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Correlation Of The Interaction Of Agricultural Production With The Volume Of Dehkanproduction In Uzbekistan

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Abstract. This article examines the problems of agriculture and agricultural production in Uzbekistan, the analysis and statistics of the World Bank.
The purpose of the scientific article is to analyze the dynamics of changes in agriculture in Uzbekistan in 2000-2019, to analyze the impact of agricultural production on agricultural production by economic and mathematical methods.
As a result of the research, the following conclusions were drawn:
Through the development of agriculture in the country, it is possible to increase the export potential of Uzbekistan, while preventing food risks;
An economic interpretation of the model parameters is possible - an increase in X by 1 unit of measure leads to an increase in Y by an average of 1.008 units. The obtained estimates of the regression equation allow us to use it for forecasting. With x = 11, Y will be in the range from 10.28 to 10.52 units and with a 95% probability it will not go beyond these limits

Keywords: agriculture, export, agricultural products, agricultural land, agricultural production, fruit and vegetable products, cotton fiber.

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Introduction

Agriculture, which accounts for 32% of Uzbekistan's GDP and employs 27% of the working population, can be one of the key factors in the country's economic growth in the context of effective public policy.

According to 2019 data, cotton fiber exports accounted for 1.6% of total exports, and at a time when this figure is declining from year to year, it is important to consider the development of other areas of agriculture in the country.

To do this, it is necessary to remove obstacles to the transformation of agriculture into a competitive sector, as well as one that serves the interests of the private sector, the population and the state. World Bank analysis shows that there are currently five major challenges to achieving this goal. Including:

- It is necessary to balance the use of agricultural land;
- It is necessary to increase the productivity of agricultural products;
- It is necessary to make maximum use of export opportunities for agricultural development;
- It is necessary to increase the efficiency of the use of budget funds to finance agriculture;
- It is necessary to protect the land ownership rights of farms [1];
- Special attention should be paid to increasing the export potential of the industry and increasing the production of value-added products. For example, in Turkey, $ 2,000 per hectare is grown, in Egypt $ 8,000, and in Israel $ 12,000. In Uzbekistan, the figure does not exceed $ 300. Our products are not able to compete in foreign markets due to the fact that the supply of goods of the same standard is not always established.

In the course of this study, we will study in detail the directions of agricultural development in the country.

Level of study of the topic

Agriculture, one of the most important factors in ensuring food security for the world's population, has been studied by experts in this field as well as by leading economists.

In a study conducted by Shi-wei Xu, Yu Wang, Sheng-wei Wang, Jian-zheng LI [2], based on the theory of abnormal oscillations of information about agricultural products and studies that have a significant impact on society methods for determining the vibration limits of agricultural product data at different time scales are discussed in detail. Based on data and survey data from the National Bureau of Statistics (NBS) of China, various statistical methods were used in this article to determine the limits of agricultural production, consumption, and price advance warning. Together with Delphi's method of mutual acquaintance, it has finally repeatedly identified the limits of early warning of information about agricultural products and conducted an early warning analysis of changes in agricultural monitoring data in 2018. The results show that: daily, weekly and monthly monitoring and early warning limits for agricultural products play an important warning role in monitoring abnormal changes in agricultural production; the limits of long-term monitoring and early warning of agricultural product data set by the research institute can provide effective early warning of current abnormal changes in agricultural products, in China can provide a reference standard for the production, consumption and price monitoring of dairy products. the early macro level at the national macro level and further improve the monitoring and early warning application of Chinese agricultural products.

Research by Rozélia Laurett, Arminda Paco, and Emerson Wagner Mainardes [3] focuses on Brazilian family farmers 'understanding of sustainable development in agriculture, its past, barriers, and implications. For this purpose, a survey was conducted with the participation of 23 farmers and qualitative research was conducted. An interview scenario was developed with subsequent content analysis to collect data. The results showed that farmers adopt sustainable development in agriculture according to 25 definitions. The study identified 19 pioneers in ensuring sustainability in agriculture; 20 barriers to sustainable development in agriculture; and 14 results of sustainable agriculture. This study provides an in-depth understanding of how sustainable development in agriculture depends on its predecessors, as well as its barriers and impacts on agriculture. The results confirm that understanding and understanding what sustainable development is is a process, and that the concept may vary in different contexts. This study aims to study Brazilian family farming in terms of sustainability.

Among the scientists of our country N. Khushmatov [4], A.Khojabekov [5], J.Ataev [6].

In the scientific research of J. Ataev the efficiency of the organization of activities of farms and dehkan farms, the factors influencing their success are conditionally divided into six groups. Given that the organization of any business entity, the effectiveness of which depends directly on the mental, physical, socio-economic thinking potential of the entrepreneur, the characteristics of the leader, as well as the characteristics of the economy are considered as factors affecting its activities. These factors contribute to the development of small business, ensuring an increase in operational efficiency in terms of quantity and quality. Informational, environmental, technical and technological, social factors and other services are also mentioned as factors that directly affect economic activity [6].

Research methodology

Along with the method of analysis and synthesis, economic-mathematical methods were used in the study to express the relationship between agricultural production and farm products.

Analysis and results

In the Republic of Uzbekistan, agriculture is important as a sector with high potential and wide opportunities. All factors affecting agriculture are divided into groups: social, economic, and directly related to both, the development of science and technology, land resources and composition, and environmental factors. In our country, which has favorable economic, social and land resources, the volume of agricultural production is growing from year to year.

In 2000, the share of farms in total agricultural output was 66.7%, and the share of farms was 5.5%, while in 2019 these figures were 68.3% and 27.9%, respectively. -jadval). Among the agricultural and livestock products produced in the Republic of Uzbekistan, milk, honey and vegetables have the highest share, followed by cereals and legumes, eggs and others.

Table 1

The structure of agricultural production, in percent [7]

	All categories of farms			
		Farms	Dehkan (personal assistant) farms	Organizations engaged in agricultural activities
2000	100	5,5	66,7	27,8
2005	100	24,3	61,7	14
2010	100	36,3	61,6	2,1
2015	100	30,7	66,9	2,4
2016	100	29,7	68,0	2,3
2017	100	29,3	68,4	2,3
2018	100	26,0	71,2	2,8
2019	100	27,9	68,3	3,8

According to the World Bank, the reduction of cotton and wheat fields in Uzbekistan, for example, by reducing them to 50%, will lead to an increase in gross agricultural output by 51%, agricultural employment by 16% and water saving by 11%.

How quickly should these lands be converted to more profitable crops? This process should be gradual and coordinated with changes in neighboring sectors. For example, the redistribution of land for growing fruits and vegetables should take place simultaneously with the improvement of agrologistics within the state and its customs borders. This, in turn, ensures rapid delivery of perishable fruits and vegetables from farmers to local consumers and the international market.

Otherwise, the profit from the processing of fruits and vegetables will be less than the profit from the sale of wheat and cotton.

The average yield of cotton, wheat, tomatoes, potatoes, milk and other products in Uzbekistan is much lower than their real potential. Increasing this figure will not only increase the profits and exports of farms and agro-organizations, but also create an opportunity to use the areas currently occupied with wheat and cotton for more profitable crops.

Issues such as insufficient funding for research and services over the decades and insufficient provision of services needed to develop the sector need to be addressed. In 2018, only 0.02% of Uzbekistan's gross agricultural output will be spent on agricultural research. However, at present, information and consulting services for local farmers are not available at all.

For comparison, middle-income countries with successful agriculture spend 1 percent of their gross agricultural output on agricultural research, while high-income countries spend an average of 2.5 percent.

The correlation model of the impact of growth in farm production in the country on the total volume of agricultural production was analyzed.

Based on the correlation field, it can be hypothesized (for the general population) that the relationship between all possible values of X and Y is linear.

The linear regression equation is $y = bx + a$

The estimated regression equation (constructed from the sample data) will have the form $y = bx + a + \varepsilon$, where ei are the observed values (estimates) of the errors εi, a and b, respectively, the estimates of the parameters α and β of the regression model to be found.

To estimate the parameters α and β - use least squares method (least squares method).

System of normal equations.

$a \bullet n + b \bullet \sum x = \sum y$

$a \bullet \sum x + b \bullet \sum x2 = \sum y \bullet x$

Table 2

To calculate the regression parameters, let's build a calculation table

x	y	x^2	y^2	x*y
7.235	6.5465	52.3458	42.8566	47.3642
7.652	6.9903	58.5527	48.8637	53.4893
8.088	7.4078	65.4164	54.8755	59.9146
8.3147	7.6506	69.1336	58.5324	63.6125
8.4372	7.7965	71.187	60.7856	65.781
8.6959	8.1087	75.6185	65.7503	70.512
8.9278	8.3464	79.7059	69.6625	74.5152
9.1383	8.5506	83.5085	73.1136	78.1383
9.3335	8.7641	87.1143	76.8089	81.7995
9.5199	8.9983	90.629	80.9687	85.6628
10.3371	9.8047	106.8558	96.1325	101.3524
10.7208	10.161	114.9345	103.2463	108.9337
10.9286	10.3285	119.435	106.678	112.8764
11.104	10.4978	123.2985	110.2048	116.5679
11.312	10.6735	127.9605	113.9228	120.7378
11.509	10.9229	132.4562	119.3089	125.7108
11.6579	11.0309	135.9063	121.6815	128.5973
11.9063	11.3302	141.7603	128.3744	134.9014
12.1411	11.4969	147.4072	132.1778	139.585
12.2843	11.6254	150.9051	135.15	142.8105
199.2435	187.0316	2034.1312	1799.0947	1912.8627

For our data, the system of equations has the form

20a + 199.243 • b = 187.032
199.243 • a + 2034.131 • b = 1912.863

We get the empirical regression coefficients: b = 1.0079, a = -0.6892

Regression equation (empirical regression equation):

y = 1.0079 x -0.6892

1. Parameters of the regression equation.

Selected averages.

$$\overline{x} = \frac{\sum x_i}{n} = \frac{199.243}{20} = 9.962$$

$$\overline{y} = \frac{\sum y_i}{n} = \frac{187.032}{20} = 9.352$$

$$\overline{xy} = \frac{\sum x_i y_i}{n} = \frac{1912.86}{20} = 95.643$$

Sample variances:

$$S^2(x) = \frac{\sum x_i^2}{n} - \overline{x}^2 = \frac{2034.13}{20} - 9.962^2 = 2.46$$

$$S^2(y) = \frac{\sum y_i^2}{n} - \overline{y}^2 = \frac{1799.09}{20} - 9.352^2 = 2.5$$

Standard deviation

$$S(x) = \sqrt{S^2(x)} = \sqrt{2.46} = 1.569$$

$$S(y) = \sqrt{S^2(y)} = \sqrt{2.5} = 1.582$$

The correlation coefficient b can be found by the formula without solving the system directly:

$$b = \frac{\overline{x \cdot y} - \overline{x} \cdot \overline{y}}{S^2(x)} = \frac{95.643 - 9.962 \cdot 9.352}{2.46} = 1.0079$$

$$a = \overline{y} - b \cdot \overline{x} = 9.352 - 1.0079 \cdot 9.962 = -0.6892$$

1.1. Correlation coefficient.

Covariance.

$$cov(x,y) = \overline{x \cdot y} - \overline{x} \cdot \overline{y} = 95.643 - 9.962 \cdot 9.352 = 2.48$$

We calculate the indicator of the tightness of communication. This indicator is a selective linear correlation coefficient, which is calculated by the formula:
The linear correlation coefficient takes values from –1 to +1.

The connections between signs can be weak and strong (close). Their criteria are assessed on the Chaddock scale:

0.1 <rxy <0.3: weak;
0.3 <rxy <0.5: moderate;
0.5 <rxy <0.7: noticeable;
0.7 <rxy <0.9: high;
0.9 <rxy <1: very high;

In our example, the relationship between trait Y and factor X is very high and direct.

In addition, the linear pairwise correlation coefficient can be determined through the regression coefficient b:

$$r_{x,y} = b \cdot \frac{S(x)}{S(y)} = 1.008 \frac{1.569}{1.582} = 1$$

2.1. The significance of the correlation coefficient.

We put forward hypotheses:

H0: rxy = 0, there is no linear relationship between the variables;

H1: rxy ≠ 0, there is a linear relationship between the variables;

In order to test the null hypothesis of the equality of the general correlation coefficient of a normal two-dimensional random variable to zero at a significance level α with a competing hypothesis H1 ≠ 0, it is necessary to calculate the observed value of the criterion (the value of the random error)

$$t_{nabl} = r_{xy} \frac{\sqrt{n-2}}{\sqrt{1-r_{xy}^2}}$$

and from the table of critical points of the Student's distribution, for a given level of significance α and the number of degrees of freedom k = n - 2, find the critical point tcrit of the bilateral critical region. If tobl <tcrit of reasons to reject the null hypothesis. If | t_{obl} | > t $_{crit}$ - the null hypothesis is rejected.

$$t_{nabl} = 1\frac{\sqrt{18}}{\sqrt{1-1^2}} = 148.349$$

According to the Student's table with a significance level α = 0.05 and degrees of freedom k = 18, we find tcrit:

t_{crit} (n-m-1; α / 2) = tcrit (18; 0.025) = 2.445

where m = 1 is the number of explanatory variables.

If | t_{obl} | > $t_{critical}$, then the obtained value of the correlation coefficient is recognized as significant (the null hypothesis stating that the correlation coefficient is equal to zero is rejected).

Since | t_{obl} | > t_{crit}, then we reject the hypothesis that the correlation coefficient is equal to 0. In other words, the correlation coefficient is statistically significant

In paired linear regression t2r = t2b, and then testing hypotheses about the significance of the regression and correlation coefficients is equivalent to testing the hypothesis about the significance of a linear regression equation.

2.2. Interval estimate for the correlation coefficient (confidence interval).

$$(r - t_{krit}\sqrt{\frac{1-r2}{n-2}}; r + t_{krit}\sqrt{\frac{1-r2}{n-2}})$$

Confidence interval for the correlation coefficient.

$$(1 - 2.445\sqrt{\frac{1-1^2}{20-2}}; 1 + 2.445\sqrt{\frac{1-1^2}{20-2}})$$

r∈(0.983;1)

The linear regression equation is y = 1.008 x -0.689

The coefficients of the linear regression equation can be given economic meaning.

The regression coefficient b = 1.008 shows the average change in the effective indicator (in units of y) with an increase or decrease in the value of the factor x per unit of its measurement. In this example, with an increase of 1 unit, y increases by an average of 1.008.

The coefficient a = -0.689 formally shows the predicted level of y, but only if x = 0 is close to the sampled values.

But if x = 0 is far from the sampled values of x, then literal interpretation can lead to incorrect results, and even if the regression line describes the values of the observed sample quite accurately, there is no guarantee that it will also be when extrapolated to the left or right.

Substituting the corresponding x values in the regression equation, you can determine the aligned (predicted) values of the effective indicator y (x) for each observation.

The relationship between y and x determines the sign of the regression coefficient b (if> 0 - direct relationship, otherwise - reverse). In our example, the connection is direct.

Elasticitycoefficient.

The coefficient of elasticity is found by the formula:

$$E = \frac{\partial y}{\partial x}\frac{x}{y} = b\frac{\overline{x}}{\overline{y}}$$

$$E = 1.008\frac{9.962}{9.352} = 1.074$$

In our example, the coefficient of elasticity is greater than 1. Therefore, when X changes by 1%, Y will change by more than 1%. In other words - X significantly affects Y.

Beta coefficient

$$\beta_j = b_j\frac{S(x)}{S(y)} = 1.008\frac{1.569}{1.582} = 1$$

Those. an increase in x by the standard deviation Sx will increase the mean Y value by 100% of the standard deviation Sy.

Approximation error.

$$\overline{A} = \frac{\sum|y_i - y_x|:y_i}{n}100\,\%$$

$$\overline{A} = \frac{0.088}{20}100\,\% = 0.44\,\%$$

On average, the calculated values deviate from the actual ones by 0.44%. Since the error is less than 7%, this equation can be used as a regression.

Empirical correlation relation.

$$\eta = \sqrt{\frac{\sum(\overline{y} - y_x)^2}{\sum(y_i - \overline{y})^2}}$$

$$\eta = \sqrt{\frac{50.013}{50.05}} = 1$$

Where

$$\sum(\overline{y} - y_x)^2 = 50.05 - 0.0409 = 50.013$$

Correlation index.

For linear regression, the correlation index is equal to the correlation coefficient $r_{xy} = 1$.

The resulting value indicates that the factor x significantly affects y

For any form of dependence, the tightness of the relationship is determined using the multiple correlation coefficient:

$$R = \sqrt{1 - \frac{\sum(y_i - y_x)^2}{\sum(y_i - \overline{y})^2}}$$

This coefficient is universal, as it reflects the closeness of the relationship and the accuracy of the model, and can also be used for any form of relationship between variables. When constructing a one-factor correlation model, the multiple correlation coefficient is equal to the pair correlation coefficient rxy.

Unlike the linear correlation coefficient, it characterizes the tightness of the nonlinear relationship and does not characterize its direction. Changes in the range [0; 1].

The theoretical correlation for the linear relationship is equal to the correlation coefficient rxy.

The coefficient of determination.

$R^2 = 12 = 0.9992$

Those in 99.92% of cases, changes in x lead to a change in y. In other words, the accuracy of fitting the regression equation is high. The remaining 0.08% change in Y is explained by factors not taken into account in the model (as well as specification errors).

Table 3

To assess the quality of the regression parameters, let's build a calculation table

x	y	y(x)	$(y_i-y_{cp})^2$	$(y-y(x))^2$	$(x_i-x_{cp})^2$	$\|y - y_x\|:y$
7.235	6.546	6.603	7.868	0.00319	7.437	0.00862
7.652	6.99	7.023	5.576	0.00108	5.337	0.00471
8.088	7.408	7.463	3.778	0.00301	3.512	0.00741
8.315	7.651	7.691	2.893	0.00163	2.714	0.00528
8.437	7.797	7.815	2.418	0.000328	2.325	0.00232
8.696	8.109	8.075	1.545	0.00111	1.603	0.00411
8.928	8.346	8.309	1.01	0.00139	1.07	0.00447
9.138	8.551	8.521	0.641	0.000867	0.679	0.00344
9.334	8.764	8.718	0.345	0.00213	0.395	0.00526

9.52	8.998	8.906	0.125	0.00854	0.196	0.0103
10.337	9.805	9.729	0.205	0.00566	0.141	0.00767
10.721	10.161	10.116	0.655	0.00201	0.575	0.00442
10.929	10.329	10.326	0.954	8.0E-6	0.934	0.000275
11.104	10.498	10.502	1.314	2.1E-5	1.304	0.000433
11.312	10.673	10.712	1.747	0.00149	1.822	0.00361
11.509	10.923	10.911	2.469	0.000151	2.393	0.00113
11.658	11.031	11.061	2.82	0.000884	2.875	0.0027
11.906	11.33	11.311	3.915	0.000368	3.78	0.00169
12.141	11.497	11.548	4.602	0.00259	4.748	0.00442
12.284	11.625	11.692	5.17	0.00444	5.392	0.00573
199.243	187.032	187.032	50.054	0.0409	49.233	0.088

Analysis of the accuracy of determining estimates of the regression coefficients.

An unbiased estimate of the variance of disturbances is the value:

$$S^2 = \frac{\sum(y_i - y_x)^2}{n-m-1}$$

$$S^2 = \frac{0.0409}{18} = 0.00227$$

$S^2 = 0.00227$ - is the unexplained variance or variance of the regression error (a measure of the spread of the dependent variable around the regression line).

$$S = \sqrt{S^2} = \sqrt{0.00227} = 0.0477$$

S = 0.0477 is the standard error of the estimate.

Regression standard error is considered as a measure of the dispersion of observational data from the modeled values. The lower the value of the standard error of the regression, the higher the quality of the model.

Sa is the standard deviation of the random variable a.

$$S_a = S \cdot \frac{\sqrt{\sum x^2}}{nS(x)}$$

S_b is the standard deviation of the random variable b.

$$S_b = \frac{S}{\sqrt{n} \cdot S(x)}$$

$$S_b = \frac{0.0477}{\sqrt{20} \cdot 1.569} = 0.00679$$

Confidence intervals for the dependent variable.

Economic forecasting based on the constructed model assumes that pre-existing relationships of variables are retained for the lead period. To predict the dependent variable of the effective indicator, it is necessary to know the predicted values of all factors included in the model.

The predicted values of the factors are substituted into the model and point predictive estimates of the studied indicator are obtained.

(a + bxp ± ε)

Let us calculate the boundaries of the interval in which 95% of the possible values of Y will be concentrated with an unlimited number of observations and Xp = 11

t_{crit} (n-m-1; α / 2) = t_{crit} (18; 0.025) = 2.445

y (11) = 1.008 * 11 -0.689 = 10.398

Calculate the forecast error for the equation y = bx + a

$$\epsilon = t_{krit} S \sqrt{\frac{1}{n} + \frac{(\overline{x} - x_p)^2}{\sum(x_i - \overline{x})^2}}$$

$$\epsilon = 2.445 \cdot 0.0477 \sqrt{\frac{1}{20} + \frac{(9.962 - 11)^2}{49.23}} = 0.0312$$

$$\epsilon = t_{krit} S \sqrt{\frac{1}{n} + \frac{(\overline{x} - x_p)^2}{n(\overline{x^2} - \overline{x}^2)}}$$

or

$$\epsilon = 2.445 \cdot 0.0477 \sqrt{\frac{1}{20} + \frac{(9.962 - 11)^2}{20(101.707 - 9.962^2)}} = 0.0312$$

10.398 ± 0.0312

(10.37;10.43)

With a probability of 95%, it can be guaranteed that the value of Y for an unlimited number of observations will not go beyond the found intervals.

Let us calculate the forecast error for the equation y = bx + a + ε

$$\epsilon = t_{krit} S \sqrt{1 + \frac{1}{n} + \frac{(\overline{x} - x_p)^2}{\sum(x_i - \overline{x})^2}}$$

$$\epsilon = 2.445 \cdot 0.0477 \sqrt{1 + \frac{1}{20} + \frac{(9.962 - 11)^2}{49.23}} = 0.12$$

10.398 ± 0.12

(10.28;10.52)

Individual confidence intervals for Y at a given X value.

(a + bx_i ± ε)

Where

$$\epsilon = t_{krit} S \sqrt{1 + \frac{1}{n} + \frac{(\overline{x} - x_i)^2}{\sum(x_i - \overline{x})^2}}$$

$$\epsilon = 2.445 \cdot 0.0477 \sqrt{1 + \frac{1}{20} + \frac{(9.962 - x_i)^2}{49.23}}$$

t_{krit} (n-m-1;α/2) = (18;0.025) = 2.445

x_i	y = -0.69 + 1.01x_i	ε_i	$y_{min} = y - \varepsilon_i$	$y_{max} = y + \varepsilon_i$
7.235042606	6.603	0.128	6.475	6.731
7.65197573	7.023	0.125	6.898	7.149
8.088039716	7.463	0.123	7.339	7.586
8.314660764	7.691	0.123	7.569	7.814

8.43724048	7.815	0.122	7.693	7.937
8.695891526	8.075	0.121	7.954	8.197
8.927818297	8.309	0.121	8.188	8.43
9.138296422	8.521	0.12	8.401	8.641
9.333504459	8.718	0.12	8.598	8.838
9.519925805	8.906	0.12	8.786	9.026
10.33710919	9.729	0.12	9.61	9.849
10.720751	10.116	0.12	9.996	10.236
10.92863269	10.326	0.121	10.205	10.446
11.10398382	10.502	0.121	10.381	10.623
11.31196284	10.712	0.122	10.59	10.834
11.50896363	10.911	0.122	10.788	11.033
11.65788431	11.061	0.123	10.938	11.183
11.90631327	11.311	0.124	11.187	11.435
12.14113725	11.548	0.125	11.423	11.673
12.28434348	11.692	0.126	11.567	11.818

With a probability of 95%, it can be guaranteed that the value of Y for an unlimited number of observations will not go beyond the found intervals.

Testing hypotheses about the coefficients of the linear regression equation.

1) t-statistics. Student's criterion.

t_{crit} (n-m-1; α / 2) = t_{crit} (18; 0.025) = 2.445

$$t_b = \frac{b}{S_b}$$

$$t_b = \frac{1.008}{0.00679} = 148.35$$

Since 148.35> 2.445, the statistical significance of the regression coefficient b is confirmed (we reject the hypothesis that this coefficient is zero).

$$t_a = \frac{a}{S_a}$$

$$t_a = \frac{-0.689}{0.0685} = 10.06$$

Since 10.06> 2.445, the statistical significance of the regression coefficient a is confirmed (we reject the hypothesis that this coefficient is zero).

Confidence interval for the coefficients of the regression equation.

Let us determine the confidence intervals of the regression coefficients, which with a reliability of 95% will be as follows:

(b - t_{crit} Sb; b + t_{crit} Sb)

(1.01 - 2.445 * 0.00679; 1.01 + 2.445 * 0.00679)

(0.991; 1.024)

With a probability of 95%, it can be argued that the value of this parameter will lie within the found interval.

$(a - t_{crit} Sa; a + t_{crit} Sa)$

(-0.689 - 2.445 * 0.0685; -0.689 + 2.445 * 0.0685)

(-0.857; -0.522)

With a probability of 95%, it can be argued that the value of this parameter will lie within the found interval.

2) F-statistics. Fisher's criterion.

$$R^2 = 1 - \frac{\sum(y_i - y_x)^2}{\sum(y_i - \overline{y})^2} = 1 - \frac{0.0409}{50.05} = 0.9992$$

$$F = \frac{R^2}{1 - R^2}\frac{n - m - 1}{m}$$

$$F = \frac{0.9992}{1 - 0.9992}\frac{20 - 1 - 1}{1} = 22007.278$$

or by the formula:

Where

$$\sum(y_x - \overline{y})^2 = 50.05 - 0.0409 = 50.0128$$

Table value of the criterion with degrees of freedom k1 = 1 and k2 = 18, Ftabl = 4.41

Since the actual value F> Ftabl, the coefficient of determination is statistically significant (the found estimate of the regression equation is statistically reliable).

Regression equation quality indicators.

Index	Value
Determination coefficient	0.9992
Average coefficient of elasticity	1.074
Average error of approximation	0.44

Conclusions and recommendation

The dependence of Y on X was studied. At the specification stage, a pairwise linear regression was chosen. Its parameters are estimated by the least squares method. The statistical significance of the equation was tested using the coefficient of determination and Fisher's test. It was found that in the studied situation 99.92% of the total variability in Y is explained by the change in X. It was also found that the parameters of the model are statistically significant. An economic interpretation of the model parameters is possible - an increase in X by 1 unit of measure leads to an increase in Y by an average of 1.008 units. The obtained estimates of the regression equation allow us to use it for forecasting. With x = 11, Y will be in the range from 10.28 to 10.52 units. and with a 95% probability it will not go beyond these limits.

An increase in the volume of farm production in the country by 1 unit will increase the volume of agricultural production by 1,008 units. The increase in agricultural production will create opportunities for GDP and exports.

References

1. Ways to make agriculture in Uzbekistan more efficient and competitive. https://www.gazeta.uz/uz/2019/07/08/agriculture/
2. Agricultural statistics, B. Mamatkulov, B. Utanov, textbook, 2021, “IQTISODIYOT”/Tashkent, 236 p.
3. Shi-wei XU, Yu WANG, Sheng-wei WANG, Jian-zheng LI. Research and application of real-time monitoring and early warning thresholds for multi-temporal agricultural products information, Journal of Integrative Agriculture, Volume 19, Issue 10, 2020, Pages 2582-2596, ISSN 2095-3119, https://doi.org /10.1016/S2095-3119(20)63368 (http://www.sciencedirect.com/science/article/pii/S2095311920633688)
4. Rozélia Laurett, Arminda Pacho, Emerson Wagner Mainardes. Sustainable Development in Agriculture and its Antecedents, Barriers and Consequences - An Exploratory Study, Sustainable Production and Consumption, Volume 27, 2021, Pages 298-311, ISSN 2352-5509,

https://doi.org/10.1016/j.spc. 2020.10.032. (http://www.sciencedirect.com/science/article/pii/S2352550920313725)
5. Xushmatov N. Methodological aspects of calculating economic and economic efficiency in the fight against cotton candy. SCIENTIFIC-PRACTICAL AGRICULTURAL JOURNAL. Special issue, 2019. Pages 7-9.
6. Xo'jabekov A. Establishment of livestock clusters and the role of farms in it. SCIENTIFIC-PRACTICAL AGRICULTURAL JOURNAL. Special issue, 2019. Pages 10-13.
7. J.Ataev. Classification of the main factors influencing the development of small business in the market of agricultural products. Scientific electronic journal "Economy and Innovative Technologies". № 2, March-April, 2020. http://iqtisodiyot.tsue.uz/sites/default/files/maqolalar/17_Atayev.pdf
8. Data of the Statistics Committee of the Republic of Uzbekistan. www.stat.uz