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CALCULATION OF POSSIBLE DAMAGES THAT MAY BE ASKED BY THE CLIENT WHO REFUSED CONTRACT EXTENSION

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Abstract: The authors of the article identified the problem of manufacturing enterprises in that a significant number of customers of their products refuses to extend the contract. This refusal is detrimental to the enterprise, since the funds have already been spent on designing the design, designing the location of the finished product, purchasing the necessary materials and components. Therefore, a method was developed to determine the extent of the potential loss that could give a manufacturing company a new client. For this purpose it is proposed to use statistics of pre-orders in which the client refused to extend the contract and did not pay the costs of the company that executed the orders for the manufacture and installation of the structure. Building a model of the level of damage that can be provided by the client, if he refuses the order, consists of stacking tables, which in addition to the level of damage includes the characteristics of the client company, such as the distance to the client, the age of the head of the client firm, the amount of the contract, date conclusion of the contract on production of a design, currency of balance of the customer.

Keywords: statistics of customer loss task, clustering, working capital, economic-mathematical model, separate functions.

In the modern economic conditions of Ukraine, the economic or political situation forces enterprises to reduce or even curtail production, and if we take agrarian firms, then the situation of lack of profit due to crop failure is added to other problems. In this regard, problems arise for manufacturing enterprises that conclude

contracts for the manufacture and installation of equipment, because a fairly significant number of customers of their products refuse to extend the contract. Such a refusal causes losses to the enterprise, because funds have already been spent on the development of the structure, the design of the location of the finished product, the purchase of the necessary materials and components.

The purpose of the work is to develop a reliable methodology that would allow minimizing risks when determining the value of new orders due to factors that can be collected at the initial stage of working with the client.

To implement the set tasks, a methodology was developed for determining the extent of possible damage that a new client can provide to a manufacturing enterprise.

The proposed algorithm was used to analyze and forecast the unprofitability of clients of MTK Ukraine LLC, whose main activity is the manufacture of corrugated metal hangars and their installation on the territory of clients, most of whom are agricultural companies.

In the table 1. a fragment of refusal data for 4 years of the company's activity is given according to the following characteristics: Date of contract (or prior agreement) and date of refusal; Business activity of the customer; Area of the customer's company; The area in which construction was planned; Distance to the customer; Number of employees; Age of the customer; Share capital; Year of foundation; The size of the hangar; Stage at which construction was stopped; Damages caused by the refusal.

In the table 1 shows the characteristics of the client's refusal to extend the contract for the manufacture of hangars. To group the data from the table. 1, a cluster analysis was used, which is designed to combine some objects into groups (clusters) in such a way that the most similar objects fall into one class, and the objects of different classes differ from each other as much as possible. All clustering algorithms require the estimation of distances between clusters or objects. For this calculation, the Euclidean distance method was adopted [4].

Table 1

Characteristics of failures

Мол замовника	Date of refusal	Business activity of the customer	Area (ha)	Area of construction	Distance to the customer, km	The age of the contact person	Number of employees	Статутний капітал	Year of establishment	The size of the hangar	Stage of work	Збитки (грн)
1	15.02.19/ 20.08.19	Cereal and industrial crops	4800	Kirovohrad region, Onikieve	299	60	62	7400	1936	20/70	Metal	1000200
2	10.11.18/ 16.07.19	Wholesale trade in food products	100	Dnipropetrovsk region, Chumaki	39,9	48	8	9375	1997	20/50	Contract	4800
3	27.05.19/ 24.06.19	Cereal crops	3000	Dnipropetrovsk region, Vasylkivka	112	53	154	340000	2004	18/50	Contract	5600

* A total of 27 such cases were collected.

The correlation analysis of the influence of economic factors on losses conducted in the Excel program showed that the most influential factors are the following: x_1 – the area of the customer's land, x_2 – the distance to the customer, x_3 - the age of the person making the decision, x_4 – the year the customer's company was founded, x_5 – height of the hangar, x_6 – length of the hangar.

The next stage was the division of all failure data into clusters. It was necessary to understand whether customers who refused construction form clusters that can be understood. Initially, the hierarchical classification of the STATISTICA package was used for this. According to this algorithm, each element is combined, and clusters are formed. Each node of the diagram represents the union of two or more clusters, the position of the nodes on the vertical axis determines the distance at which the corresponding clusters were united.

The full linkage method defines the distance between clusters as the largest distance between any two objects in different clusters, i.e., the most distant neighbors.

The measure of closeness, which is determined by the Euclidean distance between clusters, is a geometric distance in n-dimensional space. These distances, calculated from the average of each variable in the cluster, are shown in the table. 2.

Table 2.

Distances between clusters

To test the assumption that the data form 6 clusters, let's divide the data into 6 clusters using the K-means method and check the significance of the differences between the obtained groups [5].

According to the results of clustering, four groups of customers who refused to renew the contract were formed: customers with average land area are included in cluster 1, the most unprofitable customers are included in cluster 2, customers with the largest land area are included in cluster 3, Cluster 4 was assigned the construction of the smallest hangars.

An analysis of variance was performed to determine the significance of the difference between the resulting clusters. Significance for confidence probability $p < 0.05$ confirms a significant difference between clusters. Therefore, all factors were chosen correctly and are accepted.

Therefore, based on clustering, the component space consists of four regions, each of which contains points corresponding to objects from the same class. Now it is necessary to develop an algorithm that would allow assigning a new client to a certain cluster. The task of recognizing a new customer can be seen as constructing the boundaries of the decision domains that share the clusters.

Let these limits be determined by separable Y-functions [7]. They help determine whether an object belongs to a cluster. That is, it is necessary to fulfill the conditions of the so-called compactness, when each vector of features of clusters belonging to one class forms a locally limited area in the description space. If the

clusters that correspond to different clusters are spaced far enough from each other, then simple recognition schemes can be used. For example, the classification of the object by the distance from the center of gravity of the clusters or by the average distance to all elements of the sample of their corresponding centers.

6 different factors affect the formation of company losses. It is necessary to build regressions to obtain coefficients of separable functions, similar to the method described in [6]. On the basis of the obtained clusters, separable functions were constructed using the additional variable Yi, which, in linear regression calculations, took the value 1000 for one cluster and 0 for others. The calculation was carried out using the Excel program. In total, the regression was performed four times for 4 clusters. In order to minimize the risks of sudden failures, based on linear regression, the equations of linear separable functions were compiled by the method of regression analysis [7], which have the following form:

$$Y_1 = -0{,}12 + 0{,}19x_1 + 0{,}12x_2 + 0{,}05x_3 - 0{,}51x_4 + 0{,}16x_5 - 0{,}24x_6,$$

$$Y_2 = -0{,}10 + 0{,}24\,x_1 + 0{,}32\,x_2 + 0{,}15\,x_3 - 0{,}53\,x_4 + 0{,}23\,x_5 - 0{,}30\,x_6,$$

$$Y_3 = -0{,}04 + 0{,}24\,x_1 + 0{,}26\,x_2 + 0{,}09\,x_3 - 0{,}52\,x_4 + 0{,}24\,x_5 - 0{,}28\,x_6,$$

$$Y_4 = 0{,}06 + 0{,}13\,x_1 + 0{,}26\,x_2 + 0{,}19\,x_3 - 0{,}55\,x_4 + 0{,}09\,x_5 - 0{,}27\,x_6,$$

It should be noted that the regression analysis was performed for normalized data. Thus, the functions of the dependence of the loss on each cluster of customer failures depending on the factors were obtained x_1, x_2, x_3, x_4, x_5, x_6. The coefficient of approximation R2 for each regression is acceptable [9], and the standard error is relatively small. These functions are separable in cluster definition and can be used for future inputs. Thus, it is possible to identify orders that will belong to clusters with different levels of risk: the most unprofitable orders of large hangars by large enterprises founded in 2000; the most unprofitable orders of medium-sized enterprises, the smallest in terms of losses of orders of large enterprises and the smallest in terms of losses of orders of the smallest hangars of medium-sized enterprises.

For example, the following data were taken for the calculation of the customer who just contacted the company to build a hangar measuring 18/50 (Table 3).

Table 3

Incoming data

	X_1	X_2	X_3	X_4	X_5	X_6
Customer 1	5000	443	60	2003	18	50

First, it is necessary to find out which risk group the client belongs to in order to determine whether it is appropriate for the firm to accept the order. Let's substitute these data into separate functions and get the following results of the values of the distribution functions: Y_1 – 0,05; Y_2 – 0,48; Y_3 – 0,42; Y_4 – 0,43.

From values Y_i we find the maximum that includes these customers. In our case, the customer belongs to cluster 2, which includes the most unprofitable orders of medium-sized enterprises, therefore, to the most risky group.

The average loss that the company can receive during the sudden rejection of this order is UAH 564,306. We compare these data with the company's working capital at the moment, which amounts to UAH 854,000. The difference will be UAH 289,694.

Therefore, at this moment it is not recommended to accept the order, because, firstly, the customer falls into the most risky group of clusters, and secondly, working capital exceeds the average loss by only 1.5 times and, according to the company's policy, such a reserve of funds is not enough , because it puts the company in a risky position in the most difficult period for the company's work.

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