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Improving the Methods of Assessing the Socio-Economic Potential of the Regions of the Republic of Uzbekistan on the Basis of Intellectual Mathematical Models

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ABSTRACT: The article examines the investment potential of the territories of the Republic of Uzbekistan and the issues and investment distribution problems in them. Also, in the article predictions were made using programs of mathematical models of artificial neural networks in the analysis of distributions process problems,and the results were determined by comparing the results with trend and panel methods.

Sustainable territorial socio-economic development is determined by general laws of country socio-economic development, the share of export products in the total output of the region, depending on the composition of the gross regional product, in key sectors of the economy is determined by features such as competitive product, scientific potential, population income. Therefore, the problems that arise in ensuring the socio-economic development of the region in modern conditions will have their own regional characteristics.Addressing the territorial socio-economic development problems require strengthening the regulatory role of the state in determining regional economic policy, governance, the development of effective systems, tools and methods of state regulation. Sustainable territorial socio-economic development also depends on the self-sufficiency level of resources and effective budget finance, credit, tax and price policies.

KEYWORDS: Territory, Gross Territorial Product, Investment, Model, Neural Network, Layer, Intellectual Mathematical Model, Investment Potential, Prognosis.

INTRODUCTION

Socio-economic indicators of regional development, which are determined by its economic potential (production, financial, labor, natural, scientific, innovative, investment), supporting the process of sustainable socio-economic development of the region. It should be noted that in this context, one of the main tools of state regulation of sustainable socio-economic development of the region is the forecast. The main means of regulation and forecasting by the state is the economic and mathematical natural value of the balance of production and distribution of regional products[1]. Based on this, it is possible to perform various calculations to determine the interaction of changes in the economic situation in one element of the system to the economy of others.

CRITICAL ANALYSIS OF THE LITERATURE ON THE SUBJECT

Many foreign experts have used and researched artificial neural networks to predict investment processes, portfolio investments and their characteristics, as well as financial time series using artificial neural networks and portfolio optimization. In particular, U.Sharp, G.Alexander, DJBayli (2010) in their world-famous book "Investitsii" described in detail and clearly the purposes and means of financing, described all types of securities and stock markets, reflected the theory and practice of their operation , considered methods of investment management, reflected the problems of globalization of investments using concrete examples, graphs, tables

L.D. Gitman, M.D. Jonklar (2007) Global aspects of investment activity, the role of investment in the economy, strategies and tools to achieve investment goals, participants in the investment process, investors and types of investments, investment instruments and, most importantly, its attractiveness in attracting investment to regions recommendations for evaluation.

[1] Resolution of the President of the Republic of Uzbekistan No. PP-4702 "On the introduction of the rating system of socio-economic development of the regions" 01.05.2020

K.R. McConnell, S.L. Brueler (2003) devoted extensively to the most important problems of economics: macro and microeconomics, national income, employment, credit, fiscal and tax policy, and the world economy.

Söhnke Bartram, Jürgen Branke, Mehrshad Motaharilar (2020), A.Nazif Catik, Mehmet Karaçukalar (2011) on portfolio management, risk modeling and forecasting through trade and risk management by increasing efficiency, accuracy and compliance in the field of artificial intelligence asset management performed forecasting and analysis of inflation using one-dimensional time series models of networks for Turkey.

In a study by Michael Furtwaengler (May, 2019), Tobias used neural networks to find estimates close to acceptable indicators to determine a strictly optimal hedging strategy based on the key market dynamics of the concept of risk convex limits.

Samuel Björklund and Tobias Uhlins (2017) developed an artificial neural network model that predicts the expected profitability of a financial time series in order to optimize portfolio weights. They developed a portfolio optimization model using stochastic programming to evaluate the use of future revenue forecast in the relevant context. They developed an artificial neural network to predict financial time series and optimize the portfolio.

Teuvo Coxonen (1998) developed the classical clustering and vector quantization algorithm used in the processing of socioeconomic data using quantized matching factor vectors or code book vectors using neural networks.

Martin T. Hagan, Howard B. Demuth, Mark H. Bealelar (2014) developed a clear and detailed description of the basic architectures of the neural network, the rules for teaching them. They also demonstrated the sequential presentation of primary neural networks, their training methods, and practical problem-solving.

In the CIS countries, a number of experts have conducted research on the subject, in particular, Yu.P. Zaychenko (2008) studied the systems of fuzzy logic and fuzzy neural networks, which are part of artificial intelligence, and their application in various practical problems.

V.V. Kruglov and V.V. Borisov (2002) considered the theory of artificial neural networks, the construction of modern software shell-imitators of neural networks, as well as the construction of neural network expert systems to solve the problems of image recognition, clustering, forecasting, optimization. made a great contribution to the creation of their use.

E.A. Trofimova, V.D. Mazurov, D.V. Gilev (2017) conducted research on neural network tuning methods and methods for solving practical economic problems, including Rosenblatt's perceptron, Hemming network, and linear programming methods, and achieved high results.

Barskiy A.B. (2004) conducted research on the use of neural network technologies in the construction of information and management systems in science, economics, finance, and the arts. He created simple methods of teaching in static and dynamic modes. He worked on the features of decision-making systems.

Academician S.S. Gulomov on the development of the national economy, improving the investment climate in the regions, R.H. Alimov and N.M. Mahmudov on improving the investment potential, effective use of investment, B.T. on modeling the intersectoral distribution of investments on the basis of fuzzy logic. Scientists such as Baykhanov conducted scientific research

However, important aspects such as methods of introducing information systems in the economy, the principles of modeling based on intelligent neural networks, the effectiveness of the use of intellectual neural networks in the economy, their interrelationships, the conditions of development of the digital economy have not been studied. In the development of digitalization of the economy, the scientific development of innovative technologies and ideas and, on this basis, the improvement of the legal and regulatory framework are of great importance. Short-, medium-, and long-term forecasting and decision-making models that have performed well in the past may not meet today's requirements, which may require improving those models or creating a new one. This problem further enhances the relevance of this research topic.

RESEARCH METHODOLOGY

To create a neural network to solve the prognosis problem, we must first select how the neurons are connected to each other and, accordingly, the weight values in these connections. One element can affect another, depending on the relationship established. In this case, the connections determine the force acting on the weight.

A simple network has a structure that transmits signals directly, the signals pass through invisible elements at the input and eventually reach the output element. This structure has a stable feature. If the network is repetitive (i.e., it involves the transfer of communication from distant neurons to nearby neurons), it can be unstable and have very complex dynamics. Recurrent networks are of great interest to researchers in the field of neural networks, however, properly structured neural networks are still useful in effectively solving practical problems.

Neurons are regularly divided into layers. The input layer only serves to enter the values of the input parameters. Each of the latent and output neurons will be connected to all elements of the anterior layer. During the operation (use) of the network,

the values of the input variables are passed to the input elements, then the neurons of the intermediate and output layers operate in series. Each of them calculates its own activation value. The activation value is then changed using the activation function, resulting in a neuron output. Multilayer perceptron, radial-based mesh, generalized-regression mesh, and recurrent mesh can be used to solve the prediction problem.

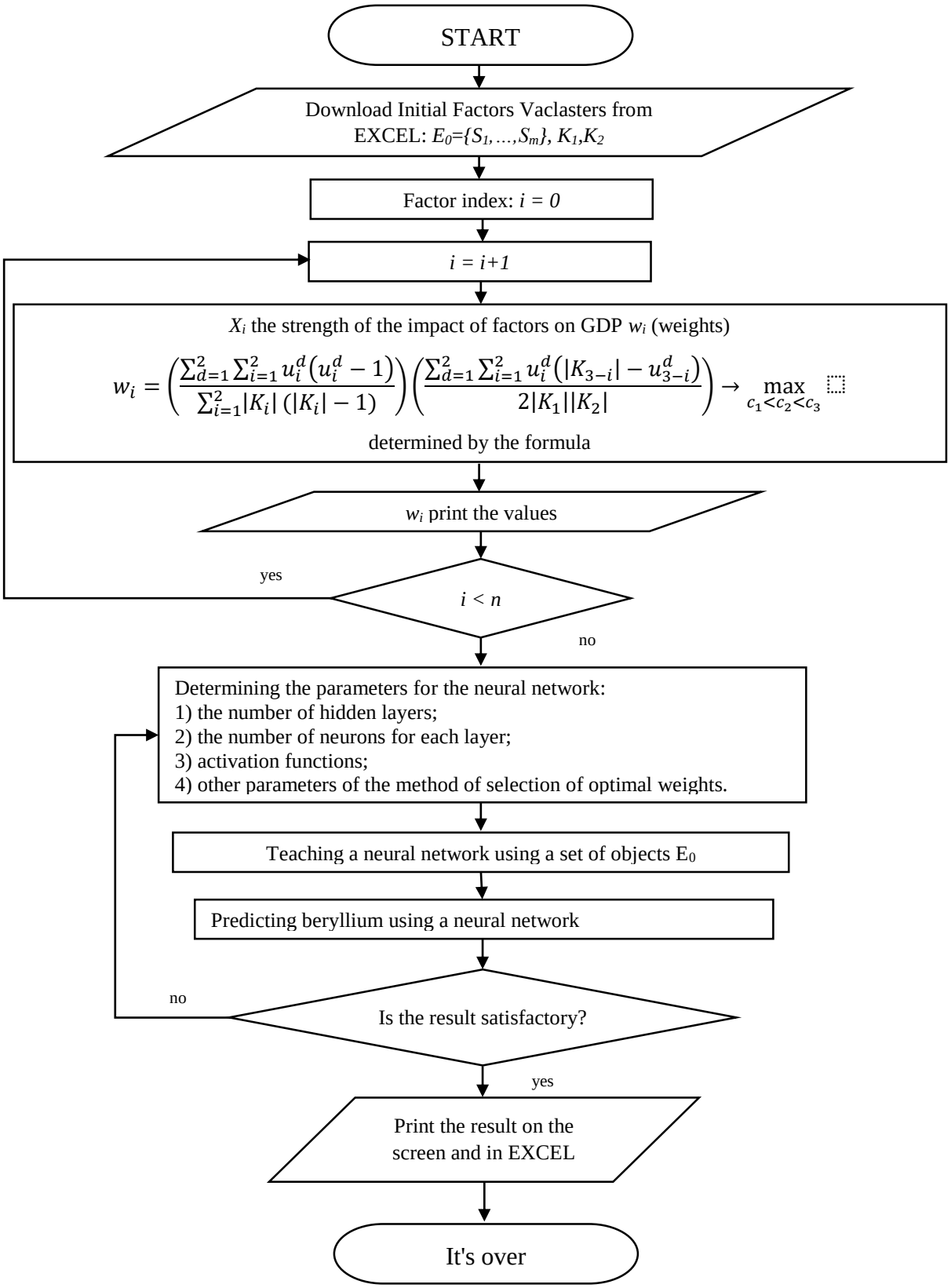

Figure 1. Algorithm for analyzing and predicting intervals between factors in a cluster for the PYTHON 3.6 program[2]

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The study developed a program of intelligent analysis and forecasting of indicators of socio-economic development of the regions of the Republic of Uzbekistan using a generalized-regression network. allows

It also allows you to increase the number of neurons in the latent layer, select prognostic models, and quickly implement multiple scenarios. It should be noted that if the prognosis result determined using neural network technology is determined only on the basis of available data, the developed program also increases the chances of achieving a definite prognosis by allowing to create a rule based on the relationships between factors and their degree of influence on the outcome factor.

In addition, it helps to easily establish a link between the parameters of the base functions and the training data in a multidimensional space. Therefore, it is easy to find conditions that satisfy the initial process of teaching with a teacher. The implementation of forecasting based on the topic of the plan consists of a number of steps, which can be seen from the following algorithm (Figure 1).

This program helps to determine the weight of factors affecting the value of GDP (or GRP) in both quantitative and qualitative terms (range 0) using intelligent mathematical models (range 0 to 1) and neural networks and intelligent mathematical models. will help to determine the forecast of the republic's GDP (or regions' GDP) for the coming years. Below is the main window of the program (Figure 2).

Figure 2. The main window of the program [2]

In the main window of the program, click the "File" button and select the unwanted data file prepared in Excel (Figure 2-3).

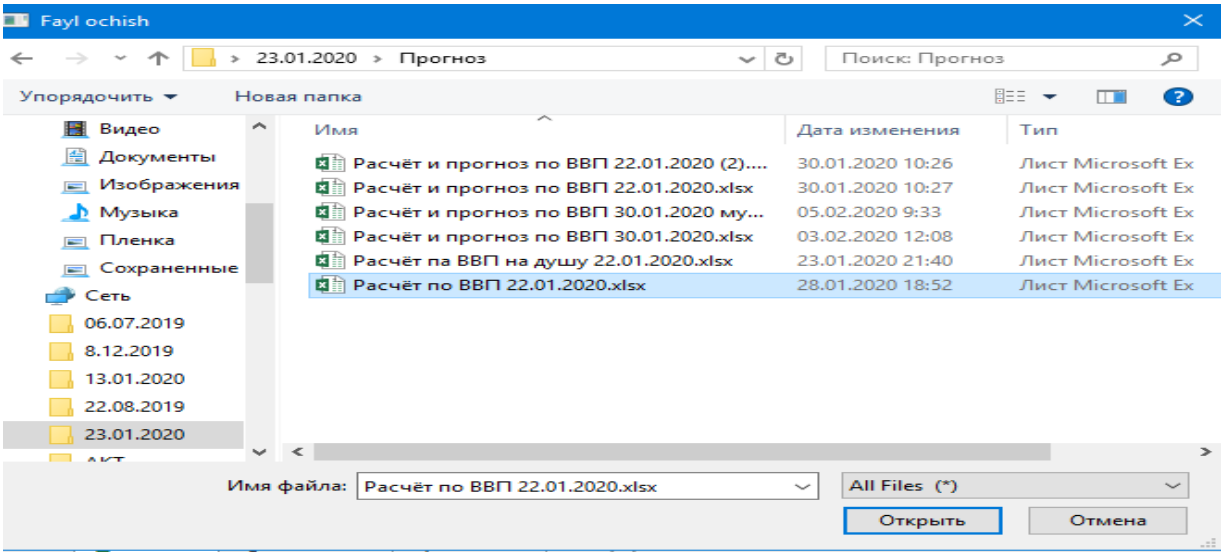
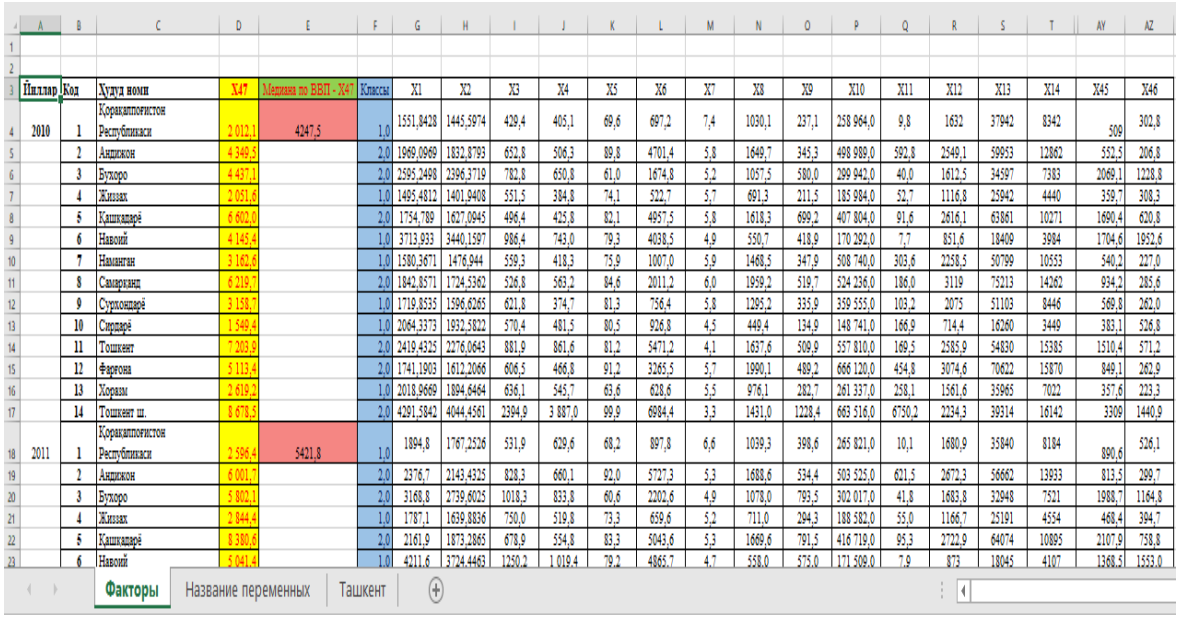


Figure 3. The program selects the working file for analysis

[2] An intellectual analysis program developed by the author is a view of the main working windows An intellectual analysis program developed by the author is a view of the main working windows

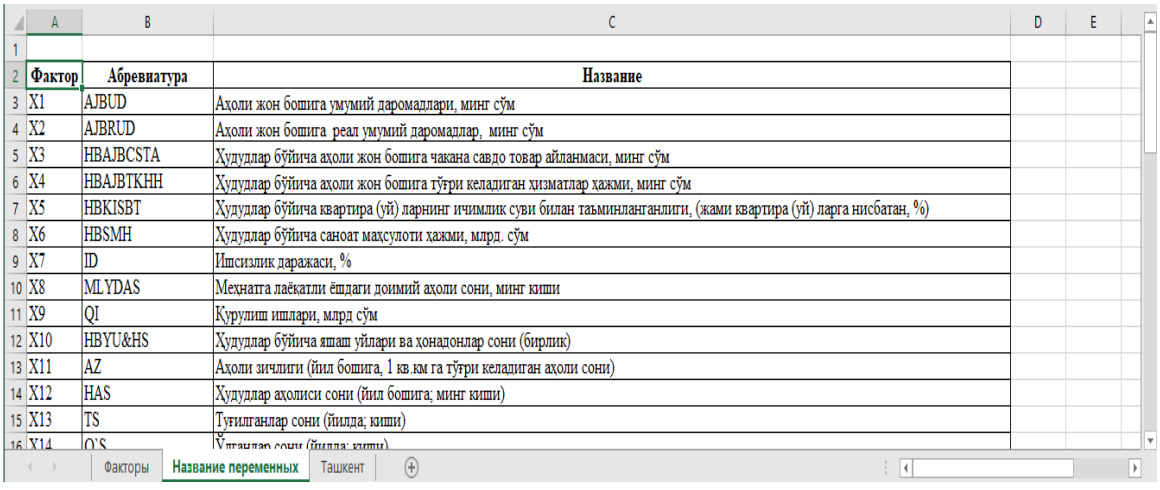
Of course, in order to use this program, you must first create an unwanted statistical (economic, financial, and social) data table in Excel that is relevant to the process being researched. According to it, the cells of column A contain years, the cells of column B the object number, the cells of column C the names of the studied objects, the cells of column D the result factor values. In column E, the median of the resulting factors is determined for the selected time interval, and in column F, the resultant factor variation of the objects along the median is divided into classes. In the remaining columns, a statistical indicator of the factors influencing the outcome factor is placed. Its appearance is shown in the following figures (Figures 4-5).



Йиллар	Код	Худуд номи	X47	Медиана по ББП - X47	Классы	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X45	X46
2010	1	Қорақалпоғистон Республикаси	2 012,1	4247,5	1,0	1551,8428	1445,5974	429,4	405,1	69,6	697,2	7,4	1030,1	237,1	258 964,0	9,8	1632	37042	8342	509	302,8
	2	Андижон	4 349,5		2,0	1969,0969	1832,8793	652,8	506,3	89,8	4701,4	5,8	1649,7	345,3	498 989,0	592,8	2549,1	59953	12862	552,5	206,8
	3	Бухоро	4 437,1		2,0	2595,2498	2396,3719	782,8	650,8	61,0	1674,8	5,2	1057,5	580,0	299 942,0	40,0	1612,5	34597	7383	2069,1	1228,8
	4	Жиззах	2 051,6		1,0	1495,4812	1401,9408	551,5	384,8	74,1	522,7	5,7	691,3	211,5	185 984,0	52,7	1116,8	25942	4440	359,7	308,3
	5	Қашқадарё	6 602,0		2,0	1754,789	1627,0945	496,4	425,8	82,1	4957,5	5,8	1618,3	699,2	407 804,0	91,6	2616,1	63861	10271	1690,4	620,8
	6	Навоий	4 145,4		1,0	3713,933	3440,1597	986,4	743,0	79,3	4038,5	4,9	550,7	418,9	170 292,0	7,7	851,6	18409	3984	1704,6	1952,6
	7	Наманган	3 162,6		1,0	1580,3671	1476,944	559,3	418,3	75,9	1007,0	5,9	1468,5	347,9	508 740,0	303,6	2258,5	50799	10553	540,2	227,0
	8	Самарқанд	6 219,7		2,0	1842,8571	1724,5362	526,8	563,2	84,6	2011,2	6,0	1959,2	519,7	524 236,0	186,0	3119	75213	14262	934,2	285,6
	9	Сурхондарё	3 158,7		1,0	1719,8535	1596,6265	621,8	374,7	81,3	756,4	5,8	1295,2	335,9	359 555,0	103,2	2075	51103	8446	569,8	262,0
	10	Сирдарё	1 549,4		1,0	2064,3373	1932,5822	570,4	481,5	80,5	926,8	4,5	449,4	134,9	148 741,0	166,9	714,4	16260	3449	383,1	526,8
	11	Тошкент	7 203,9		2,0	2419,4325	2276,0643	881,9	861,6	81,2	5471,2	4,1	1637,6	509,9	557 810,0	169,5	2585,9	54830	15385	1510,4	571,2
	12	Фарғона	5 113,4		2,0	1741,1903	1612,2066	606,5	466,8	91,2	3265,5	5,7	1990,1	489,2	666 120,0	454,8	3074,6	70622	15870	849,1	262,9
	13	Хоразм	2 619,2		1,0	2018,9669	1894,6464	636,1	545,7	63,6	628,6	5,5	976,1	282,7	261 337,0	258,1	1561,6	35965	7022	357,6	223,3
	14	Тошкент ш.	8 678,5		2,0	4291,5842	4044,4561	2394,9	3 887,0	99,9	6984,4	3,3	1431,0	1228,4	663 516,0	6750,2	2234,3	39314	16142	3309	1440,9
2011	1	Қорақалпоғистон Республикаси	2 596,4	5421,8	1,0	1894,8	1767,2526	531,9	629,6	68,2	897,8	6,6	1039,3	398,6	265 821,0	10,1	1680,9	35840	8184	890,6	526,1
	2	Андижон	6 001,7		2,0	2376,7	2143,4325	828,3	660,1	92,0	5727,3	5,3	1688,6	534,4	503 525,0	621,5	2672,3	56662	13933	813,5	299,7
	3	Бухоро	5 802,1		2,0	3168,8	2739,6025	1018,3	833,8	60,6	2202,6	4,9	1078,0	793,5	302 017,0	41,8	1683,8	32948	7521	1988,7	1164,8
	4	Жиззах	2 844,4		1,0	1787,1	1639,8836	750,0	519,8	73,3	659,6	5,2	711,0	294,3	188 582,0	55,0	1166,7	25191	4554	468,4	394,7
	5	Қашқадарё	8 380,6		2,0	2161,9	1873,2865	678,9	554,8	83,3	5043,6	5,3	1669,6	791,5	416 719,0	95,3	2722,9	64074	10895	2107,9	758,8
	6	Навоий	5 041,4		1,0	4211,6	3724,4463	1250,2	1 019,4	79,2	4865,7	4,7	558,0	575,0	171 509,0	7,9	873	18045	4107	1368,5	1553,0

Figure 4. List 1: View of the Incoming Data Table by Region 47 for Factors 2010-2019

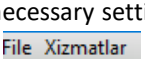
The division into medians and classes shown in Figure 4 is performed by the program itself on the basis of a chain analysis. Of course, since a lot of data does not occupy a large volume, it is also possible to include them, that is, each factor that affects the outcome factor, on the basis of a certain definition. (Figure 5)



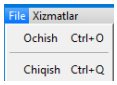
Фактор	Абревиатура	Название
X1	AJBUD	Аҳоли жон бошига умумий даромадлари, минг сўм
X2	AJBRUD	Аҳоли жон бошига реал умумий даромадлар, минг сўм
X3	HBAJBCSTA	Ҳудудлар бўйича аҳоли жон бошига чакана савдо товар айланмаси, минг сўм
X4	HBAJBTKHH	Ҳудудлар бўйича аҳоли жон бошига тўғри келадиган хизматлар ҳажми, минг сўм
X5	HBKISBT	Ҳудудлар бўйича квартира (уй) ларнинг ичимлик суви билан таъминланганлиги, (жами квартира (уй) ларга нисбатан, %)
X6	HBSMH	Ҳудудлар бўйича саноат маҳсулоти ҳажми, млрд. сўм
X7	ID	Ишсизлик даражаси, %
X8	MLYDAS	Меҳнатга лаёқатли ёшдаги доимий аҳоли сони, минг киши
X9	QI	Қурулиш ишлари, млрд сўм
X10	HBYU&HS	Ҳудудлар бўйича яшаш уйлари ва ҳонадонлар сони (бирлик)
X11	AZ	Аҳоли зичлиги (йил бошига, 1 кв.км га тўғри келадиган аҳоли сони)
X12	HAS	Ҳудудлар аҳолиси сони (йил бошига; минг киши)
X13	TS	Туғилганлар сони (йилда; киши)
X14	O'S	Ўлганлар сони (йилда; киши)

Figure 5. List 2: Name and abbreviation of factors in the program

Figure 5 shows the definition, abbreviation, and full name of the selected factors. This, in turn, justifies the scientific nature of decision making, while allowing for complete and accurate conclusions about the process.

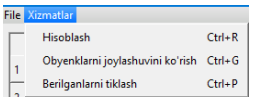
Entering or modifying information about the last column and last row of data in Table 1 of the table created in Excel is entered in the "Last row" and "Last column" cells. When all the necessary settings are made, the "Open" button is clicked. As a result, in the working window there are two "File" and "Services". 

menu window opens.

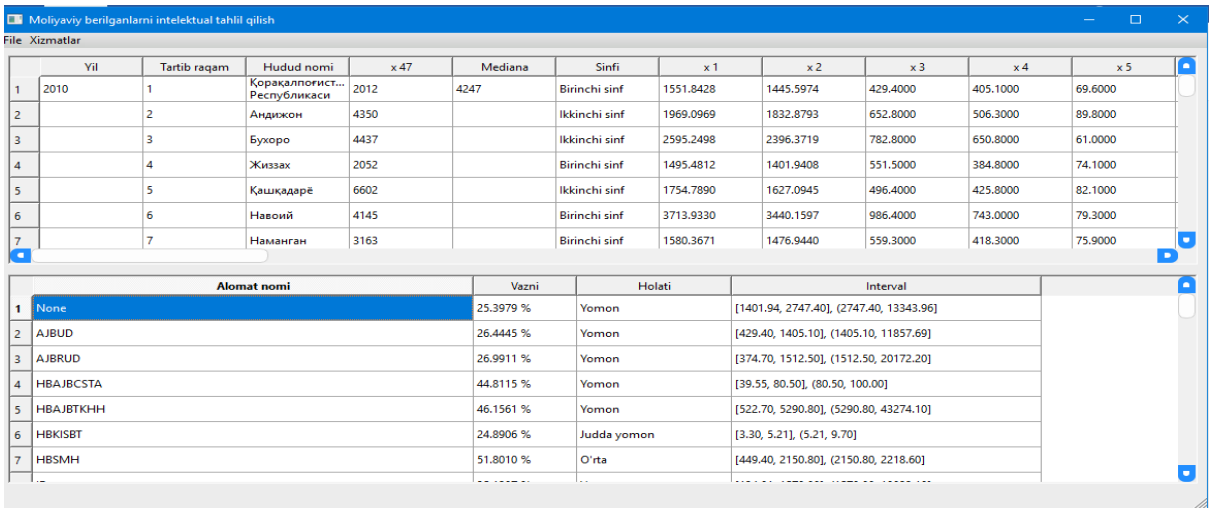


In the "File" menu you can open and close the file created in Excel 2016.

The Services menu has three commands: Calculate, View Object Location, and Restore Data: This will open the next work window (Figure 6-7).



1) With the help of the command "Calculation" it is possible to analyze the factors by means of intellectual mathematical models (intervals) and determine the weights. allows you to assess the factors that affect the process of separation, not only in terms of quantity, but also in terms of quality (Figure 6).



	Yil	Tartib raqam	Hudud nomi	x 47	Mediana	Sinfi	x 1	x 2	x 3	x 4	x 5
1	2010	1	Қорақалпоғист... Республикаси	2012	4247	Birinchi sinf	1551.8428	1445.5974	429.4000	405.1000	69.6000
2		2	Андижон	4350		Ikkinchi sinf	1969.0969	1832.8793	652.8000	506.3000	89.8000
3		3	Бухоро	4437		Ikkinchi sinf	2595.2498	2396.3719	782.8000	650.8000	61.0000
4		4	Жиззах	2052		Birinchi sinf	1495.4812	1401.9408	551.5000	384.8000	74.1000
5		5	Қашқадарё	6602		Ikkinchi sinf	1754.7890	1627.0945	496.4000	425.8000	82.1000
6		6	Навоий	4145		Birinchi sinf	3713.9330	3440.1597	986.4000	743.0000	79.3000
7		7	Наманган	3163		Birinchi sinf	1580.3671	1476.9440	559.3000	418.3000	75.9000

	Alomat nomi	Vazni	Holati	Interval
1	None	25.3979 %	Yomon	[1401.94, 2747.40], (2747.40, 13343.96]
2	AJBUD	26.4445 %	Yomon	[429.40, 1405.10], (1405.10, 11857.69]
3	AJBRUD	26.9911 %	Yomon	[374.70, 1512.50], (1512.50, 20172.20]
4	HBAJBCSTA	44.8115 %	Yomon	[39.55, 80.50], (80.50, 100.00]
5	HBAJBTKHH	46.1561 %	Yomon	[522.70, 5290.80], (5290.80, 43274.10]
6	HBKISBT	24.8906 %	Judda yomon	[3.30, 5.21], (5.21, 9.70]
7	HBSMH	51.8010 %	O'rta	[449.40, 2150.80], (2150.80, 2218.60]

Figure 6. A window to determine the impact of factors on GDP

2) In the Object Location command - In the Graphics window, we can see a graph of the location of each factor in two-dimensional space. In two-dimensional space, regions can be divided into two classes and we can visually see their location in space relative to the deviation (Figure 7).

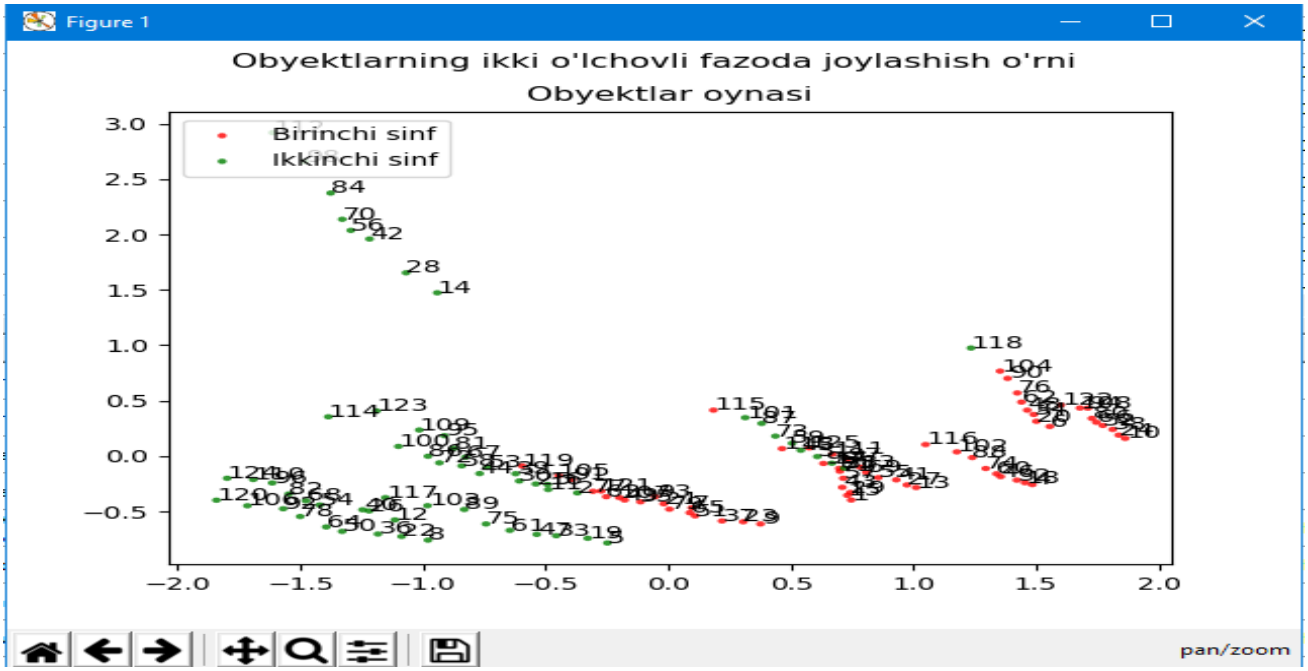


Figure 7. A view of the relative position of factors in space in a graphical window

This graph, shown in Figure 7, can be zoomed in, out, and stored in memory. This graph also provides a visual representation of the trend of change in the socio-economic potential of each region, as well as a facilitator for decision-makers and learners (Figure 8).

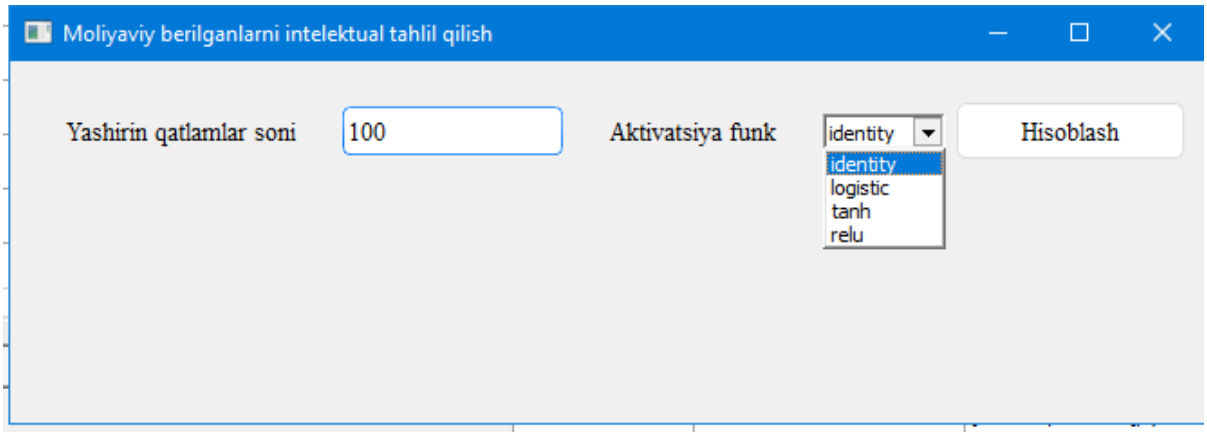


Figure 8. GDP forecasting window using intelligent econometric model and neural networks

In the Data Recovery command, GDP can be forecasted by region using an intelligent mathematical model and neural networks. In the window in Figure 8, to perform the prediction operation, you must first enter the neural network parameters:

1. "Number of latent layers" - the number of latent layers in the neural network. It should be noted that by increasing or decreasing the number of these hidden layers, it is possible to modify the calculation results and select the most optimal option;

2. "Activation function" - to determine the results of the forecast and select the type of function from the activation function to implement the scenario forecast. The selection of these functions can be modified based on the optimal value of the result;

3. "Calculation" - after entering the parameters, with the help of this command we can determine the forecast to determine the future prospects of the activity. The result is automatically placed in the empty cells in Figure 9.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	AV	AW
1	Вақт	Йиллар	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X46	X47
2	1	2010	4291,58	4044,46	2394,9	3 887,0	99,9	6984,4	3,3	1431,0	1228,4	663 516,0	6750,2	2234,3	39314	16142	18909	1440,9	8 678,5
3	2	2011	5201,4	4336,19	2928,1	4 722,9	100,0	9628,9	3,4	1434,9	1866,5	668 785,0	6875,7	2296,5	37889	16545	18438	1525,6	11 207,1
4	3	2012	6458,7	5384,35	3634,7	5 755,4	99,3	12516,4	3,3	1447,0	2300,5	675 361,0	6914,1	2309,3	38072	16229	19143	2320,9	14 091,1
5	4	2013	6678,9	6294,3	4339,9	6 941,4	100,0	15531,3	3,4	1442,0	2725,6	680 946,0	7008,8	2340,9	41647	16087	18786	2115,3	16 967,3
6	5	2014	7599,0	7146,0	5361,1	8 373,8	100,0	15468,5	3,6	1440,2	3460,1	685 756,0	7044,6	2352,9	42225	16194	19264	2517,4	21 203,7
7	6	2015	8816,6	8383,2	6540,0	9 700,5	100,0	18986,1	3,8	1441,3	4113,0	578 689,0	7099,6	2371,3	42802	16346	18991	2864,2	26 178,7
8	7	2016	10631,5	10086,8	7998,4	12 235,9	100,0	23511,9	3,6	1445,4	4633,4	583 426,0	7165,2	2393,2	43879	16517	18988	4216,5	33 118,2
9	8	2017	12937,7	11770,1	9591,6	15 815,0	100,0	30459,6	4,5	1454,1	6197,9	589 025,0	7257,9	2424,1	43150	16361	19149	4786,9	40 720,4
10	9	2018	15804,6	13344,1	11857,7	20171,94	100,0	43274,1	7,9033	1466,34	10822,1	604064,4	7380	2464,9	45548	15745	20302	8710	53 287,1
11	10	2019	17319,7	14603,3	13133,8	22374,23	100,0	48063	8,537	1470,55	11954	591474,4	7455,56	2491,13	46480,4	16131,5	20505,1	9692	74 527,6
12	11	2020	18834,8	15862,5	14410	24576,51	100,0	52852	9,1707	1474,76	13085,8	578884,4	7531,12	2517,35	47412,7	16109,8	20708,1	10674	88955,82
13	12	2021	20349,8	17121,7	15686,1	26778,8	100,0	57640,9	9,8044	1478,97	14217,7	566294,4	7606,67	2543,58	48345,1	16088	20911,2	11656	103928,4
14	13	2022	21864,9	18381	16962,3	28981,09	100,0	62429,8	10,4381	1483,18	15349,5	553704,4	7682,23	2569,8	49277,5	16066,3	21114,2	12638	118413,2
15	14	2023	23380	19640,2	18238,4	31183,37	100,0	67218,8	11,0718	1487,39	16481,4	541114,4	7757,78	2596,03	50209,9	16044,5	21317,3	13620	132333,8
16	15	2024	24895,1	20899,4	19514,6	33385,66	100,0	72007,7	11,7055	1491,6	17613,2	528524,4	7833,34	2622,25	51142,2	16022,8	21520,4	14602	145515,8
17	16	2025	26410,1	22158,7	20790,7	35587,95	100,0	76796,7	12,3392	1495,81	18745,1	515934,4	7908,9	2648,48	52074,6	16001	21723,4	15584	157573,2

Факторы | Название переменных | Ташкент

Figure 9. Forecast of GRP of the city of Tashkent for 2019-2025 using the program

ANALYSIS AND RESULTS

The forecasts of Andijan and Samarkand regions with high potential, identified as a result of economic analysis, will be determined by the above research methodology. It should be noted that, given the specific nature, capabilities and potential of each region, the advantage of this program is determined by different formulas in the package of functions, depending on the factors influencing the change in each region and their scope. Although this process is performed under a closed layer, the program can be selected via the activation function button. The values of intellectual forecasting of each region, determined as a result of operations, are given in Table 1 below.

According to Table 1, the volume of gross regional product in Andijan region in 2020 will reach 35134.5 billion soums. soums, which is 6.9% more than in 2019 (32863.3 billion soums). As a result of the consistent implementation of the tasks set in the program of socio-economic development of the region, by 2025, the gross regional product of Andijan region will reach 50690.6 billion soums. soums.

The volume of gross regional product in Samarkand region will reach 57833.8 billion soums by 2025, an average increase of 10.7% over 5 years compared to 2019 (37590.5 billion soums). is expected to be equal to UZS. According to the forecast results

in Tashkent, the volume of gross regional product in 2020 will increase by 19.4% compared to 2019 (74502.6 billion soums) and amounted to 88955.8 billion soums. soums and by 2025 this figure will increase by an average of 22.3% over 5 years and reach 157573.2 bln. soums.

Table 1. Intellectual forecast of regions with high potential (billion soums)[3]

Years	Andijan region	Samarkand region	Tashkent city
2019[4]	32863,3	37590,5	74502,6
2020	35134,5	39940	88955,82
2021	38245,7	43521,5	103928,4
2022	41356,9	47103,0	118413,2
2023	44468,2	50683,9	132333,8
2024	47579,4	54258,9	145515,8
2025	50690,6	57833,8	157573,2

Based on the scope of the topic, it is required to use the panel method to conduct econometric analysis using 64 factors and identify models of change in 2010-2019 from the observed data.

There are many methods of economic analysis, one of which is panel research. Panel research is a type of repetitive research that is the study of a similar object over a period of time. Repetition of the study means that it is carried out in a manner similar to the method used in the first stage. Thanks to panel research, there is an opportunity to help determine what qualitative changes have taken place in our facility over time. On this basis, it will be possible to determine the dynamics of temporary changes in the properties of the object and determine its development trend.

The panel research method has certain advantages. They are mainly related to the fact that the research method has been extended over time. It can be used to analyze changes over a period of time and compare the results of previous research with current ones. Simply put, based on the data obtained, it is possible to look for a relationship between the present and an event that took place some time ago. It helps to study the general trend of behavior or process changes.

In this sense, we will conduct panel analyzes using the Eviews program using 46 factors for 2010-2018 in the 14 selected regions. Initially, 19 of these factors (X1, X2, X5, X6, X7, X11, X13, X17, X22, X24, X26, X27, X29, X30, X38, X39, according to the condition $0.01 \le a \le 0.1$. , X41, X44, X45, X46). After that, when the correlation coefficient was checked, there were 14 factors left under the multicollinear condition $rx1, x2 \ge 0.8$ (X1, X2, X5, X6, X13, X17, X22, X26, X27, X30, X37, X39, X41, X45) . From the remaining 14 factors, 8 reliable factors (X1, X2, X5, X17, X26, X27, X37, X41) were selected according to the distribution law.

Using these selected factors in determining the multivariate regression equation of the gross regional product of Tashkent city, Andijan and Samarkand regions, X26 (by region of agricultural production (at current prices)) and X27 (by region of agricultural, forestry and fishery products (services) volume (in current prices, billion soums)). At the same time, first of all, these factors are not relevant for the city of Tashkent, but in the other two regions they are multicollinear compared to other factors (Table 2).

Table 2. Correlation of factors influencing GRP of Andijan region [5]

	X1	*X2*	*X5*	*X17*	*X26*	*X27*	*X37*	*X41*
X1	1							
X2	0,99511	1						
X5	0,64541	0,62234	1					
X17	0,83229	0,81485	0,46068	1				
X26	0,99383	0,98734	0,94579	0,84888	1			

[3] Based on the research, the results of calculations in the program "Intellectual Analysis of Factors" created by the author on the basis of data from the State Statistics Committee of the Republic of Uzbekistan (www.stat.uz)

[4] Real data from the website of the State Statistics Committee of the Republic of Uzbekistan (www.stat.uz)

[5] Based on the research, based on the data of the State Statistics Committee of the Republic of Uzbekistan (www.stat.uz), the results of the correlation calculation performed by the author for the Andijan region in the program "Ms Excel 2010"

X27	0,99310	0,98712	0,84710	0,84589	0,99997	1		
X37	0,3805	0,43290	0,389315	0,386335	0,415904	0,411505	1	
X41	-0,19268	-0,26112	-0,22094	-0,15471	-0,22132	-0,21697	-0,63775	1

Table 3. Correlation of factors influencing GRP in Samarkand region [6]

	X47	*X1*	*X2*	*X5*	*X17*	*X26*	*X27*	*X37*	*X41*
X47	1								
X1	0,984727	1							
X2	0,991321	0,795963	1						
X5	-0,86336	-0,70104	-0,91394	1					
X17	0,931757	0,633317	0,723529	-0,74319	1				
X26	0,99791	0,988299	0,990581	-0,86097	0,929602	1			
X27	0,997602	0,988531	0,990599	-0,86143	0,929971	0,999975	1		
X37	0,447117	0,340493	0,388892	-0,18014	0,505953	0,407914	0,406805	1	
X41	-0,84556	-0,75861	-0,80485	0,704305	-0,69327	-0,8238	-0,82193	-0,5789	1

It can be seen from the table data that factors X26 and X27 have multicollinearity in relation to other factors and these factors can be omitted when constructing the regression equation. Similarly, the correlation coefficient between the selected factors in the GRP of Samarkand region is determined (Table 3).

According to the multicollinearity condition, in this table, too, the multicollarity of factors X26 and X27 with other factors was determined. This, in turn, means that only 6 out of 46 factors in the total have a strong impact on GRP, and according to these factors, the forecast results of the regions are reflected in the following table (Table 4).

Table 4. Multi-factor panel forecast of Tashkent city, Andijan and Samarkand regions [7]

Years	Tashkent	Andijan region	Samarkand region
2019	74498,0	33105,0	37589,0
2020	75498,8	36849,7	39273,0
2021	81150,7	40090,4	42356,3
2022	86802,5	43331,1	44506,7
2023	92454,4	46571,7	46890,4
2024	96245,8	49812,4	49274,0
2025	100967,5	53221,1	51657,7

According to the table, in 2020 the volume of gross regional product of Tashkent will reach 75498.8 billion soums. soums, Andijan region - 36849.7 bln. soums and Samarkand region 39273.0 bln. soums. By 2025, the volume of gross regional product of Tashkent will increase by 44.0% compared to 2020 and reach 100967.5 billion soums. soums, Andijan region with an increase of 48.2% to 53221.1 bln. UZS and Samarkand region - 51657.7 bln. is expected to be equal to UZS.

Unfortunately, the panel method, like other research methods, is not without flaws. The main disadvantages of this method are the complexity of the process in the early stages. When it comes to large-scale research, it should be noted that it is difficult to gather and brief a large enough group, and that many of the factors that emerge from the research are squeezed out by criteria. It should also be noted that the inability to determine in the panel program whether the effects of factors have a separate level of influence individually and in combination has led to the development of a new methodology in this regard.

[6] Based on the research, based on the data of the State Statistics Committee of the Republic of Uzbekistan (www.stat.uz), the results of the calculation of the correlation performed by the author for the Samarkand region in the program "Ms Excel 2010"

[7] Based on the research, based on the data of the State Statistics Committee of the Republic of Uzbekistan (www.stat.uz), the calculation of the panel forecast made by the author in the program "Eviews 9"

It should be noted that in order to verify the reliability of the values determined using the program developed as a result of this study, we think it is appropriate to compare the predicted values determined by trend equations representing the trend of row change in EXCEL.

Based on the obtained statistical data on the dynamics of the gross regional product of Andijan region, it was determined with a degree of reliability $P^2 = 0,9952$

$$y=2,166x^4+6,5896x^3-214,68x^2+2460,1x+1971,1 \quad (1)$$

According to the trend equation, in 2025 it will increase by 4.7 times compared to 2019 to 155316.6 billion. soums.

Based on the obtained statistical data on the dynamics of the gross regional product of Samarkand region, it was determined with the degree of reliability $P^2 = 0,9997$

$$y=2,9245x^4-50,247x^3+526,93x^2+11,534x+5781,2 \quad (2)$$

According to the trend equation, in 2025 it will increase by 3.4 times compared to 2019 to 126708.1 billion. soums (Table 5).

Table 5. Trend forecast of regions with high potential in the regions (billion soums)[8]

Years	Andijan region $y=2,166x^4+6,5896x^3-214,68x^2+2460,1x+1971,1$ $R^2=0,9952$	Samarkand region $y=2,9245x^4-50,247x^3+526,93x^2+11,534x+5781,2$ $R^2=0,9997$	Tashkent city $y=5,1428x^5-119,55x^4+1074,4x^3-4149,4x^2+9382,8x+2427$ $R^2=0,9999$
2019	33353,7	37587,5	74495,0
2020	43539,1	45605,5	111508,3
2021	56879,4	55613,1	174774,6
2022	74012,0	68116,3	278629,7
2023	95626,1	83690, 8	441945,9
2024	122463,3	102982,6	688749,0
2025	155316,6	126708,1	1048835,7

Based on the obtained statistical data on the dynamics of the gross regional product of the city of Tashkent, it is determined by the degree of reliability $P^2 = 0,9999$

$$y=5,1428x^5-119,55x^4+1074,4x^3-4149,4x^2+9382,8x+2427 \quad (3)$$

According to the trend equation, in 2025 it will increase by 14.1 times compared to 2019 to 1048835.7 billion. soums.

Based on a comparison of the results obtained with all three methods, it is possible to check the reliability and adequacy of the models[9]. To do this, it is necessary to estimate the volume of gross regional product of the regions in 2019 on the basis of values determined by methods (Table 6).

Table 6. Comparative analysis of the results of the methods for 2019 (billion soums)[10]

Regions	In fact	Intellectual		Trend		Panel method		Error rate,%		
		Account	The difference	Account	The difference	Account	The difference	Intellect	Trend	Panel
Andijon	32897,2	32863,3	33,9	33353,7	-456,5	33105	-207,8	0,103	1,388	0,632
Samarkand	37593,9	37590,5	3,4	37587,5	6,4	37589	4,9	0,009	0,017	0,013
Tashkent	74527,6	74502,6	25	74495,0	32,6	74498	22,6	0,034	0,044	0,040

[8] Based on the research, based on the data of the State Statistics Committee of the Republic of Uzbekistan (www.stat.uz), the results of trend calculations performed by the author in the program "Ms Excel 2010"

[9] Otajanov U.A. (2020) Improvement of methods of assessing the investment climate of the regions of the Republic of Uzbekistan // TEST: Engineering&Management. March-April, / ISSN: 0193-4120 Page No. 5489 – 5499

[10] The final result of the author's calculations based on the data in Tables 1, 4 and 5

DISCUSSION OF RESEARCH RESULTS

It was also possible to conclude this comparison by analyzing the prognosis results of the three methods based on differences. However, the high level of differences between them in this case cast doubt on the accuracy of the conclusion about the reliability of the methods. Therefore, in the study, it is appropriate to examine the differences between the actual values and the values obtained as a result of the methods.

According to the results of Table 6, the reliability and superiority of the intellectual mathematical model trend and panel methods emerged. This is because if we focus on the error rates of the results determined by the intellectual mathematical method, it represents an average error of 0.24% over the forecast period. If we determine the result of a similar trend in terms of error rate, it has an average error of 2.42% compared to the forecast period, and these results proved the superiority of the intellectual mathematical method developed in the study.

CONCLUSIONS AND SUGGESTIONS

Analysis and in-depth study of the processes of distribution of regional investments requires an increase in the number of factors. The multiplicity of factors in turn constitutes a set of spatial indicators. In many cases, in practice, in the context of rapid analysis and decision-making, it is advisable to do so by dividing it into two half-planes in cases where it is considered a whole plane composed of these spatial indicators.

According to the results of the forecast, determined using the intellectual mathematical model developed as a result of the study, the volume of gross regional product in Andijan region in 2020 will reach 35,134.5 billion soums. soums, which is 6.9% more than in 2019 (32863.3 billion soums). As a result of the consistent implementation of the tasks set in the program of socio-economic development of the region, by 2025, the gross regional product of Andijan region will reach 50690.6 billion soums. soums.

The volume of gross regional product in Samarkand region will reach 57833.8 billion soums by 2025, an average increase of 10.7% over 5 years compared to 2019 (37590.5 billion soums). is expected to be equal to UZS. According to the forecast results in Tashkent, the volume of gross regional product in 2020 will increase by 19.4% compared to 2019 (74502.6 billion soums) and amounted to 88955.8 billion soums. soums and by 2025 this figure will increase by an average of 22.3% over 5 years and reach 157573.2 bln. soums.

According to the error rates of the results determined by the intellectual mathematical method, it represents an average error of 0.24% compared to the forecast period. If we determine the result of a similar trend in terms of error rate, it has an average error of 2.42% compared to the forecast period, and these results proved the superiority of the intellectual mathematical method developed in the study.

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