

# EDULEARN<sup>15</sup>

7TH INTERNATIONAL CONFERENCE  
ON EDUCATION AND NEW LEARNING  
TECHNOLOGIES

BARCELONA (SPAIN)  
6TH - 8TH OF JULY, 2015



# CONFERENCE PROCEEDINGS

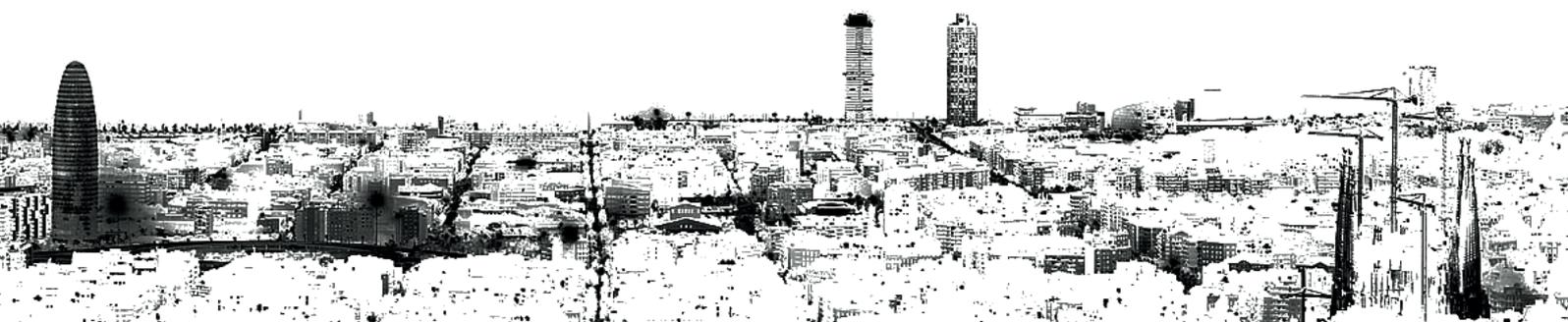


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# RESEARCH ON UNIVERSITY KEY PERFORMANCE INDICATORS: COMPARATIVE ANALYSIS

**Eugene Pitukhin, Olga Zyateva, Irina Peshkova**  
*Petrozavodsk State University (RUSSIAN FEDERATION)*

## Abstract

The article is devoted to comparative analysis of the values of performance of different groups of universities in Russia for 2014.

For this purpose a database was developed and created where the values of performance of all universities and branches for 2013 were uploaded, and the variability of the existing values of performance of higher education institutions during this period was analyzed. Then, some characteristics of the indicators in the following sections were calculated: by groups of universities (since 2014 the universities and the branches involved in the monitoring were divided by a territorial criterion into four groups, depending on the financial and economic situation in the region), by the regions and the Federal Districts, as well as by the different classes of universities. The threshold values of performance, officially published by the Ministry of Education and Science of the Russian Federation, with the calculated values were compared.

Keywords: strategic management, performance indicators, higher education, statistical analysis, comparative analysis.

## 1 INTRODUCTION

Scientific community places high emphasis on the existing Russian and international rankings of universities, as well as on their formation. The analysis of the methods of three biggest global rankings ARWU, QS and THE are presented in the article [1]. The article [2] describes the problems that existed in the ranking of universities 7-10 years ago and the present situation. In [3] the main characteristics of the system of higher education that are evaluated by the performance monitoring in Russia, as well as similar indicators used in international monitoring systems are presented.

In recent years, a number of educational rankings have appeared in Russia in order to help high school students and graduates, as well as employers, make their choice. In the conditions of fierce competition for students among universities, forecasting of higher education institutions functioning quality is one of the current trends. It allows knowing the rating of the university in advance, assessing its position among the other universities and taking early action to improve the quality of education and attract students to the university.

## 2 THE STRUCTURE OF A RELATIONAL DATABASE

From 2012 onwards, the Ministry of Education and Science of the Russian Federation annually holds "Monitoring of the Efficiency of Educational Institutions of Higher Education" by five major and two additional performance indicators [4, 5]. The results (values of each university) are published in the public domain on the Internet [6]. In order to get the predicted values, it is necessary to first analyze the actual data. Therefore, one of the first tasks is to collect and treatment data on the main indicators characterizing the activities of universities.

For storage and further processing of the available information, a database was developed and created, in which the values of performance of all parent organizations and branches for 2013 were uploaded. All information is stored in the database as a table, which consists of 1846 records (rows) and 16 fields (columns). The number of entries corresponds to the number of the universities that participated in the monitoring and for which the performance indicators have been calculated. Record fields have a number of distinctive features, by which the universities can be divided into classes. Each entry contains the necessary information about the university based on the following characteristics:

A) Characteristics of the educational organization:

- Name of the educational organization
- Type of the organization (parent organization, branch)
- Status (university, institute, academy, conservatory)
- Subordination (government, non-government)
- Legal form (budget, private)
- Organization profile (without specificity, military and police, medical, artistic, agricultural, sports, transport)
- Group (1-4)

B) Location of the organization:

- Federal District (total 8 values)
- Region (total 81 values)

C) Performance indicators (numerical values) of the organization:

- Educational activities
- Research and development
- International activities
- Financial and economic activity
- Infrastructure
- Employment
- Additional indicator

Thus, the formed base contains all the relevant information for statistical and comparative data analysis.

### **3 ANALYSIS OF THE MAIN INDICATORS OF THE UNIVERSITY**

To obtain correct predicted values of performance, first the analysis of the actual data must be carried out. To this end, the existing values of the efficiency of higher education institutions during the specified period were analyzed.

As a result of the monitoring, the performance indicators were calculated for 1846 universities: 823 parent organizations and 1023 branches. Table 1 shows the results of the distribution of the number of higher education institutions depending on their legal form of organization, departmental, group and territorial affiliation.

Table 1

Note	Value indication	Parent organization	Branch	In total
Type of organization	government	533	681	1214
	non-government	290	342	632
Legal form	budget	542	684	1226
	private	281	339	620
Group	group 1	189	6	195
	group 2	63	11	74
	group 3	206	287	493
	group 4	365	719	1084
Federal District	Far Eastern	38	48	86
	Volga	121	233	354
	Northwest	84	98	182
	North Caucasus	52	70	122
	Siberian	92	105	197
	Uralian	56	102	158
	Central	323	249	572
	South	57	118	175

Data presented in Table 1 shows that there are approximately the same number of state parent organizations and branches. The same goes for non-state universities. At the same time there are twice as many state universities as there are non-state. The situation is similar to the ratio of budgetary and private organizations. The fourth group of the universities is the largest as it includes 58.15% of the total number of universities, but it consists mainly of the branches, as their number is twice the number of the parent organizations. Leaders in the number of higher education institutions are the Central and Volga Federal Districts, the least number of universities are in the Far Eastern Federal District.

The average values of five key performance indicators for Federal Districts were calculated (Table 2). Method of calculation is presented in [4, 5].

Table 2

Federal District	Educational activities, point	Research and development, thousand rubles	International activities, %	Financial and economic activity, thousand rubles	Infrastructure, m <sup>2</sup>
Far Eastern	41,83	1077,79	0,86	2622,64	52,68
Volga	49,06	71,63	1,31	1652,96	25,60
Northwest	48,03	415,57	3,51	2210,95	23,47
North Caucasus	51,85	48,82	3,36	1055,22	15,09
Siberian	50,34	108,87	2,52	1840,92	27,35
Uralian	46,65	514,39	2,50	2192,07	22,83
Central	50,00	138,60	5,02	5464,80	21,00
South	48,77	67,36	3,25	1537,92	18,09

The results reflected in Table 2 show that the indicator for educational activities in the North Caucasus Federal District is the biggest, though at the same time the District takes the last place for research and development, economic and financial activities, as well as the infrastructure. The Far Eastern Federal District is leading in research and development and infrastructure, but has the lowest education and international indicators. The first place for the financial, economic and international activities belongs to the Central Federal District.

In the context of the regions, the results of the calculations of similar figures are presented as ten leaders and ten lagging regions in each key performance indicators (Fig. 1 - Fig. 5).

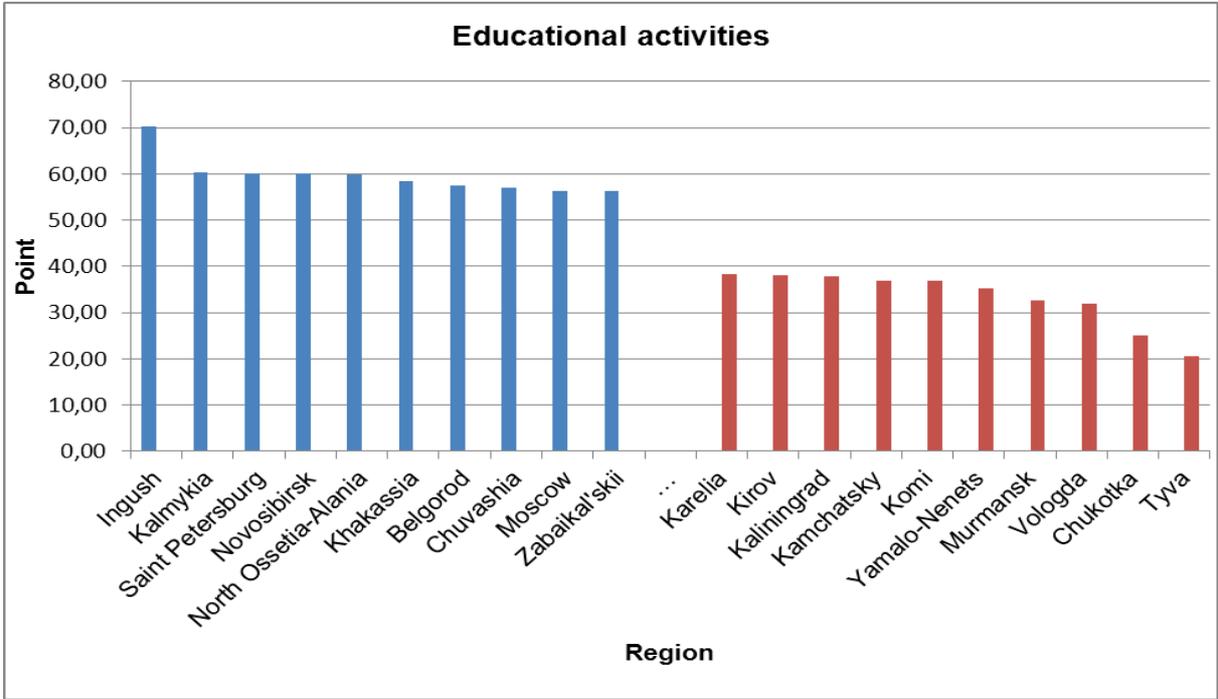


Fig.1. Ten leading ten regions lagging behind in terms of educational activities

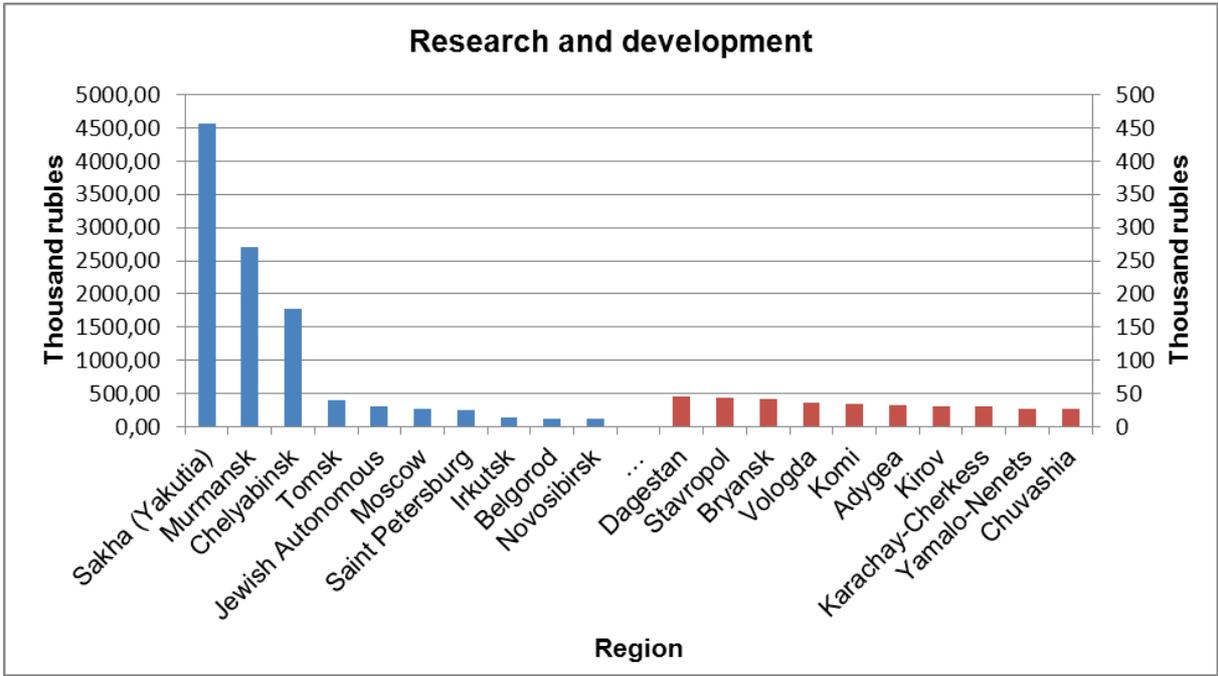


Fig.2. Ten leading ten regions lagging behind in terms of research and development

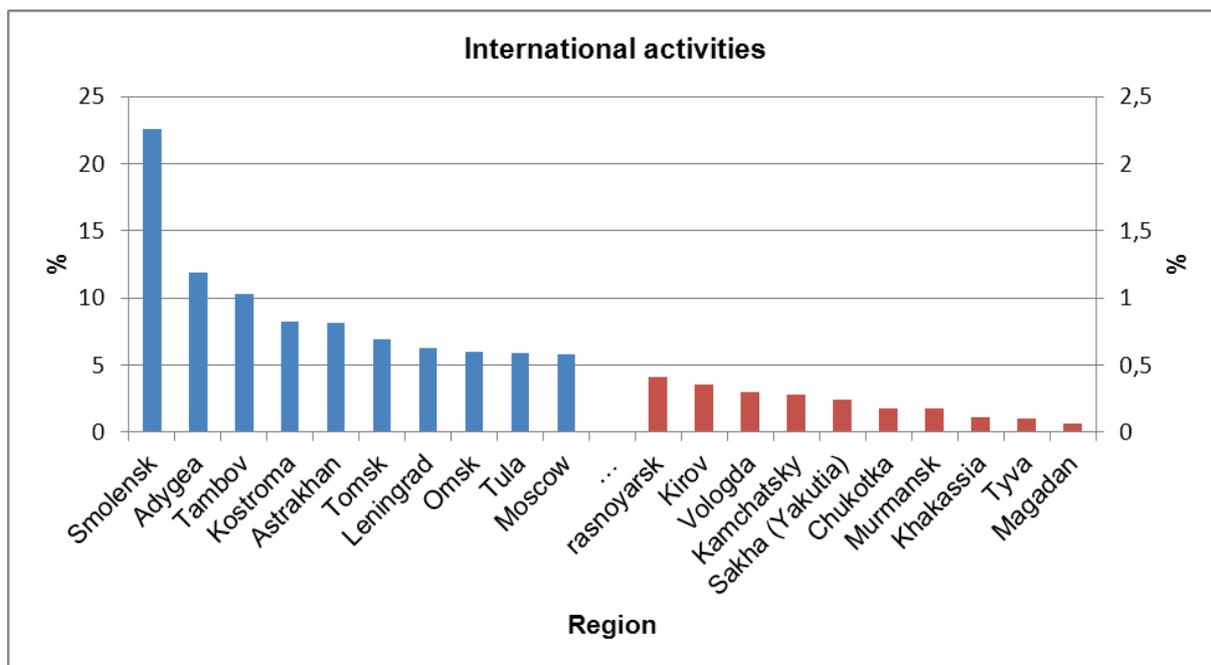


Fig.3. Ten leading ten regions lagging behind in terms of international activities

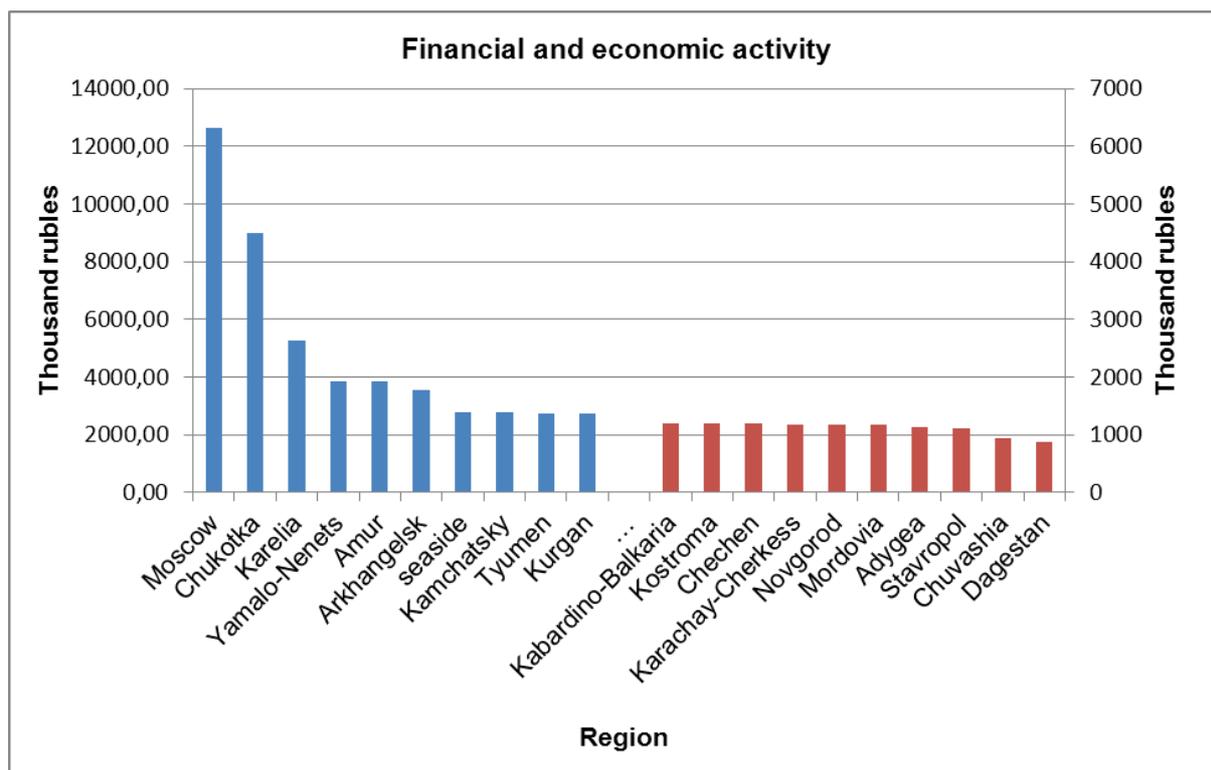


Fig.4. Ten leading ten regions lagging behind in terms of financial and economic activity

Notwithstanding the results, it is incorrect to assess the quality of all educational institutions in the region by the average value of an indicator, because the average value is affected by all types of higher education institutions represented in the region. For example, the Republic of Karelia has the average value of the indicator for educational activity of 38.3 points, and thereby heads the ten lagging regions (Fig. 1). Overall there are 8 universities in Karelia, of which 2 are the parent universities and 6 are the branches.

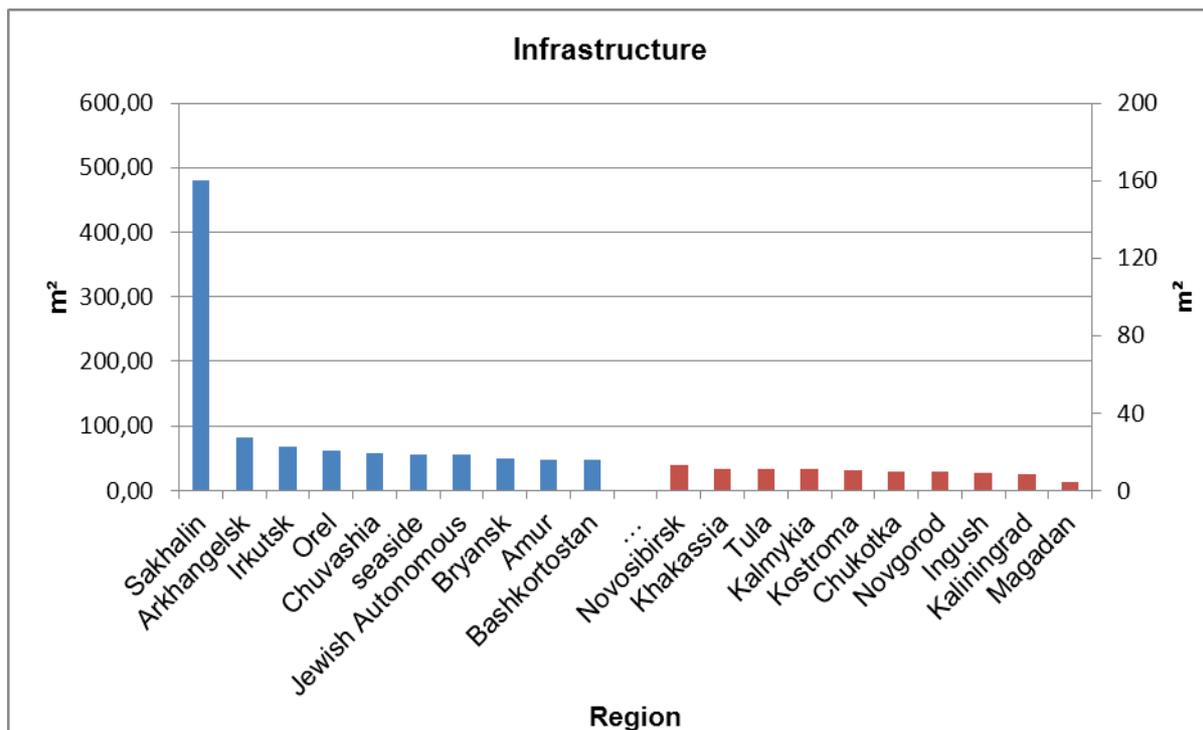


Fig.5. Ten leading ten regions lagging behind in terms of infrastructure

The average value for the branches and the parent organizations is calculated as follows:

$$\begin{array}{ccccccc} \text{The average} & & \text{The share of} & & \text{The average} & & \text{The share of} & & \text{The average} \\ \text{value of the} & = & \text{the branches} & \times & \text{value} & + & \text{the parent} & \times & \text{value of the} \\ \text{index} & & \text{the total} & & \text{of the index} & & \text{organizations} & & \text{index} \\ \text{by the region} & & \text{number of} & & \text{by the} & & \text{in the total} & & \text{on the parent} \\ & & \text{the universities} & & \text{branches in} & & \text{number of} & & \text{organizations of} \\ & & \text{in the region} & & \text{the region} & & \text{the universities} & & \text{the region} \\ & & & & & & \text{in the region} & & \end{array}$$

The parent organizations have the average value of educational activities of 67 points, and the branches have 28.7 points. Thus, it is clear that the average value of educational activities in the Republic (38.3 points) is low due to the branches:

$$\frac{6}{8} \times 28,7 + \frac{2}{8} \times 67 = 38,3$$

The value of indicator for educational activities of the parent organizations of the Republic of Karelia is not inferior to the universities of St. Petersburg (66.38 points).

Here is an opposite example of a region being a leader in some indicator. The Republic of Adygea has the indicator for international activity of 11.87% and ranks second in the group of the leaders. Overall, there are 8 universities in Adygea: 2 parent organizations and 6 branches. The average value of international activities at the parent organizations is 5.38%, and the branches have 14.05%. A relatively high percentage of this indicator at the branches is due to the fact that there is one branch whose value is 76.64%. If this branch is not taken into account when calculating the average value, the remaining five will have the average value of the indicator for international activity of 1.53% and the average for the region amounts to 2.63%:

$$\frac{5}{7} \times 1,53 + \frac{2}{7} \times 5,38 = 2,63$$

With this result, the Republic of Adygea would have been only in the 23<sup>rd</sup> place. Therefore, the conclusions on the quality of an institution are best done not by the region, but rather by the particular universities it has.

The information on the average values of the main indicators of the state and non-state parent organizations and the branches is presented in Table 3. Let's consider each indicator in details.

Table 3

Type of the organization	Subordination	Number of organizations		Average values					
				Educational activities, point		Research and development, thousand rubles	International activities, %	Financial and economic activity, thousand rubles	Infrastructure, m <sup>2</sup>
		In total	no null values	In total	no null values				
Parent organization	government	533	520	63,81	64,3	349,57	4,37	2062,93	18,82
	non-government	290	235	47,88	58,7	141,68	5,4	3690,22*	17,05
Branch	government	681	537	46,38	58,7	41,11	1,93	1966,97	33,45
	non-government	342	192	31,84	56,0	197,53*	2,07	1470,33	49,70*

\* - the universities with the extreme values of indicators (outliers) were excluded from the calculation. Overall, out of 9230 values 4 were excluded.

The following Table 4 shows the statistics on the universities, which have a "zero" indicator for educational activities.

Table 4

Type of the organization	Subordination	Number of organizations	% of the universities do not provide the information	% of the total number of universities
Parent organization	government	13	3,6	0,7
	non-government	55	15,2	3,0
Branch	government	144	39,8	7,8
	non-government	150	41,4	8,1

The overwhelming majority of the universities with "zero" indicator for educational activities are the branches (more than 80% of the total number of organizations that have not provided information). In case of the parent organizations, the number of the state ones that have failed to provide information is four times lower than that of the non-state.

From the sample containing 1846 values the distribution of the values of indicators for educational activities of the universities were graphed, with the exception of those that, for whatever reasons, have the value of zero (Fig. 6). There are 362 such organizations (Table 4).

The histogram (Fig. 6) shows a multi-modal distribution of educational activity indicator of all higher education institutions. Further this indicator would be analyzed. Let's select the parent organizations and the branches from all the universities. The results are shown in Fig. 7.

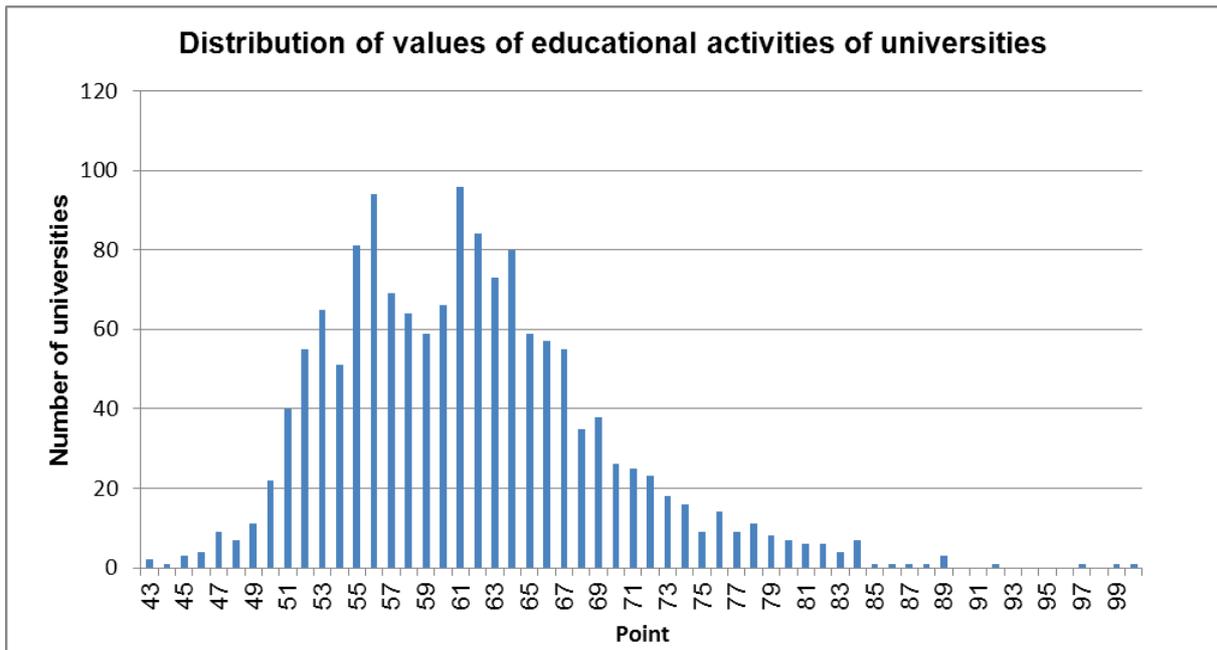


Fig.6. Distribution of the values of indicators of educational activities for universities

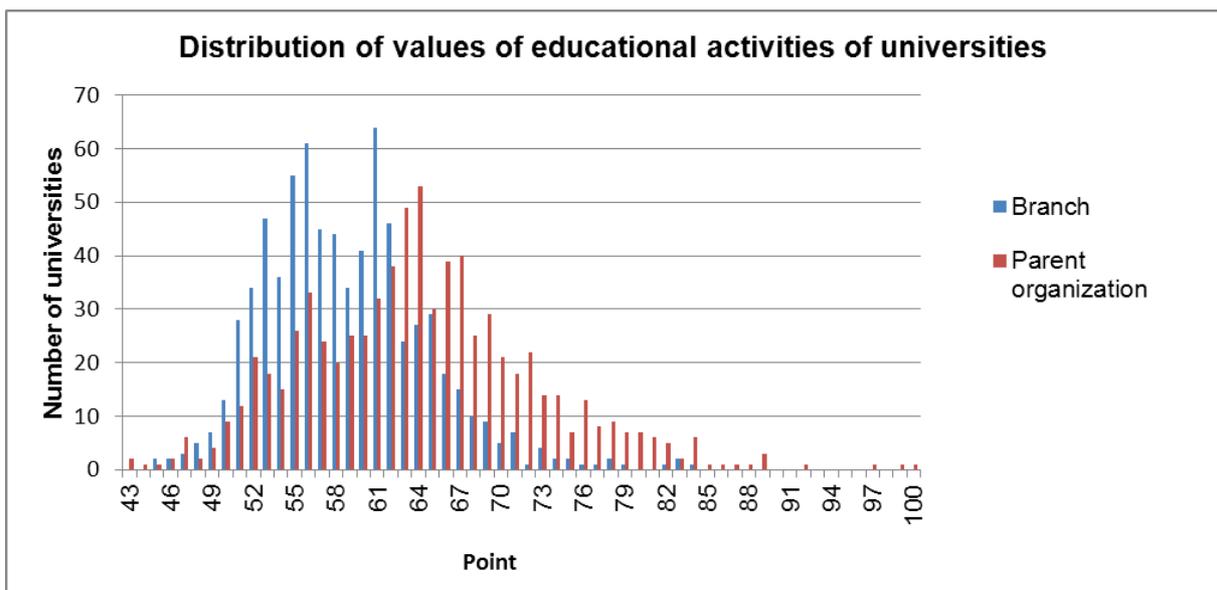


Fig.7. Distribution of the values of indicators of educational activities for parent organization and branches

When the universities were divided into the parent organizations and the branches, there are three peaks in the region of 56, 60 and 64 points. Comparison of the values of the educational activities in Table 3 with the histogram in Fig. 7 shows that the first peak is formed by the non-state universities, the second by the state branches, and the third by the state parent organizations.

The analysis of other indicators presented in Table 3 shows that the state parent organizations are spending 2.5 times more on science than the non-state, despite the fact that funding of the state parent organizations is almost half of the funding of the non-state organizations.

The peak of the international activity indicator is observed on the threshold of 1%, which is typical for most universities (Fig. 8). The values of the parent organizations and the branches are distributed exponentially with a shift which is equal to the number of higher education institutions with a zero value.

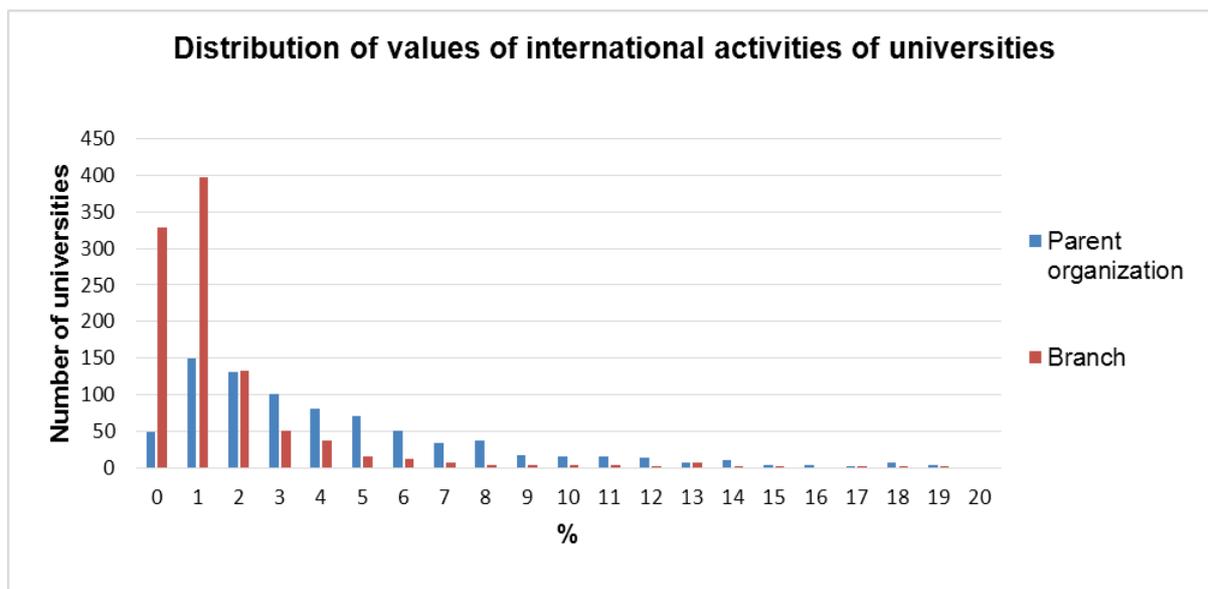


Fig.8. Distribution of the values of indicators of international activities for parent organization and branches

The value of indicator for infrastructure in the branch offices (38.87) exceeds the value of the parent organizations (18.19) more than twice. This may be due to the fact that the stated number of students in a branch is less than in a parent organization, as most of the students at the branches are part-time students. This indicator is calculated by dividing the value of the given contingent, which is equal to the total number of full-time students, by one-tenth of the number of part-time students.

#### 4 COMPARISON OF THE CALCULATED THRESHOLD VALUES OF PERFORMANCE INDICATORS OF FOUR GROUPS OF UNIVERSITY WITH THE OFFICIALLY PUBLISHED DATA

In order to verify the correctness and completeness of the initial data a comparative analysis of the threshold values of performance indicators, officially published by the Ministry of Education and Science of the RF was carried out, with the calculated values of these criteria. The threshold values of performance indicators are used by the Russian Ministry in making decisions on the efficiency of universities [4, 5]. The median values of the respective groups of the regions were taken as the threshold values for the Russian Ministry monitoring of the efficiency [7]. The calculation results are presented in Table 5.

Table 5

Group number	Characteristics	Educational activities, point	Research and development, thousand rubles	International activities, %	Financial and economic activity, thousand rubles	Infrastructure, m <sup>2</sup>
1	The threshold is officially published by the Ministry of Education and Science of the Russian Federation	64,5	136,37	4	2139,6	14,1
	The threshold value obtained by calculation	64,76	136,67	4,19	2155,05	14,09
	The deviation from the official settlement,%	0,40	0,22	4,75	0,72	0,07
	The average value of the group	56,25	263,45	5,83	12655,25	15,75
2	The threshold is officially published by the Ministry of Education and Science of the Russian Federation	66,38	122,41	4,9	1839,87	13,1
	The threshold value obtained by calculation	66,29	124,19	5,02	1840,69	13,08
	The deviation from the official settlement,%	0,14	1,46	2,45	0,04	0,15
	The average value of the group	60,19	254,17	5,71	2362,02	18,48
3	The threshold is officially published by the Ministry of Education and Science of the Russian Federation	60	70,1	1	1566,11	14,5
	The threshold value obtained by calculation	57,02	70,09	0,56	1570,07	14,55
	The deviation from the official settlement,%	4,97	0,01	44,00	0,25	0,34
	The average value of the group	48,51	408,79	2,08	1870,85	24,38
4	The threshold is officially published by the Ministry of Education and Science of the Russian Federation	60	51,28	1	1327,57	13,9
	The threshold value obtained by calculation	56,64	51,33	0,78	1327,71	14,025
	The deviation from the official settlement,%	5,61	0,09	22,00	0,01	0,90
	The average value of the group	47,08	111,95	3,07	1717,27	25,35

Studies confirm that the median values of the respective groups were taken as the threshold values if their value was higher compared to the same values of the previous period (2012). At the same time the threshold values were left at the level of 2012, when the median values came out smaller.

## 5 CONCLUSION

The results of the analysis allow the assessment of the current activities of the university in the field of educational management from various perspectives. Also, they will serve as the basis for making a long-term forecast of the performance of universities.

This forecast is expected to be obtained through the building of a complex of interconnected mathematical models enabling prediction of the dynamics of relevant indicators for various aspects until 2020, and to implement these models in the expert-analytical system interacting with an existing database.

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