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The simulation system of credit portfolio evaluation

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Abstract

A simulation system of evaluation of a portfolio of credits is presented. The system answers user's question from the list of possible questions. Design, execution and analysis of results of experiments needed for the answer are controlled by user question. Input and output data may be precise as well as probabilistic.

1 Introduction

Taking into account the large size of calculations in the frame of operation with credits, a tool is needed which would allow to evaluate fastly this or that portfolio of the credits. The exact mathematical accounts on the basis of conditions, in which each separate credit is produced, allow to receive the exact answer: the profit as the sum of the percents, paid to the bank.

However, specifity of the process of crediting consists in variability of the economic situation and subjectivity of a number of valuations. As the result the conditions for work with credits vary in comparison with source conditions, and the exact computations do not allow to predict, whether a credit portfolio will give profits (or losses), and how many.

To solve this problem it is necessary to use the simulation method, which uses apparatus of the theory of probability and apparatus of the mathematical statistics for imaging of varying situation and prediction of results.

The system, which uses simulation method to evaluate a portfolio of credits, is presented in the article. The system answers user's question from the list of possible ones about the portfolio of the credits.

It is an integrated simulation environment, which automates steps of experiment design and analysis of results. Used technique [4] is based on user question analysis, determination of necessary simulation experiments for the question answering, initiation of their execution and obtaining the answer on the basis of experiment results.

2 Settings of the task

The task is to evaluate a portfolio of the credits, to receive answers to a number of questions about it: what profit or losses have to be expected from the given portfolio of the credits in this or that economic situation, which credits have to give the biggest profit and losses.

A portfolio consists of finite number of credits. The information about the credits is the input information for the simulation model. Various portfolios can be investigated by submitting various information to the input of the model.

It is possible to change the information describing economic situation for the same portfolio. The casual character of some events results in various results for the same source conditions. A generator of random numbers is used to image this fact in the simulation model. Runs of simulation experiments with various sequences of random numbers allow to evaluate "randomness" of the values of profits or losses, i.e. to produce histograms of allocation of their values.

Each particular credit is characterized by the following information:
Creditn - the credit's number;
Typecred - type of the credit, the scheme of the credit repayment;
Scredit - the sum of the credit;
CScredit - the current sum of the credit;
Nmonths - the period (the number of months), on which the credit is provided;
Cnmonth - the remained period of the credit (the current number of months);

Percent - the percent, under which the credit is provided;
s - (s is equal to 1 or 0) solvency of the firm, which has taken the credit;
pci - the probability that the client will become insolvent;
Sec - the initial sum of the credit security;
CSec - the current sum of the credit security;
PSec - the probability of change of the current sum of the credit security;
VSecv - the value, on which the current sum of the credit security varies.

THE NUMBER OF THE CREDIT (**Creditn**) serves to identify the credit.

THE SCHEME OF THE CREDIT REPAYMENT (**Typecred**) determines rules of accounting between the bank and a client. The following schemes of the credit repayment are accepted.

Scheme 1. The credit is noninstalment . Percent from all sum of the credit is monthly paid. Repayment of the whole sum of the credit is done in the end.

Scheme 2. Equal repayments are produced each month: all sum of the credit is divided on the amount of months, for which the credit is produced. At the end of each month the percent from that sum of the credit, which has remained unpaid, plus one the next part of the credit are paid. I.e., the sum paid at the end of each month is calculated under the formula

Scredit/Nmonths + CScredit * (Percent*30) / (365*100), where:
Scredit - total sum of the credit,
CScredit - the remained sum of the credit in the past month,
Nmonths - the number of months, on which the credit is provided.

Scheme 3. This scheme is similar to the second one, however, the credit repayment is carried out not from the first month, and after grace period (Gperiod - in months). I.e., during Gperiod of months, only the percents are paid.

Scheme 4. The credit is provided for some days. In the end all sum of the credit and percents are paid.

Scheme 5. Repayment is carried out by equal payments: each month is paid the identical sum, which includes percents from the un-

paid part of the credit and a part from all sum of the credit.

THE SUM OF THE CREDIT (Scredit) is determined at the moment of output of the credit and remains constant. It can be the value from 1000 (sum of the minimum credit) up to several millions.

THE CURRENT SUM OF THE CREDIT (CScredit) shows, what sum it is necessary to pay. At the moment of allowance of credit it is equal to the sum of the credit. Each month it can vary (according to the scheme of repayment of the credit).

THE PERIOD OF THE CREDIT (Nmonths) is the period, on which the credit is provided. As a rule, it is set in months. Only if the credit is paid according the 4-th scheme, the period is set in days. It is defined at the moment of allowance of the credit and remains constant. It can be the value from several days up to tens years.

THE REMAINED PERIOD OF THE CREDIT (Cnmonth) shows how many months remain up to the end of repayment of the credit. At the moment of allowance of the credit it coincides with term of the credit. Each month it is decreased by 1.

PERCENT, UNDER WHICH THE CREDIT IS PRODUCED (Percent) defines, how many annual interest rates should be paid by the client to the bank. It is defined at the moment of allowance of the credit and remains constant. Usually interest rates make 30 % annual, 29 %, 36%. When the interest rate is being defined, the degree of risk is being taken into account.

THE SOLVENCY OF THE CLIENT WHO HAS TAKEN THE CREDIT (s) is equal to 1 or 0. Because the credit is produced to the client, which the bank considers as solvent, at the moment of allowance of the credit s is equal to 1. If the client becomes insolvent, s receives the value 0. The probability that the client becomes insolvent (pci) depends both on the client, and on the economic situation:

pci = kc*p + pc, where

kc is the coefficient of dependence of solvency of the client from a common economic situation;

p is the value describing a common economic situation (probability that any client may became insolvent because of common economic situation);

pc is the value describing solvency of the client (probability that the client may became insolvent because of his own situation).

When kc = 1 and pc = 0 the probability of change of solvency of the credit depends only on common economic situation.

CREDIT SECURITY. Allowance of the credit, as a rule, needs a support. It can to be represented:
a. As an immovable property (does not lose cost).
b. As fixed assets (is less reliable than a. as the equipment morally becomes outdated).
c. As the goods (it is unreliable).
d. Unsecured advance (is accepted extremely seldom).

At the moment of the allowance of the credit there is Sec, the initial sum of the credit security. It is supposed, that it should be equal to Scredit, though really it can be more or less. Besides, Sec can decrease on VSecv monthly with probability PSec. Thus, there is CSec, the current sum of the credit security, which originally is equal to Sec. If the solvency has become equal to zero, the sale of the credit security is carried out. It happens full or partial loss of the cost of the credit security. According to this full or partial return of the debt occurs.

3 Session

The session of the simulation system presented is described below. It begins with a question of the system to the user: "What portfolio of the credits is used?"

To answer this question it is possible to select the file containing the information about a portfolio of the credits, or to create a new file (Fig.1). To select the file, the usual Windows dialogue is used.

To create a new file, the form (Fig.2) is offered, which contains fields to input values of variables describing the separate credit, and four buttons:

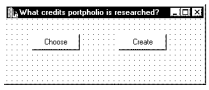


Fig.1 The form for creation of new portfolio of the credits or choosing of existent one

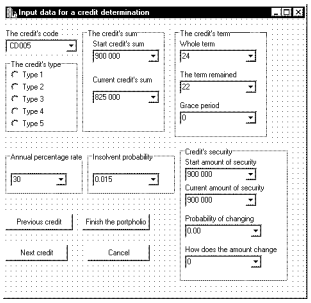


Fig 2. The form for determination of one credit of portfolio of the credits

NEXT - transition to the definition of the information about the following credit;
PREVIOUS - return to the information about the previous credit;
FINISH - completion of the file creation,
CANCEL - refusal to create the file.
For each input field a history list is stipulated, from which it is possible to select up to the 10 last entered values. The selected value can be taken without change or be modified. It simplifies the process of information input. The input fields of values, describing the scheme of the credit, sum, period, and security of the credit, are grouped and located in separate panels. The same form is offered for review and adjustment of the information about the credits in the already existing file. It is supposed, that such file can be automatically obtained from the appropriate database.

After the credit portfolio is defined, the list of questions (Fig.3) is offered to the user. The user should select the necessary question. To receive the answer to a question, it is necessary to click the "ANSWER" button.

The first two questions are located in the upper panel containing two fields of input of the additional information:
- common probability of insolvency;
- number of experiments, on the basis of which the answer will be obtained.

By default it is supposed, that one experiment is carried out. The answer to a question is received as exact values calculated on the basis of the unique experiment (Fig.4).

The answer can be received not only as exact values, but also as results of statistical observations on the basis of a series of experiments executed for various sequences of the random numbers (Fig.5).

On the middle panel (Fig.3) two questions are located to obtain the answers, for which there is no necessity to input the additional information. If the user selects one of these questions, the series of experiments with various values of common probability of insolvency is executed. An example of results is presented in Fig.6.

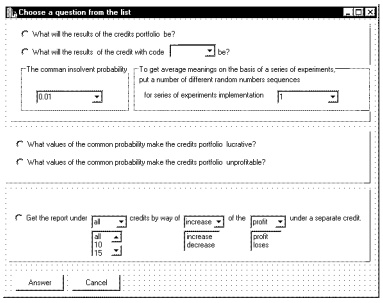


Fig.3 The form for a question choosing

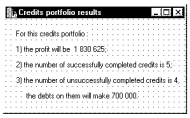


Fig.4 Results of one experiment with a portfolio of the credits

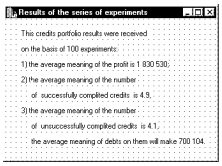


Fig.5 Result of the series of experiments with a portfolio of the credits

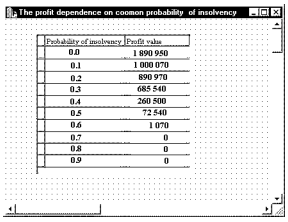
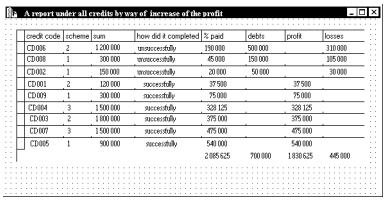


Fig.6 An example of the answer question from the middle panel

In the lowermost panel (Fig.3) the question is located, which user can form himself. The possibility is granted to receive the report on

several credits. The number of credits and the order of their layout in the report is set by the user. Appearance of the report is represented in Fig.7.



A report under all credits by way of increase of the profit

credit code	scheme	sum	how did it completed	% paid	debts	profit	losses
CD006	2	1 200 000	unsuccessfully	190 000	500 000		310 000
CD008	1	300 000	unsuccessfully	45 000	150 000		105 000
CD002	1	150 000	unsuccessfully	20 000	50 000		30 000
CD001	2	120 000	successfully	37 500		37 500	
CD009	1	300 000	successfully	75 000		75 000	
CD004	3	1 500 000	successfully	328 125		328 125	
CD003	2	1 800 000	successfully	375 000		375 000	
CD007	3	1 500 000	successfully	475 000		475 000	
CD005	1	900 000	successfully	540 000		540 000	
				2 085 625	700 000	1 830 625	445 000

Fig.7 An example of a report received by the question, which is set by the user

4 Description of the model of a credit portfolio

According to the task setting indicated in sec.2, the model is developed in the language of discrete simulation SOL [2] in the integrated simulation environment SimTeach [1, 3].

There are 2 processes in the model:

- the first one sets time of termination of simulation (in terms of model time);
- the second process generates transactions, simulating credits.

The source state of the model is determined by the values of global variables, which are input from the "credits.dat" file, and the values of local variables, which are input from the file "cred_inf.dat".

"Credits.dat" file contains the number of the credits in a researched portfolio of the credits, value of the current sum and common probability of bankruptcy. The file "cred_inf.dat" contains the information about all existing at present credits. It is possible to investigate various credit portfolios in various economic situations by changing these data. At the initial moment a transact is generated in the model for each credit.

The values of local transaction's variables are input from the file "cred_inf.dat". They are interpreted as the information about current state of the corresponding credit.

The development of transaction, representing the separate credit, is carried out as follows. It is checked if the firm has become bankrupt (pr(kc*p+pc) = TRUE?). If it has become bankrupt and the current sum of the credit can not be cancelled at the expense of the sum of the credit security, the following is executed:
- the current sum is decreased on the missing sum to cancel the indebtedness under the credit at the expense of the sum of the credit security;
- the number of unsuccessfully completed credits and the number of the credits, which have brought the losses, are increased;
- the transaction representing the given credit is liquidated.

If the firm has become bankrupt and the current sum of the credit can be cancelled at the expense of the sum of the credit security, the following is executed:
- the current sum is increased by the current sum of the credit;
- the number of the unsuccessfully completed credits is increased;
- the transaction representing the given credit is liquidated.

If the firm has not become bankrupt, the current sum is increased according to the type of the credit, and the current period of the credit is decreased on 1. Then it is checked, whether the period of the credit has expired.

If the period of the credit has expired, the number of the successfully completed credits is increased on 1. After that the transaction representing the given credit is liquidated.

If the period of the credit has not expired, the characteristics of the

credit (solvency and sum of the credit security) vary with the given probabilities. The described sequence of operations is executed as long as the credit will not be completed or the corresponding firm will not become bankrupt.

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