COMPUTER APPLICATION GUIDE FOR THE AUDITOR

DEVELOPMENT AND IMPLEMENTATION OF AUTOMATED SYSTEM FOR EVALUTION OF COMMERCIAL BANK CREDIT QUALITY

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1. ANALISIS PROBLEM OF CREDITS QUALITY

After the crisis of 1998 there was a good situation for increase of volumes of crediting by banks of the real sector of economy. It is caused, on the one hand, by time absence of high profitable speculative tools, on the other hand, by strong need of borrowed funds for "come to life" import substituting enterprises. Thus, enough strict specifications of Central Bank of Russian Federation and short-term structure of liabilities of many commercial banks have resulted in exhaustion of their credit limits. In this connection and in conditions of proceeding economic growth, the always actual problem of definition of credits quality gains in new importance.

Management by credit risk, alongside with market and operational risks, is a daily practice of any bank. The evaluation of credit risk may and should be carried out at different stages of procedure of crediting. It is possible to say, that the available and precise execution of such a procedure consists the essence of management of risk, and its level depends on elaboration and punctuality in execution of procedure.

The following structural departments and services of bank take part in credit process: credit committee, management of crediting[1], analysis department of credit risks, legal management, security department, accounting department, internal control management. The analysis department of credit risks in the structure of management of risk analysis should be independent from the management of crediting. The tasks of its employees consist in presentation for credit committee of own conclusion on each credit project of each borrower based on expert evaluations of all mentioned above services and departments. Except for the conclusions at a stage of approval of the credit, the department of the analysis of credit risks should periodically present for management of the bank the report on of the bank the report on quality of existing credit portfolio of the bank, including classification of credits after the groups of risk and to make proposals about alteration of credit policy of the bank.

It is a complicated problem to get enough reliable evaluations of quality of credits as there is no uniform indicator of probability of uncollectible funds. There is a set of indicators (factors, criteria) which should be taken into consideration. Each such a factor brings the certain contribution to the general evaluation. For example, the technique of Central Bank of Russian Federation of classification of credit portfolio after the groups of risk for formation of the reserve for probable losses in loans, takes into account two factors: the quality of covering and the quality of current servicing of the credit. At the same time, the classification of credits for internal needs of the bank may and should take also into account another parameters of the credit project, the firm of the borrower. The general quality of the credit is an enough complex function of its separate components. This function may not be determined by objective calculations. Circumstances in which the bank works, are continuously altered because of change of the general economic situation. Hence, the rules of evaluation of credit quality may be based only on the policy of the bank management, on intuition and experience of its directing board.

2.AUTOMATIC SYSTEM OF CREDIT EVALUATION AND CLASSIFICATION

The classification of bank credits after the groups of risk may be carried out either on the basis of expert evaluation of the skilled employee of the credit area, or with the help of the regular procedure aggregation of the evaluations of separate parameters of the credit received from profile experts of the bank or drawn experts. With competent arrangement of the process of crediting both methods are used simultaneously. Automatic systems of classification formed on the basis of statistical methods, neuron networks are known. However such procedures demand the "good" statistical data lines absent in modern Russian bank practice, this does not allow to follow the "logic" of classification and, and consequently, to avoid mistakes. It is necessary to add, that the majority of the parameters describing the credit project, have a qualitative character and the digital form of evaluations of statistical procedures creates only visibility of accuracy. It seems to be logical to use the experience of managing directors of the bank like the members of credit committee for definition of the essential (in the given economic conditions) parameters of the

[1] Depending on the size of bank of division may be departments, departments etc.

conditions) parameters of the credit project and creation of rules of classification in the received space of every possible combinations of these parameters. Actually, such a classification at two criteria is formed in the Instruction of Central Bank of Russian Federation from 30.06.1997 № 62a. With all these criteria it is difficult to implement the classification without the use of a special method. By the way, the problems of classification of the objects evaluated after many criteria, represent one of the problems of the theory of decision making [1]. For decision of the given problem can be used an effective method ORCLASS (ORDINAL CLASSIFICATION), developed in ISA of Russian Academy of Science. This method allows stage by stage to form the classification, to check the information on consistency, to get a general rule of decision. In the method are considered opportunities and restrictions of human system of processing the information.

The method is realized as a computer system of support of acceptance of decisions (СППР) and was used for classification of credit portfolio in the commercial bank entered into the first hundred of Russian banks (after the size of assets) in 1997-1998.

3. MULTICRETERIA ORDINAL CLASSIFICATION PROBLEM

The problem of ordinal classification, considered here, may be represented as follows. The problem situation, characteristic for the considered problem, consists in that the Decision Maker (DM) has a final set from *M* classes, to one of which he may attribute a particular object. These classes are ordered in the sense that object which is attributed into the first class, is more preferable for DM, than the object, which is attributed into the second class etc. Each object is presented by evaluations by N criteria. Gradations on scales of criteria represent the developed verbal formulations and also are ordered for DM from the best to the worse.

Since there is a final number of criteria N, and each criterion has the scale with a final number of evaluations, it is possible to construct a final set of all possible vector evaluations - the Cartesian product of all criteria scales. It is possible to create the full system of objects classification having constructed the classification of all possible vector evaluations in criteria space. When such a classification is constructed by an experienced DM, it reflects his or her rules for decision making that he or she applies in everyday practice. Therefore the constructed classification may be used for classification of real alternatives (objects, credits, etc.).

Generally the decision of the problem of creation of full classification can be carried out by consecutive presentation for DM DM of all vector evaluations for their classification. However, such an approach is inefficient even for the decision of problems concerning small dimension (up to hundreds of vector evaluations). Orderliness of classes of decisions allows to construct special procedure of DM survey for formation of full classification with presentation to him a relatively small part of all vector evaluations of this set.

Formally the problem may be represented as follows:

Given:

$K = \{K_1, K_2, \ldots, K_N\}$ is the set of criteria by which each object (credit) is estimated.

$S_q = \{k_1^q, k_2^q, \ldots, k_{\omega_q}^q\}$ for $q = 1..N$ is the set of evaluations by criterion K_q; ω_q is the number of gradations on the scale of criterion K_q; evaluations in S_q are ordered from the best to the worst.

$Y = S_1 \times S_2 \times \ldots \times S_N$ is the space of all objects for classification. Each object is described by the set of evaluations by criteria $K_1, \ldots, K_N$ and it is represented as a vector evaluation $y \in Y$, where $y = (y_1, y_2, \ldots, y_N)$, y_q it is equal to the number of evaluation from the set S_q.

$C = \{C_1, C_2, \ldots, C_M\}$ is the set of decision classes ordered from the best to the worst.

Let's use the relation of strict dominance:

$$P = \left\{ (x,y) \in Y \times Y \,\middle|\, \forall q = 1 \ldots N \quad x_q \geq y_q \quad \& \quad . \right.$$
$$\left. \& \quad \exists q_0 : x_{q_0} > y_{q_0} \right\}$$

Required: on the basis of DM's preferences to form a mapping $F : Y \to \{Y_i\}$, $i = 1..M$, (where Y_i is the set of the vector evaluations that belong to the class C_i), satisfying the condition of consistency:

$$\forall x, y \in Y: x \in Y_i, y \in Y_j, (x, y) \in P \Rightarrow i \geq j, \qquad (1)$$

In other words, the object with better set of evaluations by criteria may not belong to a worse class.

4. METHOD OF SOLUTION

Let's present briefly basic ideas of the ORCLASS method.

Let's designate the best and the worst combinations of evaluations, as $y' = (1,1,\ldots,1)$ and $y'' = (\omega_1, \omega_2, \ldots, \omega_N)$ accordingly. Naturally, $y' \in Y_1$ and $y'' \in Y_M$.

In the average layer M of the criteria space Y it is chosen the vector y, which is connected by the dominance relation with the largest number of not yet classified vectors. It is presented to a DM who determines the belonging of the vector to one of the classes. Depending on the choice of DM there are boundary elements of classes on the chains which connect the vectors y', y and/or y'', y. A chain is an ordered sequence of vectors $\langle x_1, x_2, \ldots, x_d \rangle$, where

where $(\boldsymbol{x}_{i+1}, \boldsymbol{x}_i) \in P$ and the vectors $\boldsymbol{x}_{i+1}$ and $\boldsymbol{x}_i$ differ by exactly one component.

The search for boundary elements on chains between vectors ***p*** and ***q*** is made as follows:

- In the set of vectors which are on chains, going through ***p*** and ***q***, and equidistant from these vectors, the pair ***r*** and ***s*** vectors the most removed from each other is chosen,
- Each of vectors ***r*** and ***s*** is presented to DM for classification,
- Depending on answers of DM the search for boundary elements is continued on the chains that go through the vectors ***r***, ***p*** and/ or ***r***, ***q***, and also ***s***, ***p*** and/ or ***s***, ***q***.
- If the distance between the pair of vectors equals to 1 (that is evaluations of vectors differ by 1 on one of criteria) these vectors are attributed to boundaries of the appropriate adjacent classes.
- After creation of full classification Pareto-optimal elements of boundaries are extracted.

After each presentation of vector to DM a dominance spreading is made, i.e. upper possible class for all vectors, dominated by this one, and bottom possible class for all vectors, dominating the given one, are redefined. This allows indirect classification of the large part of the criteria space and thus to reduce considerably the quantity of references to DM. Besides that the procedure guarantees the absence of contradictions (1) in the created classification, because the check of Dm's answers for consistency is constantly made, and if DM makes a mistake in the classification, he is offered to change one or several of his answers to eliminate the contradiction.

In case of occurrence of contradictions in DM's answers the following procedure is carried out. As the mistake might be made both with classification of the last state vector and with classification of one and more of the previous vectors the paired comparison of all directly classified by DM vectors is made; in case of revealing the contradiction the appropriate pair vectors is presented to DM with the proposal to change a decision class of one or both vectors. Then the procedure of contradictions elimination makes changes to the criteria space, according to the new classification. The procedure repeats until all vectors classified by DM satisfy the condition of consistency.

5. PROGRAM COMPLEX ORCLASS SUITE 1.0

Method ORCLASS was accomplished like a human-machine system of classification of objects. The complex **OrClass Suite 1.0** developed by the program consists of two subsystems.

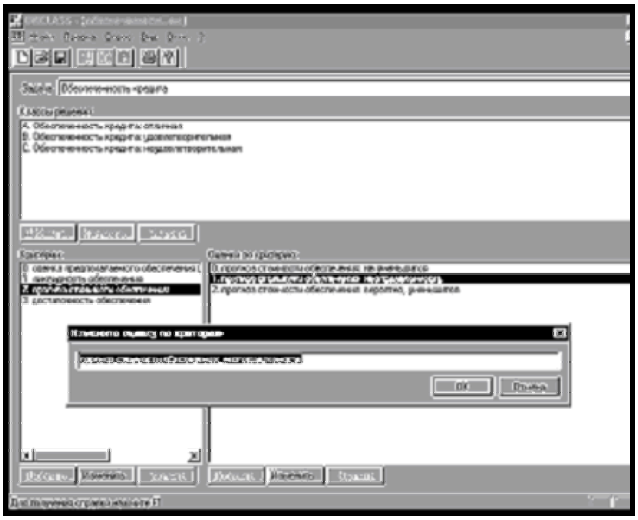

Fig. 1. Subsystem ORCLASS at the Moment of User's Targeting the Structure of the Problem

Subsystem **ORCLASS** is intended for creation of full consistent classifications. It contains the means of formation of structure of problem targeted to class the decisions, criteria, evaluations. The basic component of the subsystem is the module realizing algorithm described above of DM survey. It provides the creation of classification of all set of objects according to preferences of DM and the check of answers of DM on consistency. Besides that the subsystem ORCLASS gives the following opportunities:

- Strict targeting and correct application of decision rules by DM;
- Opportunity to interrupt temporarily survey and to keep the saved data;
- Preservation of the created classification;
- Export of the data to format Microsoft Access.

In the fig. 1.there is the subsystem ORCLASS at the moment of user's targeting the structure of the problem.

In the fig.2 the subsystem ORCLASS asks DM during creation of classification.

Fig. 2. Subsystem ORCLASS during Creation of Classification

The subsystem **OREX (ORCLASS the Expert)** is intended for formation in the mode of dialogue with the user of the description of object of classification and distribution of its class of the decision. OREX allows:

- To load files of format Microsoft Access with the description of the structure of classification and thresholds of classes of the decisions, generated by the system ORCLASS;
- To load the description of several objects from the file of format Microsoft Access and to keep results of examination of these objects in the file of results (a batch mode);
- By user's requirement to explain the conclusion in terms of structure of classification and elements of threshold of classes of decisions;
- To record the process of consultation in a file, to print the report by results of examination of object.

6. STAGES OF SYSTEM ORKLASS IMPLEMENTATION

The implementation of the system of classification of bank credit quality was carried out by the working group consisting of the members of the credit committee of the bank, the chief of the credit department and one of his assistant, the employees of the department of the credit risk analysis, securities, management of automation- and legal department of the bank, and also advisers from the Institute of the System Analysis of Russian Academy of Science, the authors of the given technique. The work can be conditionally subdivided like a sequence of stages:

1) The definition of quantity and the description of classes of bank credits quality;
2) The Definition of essential parameters of the description of bank credits, i.e. systems of criteria;
3) The creation of classification in space of all possible credits on the basis of the experience of members of the credit committee of the bank;
4) Trial classification of credit portfolio of the bank with use of the received system and updating of decision rule received on the previous steps.

After the series of iterations which have been carried out by methodological guidance of advisers from IMR of Russian Academy of Science, there were chosen the classes of bank credits quality and there was received the hierarchical system of criteria.

As final classes of decisions there were chosen:

1. The superior category of quality (Hi class): the performance by the borrower of all liabilities does not cause doubt, the line of credit is open for borrower, the limit of crediting is established. High category of quality: the all-round analysis of activity of the firm and the credit project shows high probability of fulfillment by the borrower of all obligations per contract.
2. An average category of quality: the borrower may have some difficulties with fulfillment of obligations per contract. Weak category of quality: the borrower may have certain difficulties with fulfillment of obligations per contract.
3. A doubtful category of quality: the borrower has difficulties with redemption of interests on the credit, but independent redemption of the basic debt is still probable.
4. Losses: the borrower is not capable to make redemption of the basic debt independently.

At the bottom level of hierarchy it was allocated 6 groups of criteria:

- Security of the credit;
- Evaluation of the credit project;
- Value of the borrower for bank;
- Reliability of the borrower;
- Evaluation of the financial position of the borrower;
- Stability and perspective of the firm of the borrower.

Let's describe in detail these groups:

Into the group " Security of the credit " were included such criteria as:

- Evaluation of the prospective covering;
- Liquidity of the covering;
- The forecast of the cost of the coverage;
- Sufficiency of the coverage.

Into the group " Evaluation of the credit project " were included such criteria as the profitability of the project and the preliminary conditions of its consideration describing the quality of project studying.

The value of the borrower for bank was an independent criterion.

Into the group "Reliability of the borrower" were included such criteria:

- The status of the borrower;

- Evaluation of the position of the representative of the borrower in negotiations;
- Credit history availability

and also some preliminary conditions describing the absence of compromising data on the borrower.

Into the group " Evaluation of financial position of the borrower " were included such criteria:

- Turnovers after settlement and current bank accounts;
- Type of financial stability;
- Availability of liabilities per credits to other banks;
- Share of liabilities of the 1st-4th groups of order of repayment on accounts receivable.

Into the last group "Stability and the perspective of the firm of the borrower" were included such criteria:

- Administrative culture of the organization of the borrower;
- Availability of long-term purposes and plans of their fulfillment;
- Stability of the organization - borrower depending on external conditions (the state of economy, change of the situation in the markets) for the period of crediting;

And also the preliminary conditions describing the culture of management in the organization - borrower.

The listed 6 groups of criteria are quite naturally united in pairs in the generalized groups (1ÿ and 2ÿ, 3ÿ and 4ÿ, 5ÿ and 6ÿ) with the following names:

- Validity of the credit;
- Evaluation of the borrower as the organization;
- Financial state and prospects of the borrower.

Then there was carried out the classification of possible credits in all levels of multicriteria descriptions of credits quality. Herewith there was made the check up of the quality of the received results.

There were first carried out classifications at the bottom level, inside the described groups of criteria. As the classes of quality for each group were general evaluations of the first level of hierarchy. After classification these general evaluations were filled with the concrete contents. Finally there were obtained decisive rules of definition of quality of any credit .

It is important to emphasize, that during realization of the above described stages of implementation of the system of classification there is the specification and coordination by representatives of departments of the bank of descriptions and various evaluations of parameters of the credit. Such a coordination represents a long routine procedure which, however, is extremely useful. Similar procedure is applied for coordination of the classifications received by the join work with executives of the bank. Initial results have shown, that credit policy being at first clear for understanding by all participants of the credit committee of the bank, "turned" into rather strong differing classifications. The process of their data putting together into a final classification demands a hard work and consumes working hours of the top management of the bank. Therefore, the work on creation of the system of classification of credits quality may be finished only with available political will of management of the bank by overcoming the resistance of employees of various departments of the bank who are not interested in successful functioning of such a system (it concerns to implementation of risk - management in any direction of bank activity).

Final remarks

It is necessary to note, that the technique described above may be applied to various kinds of crediting (investment, commercial, consumer, hypothecary etc.), but for each of them the systems of criteria should be developed and the classification should be created. The use of such a system is especially useful for large enough banks with the big portfolios "of credits of the same type" and especially for banks with multiple subsidiaries where its implementation secures the use of the uniform standard of credit evaluation for all filial network.

With the change of economic situation in due coarse there is inevitably the change of the set of essential credit parameters and their importance. Hence, the department of management of risks should provide periodic coordination of all system of classification in conformity with realities of the process of crediting. It may occur within the framework of bank credit policy updating and as the matter of fact it is the reflection of such an updating.

The creation and implementation of the system of credits classification has positive structural, disciplining influence on all the process of bank crediting, but for its implementation it needs availability of the person "interested in it" or its "representatives" in the management of the bank or in other words "the effective owner".

Literature

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