**Western European Journal of Modern Experiments and Scientific Methods**
Volume 3, Issue 5, May 2025
https://westerneuropeanstudies.com/index.php/1
ISSN (E): 2942-1896 Open Access| Peer Reviewed


# MATHEMATICAL MODELING IN AGRICULTURE BASICS

**Bustonova Gulchekhra Berkinboyevna,**
Teacher of the Department of Information Systems and Technologies,
Tashkent State Agrarian University, TSAU, Uzbekistan

**Abstract.** This article discusses the preliminary assessment of agricultural productivity indicators. mathematician regression the role of models, methods of their construction and practical application the application of linear and nonlinear regression models is analyzed. In particular, the mathematical foundations of linear and nonlinear regression models and their importance in drawing statistical conclusions are illustrated through examples. A visual evaluation of the model is also shown through graphical representations.
**Keywords:** regression model, prediction, productivity, statistical analysis, trend, graph.

**Introduction.** Accurate and reliable yield predictions in agriculture are essential for food security, economic planning, and agronomic policy. Such predictions depend on many factors, including climatic conditions, soil fertility, technology, and labor resources, and can be expressed through mathematical modeling and regression analysis [1].

Regression models are used to determine the functional relationship between independent variables (e.g., average temperature, rainfall, fertilizer use) and the dependent variable (yield). This article examines the mathematical analysis and practical application of linear and nonlinear regression models with examples. In agriculture, which is an important sector of the national economy, production depends on a number of factors, which is why it differs from other sectors. In agriculture, land is the main means of production.

Animal husbandry models, mineral fertilizer use models, productivity improvement models, optimal equipment use models, and Khakoza models have been developed for agricultural activities, including the development of a risk model for reducing land productivity. In the process of developing a risk model, the problem of finding an approximate solution to the incorrect problem of risk assessment based on fuzzy rule conclusions is encountered. Therefore, the analysis of risk assessment problems in a fuzzy state and the modeling and algorithmic provision of solving the incorrect problems encountered in this process are relevant for modern decision support systems.

Based on actual data on basic agricultural food products from the Institute of Forecasting and Macroeconomic Research under the Cabinet of Ministers of the Republic of Uzbekistan, a method was proposed: "Forecasting the volume of production of basic agricultural food products by optimizing the composition of arable land in 2021-2023."

**Literature review.** Technologies based on the use of Big Data are widely used by companies in various areas of business to increase business efficiency and reduce costs. Thanks to the use of Big Data technology , the logistics company UPS (United Parcel Service ) saves 8.5 million liters of fuel per year, optimizes routes and increases the speed of delivery of goods [1].

Western European Journal of Modern Experiments and Scientific Methods
Volume 3, Issue 5, May 2025
https://westerneuropeanstudies.com/index.php/1
ISSN (E): 2942-1896 Open Access| Peer Reviewed


Delivery of shipments is carried out in real time, based on the use of cartographic data, taking into account the size of the goods and delivery times, and taking into account the points of departure and arrival. The international elevator manufacturer Thyssen Krupp Elevator ensures the smooth operation of its elevators by taking into account the opening of the elevator doors, the speed of the cabin, the temperature of the engine and other parameters in real time, minimizing downtime and repair costs. More than 200 sensors installed on the Renault (Lotus) Formula 1 sports car collect the state of various parts of it during the race and, as a result of their analysis, optimize the actions of the racer [2]. According to General Electric, 30% of the population's income will be saved over 20 years based on the analysis of data based on Big Data . In November 2016, Sberbank launched a project called “Open Data”. Under this project, the bank will provide users with access to information on the number and average size of loans and applications for them, as well as on the dynamics of benefits and wages [3]. The data obtained will be used to predict the state of customers. Uralsib Bank uses the driving quality management system developed by Raxel Telematics in auto insurance [4]. This approach reduces the amount of damage by 20-30%. The Kaspersky Security Network (KSN) cloud network has implemented a process of collecting data on hundreds of millions of cases of attacks, threats and attempts to damage computers worldwide. In this case, less than a minute passes from receiving information about a suspicious object to making a decision [5]. However, it should be noted that the active development of Big Data technologies in this area requires the development of regulatory and legal documents that clearly indicate the boundaries of data distribution and its protection. It is also worth noting that the volume of global data is growing exponentially. While the amount of information generated in 2011 was 1.8 zettabytes, in 2012 it was 2.8 zettabytes, and by now it is expected to exceed 45 zettabytes [6].

AR and VR in e-commerce has also been growing and evolving rapidly in the past few years [10]. Researchers and practitioners, as well as consumers, are exploring the use of these technologies to enhance the online shopping experience. Recent studies have found that the use of AR and VR in e-commerce can increase consumer engagement and satisfaction, leading to increased sales and customer loyalty [11-12]. These technologies help consumers better visualize products, try them on virtually, and make better-informed purchasing decisions. Exciting advances have been made in the field of AR and VR in e-commerce in the area of personalized shopping experiences [13].

By leveraging consumer data and preferences, retailers can create a shopping experience that is tailored to each customer’s needs and wants. So, if you want to stay ahead of your competitors in the online retail world, it’s clear that investing in AR and VR is not without its benefits. Using these advanced technologies, you can engage with your customers like never before and create a memorable shopping experience that will drive sales and increase your profits [14].

**Research methodology.** Big Data refers not only to the conditional volume of collected data, but also to the complex of technologies required for its services, processing and storage. The results of a comparison of traditional databases and Big Data databases storing medium-sized data are presented in the table below [7]:

Indicators Traditional databases Big Data databases Data size Gigabytes to terabytes Petabytes to zettabytes Storage method Centralized Decentralized Data structure Structured

Western European Journal of Modern Experiments and Scientific Methods
Volume 3, Issue 5, May 2025
https://westerneuropeanstudies.com/index.php/1
ISSN (E): 2942-1896 Open Access| Peer Reviewed


Semi-structured and unstructured Data storage and processing models Vertical model Horizontal model Data correlation Strong Weak

As a unique proof of the interdependence of economic processes and BigData , one can consider the analysis of the HypeCycle graph compiled by Gartner for the latest technologies . As a result of reviewing the results, it can be said that BigData technology has moved from promising and emerging technologies to the list of actively used technologies and has begun to bring significant benefits to the economy. Thus, BigData technologies are not some kinds of fashion, but rather a set of technologies without which modern business cannot compete in the market.

The consulting firm McKinsey & Company states that there are five main areas of application of Big Data technology in the economy [8]:

1. Creating information that is "Transparent" for the majority;

2. Making mathematically based management decisions based on big data

to do;

3. Narrowly segmenting customers based on personal business aspirations;

4. Speed up decision-making based on big data thanks to sophisticated analytics

increase;

5. Designing next-generation products and services based on big data analysis

create and develop.

The consulting firm believes that Big Data technologies will enable competition and the development of individual enterprises. In the future, large-scale data analysis will remain the foundation for improving production efficiency.

For example, in retail, it is possible to increase a company's operating profit by more than 60% by using big data.

However, the main problem for organizations operating in one or another sector of the economy at the moment is the lack of specialists who can analyze Big Data. It is also worth noting that in e-commerce and the economy, Big Data technologies are not some abstract trend or fashion, but a real working tool. Many organizations use Big Data technology in customer service systems or to increase operational efficiency. According to scientific research by the Economist Intelligence Unit, the application of Big Data technology to many industries, including e-commerce, has led to positive results. Another clear example of the use of Big Data in the economy is forecasting. For example, the Spaceknow company processes many images taken from space to determine the price of oil. The algorithms used in this work determine the amount of oil in the warehouse, depending on the change in the appearance of the shadow, and based on this data, they can determine the level of filling of the world's largest oil depots [9].

Big Data in assessing the current state of economic processes, including e-commerce, is very large. However, ordinary statistics do not allow us to obtain very accurate information in such cases, and the assessment process often turns out to be biased in the positive direction. Using a special program designed to determine the economic activity of a country using a

Western European Journal of Modern Experiments and Scientific Methods
Volume 3, Issue 5, May 2025
https://westerneuropeanstudies.com/index.php/1
ISSN (E): 2942-1896 Open Access| Peer Reviewed


constantly changing database of images, the Spaceknow company was able to identify six thousand key enterprises in China.

All indicators of the country's activity were analyzed, including the activity of the construction process, the number of cars in parking lots, the level of smoke emissions, etc. The results obtained using this data (March 2016) did not differ much from official data. It was found that Big Data technology also brings significant economic benefits to modern logistics, which is important for e-commerce. For example, a Russian company called oneFactor has developed a geo-advisory service that allows local and transnational carriers to identify inefficient routes and optimize them. Using mobile network data, the company's specialists help to find the destination point for each parcel with great accuracy. According to CEO Google expert Eric Schmidt, the main area of application of Big Data technology is insurance. Companies offering insurance services collect data about various people and develop personal insurance plans based on this data. In addition to the above, it would not be wrong to say that Big Data technology is a tool that has the potential to radically change the process of assessing indicators of a number of economic processes. Therefore, Big Data technology is already having a significant impact on increasing competition in e-commerce and increasing production volumes.

People who understand the field of digital analytics are a necessary skill for any type of company. Especially after the transition of business to the Internet, such a specialty becomes very important. Below we will try to consider what skills a digital analyst should have in order to be in demand in the labor market.

If a company cannot conduct business online, it uses the network as the main communication channel with the target audience. In this case, the business needs specialists who can direct marketing, analyze data and provide development advice. But at the same time, the volume of global data is growing very rapidly. It is noted that the volume of global data increases by about 30% every year. That is why companies are trying to find specialists who can analyze large volumes of data and draw certain conclusions using it. Currently, analysts are paid an average starting salary of around $ 1,000. However, this salary quickly reaches higher amounts with increasing experience and skills. For example, the average salary of a digital analyst, according to trud.com, is around $ 2-2.5 thousand. If you are knowledgeable, intelligent, and love your job, you will have great value and reputation in the company that hires you as a digital analyst.

Analysis and Results. A qualified digital analyst is required to have the following knowledge, skills, and competencies:

- Good knowledge of the selected analytics tools;
- Digital analytics Google Analytics and Yandex. metrics, in addition to Google
- It should also work in Tag Manager;
- A/B testing tools work with Google Optimize, Optimizely must take;

**1. Linear regression model about general concept.**

Linear regression is a statistical model that involves a dependent variable (outcome) and one or more independent variables. variables (factors) between linear relationship represents. This using the model to determine the factors affecting productivity (e.g. fertilizer quantity, water consumption, technical suitability) the level of impact is determined.

Western European Journal of Modern Experiments and Scientific Methods
Volume 3, Issue 5, May 2025
https://westerneuropeanstudies.com/index.php/1
ISSN (E): 2942-1896 Open Access| Peer Reviewed


Simple linear regression equation as follows is written:

$$Yes + a + bX + E$$

**here:** $Y$ is the dependent variable (e.g., productivity), $X$ *is* the independent variable (e.g. fertilizer amount), $a$ - intercept (intersection point), $b$ - regression coefficient (slope), $E$ is random error (noise).

Many factorials (multiple) linear regression model and as follows:

$$Yes + a + b_1 X_1 + b_2 X_2 + ... + b_n X_n + E$$

## 2. Regression coefficients content.

$a$ - independent variables equal to zero when $Y$ of approximate value indicates.

$b$ - independent variable $X$ one to unity when increased $Y$ how in quantity indicates a change.

For example, if $b$ - 0.25 if, this this means that, every 1 kg fertilizer when used productivity is average 0.25 per centner increases.

## 3. Regression parameters assessment - ECCU method.

The regression parameters are estimated using the least squares method (LSM) The purpose of this method is is that realistic from points up to the regression line distances is to minimize the sum of squares.

$$S = (Y_i - \bar{Y}_i)^2 \text{- min}$$

here: $Y_i$ - real value, $\bar{Y}_i = a + bX_i$ -prophecy made value.

## 4. Model quality assessment: Determination coefficient.

Model's the result how much right explanation assessment for coefficient of determination $R^2$ is used.

Linear regression practical application village on the farm

Village on the farm linear regression models following in directions applies to:

- ✓ Yield forecasting - predicting yield based on the amount of fertilizer, water, and labor.
- ✓ From resources use efficiency assessment.
- ✓ Develop useful strategies - identify which factors have the greatest impact and focus on them.

## 5. Graphic of description importance.

Linear graph in regression analysis visualization the model better understanding allows. In the graph:

- ✓ points - real observations,
- ✓ red or black line - prophecy made regression line.

From the graph regression line how to the past looking at model correctness it seems.

## Conclusion and suggestions.

Above analyses this shows that linear regression models using village on the farm main of factors to productivity effect clear statistic evidence with is measured. Fertilizer, labor, and irrigation have positive effects, while equipment wear has negative effects. Using these models, farms can allocate resources more efficiently.

Western European Journal of Modern Experiments and Scientific Methods
Volume 3, Issue 5, May 2025
https://westerneuropeanstudies.com/index.php/1
ISSN (E): 2942-1896 Open Access| Peer Reviewed


**Literature:**

1. Gujarati, D. (2020). Basic Econometrics. McGraw- Hill.
2. Montgomery, DC, Peck, EA, & Vining, GG (2021). Introduction to Linear Regression Analysis.
3. Wooldridge, J. M. (2021). Introduction Econometrics: A Modern Approach.
4. Kutner, M. H., Nachtsheim, C.J., & Nether, J. (2020). Applied Linear Regression Models.
5. Bozarov, D. (2025). Mathematical analysis of linear and nonlinear regression models in econometry. Modern Science and Research, 4 (4), 1020-1025.
6. Uralovich, BD (2025). The importance and relevance of mathematics for teachers of primary education. American journal of education and learning, 3 (4), 363-366.
7. Bozarov, D., & Tufliev, E. (2025). Formation of mathematical thinking of primary education students methods. Modern Science oath Research, 4 (1), 965-972.
8. Bozarov.DU, “Implementation of factors for the development of students' economic competencies in higher educational institutions”, Scientific Information of Tashkent State Pedagogical University 2023/ 11 – issue.
9. Bozarov. DU, “Methods of developing economic competence in students”, Scientific Information of Tashkent State Pedagogical University 2023/ 12 – issue.
10. Bozarov, D. (2023). Methods of developing economic competence on the basis of interdisciplinary relations. Modern Science and Research, 2 (12), 131-137.
11. Bozarov, D. (2023). Development of economic competence of future economics students. mathematician analysis. Academic research in modern Science, 2 (27), 84-90.
12. Bozarov D. (2022). Problems of systems of linear algebraic equations. Science oath Innovation, 1 (2), 163- 171.