Multiple Linear Model for Determination of Factoring Performing Expedience

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***Abstract*—In this paper an approach to the creation of multiple linear model for determination of factoring performing expedience is given.**

***Index Terms*—factoring, factoring performing expedience, multiple linear model, artificial intelligence, adequacy of the model.**

I. I. INTRODUCTION

The scientific and technical progress and increase of people's demands requires such realization of operations and actions that would give the possibility to realize all the requirements of their implementation. Improvement of conditions of some actions performing and advance of necessary results is possible if using computer systems and systems of artificial intelligence that are require to be used in various branches of science and technique [1].

In financial activity that requires high precision and rate of operations' execution, correctness and privacy of received results the use of systems that are based on utilization of artificial intelligence are extremely reasonable [2,3].

II. II. PROBLEM DEFINITION

Factoring is among services that are becoming popular on world financial market. So the financial establishments of Ukraine should realize factoring in a way that will satisfy all the requirements of a client of the establishment and, beside this, minimize the material and time wastes and the quantity of personnel needed to perform the operation. This may be reached if to perform factoring services by systems of artificial intelligence.

To define if it is worth granting factoring services to a client with definite showings is an important point in factoring execution. It may be easily predicted by factoring performing expedience determination process modeling [3].

III. III. PROBLEM SOLVING

When making the multiple linear model for determination of factoring performing expedience exogenous and endogenous factors are considered.

Independent (exogenous) factors that are considered while determination of factoring performing expedience include:

X_1 – factor of percent of client's production on the market;

X_2 – type of goods that should be financed;

X_3 – cost of the fund that makes up the cost of the enterprise;

X_4 – quantity of type of funds that make up the cost of the enterprise;

X_5 – integral sum of outstanding debt on *i*-service on *j*-factor;

X_6 – quantity of services that have outstanding debt;

X_7 – factor of influence on the sum of outstanding debt;

X_8 – factor of typification of party that is going to get factoring;

X_9 – factor of average quantity of consumers that purchase goods, during a day;

X_{10} – factor of average monthly profits;

X_{11} – informative factor;

X_{12} – recource factor;

X_{13} – production export factor;

X_{14} – bill receivable factor.

Dependent (endogenous) factors that are considered while determination of factoring performing expedience include:

Y_1 – factor of enterprise total cost:

$$Y_1 = \sum_{k=1}^{X_4} X_3 \quad (1)$$

Y2 – factor of enterprise outstanding debt value [4]:

$$Y_2 = \sum_{j=1}^{X_6} \sum_{i=1}^{X_7} X_5 \quad (2)$$

Level of abstracting on which the analysis of relation between exogenous and endogenous factors has been performed, defined its linear type:

$$\hat{Y} = a_0 + a_1 * X_1 + a_2 * X_2 + ... + a_m * X_m \quad (3)$$

that may be showed in matrix type:

$$\hat{Y} = X * \overline{a} \quad (4)$$

where X is vector of exogenous factors of multiple linear model for determination of factoring performing

$$X = (X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, X_{12}, X_{13}, X_{14})$$

$\hat{Y}$ = (Y1, … ,Yn) — theoretic values of endogenous factors,

$\bar{a} = (a_0, a_1, a_{2i},,…,a_m)$ — vector of linear model parameters.

For each factor X_j there are *n* observations to which *n* values of result correspond.

Marking those deviations by e_i, we'll get:

$$e_i = Y_i - \hat{Y}_i = Y_i - a_0 - a_1 \times X_{i1} - a_2 \times X_{i2} - ... - a_m \times X_{im} \quad (5)$$

$$COV(e_i, e_j) = \begin{cases} const, i = j \\ 0, i \neq j \end{cases} \quad (6)$$

Marking the matrix of coefficients at unknowns in the system of normal equations as B, and the vector of right parts in the system of normal equations as $\overline{YX}$ we'll get:

$$B = X^{\grave{O}} \times X \quad (7)$$

$$\overline{YX} = X^T \times Y \quad (8)$$

where X^T is transposed matrix *X*.

Using those conventional signs, the system may be presented as:

$$B \times a = \overline{YX} \quad (9)$$

The values of parameters of the linear model may be defined by use of transposed matrix B^{-1}[5]:

$$\overline{a} = (a_0, a_1, ..., a_m) \quad (10)$$

$$\overline{a} = B^{-1} \times \overline{YX} \quad (11)$$

The value of mean-square deviation of parameters of multiple linear model for determination of factoring performing expedience looks like next:

$$s_{a_i} = \sqrt{s_e^2 \times B_{ij}^{-1}} \quad (12)$$

where $s_{a_i}^2$ is the value of a_i ration deviation,

s_e^2 is the dispersion of deviation between factual and theoretic values,

B_{ij}^{-1} is the diagonal element of B^{-1} matrix.

During practical calculations instead of the value s_e^2 its unbiased value $\hat{s}_e^2$ should be used:

$$\hat{s}_e^2 = \frac{\sum_{i=1}^{n} e_i^2}{n - m - 1} \quad (13)$$

The received quadratic deviations for the parameters of multiple linear model for determination of factoring performing expedience may be used for determination of range of those parameters:

$$a_i - \Delta a_i \leq a_i \leq a_i + \Delta a_i \quad (14)$$

$$\Delta a_i = tp \times s_{a_i} \quad (15)$$

Let's define such a ratio to determine the level of inter-factor influence:

$$t_{a_i} = \frac{a_i}{s_{a_i}} \quad (16)$$

This allows taking a decision on analyzed influence by the rule:

If $\left| t_{a_i} \right| < tp$, than the *i*-factor influences on factor *Y* non-irrelevantly [6].

To define the selected linear multiple model for factoring performing expedience determination and the level of its adequacy to a real economic process the ratio of multiple correlation may be used:

$$R = \sqrt{1 - \frac{\sum_{i=1}^{n} (Y_i - \hat{Y}_i)^2}{\sum_{i=1}^{n} (Y_i - \overline{Y})^2}} \quad (17)$$

The closer is the ratio R to 1, the more the model is better selected to define the factoring performing expedience to represent the relations between economic effects that are studied.

Multiple linear model for factoring performing expedience determination is used to get the prognostic values of a dependent factor *Y* from a set of acceptable independent factors $X_1, X_2, \ldots, X_m$:

$$Y_{пр} = a_0 + a_1 * X_{1пр} + a_2 * X_{2пр} + \ldots + a_m X_{mпр} \quad (18)$$

While valuating the prognoses of factoring performing expedience it is also necessary to define ranges but not use only the point estimate of the prognoses:

$$Y_{пр} - \Delta Y_{пр} \leq Y_{пр} \leq Y_{пр} + \Delta Y_{пр} \quad (19)$$

$$\Delta Y_{\ddot{i}} Y = tp \times \hat{s}_e \times \sqrt{X_{i\eth}^T \times B^{-1} \times X_{i\eth}} \quad (20)$$

$\hat{s}_y^2$ is the dispersion of prognoses deviation [7],

$$X_{пр} = (1, X_{1пр}, X_{2пр}, \ldots, X_{14пр}) \quad (21)$$

IV. IV. CONCLUSION

So, the multiple linear model for determination of factoring performing expedience will give the possibility to define the priority of parameters, the value of inter-factor influence and adequacy of the model [2].

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