Methods of multidimensional classification in assessing the economic efficiency of local government

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Abstract. The study is devoted to the development of additional tools for analyzing the performance of local governments. All the calculations are made on the example of the Novgorod region.

Keywords: local government, district, municipal district, management, multidimensional classification, efficiency

1. Introduction

Good governance at the municipal level is highly relevant. In accordance with the Decree of the President of the Russian Federation of April 28, 2008 *On Evaluating the Effectiveness of the Activities of Local Self-Government Authorities, Urban and Municipal Districts*, monitoring should be conducted annually with the calculation of a large number of analyzed indicators [2]. Its high-quality implementation contributes to the rapid identification of the problematic features of management processes at the municipal level, provides prerequisites for the development of effective strategies for the development of territories [4, 5].

2. Materials and Methods

In this work, we used materials of the Summary Report on the results of monitoring the effectiveness of local governments' activities in both urban municipal districts of the Novgorod region in 2014 and 2017 [3]. Abstract-logical, economic-statistical, graphic, and economic-mathematical (a cluster analysis) methods were used in the study at different stages.

3. Results

Monitoring the performance of local governments is carried out using 49 indicators, combined in 9 integrated groups (economic development, pre-school education, general and additional education, culture, physical culture and sports, housing construction and housing, housing and communal services, organization of municipal management, energy conservation and energy efficiency). An analysis was performed for 21 municipal districts of the Novgorod region.

The first integrated group of indicators "Economic Development," which includes 13 indicators (Table 1), was chosen to illustrate the use of cluster analysis techniques.

Table 1. Indicators included in the assessment of economic development in municipal districts of the Novgorod region.

	Indicators included in the enlarged group
Economic development (13 indicators)	x_1 - The number of small and medium-sized businesses per 10 thousand people, units; x_2 - The share of the average number of employees (without external part-timers) of small and medium enterprises in the average number of employees (without external part-timers) of all enterprises and organizations, %; x_3 - The volume of investment in fixed assets (excluding budgetary funds) per 1 resident, rub.; x_4 - The share of the area of land plots, which are objects of land tax, in the total area of the city district (municipal district), %; x_5 - The share of profitable agricultural organizations in their total number, %; x_6 - The proportion of the length of local public roads, which do not meet regulatory requirements, in the total length of local public roads, %; x_7 - The share of the population living in settlements that do not have a regular bus and (or) train service to the administrative center of the city district (municipal district), in the total population of the city district (municipal district), %; x_8 - Average monthly nominal accrued wages of employees of large and medium-sized enterprises and non-profit organizations, rub.; x_9 - Average monthly nominal accrued wages of employees of municipal pre-school educational institutions, rub.; x_{10} - Average monthly nominal accrued wages of employees of municipal educational institutions, rub.; x_{11} - Average monthly nominal accrued wages of teachers of municipal educational institutions, rub.; x_{12} - Average monthly nominal accrued wages of employees of municipal institutions of culture and art, rub.; x_{13} - Average monthly nominal accrued wages of employees of municipal institutions of physical culture and sports, rub.

In accordance with the objectives of the study, the decision was made to form three homogeneous groups of municipal districts of the Novgorod region according to the level of effectiveness of local governments (with high, medium and low levels).

Since the total number of groups was initially known, a cluster analysis was performed using the "k-means" method. Calculations are made in the PPP "Statistica" [1].

According to the analysis of variance, the formed groups are homogeneous and suitable for practical calculations (Table 2). Intra-group variance for all variables is below the intergroup value.

According to the 2007 data, three groups of districts of the Novgorod region with different levels of effectiveness of the activities of local governments were formed. The first group (with a high level of indicators) included 5 municipal districts, the second on (with an average level of indicators) included eleven, and the third (with a low level of indicators) group had five municipal districts.

The maximum, minimum, and average values of the indicators are shown in each formed cluster for all analyzed variables (Table 4).

Table 2. The variance analysis results of the multidimensional classification of districts of the Novgorod region.

Variable	Intergroup dispersion	Intragroup dispersion	Significance (F)	Significance level (p)
X_1	896.20	368.30	4.256	0.239
X_2	312.20	55.80	6.854	0.495
X_3	3 825.60	3 258.10	2.213	0.065
X_4	938.20	390.45	4.587	0.417
X_5	2 684.20	1 625.57	20.566	0.995
X_6	885.60	498.02	17.324	0.287
X_7	1.25	0.91	3.552	0.695
X_8	36 874.20	25 367.30	9.854	0.352
X_9	54 257.60	29 567.80	4.213	0.007
X_{10}	74 568.40	68 954.20	4.885	0.041
X_{11}	45 669.30	23 234.10	12.874	0.634
X_{12}	38 441.50	25 687.20	14.583	0.854
X_{13}	77 852.20	69 984.40	13.864	0.554

The effectiveness of local government is advisable to analyze in dynamics. Therefore, according to the data from 2014, a multidimensional classification is carried out by analogy. Seven districts of the Novgorod region were assigned to the first cluster, nine to the second, and five to the third.

It is important to evaluate not only the current level of effectiveness of the local self-government bodies' activities, but also the stability of this indicator over time (Table 3).

Table 3. Groups of municipal districts of the Novgorod region by the degree of sustainability.

District groups	Group's characteristic	Number of districts
Rapid decline in efficiency	The group includes areas moved from the first to the third cluster.	-
Moderate decline in the level of efficiency	The group includes areas that have moved down in one cluster (from first to second, from second to third)	5
Stable high efficiency	The group includes areas remaining in the first cluster in a dynamic section.	5
Steadily average efficiency	The group includes areas remaining in the second cluster in a dynamic section.	5
Stable low efficiency	The group includes areas remaining in the third cluster in a dynamic section.	3
Moderate increase in efficiency	The group includes areas that moved up one cluster (from the second to the first, from the third to the second)	3
Rapid increase in the level of efficiency	The group includes areas that have moved from the third cluster to the first one.	-

Positive dynamics in the degree of sustainability of the effectiveness level of the local self-government bodies' activities are observed in 13 districts of the Novgorod region, and there are negative dynamics in 8 districts.

Table 4. The clustering results of the Novgorod region's areas in terms of the local governments effectiveness activities in 2017.

Values	Indicators: effectiveness of local governments in the integrated group "Economic Development"												
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}
Group 1													
Maximum	309.0	27.2	144714.6	100.0	100.0	99.5	2.9	34701.3	21773.8	27589.2	29256.5	25578.0	24470.0
The average	293.4	23.7	98142.9	92.3	41.4	51.7	1.7	31661.3	20472.9	25579.1	27311.7	25797.6	21531.0
Minimum	271.0	22.1	21590.5	80.5	0.0	14.3	1.0	27060.5	18704.3	22915.0	25617.2	22085.1	17093.0
Group 2													
Maximum	455.0	33.3	204714.0	100.0	100.0	91.1	5.8	32960.5	21102.5	26326.2	27834.3	27712.0	26735.0
The average	272.7	22.1	37551.4	78.5	9.1	54.8	2.5	26917.5	19597.7	23984.4	26303.4	21850.1	19073.2
Minimum	134.0	10.9	588.8	49.2	0.0	27.6	0.9	23181.0	18028.5	22004.5	24222.1	17517.7	13366.7
Group 3													
Maximum	299.0	50.7	7542.6	100.0	100.0	72.4	6.4	25002.1	22553.7	29162.8	27495.2	27295.2	23498.0
The average	218.8	30.4	3191.9	65.6	40.0	60.1	3.7	23434.4	19706.8	25366.7	25778.2	24103.7	17151.8
Minimum	146.0	15.8	480.6	34.6	0.0	49.1	2.1	22563.1	17357.2	22252.9	22782.1	22536.1	8881.0

4. Discussion

The first group of Novgorod region's municipal districts is characterized by a high level of indicators in almost all of the analyzed indicators. An average investment in fixed assets (excluding budgetary funds) per resident was 98,142.9 rubles in 2017. This is more than 2 times higher than the average value of this indicator for the Novgorod region as a whole (43,797.1 rubles) in 2017. In these five districts of the region, small and medium-sized businesses are actively developing. The data of the first two cluster's indicators testify this finding. In the first group of administrative-territorial units, the level of nominal accrued wages of all categories of workers included in the assessment significantly exceeds these indicators of the second and third groups. The share of the length of public roads of local significance that do not meet regulatory requirements, averaged 51.7% of the total length of public roads of local importance. In 2017, 32.7% of the resident population of the Novgorod region lived in these municipal areas.

The third cluster is characterized by very low values of the indicators included in the assessment of "Economic Development" of the districts of the Novgorod region in terms of the effectiveness of local governments. For example, the volume of investments in fixed assets (excluding budget funds) in these administrative-territorial units averaged only 3,191.9 rubles per resident in 2017. In these municipalities, small and medium-sized businesses (218.8 subjects per 10,000 people) are developing at a slow pace. 60.1% of the entire roadway does not meet the requirements of standards, i.e. the quality of the road surface is not high. The share of the population living in these territories is 9.3% of the total number of inhabitants of the Novgorod region. Most of the municipal districts of the Novgorod region (nine in 2014 and eleven in 2017) were assigned to the second group, with a moderate level of indicators of local government performance indicators.

5. Conclusion

The presented methodology can be applied as one of the tools for assessing the level of effectiveness of local governments. Clustering can be carried out both for individual integrated groups of indicators, and in general for the entire list of indicators.

The advantage of this approach is the possibility of including different types of indicators in the assessment without the need for their valuation and reduction to uniformity. Dynamic slice gives a more detailed description of the degree of stability of the effectiveness of local governments.

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