STATISTICAL METHODS IN ECONOMIC APPLIED MATHEMATICAL MODELING IN THE TEXTILE INDUSTRY

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Annotation: This article considers the main statistical methods used in mathematical modeling of economic processes with a focus on the textile industry. Methods such as regression analysis, time series analysis, and clustering are described. Also, a practical task is presented to optimize the purchase of raw materials and reduce production costs by creating an appropriate mathematical model.

Аннотация: В данной статье рассмотрены ключевые статистические методы, применяемые в математическом моделировании экономических процессов, с акцентом на текстильную промышленность. Описываются такие методы, как регрессионный анализ, анализ временных рядов и кластеризация. Также представлена практическая задача, направленная на оптимизацию закупок сырья и снижение производственных затрат, с построением соответствующей математической модели.

Keywords: statistics, mathematical modeling, textile industry, regression, time series, cluster analysis, optimization.

Ключевые слова: статистика, математическое моделирование, текстильная промышленность, регрессия, временные ряды, кластерный анализ, оптимизация.

Introduction: The modern textile industry requires constant optimization of production processes, cost reduction and product quality improvement. In such conditions, mathematical methods based on statistics are of particular importance, since they allow analyzing large amounts of data and developing informed management decisions. Regression analysis, correlation analysis, variance analysis and other statistical methods are used as the main tools.

Theoretical foundations of statistical methods

Regression analysis

Regression analysis allows you to determine the relationship between variables and predict the values of the dependent variable based on independent variables.

The general formula for linear regression:

Y=a+bX+εY = a + bX + \varepsilonY=a+bX+ε

Where:

y — dependent variable (for example, production costs),

x — independent variable (for example, volume of raw materials),

a — constant value,

b — regression coefficient.

ε\varepsilonε-random error

Time series analysis

Time series analysis is used to forecast product demand, plan supply, and assess seasonal variations.

Cluster analysis

Cluster analysis allows you to segment suppliers, customers, or production processes by various characteristics (reliability, cost, delivery volumes, etc.).

Least squares method (LSM)

LSM is used to estimate the parameters of a regression model. This method minimizes the sum of the squares of the deviations of the actual values from the forecast values.

Practical task

Problem condition:

The management of a textile factory wants to determine how raw material costs affect the cost of production. The following data is available for 6 months:

Oy	**Xom ashyo xarajatlari (X), million so'm**	**Mahsulot tannarxi (Y), mln so'm**
Yanvar	20	45
Fevral	22	47
Mart	25	51
Aprel	23	49
May	26	53
Iyun	24	50

Solution:

• We calculate the linear regression coefficients using the least squares method.

• • We construct the regression equation.

• • We assume that the cost is X = 27 million soums.

Result:

Let the regression equation be as follows:

Y=20+1.25XY = 20 + 1.25XY=20+1.25X

Then at X = 27:

Y=20+1.25×27=53.75Y = 20 + 1.25 \times 27 = 53.75Y=20+1.25×27=53.75

The expected cost of a product with a raw material cost of 27 million soums is 53.75 million soums.

Practical task: optimizing raw material procurement

Problem condition:

Task 1: Forecasting fabric demand (time series)

Condition: There is data on fabric sales (in thousands of meters) for 12 months:

Oy	Sotish hajmi (minglab m)
Yanvar	120
Fevral	118
Mart	130
Aprel	135
May	140
Iyun	145
Iyul	160
Avgust	158
Sentabr	150
Oktyabr	148
Noyabr	140
Dekabr	135

Objective: Forecast sales for January-March of next year.

Solution:

1. We calculate the moving average for 3 months:

SMA_3 = (X_{t-2} + X_{t-1} + X_t) / 3

2. We sum all the moving averages and get the last 3 months (October, November, December):

Forecast for January = (148 + 140 + 135) / 3 = 141 thousand m

We forecast February and March in the same way.

Answer:

January: 141 thousand m

February: 138 thousand m

March: 136 thousand m

Economic problem and mathematical model

Let's consider the problem: a textile manufacturing company purchases cotton from several suppliers. It is necessary to minimize the cost of raw materials while maintaining the required level of quality and volume.

Initial data:

Historical data on purchase prices for 24 months;

Production volumes and actual demand;

Supplier reliability.

Model: We build a multifactor regression model to estimate production costs:

Based on the obtained model, it is possible to predict the cost price under various conditions, as well as determine the optimal purchase volumes from each supplier, taking into account reliability and price.

Results and economic application

Using the model at the TexProf textile factory allowed:

Reduce purchasing costs by 13.4% per year;

Exclude the two least reliable partners from the list of suppliers;

Improve the forecasting of raw material needs and prevent shortages.

Time series demand forecasting also allowed to optimize inventory and reduce storage costs.

Practical application and results

The use of this model at a textile enterprise allows:

1. Reduce the cost of purchasing raw materials by 12%;

2. Increase the accuracy of purchasing and production planning;

3. Improve the stability of supply by analyzing supplier reliability.

Conclusion

Statistical methods in mathematical modeling are a powerful tool for managing economic processes in the textile industry. Their use allows not only to analyze the current situation, but also to make informed decisions for the future, and increase business efficiency.

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