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**MODERN GEOINFORMATION AND COMMUNICATION**  
**TECHNOLOGIES OF ECONOMIC ANALYSIS IN MS OFFICE 365**

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***Abstract***

The article considers new geographic information and communication capabilities of MS Office 365 when used in economic analysis. The aim of the research is the development of digital mapping technology in the presentation of data of economic analysis and determination of the composition of rents, defining the productivity of geographically distributed production using a specific real statistical data. Technologies for the presentation of economic data in the form of digital Bing, 3D, and custom maps have been developed, as well as technologies of adding digital Bing maps, visualization of data illustrating the effect of rental factors on milk production in some regions of the Russian Federation. These factors are determining differential rent I (DRI), determining differential rent II (DRII), factors of administrative status (corruption) rent (ASR), factors of absolute (speculative) rent (AR). Among the standard sets of thematic mapping types, visualization in the form of a heat map is considered as the most suitable one. However, it is not recommended for practical usage due to low accuracy, instead, it is suggested to use the standard Excel-Surface diagram. On the basis of the developed technologies, rental analysis of production productivity was carried out: the authors got an equation of regression depending on the productivity of milk production on the rental proportions of DRII, DRI, ACP, AR; the values of rents corresponding to each of the rental proportions, and total rent were found. The article proves the leading position of the proportions of differential rent II (DRII) to determine the production efficiency.

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**Keywords:** Differential rent II, digital mapping, economics, information and communication capabilities, manufacturing, MS Office 365.



## **1. Introduction**

To the present moment, the enhanced capabilities of MS Office 365 have been implemented by the following main tools, which allow performing economic analysis at the space-time level (Rudikova, 2017):

- Mapping with the use of standard geographic web maps.
- Working in a local network, intranet and Internet.
- Developing web-sites, work in HTML / MHTML format.
- Working with data in XML format, answering web requests.

Recently, the rent-based theory of production regulation has been intensively developed both at the sectoral and territorial levels (Zaitsev, 2017, 2016, 2015; Efimova, Yarmolenko, & Isaev, 2014; Efimova, Yarmolenko, & Efimova, 2011; Yarullin, 2002). The concept of rent as part of the productivity of production is expanding. At the same time, each rent affects the productivity in proportion, and this influence is determined by the proportion of the corresponding rent – the rental ratio. In our opinion, complementary to modern studies (Zaitsev, 2017, 2016) is a study of the ranking of rents and their impact on productivity, which would allow identifying specific political and economic factors of production increase corresponding to these rents.

## **2. Problem Statement**

In the conditions of the development of digitalization of the economy and the expansion of the use of modern software products for analysis and reasonable management solutions to improve production efficiency, it seems necessary, to develop tools for using modern digital mapping capabilities for presenting economic data and conducting rental analysis.

## **3. Research Questions**

The following research questions are posed:

- Development of technologies for the presentation of economic data based on geo-information in the form of digital Bing-maps, 3D-maps, custom maps.
- Rental analysis of production efficiency using geo-information data in order to identify rental proportions that determine the level of production.

## **4. Purpose of the Study**

The purpose of this article is the development of digital mapping technology in the presentation of economic analysis data and determination of the composition of rents that define the production efficiency on a specific real statistical material.

## 5. Research Methods

The research was carried out with the methods of analysis and synthesis, economic-mathematical and geo-information modeling.

## 6. Findings

At present, digital geographic maps are widely used for economic and social analysis in order to make effective management decisions. In this regard, digital maps of Microsoft Office Excel 2016 are of practical importance. In this system, they are defined as add-ins:

- Bing digital maps;
- 3D Maps;
- custom maps.

In order to determine the possibility of using Microsoft Office Excel 2016 for geoinformation analysis, we will consider each of the settings for practical application for geoinformation analysis (GIA) of socio-economic phenomena.

### Working with the Bing Digital Map Add-in

We use this option to visualize data illustrating the effect of rental factors on milk production in some regions of the Russian Federation (Zaitsev, 2017). These factors include (Table 01):

- factors that determine the differential rent (DRI);
- factors determining the rent (DRII);
- factors of administrative status (corruption) rent (ASR);
- factors of absolute (speculative) rent (AR).

In this first map variant, the following commands are executed in sequence:

- **Insert** → **My add-ons** → **Watch (Вставка → Мои надстройки → Смотреть)**,
- **Office add-ons (Надстройки Office)** → select **Bing Maps (Карты Bing)**,
- select the data in the Excel spreadsheet and execute the command **Show locations (Показать местоположения)**.

**Table 01.** Ranking of large subjects of the Russian Federation by rental factors affecting the productivity of dairy cattle (fragment)

Region	Rational rental ratios in productivity g				Milk yield per 1 cow
	DRII	DRI	AR	ASR	
Voronezh region	22.1	21.4	35.7	20.8	5331
Republic of Tatarstan	26.4	21.4	35.7	20.8	4741
Belgorod region	29	24.3	25.8	20.9	3705
Republic of	26.5	20.9	31.1	21.5	5090

Udmurt					
Altai region (kray)	22.1	21.4	35.7	20.8	3841
Moscow region	36.2	33.5	11	19.3	6100
Leningrad region	42.5	26.6	10.6	20.4	6991

As a result, we get a thematic map of the influence of rental factors by region (Figure 01). In this case, pointing the left mouse button on the region displays all the text information.

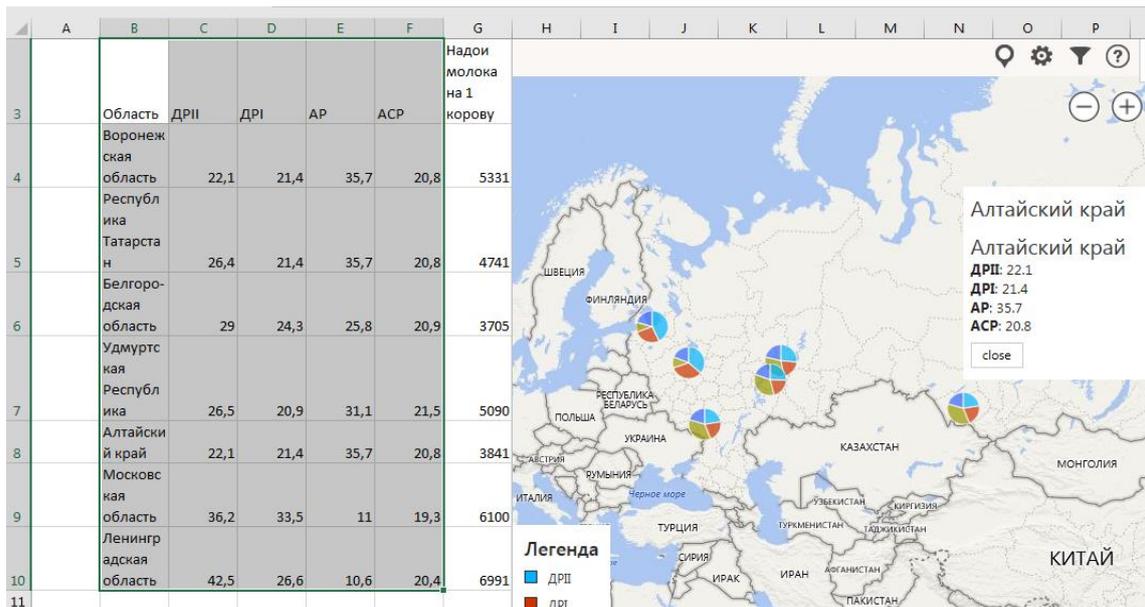


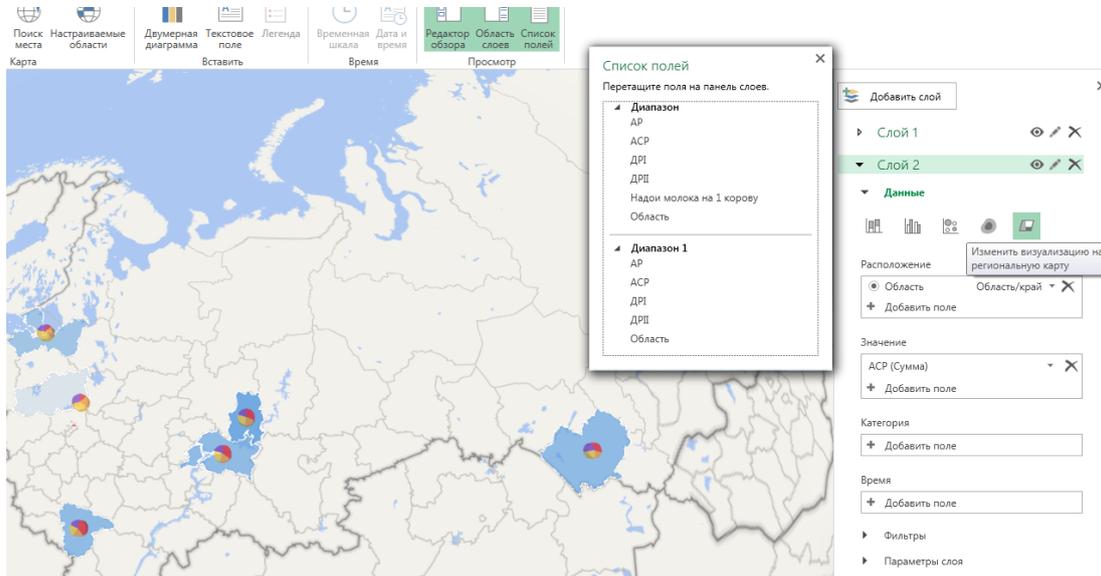
Figure 01. Thematic map of the influence of rental factors

### Work with 3D Map add-in

The second map construction variant (3D map) is done by the sequence:

- **Insert** → **3D Map** → **Open 3D-Maps** (Вставка → 3D-Карта → Открыть 3D-Maps (Карты));
- by selecting the data in the Excel table, execute the **Add selected data to 3D Maps** (Добавить выбранные данные в 3D Maps) command;
- in the window **Overview “No.”** (Обзор «№») on the **“Fields List”** («Список полей») tab, execute the command **Drag the fields to the layers panel** (Перетащите поля на панель слоев); with this command the field **the Data Area** (Область) is transferred to the **Location** (Расположение) field of the layer panel, since each country, district, region / kray (federation subject), city, street corresponds to a position on the map defined by geographic latitude and longitude;
- in the **Height** (Высота) field of the layers panel by clicking on the plus-shaped label all fields of thematic data are entered alternately;
- the **“Layer Parameters”** («Параметры слоя») mode sets the graphic parameters, and by turning on the **regional map visualization** (визуализации региональной карты) mode,

the boundaries of the corresponding administrative unit are displayed with all thematic data (Figure 02).



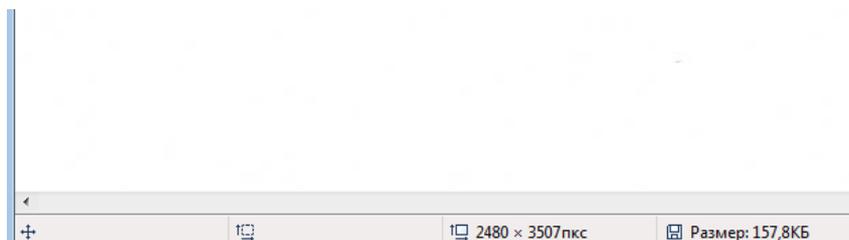
**Figure 02.** Boundaries of the corresponding administrative unit with all thematic data

The color density of the administrative unit characterizes the value of the current parameter - in this case, the value of the ASR.

### Making custom maps

Custom maps can solve a wider range of tasks than digital Bing cards and 3D maps. They easily adapt to any particular tasks and occupy less space in the computer's memory. In addition, the researcher can define his/her own rectangular coordinate system, which cannot be done in the above-mentioned digital maps. Custom maps are created for point and area objects, and area objects (user areas) should be created in the format shp (Shapefile), i.e. as shapefiles used in the ArcGis system (by ESRI USA), as well as in kml (Keyhole Markup Language File) format for representing three-dimensional geospatial data in Google Earth. Let us show the order of creating a custom map using the example of point objects.

1. Custom maps are created on a raster substrate base made in any standard raster format. In our example, such a substrate is created in the form of a file **IzobPolzKarty.jpg** (ИзобПользКарты.jpg), represented by the program Paint (Figure 03). The basis here is a blank sheet of white writing paper. Its size is 2480X3507 pixels.



**Figure 03.** A raster substrate base

2. Given the screen coordinate system (the y axis is directed downward with the normal x axis direction), we construct a thematic map of the cost of one square meter of land - the specific indicator of land cost (SILC) - on the points of the regular grid shown in the Excel table (Figure 04). Note that an irregular grid can be also defined with the points.

Номера точек	X	Y	Стоимость 1 кв метра
1	100	100	55,6
2	300	100	55,91
3	500	100	55,6
4	700	100	54,82
5	900	100	54,8
6	1100	100	55,21
7	1300	100	56,78
8	100	300	56,44
9	300	300	56,36
10	500	300	56,07
11	700	300	55,47
12	900	300	55,06
13	1100	300	55,51
14	1300	300	57
15	100	500	57
16	300	500	56,86

**Figure 04.** A thematic map of the cost of one square meter of land

In Figure 04, the X, Y coordinates are in pixels, the cost is in arbitrary units. One pixel corresponds to one meter on the ground.

3. The technology of making a custom map comes down to the following successive operations:

- **Insert** → **3D Map** → **Open 3D-Maps** → **New scene** → **Create a custom map** (**Вставка** → **3D-Карта** → **Открыть 3D-Maps(Карты)** → **Новая сцена** → **Создать пользовательскую карту**);
- in the **Custom Map Settings** (**Параметры пользовательской карты**) window execute the command **Import Picture as a background map for your data** (**Импортировать рисунок в качестве фоновой карты для ваших данных**); for this purpose, the previously prepared substrate file **IsobPolzKarty.jpg** (**ИзобПользКарты.jpg**) is imported;
- by executing the command **Space of pixels** (**Пространство пикселей**), the system of rectangular coordinates of the screen is set; the commands **Turn the axis; Swap the X and Y axes** (**Перевернуть ось, Поменять местами оси X и Y**); the coordinate system can be changed as desired; after the execution of the **Apply, Finish** (**Применить, Готово**) commands, the coordinate system will be set finally;
- by running the standard command **Insert** → **3D-Map** → **Open 3D-Maps** → (**Вставка** → **3D-Карта** → **Открыть 3D-Maps(Карты)** →) (after highlighting the data in the Excel table) **Add the selected data to 3D Maps** (**Добавить выбранные данные в 3D Maps**);

- on the “List of fields” («Список полей») tab, execute the command Drag fields to the layers panel; at the same time, put the X field in the Location section in accordance with the Coordinate on the X axis, and the Y field in the Y axis coordinate, the Point number fields and the Cost per 1 square meter move to the Height section;
- on the “List of fields” («Список полей») tab, execute the command **Drag fields to the layers panel** (Перетащите поля на панель слоев); at the same time, put the X field in the **Location** section in accordance with the **Coordinate on the X axis** (Координата по оси X), and the Y field – on the **Y axis coordinate** (Координата по оси Y), the **Point number** (Номера точек) fields and the **Cost per 1 square meter** (Стоимость 1 кв метра) move to the **Height** (Высота) section;
- in the section of diagrams, it is necessary to execute the **Change visualization to heat map** (Изменить визуализацию на тепловую карту) command; in the **Parameters section of the layer**, set the **Value of the color scale** (Значение цветовой шкалы) to 103%, and the **Radius of influence** to 448%; it is also recommended with the **Add Color** (Добавить цвет) command select the six colors of the present diagram with the color transition from the minimum value of the SILC to the maximum.

The resulting diagram (Figure05) divides the whole territory into two zones: a zone with SILC values equal to and greater than 56, and a zone with values of this indicator equal to or less than 55. It should be noted that this diagram gives only a visual representation of the distribution of the studied indicator and is not suitable for accurate calculations. For the presentation of a custom map suitable for performing accurate SILC calculations or other territorial phenomena, it is necessary to use the Excel **Surface** diagram. The data is represented here in rows along the X axis. The first row of data corresponds to the smallest Y value, and the last one to the largest (Figure 06).

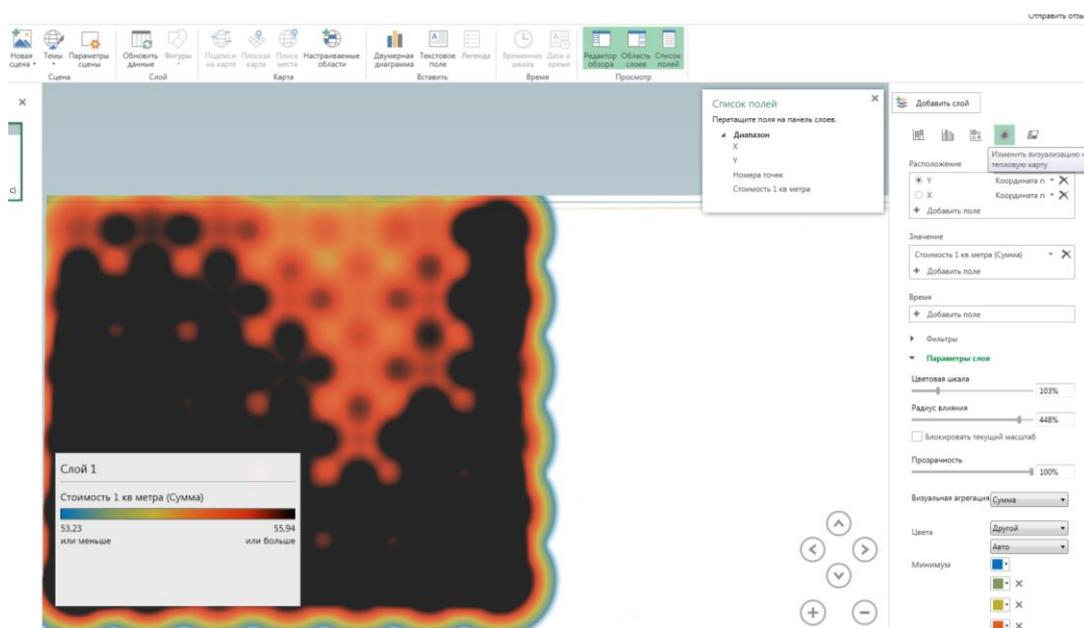


Figure 05. Heat map

Y								
100	55,6	55,91	55,6	54,82	54,8	55,21	56,78	
300	56,44	56,36	56,07	55,47	55,06	55,51	57	
500	57	56,86	56,48	56,03	55,15	55,6	56,28	
700	57,05	57,09	56,61	56,18	55,51	56,79	56,48	
900	57,4	57,14	56,69	56,2	56,37	56,64	57	
1100	57,59	57,2	56,68	56,9	56,92	57,15	57,26	
	100	300	500	700	900	1100	1300 X	

Figure 06. A custom map suitable for performing accurate SILC

Further on, the algorithm for constructing the surface will be as follows.

1. After data capture, execute the command **Insert** → **Maps** → **Other charts with maps** (**Вставка** → **Карты** → **Другие диаграммы с картами**) (Figure 07).

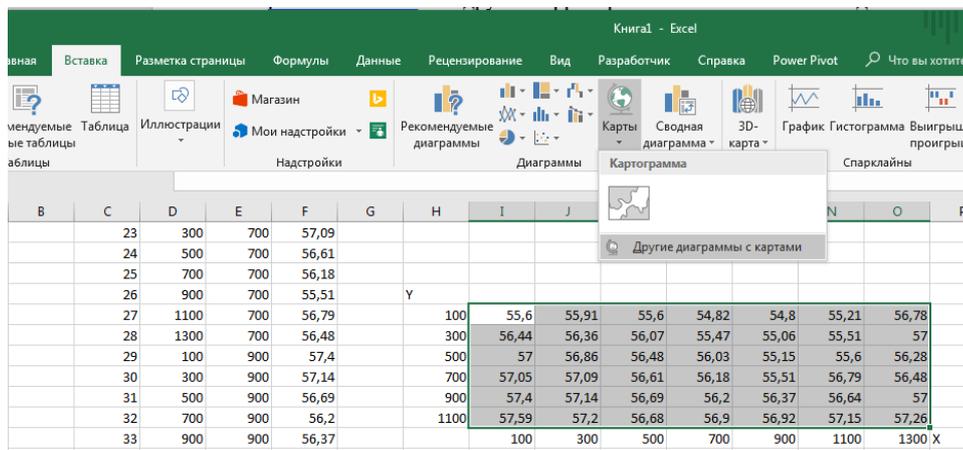


Figure 07. Algorithm for constructing the surface (step 1)

2. Select the “Surface” («Поверхностная») diagram (Figure 08). Rotating in this case around the X axis at 1800 and around the Y axis, by 900, the desired orientation of the surface is achieved, i.e., its horizontal projection.

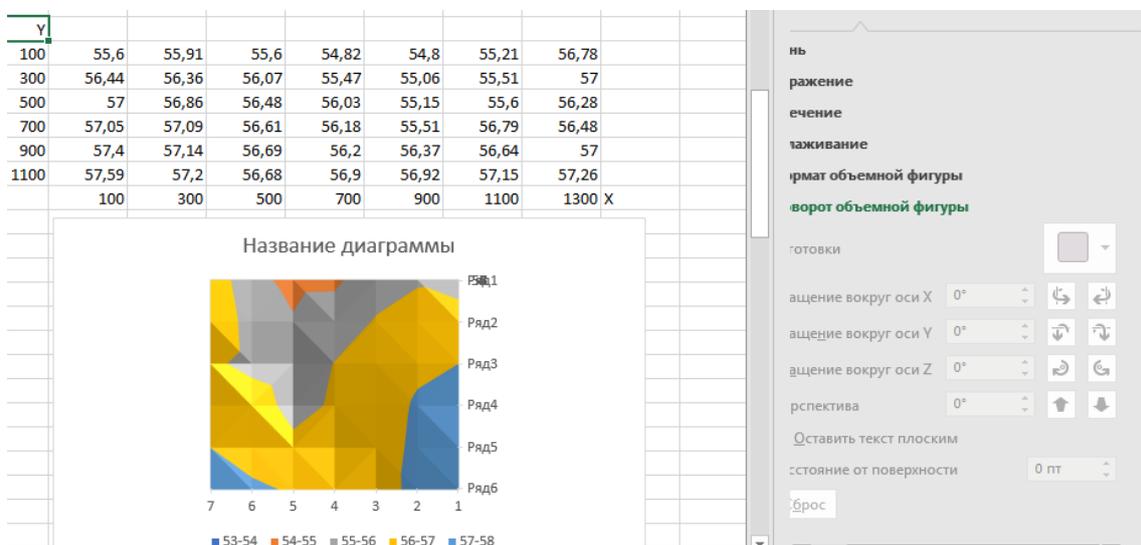


Figure 08. Algorithm for constructing the surface (step 2)

To sign the coordinates, right-click on the diagram and get a pop-up menu in which choose the **Select data (Выбрать данные)** option (Figure 09). In the **Select data source (Выбор источника данных)** window that appears, enter your data range in the **Data range for chart (Диапазон данных для диаграммы)** by capturing (Figure 10).

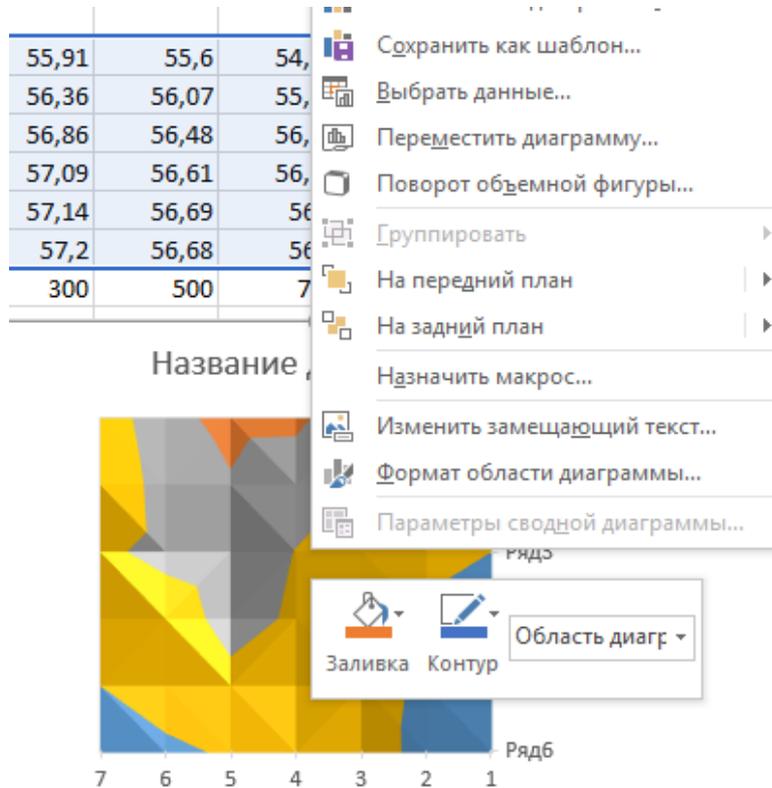


Figure 09. Select data to construct a surface

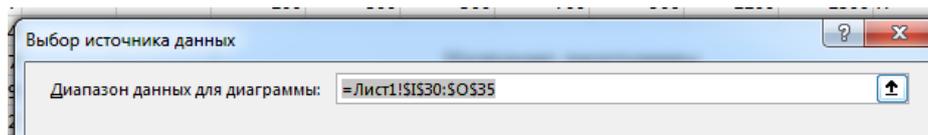


Figure 10. Data entry for surface construction

With the **Change (Изменить)** command (Figure 11), replace the text name of each row with the corresponding Y coordinate value (Figure 12).

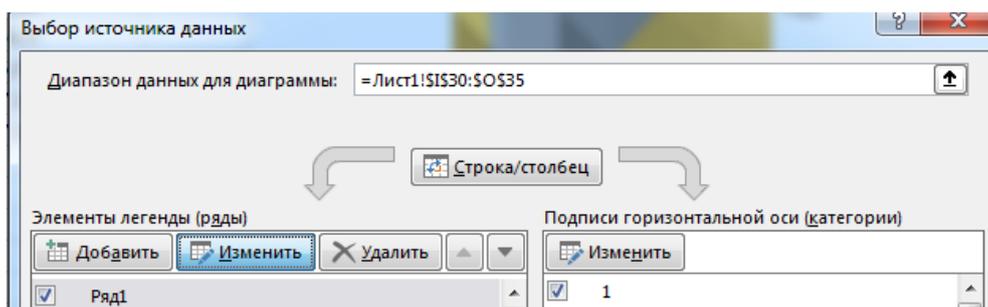


Figure 11. Selecting the command **Change (Изменить)** the vertical axis

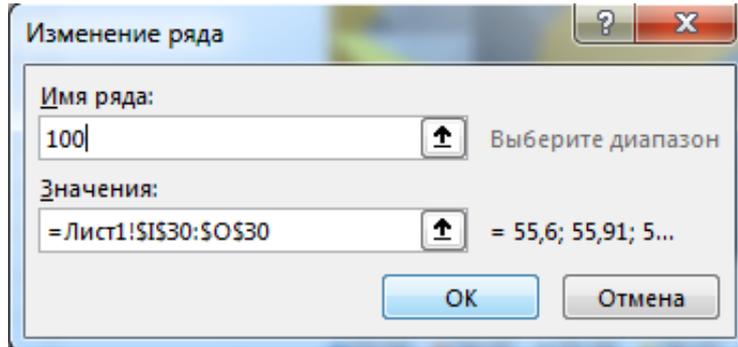


Figure 12. Changing the text name of each row of the vertical axis

To replace X values, execute the **Change (Изменить)** in the right half of the **Select Data Source (Выбор источника данных)** window (Figure 13) and enter a range of labels (Figure 14).

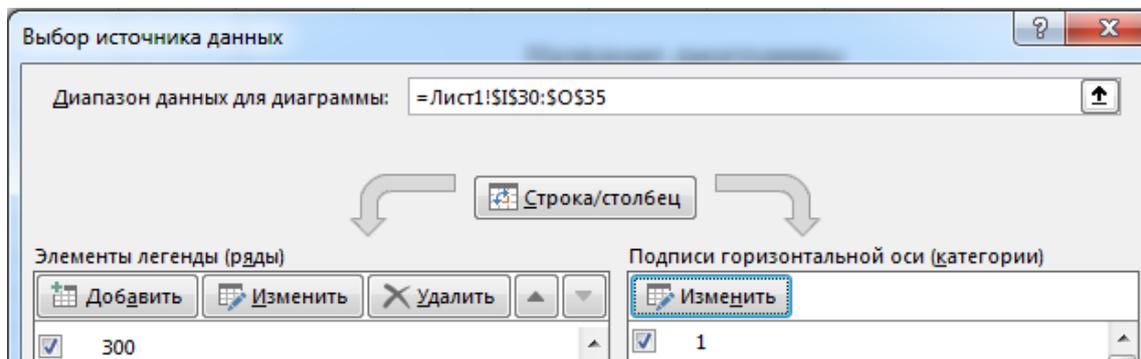


Figure 13. Selecting the command to change horizontal axis

Y							
100	55,6	55,91	55,6	54,82	54,8	55,21	56,78
300	56,44	56,36	56,07	55,47	55,06	55,51	57
500	57	56,86	56,48	56,03	55,15	55,6	56,28
700	57,05	57,09	56,61	56,18	55,51	56,79	56,48
900	57,4	57,14	56,69	56,2	56,37	56,64	57
1100	57,59	57,2	56,68	56,9	56,92	57,15	57,26
	100	300	500	700	900	1100	1300

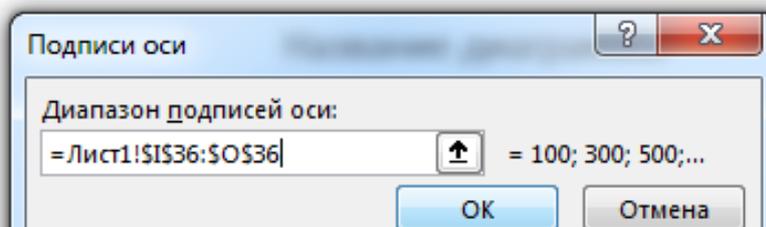


Figure 14. Changing the text name of each row of the horizontal axis

After entering OK, we will receive a new view of the **Data Source Selection (Выбор источника данных)** window (Figure 15) and the correct representation of the surface chart (Figure 16). On its basis,

you can build a map of isolines of cost. To do this, use the command **Insert** → **Maps** → **Other charts with maps** (**Вставка** → **Карты** → **Другие диаграммы с картами**) to enter the **Surface** (**Поверхностные**) and select the **Colorless volume surface** (**Бесцветная объемная поверхность**) (Figure 17).

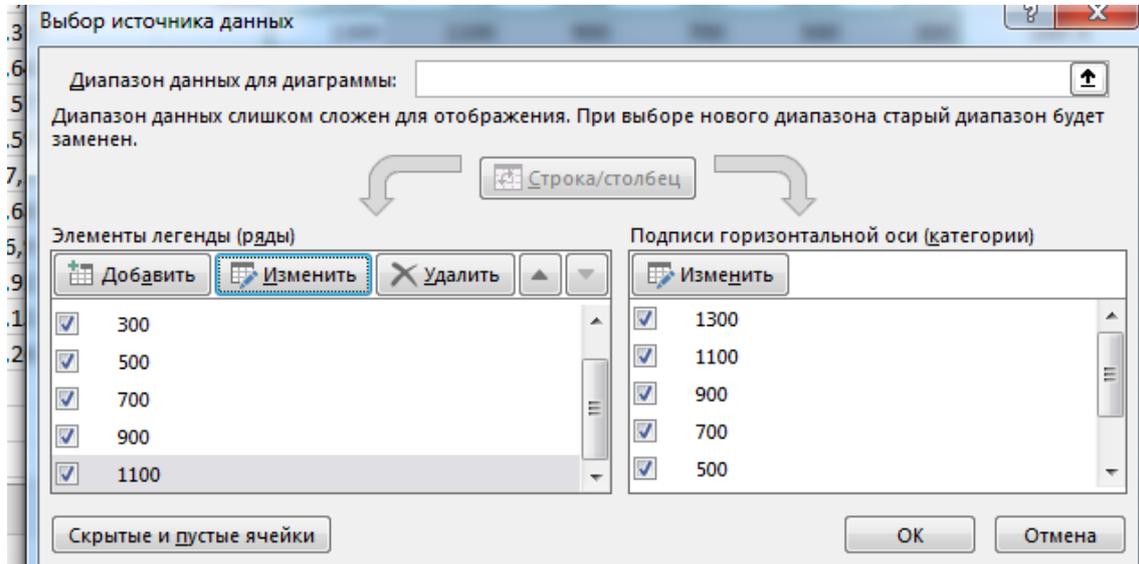


Figure 15. Choosing the data source

## Диаграмма стоимости земли

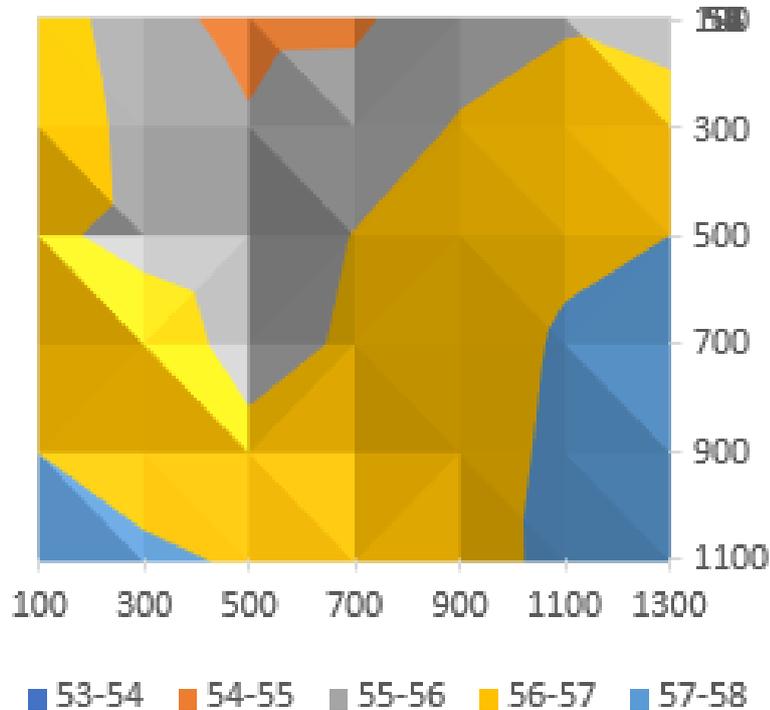
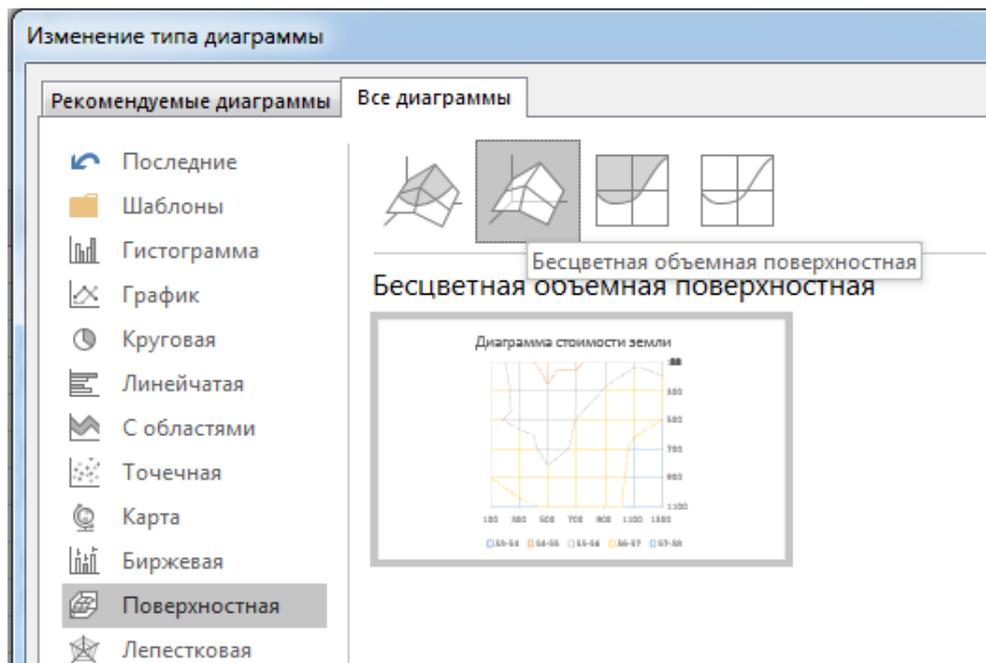


Figure 16. Correct representation of the surface chart



**Figure 17.** Map of isolines of cost

The surface diagram has the following positive properties:

- It is accurate. The chart model does not introduce modeling errors in contrast to the thermal model. Its accuracy depends only on the accuracy of the source data.
- All zones are clearly distinguished by colors and isolines in contrast to the blurred zones of the heat map; the colors of the zones can be changed by standard means.
- It is possible to build a map of isolines, change their thickness, color and other parameters.

#### **Rental analysis of production efficiency**

For the implementation of rental analysis of livestock productivity, shown in Figure 01 (Table 01), we draw up a regression equation that establishes the dependence of productivity on the rental proportions of factors DII, DRI, ASR, AR.

Such an equation will be the basis for calculating the above rents: DRII, DRI, ASR, AR. According to Figure 01, the following regression equation is derived in Excel:

$$Y = 182.9 * DRII + 25.9 * DRI + 56.2 * ASR - 114.2 * AR, \quad (1)$$

with the coefficient of determination of the model equal to 0.98 and the calculated value of the F-criterion equal to 41.6 with the threshold value of this criterion with 3 degrees of freedom and significance level of 0.05 equal to 8.9.

The value of the rent corresponding to the rental factor  $i$ , we find the following way:

$$P_i = Y_{act.i; min.j,k,l} - Y_{min. I,j,k,l}, \quad (2)$$

where  $Y_{act.i}$ ;  $min.j,k,l$  – efficiency at the actual value of factor i and the minimum values of factors j, k, l;  
 $Y_{min. I,j,k,l}$  – efficiency at the minimum values of all factors.

As an example, let us show the calculation of the rent corresponding to a certain rental factor or rental ratio.

In Table 02, rational rental ratios in terms of efficiency of DRI, ASR, AR when calculating  $U_{act.i}$ ;  $min.j, k, l$  are taken to be minimal, and rental proportions in DRII are taken as actual.

**Table 02.** Calculation of the rent corresponding to the rental ratio for factor DRII

Region	Rational rental ratios in efficiency				$Y_{act.i}; min.j,k,l$	$Y_{min. I,j,k,l}$	Rent Pi
	DRII	DRI	AR	ASR			
Voronezh region	22.1	20.9	11	19.3	2998.65	2998.65	0
Republic of Tatarstan	26.4	20.9	11	19.3	3785.43	2998.65	786.773
Belgorod region	29	20.9	11	19.3	4261.15	2998.65	1262.49
Republic of Udmurt	26.5	20.9	11	19.3	3803.73	2998.65	805.070
Altai region (kray)	22.1	20.9	11	19.3	2998.65	2998.65	0
Moscow region	36.2	20.9	11	19.3	5578.54	2998.65	2579.88
Leningrad region	42.5	20.9	11	19.3	6731.25	2998.65	3732.6

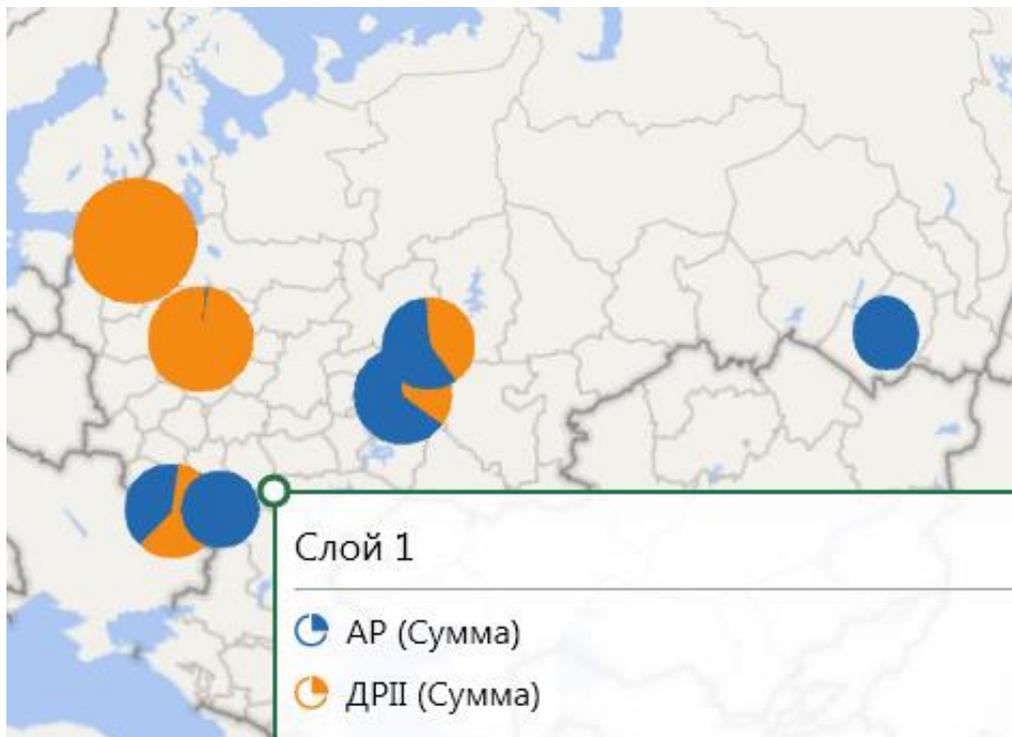
Performing similar calculations for each rental ratio, we will create a general table of calculated rents and find the total rent as a row-wise sum of values (Table 03).

**Table 03.** Rent values for each rental proportion

Region	Rents				Total rent
	DRII	DRI	AR	ASR	
Voronezh region	0	12.96801	1410.393	79.9797	1503.341
Republic of Tatarstan	786.7736	12.96801	1410.393	79.9797	2290.114
Belgorod region	1262.497	88.18246	854.1025	68.55403	2273.336
Republic of Udmurt	805.0707	0	1151.915	0	1956.985
Altai region (kray)	0	12.96801	1410.393	79.9797	1503.341
Moscow region	2579.886	326.7938	22.47638	251,3648	3180.52
Leningrad region	3732.6	147.8353	0	125.6824	4006.118

On the basis of Table 03 data, it follows that the values of DRI and ASR can be neglected, since their values are less than the errors of the regression model (1). From this it follows that for these areas the corresponding rental proportions have practically no effect on the productivity of dairy production. The decisive impact on productivity has rental proportions that determine the rents of DRII and AR. This leading position is occupied by the proportions defining DRII. Only Moscow and Leningrad regions possess such proportions. The smaller of them, the total rent 3180.52, is larger than the highest of the remaining areas 2290.114 in 1.4 times. This confirms the decisive importance of the factors determining DRII in the growth of the productivity of agricultural production. The task of the state is to filter the volatility factors (Zaitsev, 2017, 2016, 2015), which do not encourage investments in agricultural production. On the other hand, the preferential position of the AR, for example, one of them – monopoly

– leads to a decrease in production, in this real example, in 1.4 times. Figure 18 illustrates the territorial distribution of rents DRII and AR.



**Figure 18.** Territorial distribution of rents DRII and AR

## 7. Conclusion

This article solves the problem of developing technology for digital mapping of regional economic data in MS Office 365, and also proves the leading position in the productivity of production of geographically distributed proportions on the digital map defining DRII. The developed technologies can be used in educational modules, in the parts of the educational process related to the analysis of geographically distributed economic and social data.

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