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Application of ABC-XYZ Analysis to the Assessment of Food Product Rate and Analytical Management Methods on the Terminal

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ABSTRACT: The theoretical and practical aspects of the assessment and control of the ABC-XYZ application analysis system in the assessment of turnover, as well as the analysis of cargo flow management at the cargo terminal are investigated. In this paper, on the basis of ABC-XYZ analysis, we will consider a virtual model of a terminal owned by a logistics company, the main cargo turnover in which is created by food. Analysis of recent research and publications. ABC analysis is based on the Pareto rule, according to which 20% of assortment positions provides 80% of the profit

KEYWORDS: Turnover, Analytical Method, Cargo Terminal, Expert Assessment, Control Area

I. INTRODUCTION AND LITERATURE REVIEW

ABC analysis is based on the Pareto rule, according to which 20% of assortment positions provide 80% of the profit. Practice shows that 10% of assortment items (group A) give 80% of turnover; 15% of assortment items (group B) give 15% of turnover; 75% of items in the assortment (group C) give 5% of turnover. Given this, the entire range of commercial enterprises can be divided into groups according to their importance[3].

Group A - very important products that must always be present in the range. If sales were used as a parameter in the analysis, then this group includes sales leaders by quantity. If the trade margin was used as a parameter in the analysis, then this group includes the most profitable goods.

Group B - goods of medium importance.

Group C - the least important goods, these are applicants for exclusion from the assortment and new goods.

XYZ analysis is a tool that allows you to divide products according to the degree of sales stability and the level of consumption fluctuations. The method of this analysis consists in calculating each commodity position of the coefficient of variation or fluctuation of consumption. This coefficient shows the deviation of the flow from the average value and is expressed as a percentage. As a parameter, there may be a volume of sales (quantity), the number of sales, the amount of the realized trade margin. The result of XYZ analysis is the grouping of goods into three categories, based on the stability of their behavior:

- **Category X**, in which products fall with sales fluctuations from 5% to 15%. These are goods characterized by a stable amount of consumption and a high degree of forecasting.

- **Category Y**, in which products fall with sales fluctuations from 15% to 50%. These are goods characterized by seasonal fluctuations and average forecasting capabilities.

- **Category Z**, into which products fall with sales fluctuations of 50% and higher. These are goods with irregular consumption and unpredictable fluctuations; therefore, it is impossible to predict their demand.[1][2].

The combination of ABC and XYZ analyzes reveals absolute leaders (AH group) and outsiders (CZ). Both methods complement each other well. If ABC analysis allows us to estimate the contribution of each product to the sales structure, then XYZ analysis allows us to estimate sales jumps and its instability. It is recommended to do a combined analysis, where two parameters are used in the ABC analysis - sales and profit. In total, when carrying out such a multidimensional combined analysis, 27 product groups are obtained. The results of this analysis can be used to

optimize the range, assess the profitability of product groups, evaluate logistics, and evaluate the customers of a wholesale company[4][5]

Regression model:

$$y = f(x, b) + \varepsilon, E(\varepsilon) = 0$$

where, b - model parameters, E - random error

Multivariate regression equation.

$$y = f(x, b) = b_0 + b_1x_1 + b_2x_2 + \dots + b_kx_k$$

Where b_j are regression parameters (coefficients), x_j is regressors (model factors), k is the number of model factors. The combination of ABC and XYZ analyzes reveals absolute leaders (AH group) and outsiders (CZ). Both methods complement each other well. If ABC analysis allows us to estimate the contribution of each product to the sales structure, then XYZ analysis allows us to estimate sales jumps and its instability. It is recommended to do a combined analysis, where two parameters are used in the ABC analysis - sales and profit. In total, when carrying out such a multidimensional combined analysis, 27 product groups are obtained. The results of this analysis can be used to optimize the range, assess the profitability of product groups, evaluate logistics, and evaluate the customers of a wholesale company[6].

II. SOLATION OF PREVIOUSLY UNSOLVED PARTS OF A COMMON PROBLEM

As a result of the analysis, three subsets of the analyzed set of objects are identified that require a different approach to management. The object of analysis is the volume of inventories (in monetary terms) for assortment positions, and the sign of analysis is the share of stocks (in%) of individual items of the assortment in the total stock. Therefore, for analysis, the share of individual positions in the total stock is calculated. The stock share for a specific position is calculated as the ratio of the stock for this position to the total amount of stocks. Then assortment positions are ranked in descending order of their share in the total value of stocks. Using the proposed algorithm for allocating groups and taking into account the comment on the specifics of a particular set, assortment positions are divided into appropriate groups.[4]



Figure 1. Sample ABC Curve

We will conduct an ABC analysis of our available data. To do this, we find the share of each product in the general assortment and sort the goods by it. Then, we also calculate the accumulated share of the goods by the formula:

$$y_i = y_{i-1} + x_i$$

y_i - the accumulated share of the goods

y_{i-1} - the previous value of the accumulated share

x_i - the proportion of goods in the total range.

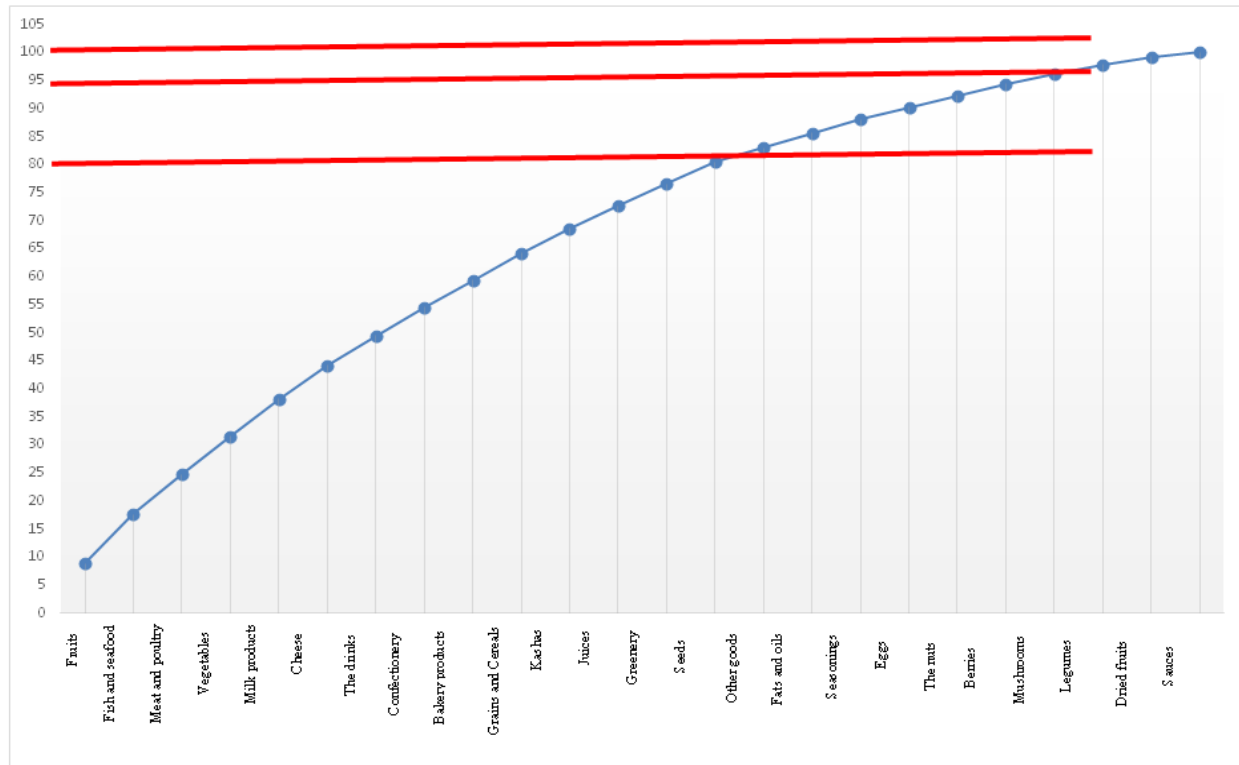


Figure 2. ABC analysis curve

For the division of goods into groups, taking into account the degree of unevenness of demand for each assortment position, a different type of analysis is used - XYZ-analysis. The XYZ analysis implies the division of the entire range of products (resource nomenclature) into three groups depending on the degree of uniformity of demand and accuracy of forecasting. The uniformity of demand can be determined by indicators of relative variability (variation) of demand, among which the coefficient of variation, determined by the formula, is the most frequently used and easily calculated.[4]

$$V = \frac{\sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}}}{\bar{x}} * 100\%$$

Where:

$$\sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}}$$

- standard deviation;

\bar{x} - is the average (monthly average, quarterly average, annual average) demand value for the assessed position;

n - is the number of periods (months, quarters, years) for which an assessment was made.

The purpose of the article. In the problem to be solved, the goal of ABC-XYZ analysis is the distribution of the positions of the assortment into groups depending on the degree of unevenness of demand for each assortment position. That is, it is necessary to determine: assortment positions, sales volumes for which are practically unchanged over time (group X); assortment positions, sales volumes for which change over time, but not very significantly and / or quite predictably (group Y); assortment positions, sales volumes for which change over time significantly and almost unpredictably (group Z). On this basis, the object of analysis is the data on the sale of inventories (in monetary terms) for assortment positions, and the indicator of analysis is the degree of unevenness in the implementation of assortment positions over time. Therefore, for analysis, the coefficient of variation is calculated for each position of the assortment using the above formula. The positions are then ranked in order of increasing value of the coefficient of variation. According to the proposed algorithm, assortment positions are divided into corresponding groups:

1. Formulation of the purpose of the analysis.
2. Determination of variation coefficients for individual positions of the analyzed set.
3. The grouping of objects in a set in order of increasing coefficient of variation.
4. Construction of the curve XYZ.



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5. The division of the set of analyzed objects into three groups: group X, group Y, and group Z.

The range of products is divided into groups in accordance with the interval in which the coefficient of variation for this position falls. For this task the following group ranges are offered:

| Group | Interval (coefficient of variation) |
|-------|-------------------------------------|
| X | $0 < v < 10$ |
| Y | $10 < v < 25$ |
| Z | $25 < v < g$ |

Table 1. The range of groups ABC-XYZ analysis

The main advantage of logistics and supply chain management in modern business is the ability to ensure the integration of the efforts of the logistics system and supply chain in achieving the strategic goals of organizing logistics management - material, informational and financial flows. In other words, the material flow in logistics is often a set of inventory items located in different points of space (in storage areas, in production, in vehicles, in trading floors) and interconnected by the logic of the development of the business process of producing products or rendering services. The content of the procedure of the inventory management cycle can be divided into calculated, managerial and complex procedures. We will consider a virtual model of a terminal owned by a logistics company, the main cargo turnover in which is created by food.

| | Share % | Var. coefficient | XYZ | Accum. Share. | ABC | ABC-XYZ |
|--------------------|----------|------------------|-----|---------------|-----|---------|
| Fruits | 8,833903 | 30,5485% | Z | 8,833903 | A | AZ |
| Fish and seafood | 8,804721 | 4,6263% | X | 17,63862 | A | AX |
| Meat and poultry | 7,141978 | 28,6159% | Z | 24,7806 | A | AZ |
| Vegetables | 6,776939 | 46,1396% | Z | 31,55754 | A | AZ |
| Milk products | 6,695807 | 33,2692% | Z | 38,25335 | A | AZ |
| Cheese | 5,917631 | 39,0366% | Z | 44,17098 | A | AZ |
| The drinks | 5,363921 | 39,5018% | Z | 49,5349 | A | AZ |
| Confectionery | 4,983109 | 21,7712% | Y | 54,51801 | A | AY |
| Bakery products | 4,928227 | 40,1307% | Z | 59,44624 | A | AZ |
| Grains and Cereals | 4,788772 | 23,4785% | Y | 64,23501 | A | AY |
| Kashas | 4,38496 | 37,1553% | Z | 68,61997 | A | AZ |
| Juices | 3,988096 | 30,2211% | Z | 72,60807 | A | AZ |
| Greenery | 3,904277 | 22,7338% | Y | 76,51234 | A | AY |
| Seeds | 3,90313 | 22,0064% | Y | 80,41547 | B | BY |
| Other goods | 2,624796 | 33,2196% | Z | 83,04027 | B | BZ |
| Fats and oils | 2,578116 | 37,5859% | Z | 85,61838 | B | BZ |
| Seasonings | 2,426222 | 32,7475% | Z | 88,04461 | B | BZ |
| Eggs | 2,234924 | 27,2542% | Z | 90,27953 | B | BZ |
| The nuts | 2,080794 | 18,9242% | Y | 92,36032 | B | BY |
| Berries | 2,021246 | 20,2555% | Y | 94,38157 | B | BY |
| Mushrooms | 1,748894 | 25,8833% | Z | 96,13046 | C | CZ |
| Legumes | 1,706324 | 2,8281% | X | 97,83679 | C | CX |
| Dried fruits | 1,359726 | 3,2482% | X | 99,19651 | C | CX |
| Sauces | 0,803485 | 25,2736% | Z | 100 | C | CZ |



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III. CONCLUSIONS AND DISSCUTION

From the point of view of logistics, analyze the above list - it can be concluded that products such as Mushrooms and Sauces should be excluded from circulation, firstly, because they bring the least profit for the company, which deals with their implementation, and, therefore, for the serving their logistic company. Secondly, the demand for them is as unstable as possible, which entails either the formation of surplus production or the appearance of a deficit and, consequently, an even greater decrease in demand. Thus, the carrier company, also analyzing the reverse flow of information, must be prepared for the fact that in the future the demand for the transportation of goods from the CZ, CX, BZ groups may begin to decline or completely cease.

| | |
|--------------------|----|
| Fish and seafood | AX |
| Confectionery | AY |
| Grains and Cereals | AY |
| Greenery | AY |
| Fruits | AZ |
| Meat and poultry | AZ |
| Vegetables | AZ |
| Milk products | AZ |
| Cheese | AZ |
| The drinks | AZ |
| Bakery products | AZ |
| Kashas | AZ |
| Juices | AZ |
| Seeds | BY |
| The nuts | BY |
| Berries | BY |
| Other goods | BZ |
| Fats and oils | BZ |
| Seasonings | BZ |
| Eggs | BZ |
| Legumes | CX |
| Dried fruits | CX |
| Mushrooms | CZ |
| Sauces | CZ |

Table 3. Combining ABC-XYZ-analysis to improve the performance of the cargo terminal

In general, as indicated in Table 4, all products of group A require daily monitoring, and depending on the XYZ analysis indicator, the relative lot size is formed. Products of the same group B - do not require special attention.

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