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Research on a Comprehensive Evaluation System of Multi-Dimensional Psychological Test Scales Based on Factor Analysis Method

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Abstract

Based on factor analysis, 148 subjects were evaluated by symptom checklist 90 (SCL-90), Big Five personality scale and career maturity scale. After standardized and non-dimensional data processing and verification of suitability, six key common factors were extracted, including mental health, career planning, information processing.personality traits, psychological deterioration degree and interpersonal relationship.and the cumulative variance contribution rate was 82.59%. The effective samples were divided into three types: sunshine elite type, medium adaptability type and workplace apprenticae type by systematic clustering method. The research results provide scientific basis for talent selection, training and team building, and emphasize the importance of mental health assessment and individualized training.which has theoretical and practical value.

Keywords: psychological test scale, factor analysis, systematic clustering

1. Introduction

With the intensification of social competition and the acceleration of life pace, mental health issues have increasingly attracted widespread attention from all walks of life. Mental health is not only related to an individual's sense of happiness and quality of life, but also directly affects work efficiency and social stability. Therefore, how to scientifically and systematically assess an individual's mental health status has become an important research topic in the fields of psychology, management, and education.

Traditionally, mental health assessment often relied on a single psychological measurement tool. Although this method is simple and easy to implement, it is difficult to comprehensively reflect the multi-dimensional psychological characteristics of an individual. To address this deficiency, researchers in recent years have begun to explore methods of comprehensive assessment using multiple psychological measurement scales, in order to obtain a more comprehensive and accurate understanding of the mental health status of the tested individuals.

In this context, this study is based on factor analysis by Tong L et al.(2025)[1] and integrates the SCL-90 Symptom Self-Rating Scale, the Big Five Personality Scale, and the Vocational Maturity Scale to construct a multi-dimensional psychological test scale comprehensive assessment system. This system aims to systematically and objectively reflect the mental health status, interpersonal relationships, career cognition, and planning ability of the tested individuals in multiple aspects, providing scientific basis for enterprise recruitment, talent cultivation, and team building.

This research not only enriches the theoretical system of mental health assessment, but also provides practical assessment tools and methods for enterprise practice, and has important theoretical and practical significance.

2. Construction of Indicator System and Evaluation Methods

2.1 Overview of Psychological Measurement Scales

Qiao J et al.(2025) [2] said that various psychological test scales are used for different populations and scenarios. Among them, the Symptom Checklist-90 (SCL-90), Career Maturity Scale, and Big Five Personality Inventory are widely applied in talent recruitment.

The **SCL-90** is one of the most renowned mental health assessment tools globally, extensively used for screening psychiatric symptoms. It comprises 90 items covering a broad range of psychological symptoms, including somatic complaints, obsessive-compulsive tendencies, interpersonal sensitivity, depression, anxiety, hostility, phobic

anxiety, paranoid ideation, and psychoticism. This scale provides a multidimensional evaluation of an individual's mental health status.

According to Rice S et al.(2020)[3], the **Career Maturity Scale** focuses on assessing an individual's readiness for career planning and decision-making, aiding in clarifying professional goals and enhancing career development capabilities.

The **Big Five Personality Inventory**, based on the "Big Five Personality Theory," is a classic tool for measuring personality traits, said by Tokarz R E et al.(2025)[4]. It evaluates individuals across five dimensions: Neuroticism (emotional stability), Extraversion, Openness to Experience, Agreeableness, and Conscientiousness, offering insights for personalized development and team building.

Table 1. Summary Table of Evaluation Indicators of the Three major Psychological Test Scales

	Scale Name	Evaluation index
The mental health of the test subjects State Evaluation Scale	SCL-90	somatization obsessive-compulsive interpersonal sensitivity depression anxiety hostility phobic anxiety paranoid ideation psychoticism others
	The Career Maturity Scale	information application Professional awareness Self-awareness Personal adjustment Personal adjustment Values career choice Condition assessment
	The Big Five Personality Inventory	Neuroticism Extraversion Openness Agreeableness Conscientiousness

2.2 Data Preprocessing

2.2.1 Directional Adjustment of Indicators

When processing the data of different psychological test scales, we found that there were significant differences in the positive and negative directions of the indicators of each scale. Specifically, an increase in the numerical value of some indicators represents a positive evaluation, while others are the opposite, indicating a negative situation. Particularly, all 10 indicators in the SCL-90 scale are classified as negative indicators because the higher the score, the stronger the physical discomfort it represents, said by Chen X et al.(2024)[5]. In the Big Five personality scale, "neuroticism" is also treated as a negative indicator because it reflects emotional instability, and a high score is not conducive to mental health. The other four dimensions in this scale (extraversion, openness, agreeableness, and conscientiousness) exhibit an interval characteristic; their values are not simply a matter of high or low quality, but need to be interpreted in combination with specific contexts.

To unify the assessment criteria, we adjusted the directionality of the indicators that were clearly positive or negative. Table 2 lists the results of the analysis of the positive and negative directions of some key indicators:

Table 2. Positive and Negative Analysis of Some Indicators

Evaluation index	positive or negative.
The 10 evaluation indicators in the SCL90	-
The 8 evaluation indicators in the career maturity scale	+
The 'neuroticism' evaluation index in the Vocational College Five Personality Scale	-

Note: "+" represents positive indicators, meaning the higher the value, the better; "-" represents negative indicators, meaning the lower the value, the better.

For the negative indicators in the scale, this article uniformly adopts the maximum threshold method for positive transformation, and the formula is as follows:

$$y_i=1-\frac{x_i}{x_{max}} \tag{1}$$

Among them, y_i represents the value after normalization, x_i represents the original value before normalization, and x_{max} represents the maximum value of all data under this indicator.

For the interval indicators in the Big Five Personality Scale, we adopted appropriate standardization methods to ensure the consistency and comparability of the data. The formula is as follows:

$$y_i=\begin{cases} 1-\frac{q_1-x_i}{max\{q_1-m,\ M-q_2\}} & x<q_1 \\ 1 & x\in[q_1,q_2] \\ 1-\frac{x_1-q_2}{max\{q_1-m,\ M-q_2\}} & x>q_2 \end{cases} \tag{2}$$

2.2.2 Standardization of Indicators

The indicators that have undergone normalization processing are further subjected to standardization treatment, aiming to obtain a set of standardized and uniform data sets, while eliminating the influence of different units of measurement on data analysis. The specific formula for standardization processing is as follows:

$$y_i=\frac{x_i-\bar{x}}{S} \tag{3}$$

Among them,y_i represents the standardized value, x_i represents the original value before standardization, $\bar{x}$ represents the average value of all data for the corresponding indicator, and S represents the standard deviation of all data for the corresponding indicator.

2.3 Selection of Factor Analysis Model

Factor analysis, as an important tool in multivariate statistical analysis, is widely applied in the field of comprehensive evaluation. Domain. By analyzing the correlation matrix relationships among the original variables, it simplifies and optimizes the evaluation system by reducing the complex original indicator variables to a few comprehensive factors.

Suppose the p-dimensional random vector $x=(x_1,x_2,\ldots,x_p)'$ has a mean vector$u=(u_1,u_2,\ldots,u_p)'$and a covariance matrix $\Sigma_{p\times p}=(\sigma_{ij})$. The general model of factor analysis is:

$$\begin{cases} x_1=u_1+a_{11}f_1+a_{12}f_2+\cdots+a_{1m}f_m+\varepsilon_1 \\ x_2=u_2+a_{21}f_1+a_{22}f_2+\cdots+a_{2m}f_m+\varepsilon_2 \\ \vdots \\ x_p=u_p+a_{p1}f_1+a_{p2}f_2+\cdots+a_{pm}f_m+\varepsilon_p \end{cases} \tag{4}$$

Here, f_1, f_2, …, $f_m$are called common factors and $\varepsilon_i(i=1,2,\ldots,p)$ are special factors. The common factors appear in the expression of each original variable $x_i(i=1,2,\ldots,p)$ and can be understood as certain characteristics shared by the original variables. Formula 4 can be written in matrix form as: $X=u+Af+\varepsilon$, where $f=(f_1,f_2,\ldots,f_m)'(m\leq p)$ is the common factor vector and $A_{p\times m}=(a_{ij})$ is called the factor loading matrix, and it is assumed that the rank of A is m.

The factor loading matrix has the following statistical significance:

(1) Sum of squares of row elements: It reflects the total influence of each common factor on all the original variables, also known as common variance. It measures the ability of the common factor to explain the variation of the original variables.

(2) Sum of squares of column elements: Corresponding to the square sum of the factor loadings of each original variable for the common factor, it can be regarded as the "weight" of the variable in the common factor space. The larger the sum of squares of column elements, the more significant the influence of the corresponding original variable on the common factor.

By representing the factor analysis model in matrix form, we can more clearly understand the relationship between the common factors and the original variables. This model not only simplifies the complexity of the original variables but also provides a solid theoretical foundation for subsequent comprehensive evaluation. In this paper, we will use the factor analysis model to conduct a comprehensive analysis of the data of the psychological test scale to construct a scientific and reasonable mental health assessment system.

3. Empirical Analysis of Mental Health Status Evaluation

3.1 Data Suitability Test

The KMO test is designed to assess the relative magnitudes of the simple correlation coefficients and partial correlation coefficients among the original variables, thereby determining whether the data are suitable for factor analysis, said by Karimian Z et al.(2024)[6]. When the KMO value approaches 1, it indicates that the correlations among the variables are strong, making factor analysis highly suitable; conversely, if the KMO value is close to 0, it implies that the correlations among the variables are weak, and factor analysis may not be suitable. The criterion proposed by Kaiser states that a KMO value greater than 0.9 is generally considered highly suitable for factor analysis.

Moreover, the Bartlett's sphericity test is used to examine the degree of correlation among the variables. The null hypothesis of this test is that the correlation coefficient matrix is the identity matrix, meaning that the variables are independent of each other and not suitable for factor analysis.

The test statistic is obtained by calculating the determinant of the correlation coefficient matrix. If the value of this statistic is large and the corresponding p-value is less than the significance level (usually 0.05), then the null hypothesis is rejected, indicating that there is a significant correlation between the data and making factor analysis suitable.

Before conducting factor analysis, these two tests are indispensable steps, jointly ensuring the applicability of the data and the effectiveness of the analysis.

For the data set of this article, we conducted the KMO test and the Bartlett's sphericity test, and the results are summarized in Table 3:

Table 3. The results of KMO test and Bartlett spherical test

KMO and Bartlett tests		
The measurement of the suitability of KMO sampling		0.901
Bartlett sphericity test	Approximate Chi-square	2799.350
	Degree of Freedom	300
	Significance level	0.000

The results show that the KMO value is 0.901, which is greater than the threshold of 0.9. At the same time, the p-value of the Bartlett's sphericity test is significantly less than 0.05 (actually 0.000). Both of these tests strongly support the conclusion that the original data is highly suitable for factor analysis.

3.2 Factor Extraction and Interpretation

When determining the number of common factors, we followed two main principles: one is that the initial eigenvalue is greater than 1, and the cumulative contribution rate is greater than 80%. Based on these criteria, we extracted six principal components from the original data. These six principal components not only contain a large amount of information of the data, but also have a cumulative variance contribution rate of 82.59%, indicating that they can well explain the variability of the original data.

Table 4 shows the results of total variance explanation, as follows:

Table 4. Total variance explanation table

elements	Initial eigenvalue			Extract the sum of squares of the load values			Rotational load square sum		
	sum	variance percentage	cumulative percentage	sum	variance percentage	cumulative percentage	sum	variance percentage	cumulative percentage
1	11.171	44.685	44.685	11.171	44.685	44.685	8.594	34.375	34.375
2	4.498	17.993	62.678	4.498	17.993	62.678	4.321	17.282	51.657
3	2.361	9.444	72.121	2.361	9.444	72.121	3.308	13.231	64.888
4	1.033	4.130	76.252	1.033	4.130	76.252	2.023	8.091	72.979
5	0.855	3.422	79.673	0.855	3.422	79.673	1.237	4.949	77.928
6	0.729	2.917	82.590	0.729	2.917	82.590	1.166	4.662	82.590
7	0.637	2.550	85.140						
8	0.560	2.239	87.378						
9	0.383	1.533	88.911						
10	0.360	1.440	90.351						

To present the distribution of factor loadings more intuitively, we plotted a color scale graph based on the rotated component matrix. In the graph, the darkness of the color reflects the closeness of the relationship between the variable and the common factor. The darker the color, the larger the load value and the closer the relationship.

Furthermore, we used the Varimax maximum variance method to rotate the factor loadings matrix to obtain a clearer factor structure. The rotated factor loadings matrix is shown in the table below. The relationship between each factor and the original variables has been better explained.

Table 5. Based on the rotated component matrix table

	elements					
	1	2	3	4	5	6
somatization	0.865	0.103	0.147	0.064	0.147	0.083
obsessive-compulsive	0.704	0.046	0.240	-0.027	0.483	0.087
interpersonal sensitivity	0.867	0.111	0.252	0.054	0.034	0.000
depression	0.868	0.185	0.076	0.077	0.137	0.070
anxiety	0.904	0.167	0.082	0.013	0.093	0.109
hostility	0.806	0.064	0.193	0.112	0.022	-0.067
phobic anxiety	0.798	0.127	-0.011	0.126	-0.125	0.024
paranoid ideation	0.932	0.107	0.062	0.077	-0.028	0.069
psychoticism	0.881	0.109	0.170	0.016	0.035	0.040
others	0.834	0.030	0.206	-0.010	0.131	0.059
Number of postive items	0.947	0.128	0.208	0.048	0.128	0.065
Mean of positive items	0.205	0.005	0.168	0.086	0.907	0.021
Neuroticism	0.256	0.666	0.218	0.106	0.004	0.453
Extraversion	0.088	0.440	0.043	0.725	0.074	0.272
Openness	0.118	0.251	0.139	0.845	0.049	-0.071
Agreeableness	0.133	0.340	0.234	0.148	0.046	0.843
Conscientiousness	0.087	0.663	-0.030	0.622	-0.017	0.259
information application	0.260	0.003	0.875	0.056	0.070	0.123
Professional awareness	0.153	0.493	0.719	0.056	0.182	0.103
Self-awareness	0.271	0.739	0.384	0.177	-0.007	0.015
Personal adjustment	0.324	-0.065	0.862	-0.028	0.068	0.060
Personal adjustment	0.041	0.809	-0.302	0.324	-0.078	0.091
Values	0.189	0.424	0.598	0.298	0.091	0.084
career choice	0.164	0.882	0.016	0.269	0.010	0.084
Condition assessment	0.128	0.714	0.469	-0.009	0.108	0.041

From this, the entire general factor analysis model for the indicators of this research project can be obtained. For exampl:

Somatization =0.865*F_1+ 0.103*F_2 + 0.147*F_3 + 0.064*
F_4+ 0.147*F_5 + 0.083*F_6; Obsessive-compulsive symptoms = 0.704*F_1 + 0.046*F_2 + 0.240*F_3 .
- 0.027*F_4 + 0.483*F_5 + 0.087*F_6.The remaining indicators are derived from this and the formulas expressing each indicator variable as a linear combination of each common factor are obtained.

Based on the factor loadings matrix after rotation, the following conclusions can be drawn:

The first principal component is mainly related to the SCL-90 scale, reflecting the general mental health status of the test subjects, including aspects such as emotional problems, interpersonal sensitivity, and the severity of psychological symptoms. Therefore, it can be regarded as the "mental health status factor".

The second principal component is related to some indicators in the career maturity scale and the Big Five Personality Scale, covering aspects such as career decision-making, self-efficacy, and career attitude. It reflects the test subjects' self-awareness and career development ability, and can thus be named as the "self-awareness and career assessment ability factor".

The third principal component mainly involves indicators in the career maturity scale such as information application and personal adjustment, reflecting the test subjects' information application and self-regulation abilities in career development. Hence, it is called the "information application and adaptability factor".

The fourth principal component is mainly composed of the extroversion, openness, agreeableness, and conscientiousness indicators in the Big Five Personality Scale, representing the personality traits of the test subjects. Therefore, it is named as the "personal personality factor".

The fifth principal component is related to the average symptom manifestation, reflecting the extreme degree of the test subjects' overall psychological state, and can be regarded as the "mental health deterioration factor".

The sixth principal component focuses on the agreeableness indicator, reflecting the cooperation and friendliness of the test subjects in interpersonal communication, and thus is named as the "interpersonal tendency factor".

In conclusion, based on the SCL-90, the Big Five Personality Scale, and the Career Maturity Scale, we have constructed a comprehensive evaluation system consisting of six indicators. These indicators are: mental health status, self-awareness and career planning ability, information application and adaptability, personal character, degree of mental health deterioration, and interpersonal relationship tendency. This system can conduct a comprehensive and objective assessment and summary of the mental health status of the test subjects from multiple dimensions.

3.3 Factor Score Calculation

Factor scores are obtained by reversing the factor analysis process, converting the extracted common factors into linear combinations of the original variables. This step enables us to quantify the scores of each test subject on each common factor, thereby providing a comprehensive understanding of their mental health and personality traits.

The following is the coefficient matrix between each common factor and the original variables:

$$\begin{cases} x_1=u_1+a_{11}f_1+a_{12}f_2+\cdots+a_{1m}f_m+\varepsilon_1 \\ x_2=u_2+a_{21}f_1+a_{22}f_2+\cdots+a_{2m}f_m+\varepsilon_2 \\ \vdots \\ x_p=u_p+a_{p1}f_1+a_{p2}f_2+\cdots+a_{pm}f_m+\varepsilon_p \end{cases} \Rightarrow \begin{cases} f_1=b_{11}x_1+b_{12}x_2+\cdots+b_{1p}x_p \\ f_2=b_{21}x_1+b_{22}x_2+\cdots+b_{2p}x_p \\ \vdots \\ f_m=b_{m1}x_1+b_{m2}x_2+\cdots+b_{mp}x_p \end{cases} \quad (5)$$

Using this coefficient matrix, the scores of each test subject on the six common factors can be calculated. The specific calculation method is to multiply the observed values of the corresponding variables by the corresponding coefficients and then sum them up. These scores will serve as the basis for subsequent cluster analysis, helping us further understand and categorize the mental health status of the test subjects.

Table 6. Based on the rotated component matrix table

Component score coefficient matrix						
	Elements					
	1	2	3	4	5	6
somatization	0.109	-0.026	-0.041	0.003	0.044	0.034

obsessive-compulsive	0.049	-0.002	-0.05	-0.068	0.381	0.039
interpersonal sensitivity	0.113	-0.013	0.034	0.01	-0.085	-0.077
depression	0.113	0.021	-0.077	-0.021	0.052	0.001
anxiety	0.123	0.02	-0.075	-0.068	0.005	0.059
hostility	0.111	-0.034	0.029	0.078	-0.085	-0.144
phobic anxiety	0.134	-0.023	-0.049	0.058	-0.195	-0.022
paranoid ideation	0.141	-0.031	-0.05	0.018	-0.123	0.027
psychoticism	0.121	-0.003	-0.011	-0.031	-0.069	-0.017
others	0.104	-0.035	-0.005	-0.028	0.02	0.024
Number of postive items	0.119	-0.012	-0.018	-0.015	0.01	-0.002
Mean of positive items	-0.062	0.006	-0.105	0.023	0.858	-0.039
Neuroticism	-0.008	0.148	-0.023	-0.174	-0.038	0.348
Extraversion	-0.024	-0.124	-0.023	0.441	0.033	0.166
Openness	-0.012	-0.183	0.082	0.643	-0.019	-0.224
Agreeableness	-0.031	-0.138	-0.019	-0.038	-0.029	0.921
Conscientiousness	-0.016	0.034	-0.066	0.27	-0.022	0.105
information application	-0.035	-0.141	0.353	0.089	-0.122	0.056
Professional awareness	-0.066	0.143	0.225	-0.11	0.064	-0.093
Self-awareness	-0.012	0.264	0.093	-0.105	-0.061	-0.239
Personal adjustment	-0.019	-0.128	0.35	0.045	-0.125	0.001
Personal adjustment	0.005	0.292	-0.19	-0.046	0.007	-0.098
Values	-0.043	0.026	0.209	0.124	-0.028	-0.096
career choice	-0.009	0.324	-0.082	-0.107	0.035	-0.161
Condition assessment	-0.049	0.319	0.109	-0.257	0.06	-0.2

4. Cluster Analysis and Result Interpretation

4.1 Systematic Clustering Method

The systematic clustering method is a bottom-up clustering strategy. Initially, each sample or variable is regarded as an independent clustering group. This method calculates the distance between data points of different clustering groups and identifies and merges the two closest groups. Then, this process is repeated iteratively until all data points are grouped into one cluster, and an intuitive cluster lineage diagram is generated based on this. This process provides an effective visual means for understanding the similarities and differences between data points.

In this study, the specific implementation process of the systematic clustering method is shown in Figure 1, which illustrates the gradual merging process from the initial independent sample groups to the final single clustering group:

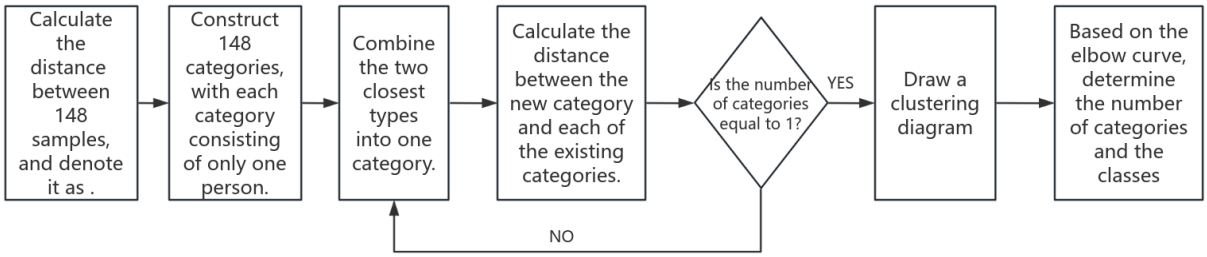

Figure 1. The application of the system clustering method in this problem using a flowchart

(1) Distance measurement: To accurately calculate the degree of closeness between samples, this paper adopts the Euclidean distance as the measurement standard. The Euclidean distance measures the straight-line distance between two points in a multi-dimensional space, and its formula is:

$$d(\vec{x}_i,\vec{x}_j)=\sqrt{\sum_{k=1}^{p}\left(x_{ik}-x_{jk}\right)^2} \quad (6)$$

(2) Calculation of inter-cluster distance: During the process of merging clusters, it is necessary to define the distance between clusters. In this paper, the within-group average connection method was selected. This method

calculates the average distance of all sample point pairs between two clusters as the distance between these two clusters. The specific formula is:

$$D(G_p,G_q)=\frac{\sum_{i=1}^{C_n^2} d_i}{C_n^2} \quad (7)$$

Among them, $G_p$and G_q represent two classes, $D(G_p,G_q)$ represents the distance between two data points of the two classes, d_i is the distance between any two data points in $G_p$and G_q, and n is the total number of data points.

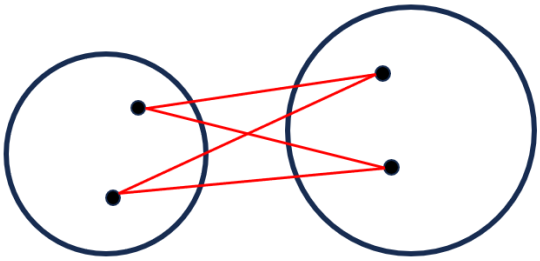

Figure 2. Schematic Diagram of Intra-group Average Connection Method

Figure 2 visually presents the schematic diagram of the intra-group average connection method. Through this diagram, the calculation process of the distance between clustering groups and the basis for their combination can be clearly understood.

In conclusion, the system clustering method combined with Euclidean distance and the intra-group average connection method effectively realizes the clustering analysis of the psychological measurement data of the tested subjects, providing a solid statistical basis for the subsequent classification of psychological states.

4.2 Clustering Results and Analysis

Figure 3 shows the elbow curve obtained through the system clustering method under the comprehensive evaluation index system. This curve helps us determine the optimal number of clusters. After obtaining the scores of 106 valid test subjects on six common factors, we used the system clustering method and combined with the analysis of the elbow curve to scientifically divide the test subjects' group into three categories. Specifically, from the initial 148 test subjects, through detailed clustering analysis, we identified three groups: A, B, and C. Group A consists of 56 people, Group B consists of 49 people, and Group C consists of 43 people.

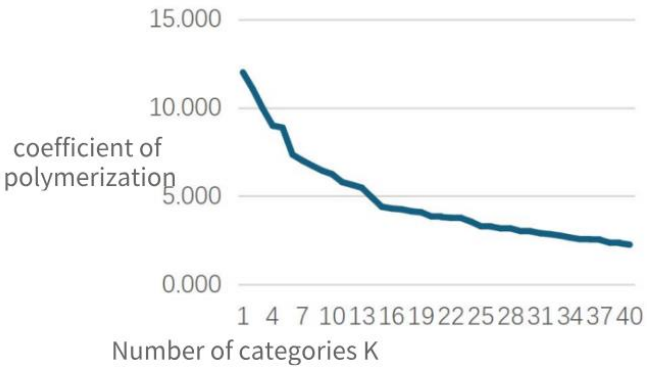

Figure 3. Elbow Curve under the Comprehensive Evaluation Index System

Group A (Sunshine Elite Type): The final clustering center value of this group is 0.049, and there are a total of 56 people. They exhibit a high level of physical and mental health, possess extremely strong professional capabilities, and are leaders and pioneers in the workplace. For business owners, such talents are undoubtedly valuable resources and deserve focused cultivation and attention.

Group B (Middle-Grade Adaptation Type): There are 49 people in this category. Their clustering center value is 0.069. Although these test subjects may not be as outstanding in professional capabilities as Group A, they have stable emotions and a clear understanding of their career and unique ideas. This type of job seekers occupies a considerable proportion in the workplace and is the backbone force for the stable development of the enterprise.

Group C (Workplace Apprentice Type): This category consists of 43 people, with a clustering center value of 0.091. These test subjects have more room for improvement in mental health and professional capabilities, but this does not mean they have no value. Through correct guidance and cultivation, they have the potential to fully exert their abilities and become important forces for the enterprise in the future.

In conclusion, the clustering analysis results not only provide a detailed classification of the test subjects' psychological states for us, but also provide important reference basis for the enterprise's talent management and team building.

5. Conclusion

Amid heightened focus on mental health due to intensified social competition and accelerated life paces, this study addressed the inadequacy of traditional single-scale mental health assessments by developing a multi-dimensional evaluation system. It integrated three key psychological scales—Symptom Checklist 90 (SCL-90), Big Five Personality Inventory, and Career Maturity Scale—to assess 148 subjects, employing a combined framework of factor analysis and systematic clustering.

After preprocessing (directional adjustment of positive/negative indicators and standardization) to ensure data consistency, factor analysis was conducted: KMO test (0.901) and Bartlett's sphericity test ($p < 0.001$) confirmed data suitability. Six common factors were extracted, with an 82.59% cumulative variance contribution rate, covering mental health status, self-awareness & career planning, information application & adaptability, personality traits, mental health deterioration, and interpersonal tendency—effectively condensing multi-scale information. Subsequently, systematic clustering (Euclidean distance + intra-group average linkage) classified 106 valid samples into three types: "Sunshine Elite" (56 subjects, strong mental health/professional abilities), "Medium Adaptability" (49 subjects, stable emotions/clear career cognition), and "Workplace Apprentice" (43 subjects, growth potential in mental health/proficiency).

The factor analysis-systematic clustering combined model exhibited excellent performance: factor analysis simplified complex multi-scale data while retaining 82.59% of original information, and clustering based on factor scores enabled accurate, interpretable classification. This overcomes single-scale one-sidedness, provides a scientific tool for talent management, and verifies the superiority of multi-scale integration and multi-algorithm combination in comprehensive mental health evaluation.

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