MODELS FOR PREDICTING GROSS AGRICULTURAL OUTPUT

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Annotation:
This article discusses the econometric model of error-free calculation of gross agricultural output.
Keywords:
Agricultural products, industry, forecasting models, gross output, calculation, correlation coefficient.

Introduction

Agriculture is an industry aimed at providing the population with food (food, food) and the extraction of raw materials for a number of industries. This industry is one of the most important, represented in almost all countries. About 1 billion economically active people are employed in the world's agriculture.

State food security depends on the state of the industry. Sciences such as agronomy, animal husbandry, land reclamation, crop production, forestry, etc., are directly or indirectly related to agricultural problems.

The emergence of agriculture is associated with the so-called "Neolithic revolution" in the means of production, which began about 12 thousand years ago and led to the emergence of a productive economy and the subsequent development of civilization. The econometric model is an economic-mathematical model, the parameters of which are estimated using methods of mathematical statistics. It acts as a means of analysis and forecasting of specific economic processes both at the macro level and at the microeconomic level based on real statistical information. The most common econometric model, which is a system of regression equations that reflect the dependence of endogenous values (desired) on external influences (current exogenous values) under the conditions described by the estimated parameters of the model, as well as lag variables. In addition to the regression equations, other mathematical statistical models are used. To determine the relationship between time and gross agricultural product, quantitative estimates based on econometric models are needed. To quantify the relationship of both indicators, we use linear regressions. Based on the data presented in the table, we build a linear regression model.

Agriculture with the domestication of animals and growing plants appeared at least 10,000 years ago, first in the region of Central Asia, and then in China [2]. Agriculture has undergone significant changes since the beginning of agriculture. In Asia, Egypt and India, the first systematic cultivation and collection of plants that had previously been collected in the wild began. Initially, agriculture depleted the diet of people - dozens of constantly used plants for agriculture, a small proportion

Main part

The development and productivity of agricultural production is affected by the balance of the state's economy, the political situation in it, and its food independence. At the same time, agriculture in a market economy is not able to fully compete with other sectors, therefore, the level and effectiveness of its support from the state correlates with the welfare of the state itself. Support measures may include:

- preservation of certain prices for various types of agricultural products (regulation of market prices, ensuring profitability production) by controlling foreign trade and other instruments;
- subsidies, compensation payments;
- preferential loans to peasants;
- preferential taxation of agricultural organizations;
- financing of research, education and advanced training of agricultural workers;
- measures to attract foreign direct investment;
- development of rural infrastructure;
- land reclamation and irrigation projects;
- development of legal acts.

The role of agriculture in the economy of a country or region shows its structure and level of development. As indicators of the role of agriculture, the share of people employed in agriculture among the economically active population is used, as well as the share of agriculture in the structure of gross domestic product. These rates are quite high in most developing countries, where more than half of the economically active population is employed in agriculture. Agriculture has an extensive development path, that is, an increase in production is achieved by expanding sown areas, increasing the number of livestock, and increasing the number of people employed in agriculture. In such countries, whose economy is of the agrarian type, indicators of mechanization, chemicalization, land reclamation, etc. are low. Approved progressive changes are also taking place in countries of an industrial type, but the level of intensification in them is still much lower, and the share of people employed in agriculture is higher than in post-industrial ones. Moreover, in developed countries there is a crisis of overproduction of food products, and in the agricultural, on the contrary, one of the most acute problems is the problem of nutrition (the problem of malnutrition and goloda)

Developed agriculture is one of the country's security factors, as it makes it less dependent on other countries. For this reason, agriculture is supported and subsidized in developed, industrialized countries, although from an economic point of view it would be more profitable to import products from less developed countries.

Table 1

Gross agricultural products of Uzbekistan

Year	Time (X)	Gross Agricultural Product (Y)
2000	1	980,1
2002	2	2242,5
2004	3	3285,9
2006	4	5302,4
2008	5	7677,1
2010	6	11229,8
2014	7	17235,5
2018	8	25377,2
2020	9	33486,6

To determine the relationship between the economic growth of both countries, a correlation coefficient is used. The correlation coefficient is a statistical indicator of the dependence of two random variables. The correlation coefficient can take values from -1 to +1. At the same time, a value of -1 will indicate a lack of correlation between values, 0 means zero correlation, and +1 means a complete correlation of values. That is, the closer the value of the correlation coefficient to +1, the stronger the relationship between two random variables

$$r_n = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})}} \quad (1)$$

$r_{xy} = 0{,}72$

The following table is used to verbally describe the values of the correlation coefficient:

Table 2

The value of the correlation coefficient and its interpretation

The value of the correlation coefficient r	**Interpretation**
0 <r <= 0.2	Very weak correlation
0.2 <r <= 0.5	Weak correlation
0.5 <r <= 0.7	Average correlation
0.7 <r<= 0.9	Strong correlation
0.9 <r <= 1	Very strong correlation

The result of calculating the correlation shows that the economies of China and Uzbekistan have strong correlations, that is, they are closely related to each other. This means that the development of the Chinese economy affects the development of the economy of Uzbekistan.

To build a linear regression, it is necessary to determine the parameters of the equation. To do this, using least squares methods, we will determine the regression parameters.

The least squares method is a mathematical method used to solve various problems, based on minimizing the sum of the squared deviations of some functions from the desired variables. It can be used to “solve” uncertain systems of equations (when the number of equations exceeds the number of unknowns), to search for solutions in the case of ordinary (not redefined) nonlinear systems of equations, to approximate point values, a certain function. OLS (Least Squares Method) is one of the main methods of regression analysis for estimating unknown parameters of regression models from sample data.

So, the essence of using the least squares method is linear dependence, for which the function of two variables a and b F (a, b) $=\sum_{i=1}^{n}(y_i-(ax_i+b))^2$ takes the least value. That is, with data a and b, the sum of the squared deviations of the experimental data from the line will be the smallest. This is the essence of the least squares method.

Thus, the solution to the problem is to find the extremum of the function of two variables. A system of two equations with two unknowns has been compiled and solved. We find the partial derivatives of the function F (a, b) = $\sum_{i=1}^{n}(y_i-(ax_i+b))^2$ with respect to the variables a and b, equating these derivatives to zero.

$$\begin{cases} \dfrac{\partial F(a,b)}{\partial a} = 0 \\ \dfrac{\partial F(a,b)}{\partial b} = 0 \end{cases} \Rightarrow \begin{cases} -2\sum_{i}^{n}(y_i-(ax_i+b))x_i = 0 \\ -2\sum_{i}^{n}(y_i-(ax_i+b)) = 0 \end{cases} \quad (2)$$

$$\begin{cases} a\sum_{i=1}^{n}x_i^2 + b\sum_{i=1}^{n}x_i = \sum_{i=1}^{n}x_i y_i \\ a\sum_{i=1}^{n}x_i + \sum_{i=1}^{n}b = y_i \end{cases} \Rightarrow \begin{cases} a\sum_{i=1}^{n}x_i^2 + b\sum_{i=1}^{n}x_i = \sum_{i=1}^{n}x_i y_i \\ a\sum_{i=1}^{n}x_i + nb = y_i \end{cases} \quad (3)$$

We solve the problem using the equation method, using the equation method (for example, using the substitution method or the Cramer method), and get the formula for finding the coefficients using the least squares method. Using least squares formulas, find the coefficients a and b.

We solve the equation by any method (for example, by the substitution method or the Cramer method) and we obtain the formula for finding the coefficients by the least squares method. For data a and b, the function formula takes the smallest value. This is all the least squares method. The formula for finding the parameter is the formula, formula, formula, and the parameter n is the amount of experimental data. The values of these amounts are recommended to be calculated separately. The coefficient is determined after calculation b.

In our problem n = 9, the necessary formulas for the required coefficients were added in the applications.

We use least squares formulas to find the coefficients a and b. Substitute them in the corresponding values from the last column of the table:

Y = 3887.612 * x - 7569.49 (4)

Using the Fisher test, we check the adequacy of the model. F - Fisher's criterion is a parametric criterion and is used to compare the variance of two variational series. The empirical value of the criterion is calculated by the formula:

$$F = \frac{r^2}{1-r^2}(n-2)$$

$$F = \frac{0,52}{1-0,52} * 7 = 7,58$$

Ftab = 3.78

If a;

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Thus, the correspondence of the constructed econometric requirements to the Fisher criterion is a process of studying the adequacy of the constructed models.

Student T-test is the common name for a class of statistical methods for testing hypotheses based on student distribution. The most common cases of the t-test are related to checking the equality of average values in two samples.

T-statistics are usually a combination of the following: the numerator is a random variable with zero expectation (when the null hypothesis is satisfied), and the denominator is a sample of the standard deviation of this random variable, obtained as the square root of the unbiased variance estimate.

$$t_a = \frac{a}{m_a} \quad t_b = \frac{b}{m_b}$$

$$m_a = \sqrt{\frac{\sum (y - \hat{y})^2}{n-2} * \frac{\sum x^2}{n\sum (x - \bar{x})^2}}$$

$$m_b = \sqrt{\frac{\sum (y - \bar{y}_x)^2 / (n-2)}{\sum (x - \bar{x})^2}}$$

$$m_a = \sqrt{\frac{0,47}{5} * \frac{556,9}{7*9,2}} = \sqrt{\frac{261,7}{322}} = \sqrt{0,81} = 0,9$$

$$t_a = \frac{a}{m_a} = \frac{6,3}{0,9} = 5,67$$

$$m_b = \sqrt{\frac{0,47/5}{9,2}} = 0,1$$

$$t_b = \frac{b}{m_b} = \frac{0,21}{0,1} = 2,1$$

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