variables with intricate relationships are attributed to a multivariate statistical analysis method of a few comprehensive factors [2]. Principal component analysis transforms a set of possible correlation variables into a set of linear uncorrelated variables by orthogonal transformation. The converted set of variables is called the principal component [3]. The extracted principal compo--nents are called F1, F2, etc., respectively, which means that the information existing in F1 does not need to appear again in F2, that is, Cov (F1, F2) = 0. Among them

$$Fp\ (\text{P-th principal component}) = a1i \bullet Zx1 + a2i \bullet Zx2 + \ldots\ldots + api \bullet Zxp \quad (1)$$

Factor analysis can effectively reduce the dimensionality of the space under study [4]. This study used factor analysis to reduce the dimension of the indicator.

B. *Introduction to Cluster Analysis*

Cluster analysis is an ideal multivariate statistical technique. There is a degree of similarity between the samples or indicators studied. According to a plurality of observation indicators, find the statistic that can measure the degree of similarity between the indicators, and use the statistics as the basis for the classification type [5]. The similarly large indicators (samples) are divided into one class, and other samples (indicators) with similar similarity are aggregated into one class until all the samples (indicators) are aggregated. The Q-type clustering analysis classifies the samples, and the R-type clustering analysis classifies the variables [6]. This study used cluster analysis to classify provinces.

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III. Model Building and Solving

The Ministry of Finance of the People's Republic of China gives three methods for calculating the "low standard of protection" [7]. We give a preliminary analysis and conclude that the influencing factors of the "low standard of protection" are mainly disposable income, total consumption, food consumption, the per capita GDP, the national minimum living standard, and the total fiscal expenditure of the provinces are also affected by the national average minimum living standard. The study obtained data from various indicators of Chinese provinces from 2008 to 2016 in the website of the National Bureau of Statistics of China [8] and obtained their average values. Let be the national average minimum living standard, is per capita disposable income, provincial fiscal expenditure, is per capita food consumption, is total resident consumption and is per capita GDP.

A. *The Process of Factor Analysis*

Calculate the covariance matrix of the sample data [9]:

$$\sum = (s_{ij})_{P*P}$$

$$s_{ij} = \frac{1}{n-1}\sum_{k=1}^{n}(X_{ki} - \bar{X}_i)(X_{kj} - \bar{X}_j)\ (i, j = 1,2,\ldots,p) \quad (2)$$

Calculated eigenvalues and corresponding orthogona--lized unit eigenvectors.

In this study, 31 provinces were collected and 31 were taken, and p took 6 principal components in the 6-finger study. i and k refer to the i-th and k-th indicators.

The former larger eigenvalue is the variance corresponding to the previous principal component, and the corresponding unit eigenvector is the coefficient of the principal component with respect to the original variable, then the first variable

The main components are:

$$F_i = a_i' X \quad (3)$$

The variance (information) contribution rate of the principal component is used to reflect the amount of information, which is **Error! Reference source not found.**

$$\alpha_i = \lambda_i / \sum_{i=1}^{m}\lambda_i \quad (4)$$

In the end, several principal components are selected, ie, the determination of , , , ..., is determined by the variance (information) cumulative contribution rate **Error! Reference source not found.**.

$$G(m) = \sum_{i=1}^{m}\lambda_i / \sum_{k=1}^{p}\lambda_k \quad (5)$$

When the cumulative contribution rate is greater than 85%, it is considered to be sufficient to reflect the information of the original variable, and the corresponding is the former principal component of the extraction **Error! Reference source not found.**

B. *The result of factor analysis*

The above calculation steps are implemented by SPSS software, and the results are shown in Table 1:

Table 1 KMO and Bartlett's Test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.587
Bartlett's Test of Sphericity	Approx. Chi-Square	108.243
	Df	15
	Sig.	0

In Table 1, KMO>0.5, the value of sig is much less than 0.05, which proves that factor analysis can try.

Table 2 Component Score Coefficient Matrix.

Index	Component 1	Component 2
Per capita disposable income	0.958	0.060
Total consumption	0.946	0.089
Food consumption	0.630	0.424
Per capita GDP	0.626	0.606
National minimum living standard	0.270	0.881
Total fiscal expenditure of each province	0.083	0.709

In Table 2, the ratio of per capita disposable income in factor F1, total consumption, food consumption, and per capita GDP ratio load is higher, and they reflect the consumption status of residents, so they are named as "consumption factor", the national minimum living standard in factor F2 The ratio of the province's total fiscal expenditure is higher, and the government will be affected by other provinces and its own total financial expenditure when formulating the minimum living standard, so it is named as "financial factor". The classification of various factors is shown in Table 3:

Table 3 Factor classification.

Variable	Principal component 1	Principal component 2
High load indicator	x2, x5, x4, x6	x1, x3
Primary component naming	Consumption factor	Financial factor

C. *The process of Cluster Analysis*

Based on the previous model preparation, the study has carried out principal component analysis on all indicators to extract two major components F1 (consumption factor) and F2 (financial factor).

Study the class average method in the hierarchical clustering method:

$$D_{MJ}^2 = \frac{n_K}{n_M} D_{KJ}^2 + \frac{n_L}{n_M} D_{LJ}^2 \quad (6)$$

"D^2" is the square of the Euclidean distance and "n" is the number of samples contained in each category.

Distance to choose Euclidean distance:

$$d_{ij} = \sqrt{(X_{i1} - X_{j1})^2 + (X_{i2} - X_{j2})^2 + \cdots + (X_{ip} - X_{jp})^2}$$
$$= [\sum_{k=1}^{p}(X_{ik} - X_{jk})^2]^{1/2} \quad (7)$$

D. *The result of Cluster Analysis*

Through the SPSS software, we obtained the tree diagram of the classification results. The above figure divides the

province into three types of final classification results as shown in Figure 1:

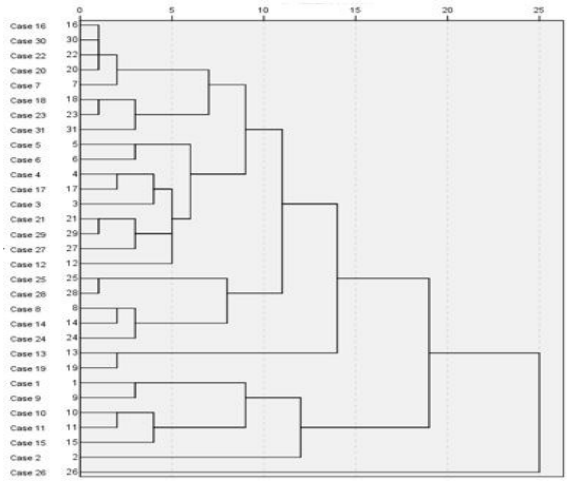

Fig. 1. Province classification tree.

The study found that the classification results of Chinese provinces are shown in Table 4:

Table 4 The study gives the following three types of provinces as follows.

Category	Provinces
category 1	Beijing Tianjin Shanghai Jiangsu Zhejiang Shandong
category 2	Hebei Shanxi Inner Mongolia Liaoning Jilin Heilongjiang Anhui Fujian Jiangxi Henan Hubei Hunan Guangdong Guangxi Hainan Chongqing Sichuan Guizhou Yunnan Hebei Shanxi Inner Mongolia Liaoning Jilin
category 3	Tibet

IV. Research Conclusion and Evaluation

A. *Conclusion*

The study divided them into three categories according to the mathematical model of "subsistence allowances" in various provinces in China. The "subsistence allowances" of the same category of provinces is highly relevant, and the correlation between the different categories of provinces is small. The provinces in category 1 are more affected by consumption factors, the provinces in category 2 are more affected by consumption factors and fiscal factors, and the provinces in category 3 are more subject to fiscal factors.

This is because the economy of the eastern part of China in the category 1 is relatively developed **Error! Reference source not found.**, the ratio of per capita disposable income, total consumption, food consumption, and per capita GDP are high, and the method of determining the mathematical model of "subsistence allowances" Influen--ced by the economic development level of such provinces, it is mainly affected by consumption factors; while the economic development of China's central and western provinces in category 2 is slightly backward **Error! Reference source not found.**, the method of determining the mathematical model of " subsistence allowances " Not only is it affected by consumption factors, but also by fiscal factors; the economic development of provinces in category 2 is relatively backward, and the method of determining the mathematical model of "subsistence allowances" is mainly influenced by fiscal factors.

B. *Evaluation*

The study first performs factor analysis to extract two principal components, and then clusters according to the provincial principal component scores. The factor-cluster analysis model reflects that the provincial minimum living standards are more intuitive and reasonable, and are convincing.

However, the study used the average of nine indicators for each province, and there may be deviations in the calculation of the "subsistence allowances" for a certain province. This study only covers 31 provinces in which China implements the "subsistence allowances" policy, excluding Hong Kong, Macau and Taiwan.

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