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METHODOLOGICAL BASIS FOR CONSTRUCTING A GENERALIZED INDICATOR OF GOODS AND SERVICES CONSUMPTION

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Abstract

The territorial differentiation analysis determined by economic, social, demographic, natural, and other regional conditions is one of the means of scientific cognition method of formation and cause-effect relationships mechanism of consumption level. However, this task is difficult for there is no single (universal) developed indicator of goods and services consumption level. Specific indicators are the indicators of individual elements only. Our objective is to obtain a quantitative (statistical) consumption level estimation in the regions of Russia. Based on the fact that “consumption level” is a synthetic category that has many aspects and indicators we proposed to form a system of relevant statistical indicators based on official information. In accordance with this, the following research tasks were set: to obtain a generalizing multidimensional consumption of goods and services level assessment in the constituent entities of the Russian Federation; to determine the typology of the regions using the obtained estimates; to develop econometric models of generalized indicators; to identify the most important factors affecting regional differences in the consumption level in the Russian Federation. As a result of the constituent entities of the Russian Federation typology, according to a generalized assessment of consumption (goods and services), it was found that the majority of regions (67%) belong to a group with average consumption level, 16% to a group with high level and 17% to a group with low consumption level.

Keywords: Standard of living, consumption; region, generalized indicator, multidimensional evaluation, statistics.

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1. Introduction

Effective social policy in the regions of the Russian Federation is based on the knowledge of the causes and factors determining the territorial differences in the living standards of the population. In this regard, the role of regional statistics is undoubtedly great, being a means of informational and methodological support of the decision-making process for regulating the standards of living of the people in the regions.

The substantive aspect of the category of "standard of living" should be considered thoroughly. The standard of living in the narrow sense is, above all, in our opinion, the achieved level of material goods and services consumption by the population. In a broad sense, the category of "standard of living" includes the whole complex of socio-economic conditions of society, interpreted in the literature quite ambiguously.

To characterize the standard of living of the population from the point of view of the concept of consumption, the following indicators are used: total and average consumption of goods and services volume per capita (both for the population and for individual social, age and gender, and income groups).

2. Problem Statement

Consumption is a use of a product in the process of satisfying needs. Thus, a person acquires goods and services in order to meet his/her needs. Throughout his/her life, a person experiences many needs in various spheres of life, starting with physiological requirements and ending with the needs for personality self-realization and self-actualization.

The consumption level is a multicomponent category and to describe it a single indicator is not enough. It is necessary to develop a system of indicators, each of which will be considered in a regional context. This will allow to solve the scientific problem of inter-regional comparative analysis. At the final stage of the study, it is necessary to develop and calculate generalizing indicators for individual integrated groups of consumption (goods, services, etc.).

The population well-being and its differentiation by constituent entities of the Russian Federation should be estimated by developing generalizing consumption indicator for three indicators: a generalized food consumption indicator, a generalized of non-food items consumption indicator, and a generalized services consumption indicator.

A generalized consumption estimation of different countries and regions was carried out by many researchers. We can note similar studies on Romania (Dumitru & Stănescu, 2014; Mârza, Mărcuţă, & Mărcuţă, 2015), Prague (Varvazovska & Prasilova, 2015), Russia (Proskurina, 1999; Zadorova, 2017). Brovkova proposes original consumption indicators as the most suitable for analyzing the socio-economic inequality of Russian regions (Brovkova, 2014).

An important question is the role of individual factors in regional differences in the level of consumption. A wide range of scientists from different countries mentioned it. Madzík, Piteková, & Daňková (2015) analyze the links between the competitiveness of individual countries and the consumption level of their population. Wang and Hao (2018) study the Internet impact on “sustainable consumption in an international context”. The impact of the poverty factor is considered in the works of Kochkin (2016), Zalivcheva and Iosipenko (2016).

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We consider it rather non-standard to study the influence of spirituality state in society on the motivation of needs of the subject (Piryutko, 2013) and the socialization factor on the consumer behavior model (Shilova, 2014).

The issues of financing consumer spending and the concept of "conscious consumption" are reflected in the scientific works of Abramuszkinová and Rozbořil (2014), Quoquab and Mohammad (2016) and Lim (2017).

Macroeconomic aspects and factors of household consumption are conceptually reviewed in Hoang, Pham, & Ulubaşoğlu (2014) and Manakhova (2014).

In our opinion, there is a certain lack of research on the statistical description of the consumption level in households of the Russian Federation. However, without a generalized assessment of consumption, it is difficult to obtain an objective situation of the Russians standard of living.

3. Research Questions

This study posed the following questions.

1. to analyze the information base for calculating statistical indicators of consumption and the standard of living of the population;

2. to develop a methodology for calculating generalized consumption indicators based on the synthesis of particular indicators

3. to develop multi-factor regression models of generalized consumption indicators in the regions of the Russian Federation;

4. to make a quantitative assessment of the role of factors determining territorial differences in the level of consumption of the population in Russia.

4. Purpose of the Study

The work aims at a statistical consumption analysis of the population in the Russian Federation.

The research object is the differences in the consumption level of the population and the factors determining them in the Russian Federation and its regions.

Statistical laws and interrelations of socio-economic processes characterizing the differentiation of the consumption level of the population in the Russian Federation are considered as a research subject.

5. Research Methods

The study was carried out based on the materials of the Federal State Statistics Service of Russia, as well as scientific publications on the subject under study.

The methodological and theoretical basis of the study consists of laws and other regulatory acts of the Russian Federation, the work of domestic and foreign experts in statistical study of the standard of living and household consumption.

For a comparative assessment of consumption indicators in regions, nonparametric methods of statistical analysis are used. The main advantage of these methods is the possibility of targeted "compression" of the initial information, the quantitative characteristics of attribute features, the synthesis of the values of particular indicators into the integral ones and the simplicity of results interpretation.

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Non-parametric estimation methods include: a ranking method, the scoring method, a sum of the places method, a multidimensional average method, a "Pattern" method, and other methods. A generalizing expression of the multi-scale characteristics of a multidimensional phenomenon, taking into account the differences common for natural values of attributes, makes it possible to obtain the multidimensional average and the "Pattern" methods.

The algorithm of the multidimensional average method is as follows:

- source data matrix is replaced by matrix of normalized values (the average value of each consumption indicator is calculated for the studied population of regions ($\overline{x_i}$) and the normalized values of private consumption indicators for each region are determined (t_{ij});

- multidimensional average estimate of consumption level is calculated from the normalized values of particular consumption indicators, i.e. for each line (region) there is the arithmetic average of the normalized values

$$\overline{t_j} = \frac{\sum t_{ij}}{n} \qquad (1)$$

The "Pattern" method differs from the multidimensional average method in that the best values of indicators are used as the basis for pairwise comparisons.

The maximum values of the indicators being taken as the best ones for the factors that have a direct impact on the phenomenon under study:

$$t_{ij}fact = \frac{x_{ij}}{x_{\max}} \qquad (2)$$

For factors that have the opposite effect on the phenomenon under study (the so-called anti-factors), the minimum values of the indicators are taken as the best, and the inverse formula should be used to calculate the normalized values: $t_{ij}antifact = \frac{1}{t_{ij}^{факт}} = \frac{x_{\min}}{x_{ij}}$ (3)

A generalized estimate is also calculated from the normalized values of particular consumption indicators, as the arithmetic average of the normalized values of the indicators.

The highest values of the generalized assessment indicate a high level of the socio-economic phenomenon under study.

A disadvantage of such an assessment (underestimated) is that the analysis does not take into account the priority of some features over the others due to their information capacity and socio-economic significance.

To take into account the role of each particular indicator in the formation of a generalized assessment, in which the latter is calculated on the basis of the standardized values considering of particular indicators, i.e. using weighting coefficients can be a more preferred approach:

$$\overline{t_j} = \frac{\sum t_{ij} d_i}{\sum d_i} \qquad (4)$$

where d_i – weighting coefficients, found this or that way.

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The weighting coefficients can be taken as certain types of products ratio in the total expenditure of household food products purchase of households in the Russian Federation.

To determine the weighting coefficients a ranking method of features selected according to the degree of their significance for the analysis can be used. The method is followed by the subsequent assignment of weighting coefficients to the features based on expert judgment. For example, the largest weighting coefficient is defined as the most consumed food product.

To study the factors influencing the state of consumption in regions, we developed models in the form of linear multiple regression equations, which are an analytical form of the dependence on various factors of the modeled indicators.

6. Findings

Goods and services consumption analysis begins with necessary statistical information collecting.

Sources of information concerning the consumption of the population are: current accounting, reporting of enterprises, organizations, and serving institutions; labor statistics, employment of population data, household budgets data, population censuses, sociological and other surveys concerning social life conditions and human activities.

To obtain economic and statistical information on living standards of various groups and segments of population, state statistics agencies conduct sample surveys of household budgets, the data of which are used to assess the level and dynamics of material well-being of households with different incomes. The survey is conducted in all constituent entities of the Russian Federation by a selective method based on indicators characterizing household composition by sex, age, occupation, income from sources of income, expenditures by type of expenditure, purchases and consumption of food and non-food items, expenditures on certain types of services, housing conditions indicators, personal subsidiary farming and other indicators.

To characterize the differentiation of the Russian Federation regions by consumption level of goods and services by the population and develop region typology, generalized consumption indicators using the “Pattern” method were calculated on the basis of private consumption indicators (Table 01).

Table 01. The system of indicators for generalized indicators of consumption calculation

Generalized consumption indicators	Private consumption indicators
Generalized consumption indicators of food products	Average consumption of food in households per household member, kg per year: -bread products - potatoes -vegetables and cucurbits - fruits, berries - meat and meat products - milk and dairy products -fish and fish products -eggs, pcs. -sugar and confectionery - oil vegetable and other fats

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Generalized consumption indicator of non-food items	Durable goods provision (pieces per 100 households per year): - TVs - video and movie cameras -personal computers - refrigerators -dishwashers -mobile phones -microwaves -music centers -electric vacuums - air conditioners -the provision of the population with housing (sq.m. per person) -the provision of the population with cars (units per 1000 population)
Generalized consumption indicator of services	The volume of services for population (rubles per capita): - chargeable service -household -communications -transport -utility services
Generalized consumption indicator	- generalized consumption indicator of food products; - generalized consumption indicator of non-food items; - generalized consumption indicator of services.

Note: Source: Compiled by the authors according to the Federal State Statistics Service (http://www.gks.ru)

Table 02 presents the grouping results for all generalized consumption indicators. As can be seen from the table, the Russian Federation regions are unevenly distributed into groups for each generalized assessment.

Table 02. Grouping of the Russian Federation regions according to generalized consumption indicators

Groups of regions by consumption level	**Number of regions**			
	Generalized consumption indicator	**Generalized consumption indicators**		
		food products	**non-food items**	**services**
Low consumption level	14	48	6	40
Middle consumption level	55	8	46	34
High consumption level	13	26	30	8
In total	82	82	82	82

Note: Source: Authors

More than half of the regions have low food and services consumption levels. By consumption of non-food items 56% of the entities are in the group with average consumption level.

According to a generalized assessment of consumption (goods and services), the main part of the regions (67%) is in a group with average consumption level, 16% in a group with high level and 17% in a group with low consumption level.

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The group with low consumption level is represented by 14 entities of the Russian Federation, they are mainly the republics of the North Caucasus and the regions that are outsiders due to socio-economic situation: the republics of Dagestan, Ingushetia, North Ossetia-Alania, Chechen, Karachay-Cherkess, Kalmykia, the Crimea, Mari El, Chuvash, Tyva, Khakassia, Altai, as well as the Smolensk and Tambov regions. This group has the lowest values of generalized estimates of consumption of both food products and non-food items and services.

The group with high level of consumption, and therefore high living standards included 13 highly developed regions, mainly in terms of economic development: cities of federal significance: Moscow, St. Petersburg, Sevastopol, as well as the Murmansk, Moscow, Sakhalin, Sverdlovsk, Magadan regions, the republic of Sakha, Kamchatka, Khabarovsk, Krasnodar Territories, Chukotka autonomous area.

The most numerous group is formed by 55 regions of the Russian Federation with average consumption level and standard of living. In this group, there are average values of multidimensional indicators of food, non-food items, and services consumption. This group includes the Samara region.

The constructed typology of regions can be used for the formulation of regional policies and in the diagnosis of their socio-economic status. At the same time, it is necessary to establish the influence of which factors lead to the differentiation of regions in terms of living standards, characterized by the consumption of goods and services by the population. That is, it is necessary to identify the presence of statistical relationship between the considered effective and factor features and to quantify the influence extent of the argument factors on consumption indicators. The implementation of this goal is carried out by the multi-factor regression model's development.

In terms of regional consumption levels variation, it is possible to solve of the problem of identifying objective causes and factors determining interterritorial differences by developing multi-factor regression models of generalized consumption indicators:

Y1 - generalized indicator of food consumption level,

Y2 - generalized indicator of non-food items consumption level,

Y3 - generalized indicator of services consumption level,

Y4 - generalized indicator of consumption level.

The homogeneity analysis of the studied aggregates of consumption indicators revealed that the private and generalizing consumption indicators are homogeneous territorial series. When developing the indicators models, 82 regions of the Russian Federation were included into the statistical aggregates.

Regression models of generalized consumption indicators development, which are the most informative indicators of the population welfare level among the studied indicators, is the final stage of identifying the factor-arguments determining territorial differences in the standard of living of the population. Further on, we shall use the factor variables numbering introduced during the study.

Consistently conducted multi-step regression analysis allowed us to determine the range of factor-arguments of the generalized indicator of food products consumption:

X4 - percentage of men of the total population;

X5 - level of urbanization of the population;

X6 - male lifetime expectancy;

X11 -level of general unemployment;

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X13 - quality of living conditions, characterized by the proportion of apartments provided with bath and shower;

X24 - average yield of grain crops for several years.

Model of generalizing index of food products consumption:

$$\hat{y}_1 = -0,62 + 0,003x_5 + 0,009x_6 + 0,011x_4 - 0,003x_{11} - 0,001x_{13} + 0,002x_{24}$$

The linear equation coefficients of multiple regression express the degree of food products consumption level change by the population in the regions of the Russian Federation due to an increase in the values of the corresponding factor features for fixed values of other factor-arguments and the averaged influence of other unrecorded factors. The free member of the regression equation b_0=-0,62 characterizes the value of the initial ordinate of the regression plane in five-dimensional space.

Regression equation in a standardized form:

$$\hat{t}_1 = 0,781t_5 + 0,501t_6 + 0,226t_4 - 0,228t_{11} - 0,371t_{13} + 0,297t_{24}$$

The greatest significant influence on the formation of territorial differences of the generalized indicator of food products consumption has a differentiation in the level of urbanization of the territory (d_5=0,376). The second priority is the differences in the lifetime expectancy of men in the regions, under the influence of which 9.4% of variation of the phenomenon being studied is formed. The priority of other factor arguments in terms of their influence intensity on differences in food products consumption in a region is expressed by the following sequence: X13, X24, X11, X4.

The multiple regression equation includes the most significant regression coefficients by the t – criterion. The value of the coefficient of multiple correlation was 0.698, which is slightly higher than the similar values of particular indicators of food products consumption.

Regression model of general indicator of non-food items consumption:

$$\hat{y}_2 = 0,6722 - 0,0063x_{11} + 0,0001x_{22} + 0,0002x_{19} + 0,0009x_{13} + 0,0021x_{10}$$

Model in standardized form:

$$\hat{t}_2 = -0,451t_{11} + 0,191t_{22} + 0,292t_{19} + 0,243t_{13} + 0,183t_{10}$$

The variation in non-food items consumption by 50% is due to the unemployment rate (d_{11}=30,9%) and the ratio of marriages and divorces (d_{19}=18,9%). The quality of living conditions, characterized by the proportion of apartments provided with a bath and shower (x_{13}), the level of environmental pollution (x_{22}) and the share of people employed in industry, construction and agriculture (x_{10}), have a positive impact on this process.

The regression model of territorial differences in services consumption by the population is described by the following equations:

$$\hat{y}_3 = 0,3914 + 0,0000x_{20} + 0,0039x_{13} - 0,0092x_{11} + 0,0068x_{10}$$

Model in standardized form:

$$\hat{t}_3 = 0,418t_{20} + 0,382t_{13} - 0,254t_{11} + 0,232t_{10},$$

The model allowed to determine the priority factor-arguments in the formation of territorial differences in the consumption of services:

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- with a positive impact - investment in fixed capital per capita(x20), quality of living conditions, characterized by the proportion of apartments (x13) with bath and shower, the proportion employed in material production: industry, construction and agriculture (x10);
- with a negative impact - the unemployment rate (x11).

Generalized consumption indicators of private aspects of consumption reflect just a part of the total consumption of the population, since there are food products, non-food items, and services consumption, etc. In this regard, it is worthwhile developing a regression model of a generalized consumption indicator (calculated by the multidimensional average method) consisting of three indicators:

- generalized consumption indicator of food products;
- generalized consumption indicator of non-food items;
- generalized consumption indicator of services.

As a result of a multi-step regression analysis, a regression model of territorial differences in the consumption of all goods and services was obtained. The model is described by the equation:

$$\hat{y}_4 = -0{,}777 + 0{,}0\mathbf{03}x_5 + 0{,}00\mathbf{0}x_{20} + 0{,}00\mathbf{2}x_{24} + 0{,}02\mathbf{3}x_4 + 0{,}00\mathbf{0}x_7$$

Model in standardized form:

$$\hat{t}_4 = 0{,}62\mathbf{9}t_5 + 0{,}21\mathbf{3}t_{20} + 0{,}33\mathbf{2}t_{24} + 0{,}38\mathbf{4}t_4 + 0{,}17\mathbf{6}t_7$$

The model revealed a stable interdependence of regional levels of a generalized consumption indicator on the level of urbanization, characterized by the proportion of the urban population (x_5): with the urbanization development (by increasing the share of urban population by 1 percentage point), the average population consumption increases by 0.0032 or 0.32%. The semantic load of this dependence is determined by the fact that the level of consumption of goods and services in urban areas is significantly higher compared to rural areas.

Differentiation of population consumption, according to the considered models, is due to the following factors: urbanization level (X_5); proportion of men in the population (X_4); average yield of grain crops for several years(X_{24}); capital investments per capita (X_{20}); the average annual number of people employed in the economy (X_7).

The cumulative coefficient of linear model determination means that the variation of the generalized consumption indicator, explained by the variation of the considered argument factors described above, is 70.7%. About 50% of this influence is due to the urbanization process (d_5=38,7%) and the share of the working-age population is (d_4=9,5%). Moreover, average annual number of people employed in the economy, the level of investment in fixed assets as well as grain crops yield have a positive impact on the process of regional values of total consumption forming.

Correlation analysis reveals the presence of a stable relationship between regional levels of a generalized consumption indicator and its determining factors.

Multifactor models testing for multicollinearity shows that the coefficients of the multiple regression equations, expressing the dependence of regional levels of the generalized consumption indicator on several factors, retain their content and direction.

Comparing the calculated values of the simulated characteristic with the empirical ones is a mathematical category expressing the degree of convergence of the simulation results and the quality of

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the regression equation. The calculated values of the F-criterion are much larger than the tabulated ones with a probability of 0.95. This allows to conclude that the permissible level of convergence of empirical and calculated values with the risk of error, respectively, is in no more than 5% of cases. The average approximation error is also within the acceptable level.

The study of the quantitative measure of the influence of determining factors on territorial differences in consumption levels can be performed using partial elasticity coefficients characterizing the relative degree of change of the dependent variable with a change in the values of each factor-argument for 1% with the averaged influence of other factors and abstraction from the influence of unrecorded factor signs.

However, elasticity coefficients cannot be used as a basis for determining the priority of factor feature, since they do not take into account the extent of the influence of the arguments determined by the levels of variation on the dependent value.

The priority of factor-arguments is most fully expressed by means of partial determination coefficients, characterizing the degree of variation influence of this or that factor feature on the formation of the dispersion of dependent variable.

The calculated values of the partial elasticity coefficients indicate that food consumption is the most elastic in relation to the expected men lifetime: the increase of the male population lifetime up to one percent results in an increase in regional levels of consumption of food products up to 0.882%. Food consumption under the influence of urbanization ($Э_5$=0,313) and the unemployment rate ($Э_5$=0,313) is also very elastic.

Non-food consumption is relatively elastic to the ratio of marriages and divorces and unemployment. The increase in the number of marriages up to 1% leads to an increase in the consumption of non-food items by 0.19%. An increase in the unemployment rate of 1 percent leads to a decrease in the consumption of these goods by 0.133%. As for other argument factors, the consumption of non-food items is of low elasticity.

The services consumption is characterized by elasticity with respect to the “quality of living conditions” factor, characterized by the proportion of apartments provided with bath and shower ($Э_{13}$=0,647), as well as with regard to the factors of the level of investment in fixed assets ($Э_{20}$=0,647) and the unemployment rate ($Э_{11}$= -0,216).

A very high degree of elasticity occurs in the generalized consumption indicator relative to the proportion of men in the total population: with the increase in the proportion of men by one percent, the consumption of all goods and services increases by 1.785%. This indicator is also elastic in relation to the urbanization of the population ($Э_5$=0,346).

The elasticity analysis made it possible to estimate the intensity of the influence of factors-arguments on the formation of the values of the simulated characteristics - generalized consumption indicators that characterize standard of living of the population of the regions.

The construction of multifactor regression models of the population well-being level has revealed some regularities of territorial differentiation of standard of living of the population of the Russian Federation regions. The construction also pointed out the range of factors determining it.

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7. Conclusion

The results of the conducted analysis of the differentiation of goods and services consumption by the population in the Russian Federation and its regions allow us to draw the following conclusions.

1. At present, to assess the population standard of living is worthwhile to use the quantitative assessment of the studied phenomenon based on generalized assessments of food, non-food items and services consumption level.

2. The main sources of information on consumption in Russia are various types of reporting, the results of sociological and other sample surveys of social conditions of life and human activities.

3. The methodology for generalized indicators development is described in detail in literature, and most often it is a calculation of a multidimensional average estimate from indicators of consumption using non-parametric estimation methods. We suggest 4 multidimensional consumption indicators that characterize the phenomenon being studied comprehensively - “a generalized indicator of food consumption level”, “a generalized indicator of non-food items consumption level”, “a generalized indicator of services consumption level”, “a generalized indicator of consumption level”.

4. As a result of the typologization of the constituent entities of the Russian Federation, a generalized assessment of consumption (goods and services) revealed that the main part of the regions (67%) is in a group with the average consumption level, 16% in a group with high level and 17% in a group with low consumption level.

The group with a low level of consumption is represented by 14 subjects of the Russian Federation, mainly the republics of the North Caucasus and outsider regions by socio-economic situation: the republics of Dagestan, Ingushetia, North Ossetia-Alania, Chechen, Karachay-Cherkess, Kalmykia, the Crimea, Mari El, Chuvash, Tyva, Khakassia, Altai, as well as the Smolensk and Tambov regions. This group has the lowest values of generalized estimates of consumption of both food and non-food products and services.

The group with a high level of consumption, and therefore a high standard of living, includes 13 highly developed regions, mainly in terms of economic development: federal cities of Moscow, St. Petersburg, Sevastopol, the Murmansk, Moscow, Sakhalin, Sverdlovsk, and Magadan regions, the Sakha Republic, Kamchatka, the Khabarovsk, Krasnodar Territory, the Chukotka Autonomous area.

The most numerous group is formed by 55 regions of the Russian Federation with an average level of consumption and standard of living. In this group, the average values of multidimensional indicators of consumption of food, non-food items and services. This group includes the Samara region.

The constructed typology of regions can be used for the formulation of regional policies and in the diagnosis of their socio-economic status.

5. The conducted statistical study of the factors of territorial differentiation of population consumption in the regions of the Russian Federation showed that the simulated socio-economic phenomenon is the result of the impact of a large number of socio-economic factors having different directions and different forms of manifestation. The level of regional economy development, the specificity of its structure and employment, as well as socio-demographic factors play a significant role in shaping the consumption of the population, its level and proportions of distribution among various groups of the population.

The regions typology in terms of standard of living of the population, the results of modeling factor relationships of generalized consumption indicators, identifying and analyzing the leading factors determining territorial differences, in our opinion, can serve as information support for the decision-making process for regulating living standards in the regions of the Russian Federation. An effective management system at various levels should be based on a statistical analysis of the most important characteristics of the differentiation of population consumption, identifying the most significant patterns in their change.

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