ABOUT ONE APPROACH TO THE FORMAL ASSESSMENT FOR THE QUALIFICATION OF COMMERCIAL BANK CREDIT ANALYSTS

Non-effective credit management can lead to significant losses and even bankruptcy of a bank. Therefore, in order to minimize possible losses, bank specialists should assess the creditworthiness of a potential borrower at a high level. This fact and the high competition of banks has led to the widespread use of scoring systems. At the same time, there is no universal scoring model, and the automated system cannot detect suspicious behavior or a borderline state of the client. Thus, to make a credit decision, it is advisable to rely not only on the results of the scoring system, but also on the opinion of qualified experts (credit analysts), which is especially important when the economic situation changes. Therefore, the formal scheme of assessing the qualifications of a credit analyst based on available a priori information is relevant. In accordance with the proposed approach to assessing credit histories, analysts use their testing based on previously identified results of the analysis of credit histories in banks. The tested candidates have to assign former bank borrowers to one of two classes – a trustworthy borrower who easily fulfills the terms of the loan, or an unreliable borrower who repaid the loan by force. If, according to the test results, the average risk of a credit analyst decisions is less than the decisions a priori risk that a bank manager makes only on the knowledge basis for the probabilities of the reliable and unreliable clients appearance, then the credit analyst is considered qualified. In addition, a scheme for selecting the most qualified credit analysts in the credit decision-making group based on the proposed formal conditions is provided. For practical application of the proposed approach, it is sufficient to assess the a priori probabilities of reliable and unreliable customers in the test sample of credit histories and conditional probabilities of errors made by a potential credit analyst in classifying customers of a bank with a known credit history. A model example illustrating the proposed approach is given.

Keywords: credit analyst, scoring system, classification the risk of a potential borrower.

Introduction. It is known that bank loans, which bring the main income of a commercial bank, with inefficient management, can lead to significant losses and even bankruptcy of the bank.

To minimize possible losses, before issuing a loan, bank specialists conduct a credit assessment of the solvency of a potential borrower, which often consists in comparing the client's characteristics with other clients of an earlier period. A loan application will only be granted if the client's characteristics satisfactorily match those who have not defaulted. To assess the creditworthiness of a client, there are two approaches: using a scoring system and based on the assessment of a credit analyst.
Each of the approaches has its own advantages and disadvantages. 

Since the high competition of banks in the field of lending leads to the need to formalize the processes of making credit decisions, automated systems for the formation of credit decisions (the so-called scoring systems) are now quite widespread, which, with a certain degree of certainty, are able to classify customers into reliable and unreliable [1; 2].

According to [3], the classification of the applicant is based on such characteristics as gender, age, marital status, education level, loan amount, loan term, real estate, monthly income, as well as similar characteristics of the personal information of the spouse of the potential borrower.

At the same time, as rightly stated in [4], there is still no universal credit scoring model. In addition, sometimes scoring systems classify the borrower as reliable, while bank experts note that his demeanor, appearance, and emotional state are suspicious.

It follows that for making a credit decision, it is advisable to take into account not only the results of the scoring system classification but also rely on the opinion of qualified experts (credit analysts), which is especially important when the economic situation changes [4; 5].

The task of a credit analyst is to evaluate, based on the characteristics of the client and his knowledge, intuition, the solvency of the client. That is, the main task of a credit analyst specialist is to minimize the risk of loan default. Although it is believed that the opinion of a credit analyst can be subjective, and computer-scoring systems make a formal decision on issuing a loan, recently a large number of scientific publications have been devoted to the integration of scoring systems and the knowledge of credit analysts [5]. The task of selecting qualified experts for the group is also relevant [6].

The term "qualified" expert is quite common in publications, including scientific literature. Intuitive definition of such a term is clear: a qualified expert is a recognized specialist in a particular subject area. However, the assessment of the qualifications of credit analysts requires the formalization of an individual expert the knowledge.

The qualification of a credit analyst can be integrally characterized by the probabilities (frequency) of his mistakes made in assessing the creditworthiness of a client. At the same time, erroneous decisions of an expert can be of two types: recognizing an unreliable client as trustworthy and vice versa refusing to issue a loan to a trustworthy potential borrower.

Since, in the general case, the material losses of a commercial bank from such errors are different, it is reasonable, as is customary in statistical classification methods, to evaluate the qualifications of a credit analyst in the framework of Bayesian strategies. In other words, to characterize the classifications of credit analysts in terms of the average losses of their decisions [7].

**Formulation of the problem.** The purpose of the article is to build a formal scheme that allows, based on the available a priori information, to assess the qualifications of a credit analyst and to select the most qualified credit analysts.

**Methodology.** For the study, the apparatus of probability theory, mathematical statistics and methods of the statistical decision theory (Bayesian classification strategy) were used.

**Research results.** For building a credit analysts group, potential candidates are tested. The data of the bank’s credit flows are used for evaluation. The tested candidate is asked to classify the bank’s former borrowers into one of two classes – a trustworthy borrower who fulfilled the loan conditions without problems (class $V_1$) or an unreliable borrower who repaid the loan by force (class $V_2$).

The tested candidate, based on the available information of credit histories and his intuition, makes decisions about the reliability of the client in the form of an indicator variable

$$\delta = \begin{cases} 
1, & \text{if the expert decides in favor } V_1, \\
2, & \text{if the expert decides in favor } V_2, 
\end{cases}$$

(1)

It is assumed that when classifying clients, in addition to the correct ones, erroneous decisions can be made: a trustworthy client is assigned to the class $V_2$, or an unreliable client – to the class $V_1$, i.e. errors of the first and second kind are allowed [7].

In accordance with the statistical decisions theory, possible solutions are characterized by the payoff matrix

$$L = \begin{pmatrix} L_{11} & L_{12} \\ L_{21} & L_{22} \end{pmatrix},$$

(2)

where $L_{11}$ and $L_{22}$ – losses associated with the right decisions, $L_{12}$ and $L_{21}$ – losses associated with mistakes to recognize a trustworthy client as untrustworthy and vice versa.

Then the decisions average risk $R$ made by a credit analyst is determined by the mathematical expectation of these losses

$$R = \sum_{k=1}^{2} \sum_{m=1}^{2} L_{km} P(V_k, \delta = m),$$

(3)

where the value $P(V_k, \delta = m)$ denotes the probability of the joint execution of two random events: in accordance with the credit history data, a particular borrower belonged to the class $V_k$, $k = 1, 2$, and the credit analyst made a decision $\delta = m$ in favor of the $m$-th class $V_{m}, m = 1, 2$.

We will evaluate the qualifications of credit analysts as follows:

1. A credit analyst is qualified (Figure 1) if the average risk $R$ of his decisions is less than the a priori risk $R_a$ of decisions that the bank makes only based on the probabilities knowledge of trustworthy and untrustworthy clients the appearance, i.e. the strict inequality holds

$$R < R_a.$$  

(4)

2. A credit analyst $A_i$ is more qualified than a credit analyst $A_j$ if the decision-based $A_i$ average risk $R_i$ is less than the decision-based $A_j$ average risk $R_j$, i.e. the strict inequality holds

$$R_i < R_j.$$  

(5)

We will assume that based on the data of previous borrowers credit histories, it is possible to estimate a priori probabilities $P(V_1)$ and $P(V_2) = 1 - P(V_1)$ the appearance of trustworthy and unreliable borrowers.

Based on a retrospective analysis for available credit histories, it is also possible to estimate the values of the conditional probabilities of credit analyst errors

$$P_i^2 = P(\delta = 2 | V'_1),$$  

(6)

$$P_i^1 = P(\delta = 1 | V'_2).$$  

(7)

We will assume that the losses associated with correct decisions are equal to zero, that is, $L_1 = L_2 = 0$. Then, if we take into account that according to the formula for the probabilities product
and taking into account the notation (6), (7), the risk of a credit analyst mis-classification (a posterior risk (3)) can be written in an equivalent notation

\[ R = L_1P(V_1|\delta_1)P(\delta_1) + L_2[1-P(V_1|\delta_1)]P(\delta_2). \]  

Let us now obtain an expression for the a priori risk \( R_0 \) appearing on the right side of inequality (4). It is clear that if information about the borrower is not used, then the a priori decisions of the bank are reduced to choosing one of two alternative options: either classify any client as trustworthy (make a decision in favor of \( V_1 \)), or always make a decision about the unreliability of a potential borrower (make a decision in favor of \( V_2 \)).

Obviously, in the first case, the a priori risk will be equal to the value

\[ R_0^{(1)} = L_1[1 - P(V_1)], \]  

and in the second – the value

\[ R_0^{(2)} = L_2P(V_1). \]  

Of course, the a priori losses of the bank (a priori risk) are determined by the minimum of the a priori risks of the bank's decisions: to make a decision to issue a loan or not to make such a decision, that is

\[ R_0 = \min\{R_0^{(1)}, R_0^{(2)}\}. \]  

To illustrate the proposed approach, consider a model example.

**Model example.** An examination of five candidates was conducted to form a group of credit analysts. Existing data from credit histories was used for the exam, which included 70% of good borrowers (repaid the loan without problems) and 30% of bad borrowers (repaid the loan by force). Thus, the a priori probabilities of trustworthy and untrustworthy customers can be estimated by the probabilities \( P(V_1) = 0.7 \) and \( P(V_2) = 0.3 \).

Applicants were asked to evaluate their creditworthiness on the basis of the available information about these borrowers. As a result, the conditional probabilities of erroneous decisions for each of the five potential candidates were estimated (Table 1).

### Table 1

<table>
<thead>
<tr>
<th>Expert</th>
<th>Conditional probability distribution</th>
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<tbody>
<tr>
<td></td>
<td>( P(\delta_1</td>
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<tr>
<td>1</td>
<td>0.95</td>
</tr>
<tr>
<td>2</td>
<td>0.942</td>
</tr>
<tr>
<td>3</td>
<td>0.941</td>
</tr>
<tr>
<td>4</td>
<td>0.987</td>
</tr>
<tr>
<td>5</td>
<td>0.948</td>
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</tbody>
</table>

Let the error loss ratio be \( \omega = \frac{L_2}{L_1} = 7 \).

Let us determine the risk of making a credit decision without the participation of credit analysts (a priori risk (9), (10)):

\[ R_0 = \min\{R_0^{(1)}, R_0^{(2)}\} = \min\{0.3, 4.9\} = 0.3. \]  

The risk associated with the decisions of the \( i \)-th expert is determined by the formula (8). The results are presented in Table 2.

Based on the calculated risks of making a credit decision, candidates are identified who, according to formula (4), should be included in the group. Since the risks of the
first, fourth and fifth credit analysts are less than the prior risk
\[ R^{(1)} < R^0, \quad R^{(4)} < R^0, \quad R^{(5)} < R^0, \]
than the inclusion of these candidates in the group is expedient.

The risk of the second and third credit analysts is greater than the a priori risk \( R^{(2)} > R^0, \quad R^{(3)} > R^0, \) therefore their inclusion in the group does not make sense.

Credit analysts included in the group are ranked according to (5) based on their qualifications.

Since, according to the values of credit decision risk \( R^{(i)} \) calculated in the table 2: \( R^{(4)} < R^{(3)} < R^{(5)} \), then the most qualified fourth credit analyst, then the fifth, and then the first.

**Conclusions.** Formal conditions that allow assessing the qualifications of a credit analyst in terms of the minimum average risk have been obtained. It is shown that for the practical use of the proposed approach, it is sufficient to estimate the a priori probabilities of trustworthy and unreliable customers in a test sample of credit histories and the conditional probabilities of errors that potential credit analysts make when classifying bank customers with a known credit history. A model example illustrating the proposed approach is presented. Further development of the research of the proposed approach should be directed to the generalization of the obtained results based on the methods of interval analysis [8].

<table>
<thead>
<tr>
<th>Expert</th>
<th>Expert decision risk ( R^{(i)} )</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>0.263</td>
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<tr>
<td>2</td>
<td>0.3037</td>
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<td>3</td>
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<td>4</td>
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<td>5</td>
<td>0.2578</td>
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**References:**