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**ANALYSIS OF THE PRINCIPAL COMPONENTS FOR THE
FORMATION OF THE REGIONS RATING**

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Abstract

The questions of formation of the regions rating on the certain aspects of the quality of life are considered. More than 100 features, characterizing labour resources, education, innovations have been analysed. Their structuring was made on the basis of the analysis of the previously developed hierarchical model of the quality of life and cognitive model of the macroeconomic reproduction process. A preliminary analysis of the characteristic discriminant force made it possible to form five types of local samples. The first and second local samples characterize the state of the labour resources of the regions of the Russian Federation. The third and fourth local samples characterize delivery of learning services to the population. The fifth local sample characterizes the innovation activity of the regions of the Russian Federation. The algorithm for formation of the regions rating is proposed. The algorithm based on the sequential application of the principal components analysis first for local samples, and then for the integral sample. The purpose of the analysis of integral sample is to form a single integral characteristic for formation the rating of regions in education, labour, innovations. The global regions rating is formed, TOP-groups of regions of the Russian Federation in sphere of education, labour and innovations are defined.

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Keywords: Integral sample, local sample, principal component, quality of life, rating of regions.



1. Introduction

Modern problems of globalization and balanced development of countries and regions put forward the tasks of comparative analysis and measurement of different indices of the quality of life (McKenzie, 2005; Nardo, Saisana, Saltelli, & Tarantola, 2005; Thaler & Sunstein, 2008; Handbook on Constructing Composite Indicators: Methodology and User Guide, 2008; Somarriba & Pena, 2009). Various measures of the poverty level, socio-economic inequality, corruption of society, its intellectual potential, transparency of financial institutions, effectiveness of public administration determine the social and political climate in society, allow us to assess the level of social tension, predict and prevent various forms of terrorism, crime, social pathology.

The specific of the current period of development of Russian society only increases the relevance of these tasks in the country. Is it possible to compare the quality of life of different regions of the Russian Federation, what is the degree of their differentiation, how to determine the direction of the dynamics of the various integral properties of the quality of life in each region, what are the causes of the observed changes, what are the key directions for improving social and economic policy from the point of view of achieving the goals in improving living standard of the population of the region? – all these questions urgently require the development of a special methodology for interregional analysis of various categories of living standard in the different regions of the Russian Federation and their dynamics (Tatarkin, 2016; Zhgun, 2017; Kuznetsov, Rastova, & Rastov, 2017).

2. Problem Statement

The category “quality of life” is a complex of interrelated components, each of which is also determined by the action of many factors. Within the researches a system hierarchical model of the quality of life is developed and represented in the form of triads of interrelated components. The levels and a set of components of the quality of life are defined (Ilyasov, Martynov, Gerasimova, Makarova, & Zakieva, 2017). As a result of the analysis it was determined a triad of components of the quality of life taking into account earlier studies and on the basis of the analysis of the contours of the reproduction process (Guzairov, Degtyaryova, & Makarova, 2015). It includes the quality of labour, demand and employment; a level of education; an income level as an economic component of the quality of life, closely connected with education and employment and considered from the point of view of scientific and innovative activity. In general, the listed components of the quality of life triad are covered by the main contour of the reproduction process “production-consumption”, which includes the real sector, the household sector and the regulatory mechanism of the labour market.

3. Research Questions

This research deals to the construction of the rating regions for certain aspects of quality of life by the application of principal component analysis.

4. Purpose of the Study

The purpose of the study is to develop the algorithm for formation of the regions rating in education, labour, innovations.

5. Research Methods

As a method of research is used the principal components analysis (Jolliffe, 2002; Manly, 2004; Lindman & Sellin, 2011).

The proposed algorithm for formation of the regions rating is based on the sequential application of the principal components analysis first for local samples, and then for the integral sample.

The main steps of the algorithm are as follows.

At the first step, the importance of the constructed components for each i-sample is analyzed.

At the second step the significant principal components are selected for the formation of an integrated region rating for each of the i-sample. For this purpose there is analyzed a total dispersion cumulative percentage depending on the selected main components which should be greater or equal to the required percentage. If the condition is not fulfilled, then it returns to the step of selecting the significant main components. If the condition is fulfilled, then the new identified generalized characteristics (main components) are calculated for each selected the significant component at the previous step.

The number of selected principal components is marked by n, the number of Russian Federation regions in is q. The calculation is made by the formula:

$$F(x)=a_1*x_1+ a_2*x_2+ a_3*x_3+...+ a_m*x_m.$$

At the third step, the matrix of integral characteristics X_{int} of dimension $q*n$ is formed according to the results of calculating the new identified generalized characteristics.

At the fourth step the components are analyzed for the generated matrix of integral characteristics and the significance of the constructed components are analyzed now for a sample with integral indices X_{int} .

At the fifth step a new identified generalized characteristic for the sample X_{int} with integral characteristics is calculated. A global rating of the Russian Federation regions in education, labour, innovations is formed based on descending/ascending scale of the new generalized characteristics and TOP-groups of regions are identified.

6. Findings

6.1. The composition of the local samples

More than 100 features, characterizing labour resources, education, innovations have been analysed. Their structuring was made firstly, on the basis of the analysis of the proposed model of the quality of life in the form of a hierarchy of triads (Ilyasov et al., 2017), and secondly, on the basis of the analysis of a previously developed cognitive model of the macroeconomic reproduction process (Guzairov et al., 2015). Based on the results of the analysis, it is proposed to combine all the

characteristics into three groups. A preliminary analysis of the characteristic discriminant force made it possible to form five types of local samples.

The first two local samples characterize the state of the labour resources of the regions of the Russian Federation. The sample 1 includes the following characteristics: the number of economically active population; the number of employed population in agriculture; the number of employed population in mining; the number of employed population in manufacturing; the number of employed population in the production and distribution of electricity, gas and water; the number of employed population in building; the number of employed population in wholesale and retail trade; the number of employed population in education; the number of employed population in health care and social services; number of unemployed; average monetary incomes; average monthly nominal wage paid to employees in organizations; gross regional product in 2012; commissioning of the total area of houses. The sample 2 includes the following characteristics: gross regional product; the number of employed population with higher education; the number of employed population with a basic general education; the need for workers declared by organizations in the employment service; average time of job search for unemployed; the number of employed population with secondary vocational education; average monthly nominal wage paid to employees in organizations.

The purpose of the analysis of the first sample is to identify clusters of Russian Federation regions that differ in the level of employment of the population in the main economic activity, taking into account the population's incomes and living conditions.

The purpose of the analysis of the second sample is to identify clusters of Russian Federation regions that differ in the level of economic development and the demand for workers, including with higher education.

The third and fourth local samples characterize delivery of learning services to the population (the sphere of education in the regions of the Russian Federation). The sample 3 includes: the number of pre-school educational organizations; the number of professional educational organizations that train skilled workers and employees; the number of educational institutions of higher education; the number of teaching staff of higher educational institutions; the number of personal computers used for educational purposes, in higher education organizations per 1000 students; the number of personal computers used for educational purposes in professional educational organizations in training for 1000 students; the number of personal computers used for educational purposes in state and municipal general education organizations, per 1000 students; balanced financial result of organizations; fixed capital in the economy (full reported value at the end of the year). The sample 4 includes: the area; population; investments in fixed capital; average monetary incomes (monthly); the number of general education institutions; the number of professional educational institutions training skilled workers and employees; the number of students training on the programs of skilled workers, employees, the number of skilled workers and employees.

The purpose of the analysis of the third sample is to identify clusters of Russian Federation regions that differ in the level of higher education with equipment and the production potential of the region. The purpose of the analysis of the fourth sample is to identify clusters of Russian Federation regions that

differ in the level of general and secondary vocational education with the monetary incomes of the population.

The fifth local sample characterizes the innovation activity of the regions of the Russian Federation. The sample includes the following characteristics: the number of institutions carrying out scientific research and development; the number of researchers with academic degrees; innovative activity of institutions; a volume of innovative goods, works, services; population; investments in fixed capital; average monetary incomes.

The purpose of the analysis of the fifth sample is to identify clusters of Russian Federation regions that differ in the level of innovation activity with investment spending.

The official statistical data in 2013 published on the website of the Federal State Statistics Service (Regions of Russia, 2013) are used for the formation of the listed local samples.

6.2. Calculation results of the region rating in education, labour, innovations

Based on the results of the component analysis of local samples, an integral sample was compiled. The sample includes the following characteristics: the level population employment by main economic activities with regard to living conditions, the level of population employment in mining with regard to incomes, the need for workers with higher and basic general education with regard to the level of economic development, the level of development of higher education with regard to the production potential of the region (the number of institutions and teaching staff), the level of development of general and secondary special education, with regard to the population, the level of innovation activity in the region, with regard to the population and investment.

The purpose of the analysis of integral sample is to form a single integral characteristic for formation the rating of regions by managing the quality of life in education, labour, innovations.

The component analysis of the integral sample is carried out and the summary characteristic of three components with the indication of values is received. In Table 01 there are characteristic coefficients for the constructed main components. The coefficients of informativity is carried out. It follows from the calculations that f1, f2, f3, f5, f6 are significant in the first main component, f4, f5, f6 are significant in the second main component, and f4, f5 are significant in the third main component.

Table 01. Characteristic coefficients for the main components

Characteristics	Name	Component 1	Component 2	Component 3
The level of population employment in by main economic activities with regard to living conditions	f1	0,416204	-0,197327	-0,348793
The level of population employment in mining with regard to incomes	f2	0,416565	-0,218804	-0,273168
The need for workers with higher and basic general education with regard to the level of economic development	f3	0,416341	-0,194212	-0,347493
The level of development of higher education with regard to the production potential of the region (the number of institutions and teaching staff)	f4	0,398227	-0,492094	0,706507

The level of development of general and secondary special education, with regard to the population	f5	0,401406	0,524714	0,414376
The level of innovation activity in the region, with regard to the population and investment	f6	0,400245	0,59832	-0,110049

Component 1 has equal high coefficients for all characteristics and describes 94% input data dispersion excluding other principal components. It means that the received component 1 can be considered as an integral characteristic for the formation of a global region rating in education, labour, innovations.

For a global region rating in education, labour, innovations it is necessary to calculate F1 for each region using the following formula:

$$F1=0,416204*f1+0,416565*f2+0,41634*f3+0,398227*f4+0,401406*f5+0,400245*f6.$$

Putting the values of the new generalized characteristic in descending/ascending scale, and according to the regions of the Russian Federation, we get the global region rating of the Russian Federation in education, labour, innovations (Table 02). At the step of the preliminary data analysis of living standard in education, labour, innovations, high values of characteristics for Moscow and St. Petersburg were obtained. Due to it the highest rating was given to these cities, and they were excluded from the analyzed sample.

Table 02. Global region rating of the Russian Federation in education, labour, innovations

Number	Region	Component 1	TOP
1	St. Petersburg		TOP-10
2	Moscow		
3	Khanty-Mansi Autonomous Okrug-Yugra	2929301	
4	Moscow Region	2264667	
5	Yamalo Nenets Autonomous Okrug	1786176	
6	Krasnodarsky Krai	1537658	
7	Sverdlovskaya oblast	1461973	
8	Tatarstan Republic	1436670	
9	Krasnoyarsky Krai	1080477	
10	Bashkortostan Republic	996260,1	
11	Samarskaya Oblast	952913,4	TOP-20
12	Permsky Krai	912721,1	
13	Nizhegorodskaya Oblast	860246,1	
14	Chelyabinskaya Oblast	821562,7	
15	Rostovskaya Oblast	811855	
16	Leningradskaya Oblast	764590,1	
17	Irkutskaya Oblast	756287,9	
18	Primorsky Krai	724671,3	
19	Kemerovskaya Oblast	714867,5	
20	Tyumenskaya Oblast without autonomous regions	708045,9	

7. Conclusion

The algorithm of formation a global region rating in education, labour, innovations is proposed. The main feature of the method consists, first, in the use of an integral sample, which is compiled on the basis of generalized characteristics as the results of the analysis of local samples and is given in the significant principal components. Secondly, the feature of the algorithm consists in calculating the global region rating on the basis of the component analysis results of the integral sample and the first principal component is used for the calculating formula. The global region rating in a form of linear combination of generalized characteristics with weighted coefficients calculated by component analysis of the integral sample makes it possible to exclude subjectivity of expert opinions and increase the degree of objectiveness for the formation of TOP-groups of regions for the next decision-making.

According to the proposed algorithm, many characteristics is combined into a single integral characteristic for the quality of life in education, labour, innovations for the regions of the Russian Federation. An integral sample was formed, on the basis of generalized characteristics revealed by the analysis of five local samples and is given the first significant principal components. The feature of the method is a calculation the global region rating by the component analysis of the integral sample. The analysis of the principal component significance helped to select the first principal component. Using weighted coefficients of the first principal component in the calculation of the quality of life in education, labour, innovations gives the opportunity to increase the degree of objectivity in the analysis and management decision making. With the help of the calculated indicator of the quality of life, all regions are ordered in one-dimensional space in descending scale, a rating of regions is formed, there are marked TOP-groups of the Russian Federation regions in education, labour and innovations.

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