

A Novel Software Model for Credit Requests Rating: Scoring Model

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Abstract—The credit rating model in this study was developed for credit foundations. Many banks and credit foundations use special software for credit demand ratings of customers. This software uses ratio analysis for generating credit solutions. Whereas, that will give effective results when "Financial Tables Analysis Technics" are used together.

With financial tables analysis, comparative analyses, perpendicular analyses, ratio analyses, and cash trend tables can be analysed separately, which results is a company being able to view current and future liquidity, profitability, strength of payment debit with comments on the generated results. Points were calculated for each analysis technique and a single credit score was achieved from all calculated points. After these procedures, a credit score was automatically calculated using the scoring model (SM) and process end with last decision to be comment according to SM scale.

Index Terms—Financial analysis, evaluation of credit demands, creditability, scoring model.

I. INTRODUCTION

In today's world, information technology has become involved in so many processes; computer systems have become essential to our lives. With increasing implementations of computer systems in almost every area, measurements and ratings of credit demands in the digital environment help us to make the most incisive decisions. However, there may be some failures or absences in these ratings. Credit companies, as it is supposed to be, make unremarkable positive or negative decisions based on qualitative data, statistical measurements, and ratio analyses that consist solely of financial surveys with its absent aspect. In addition, the inadequacy of financial analysts in implementations and interpretations of financial schedule analyses is remarkable. Furthermore, there are no occupational organizations that train financial analysts in Turkey.

In this study, it was aimed to help credit organizations make more logical decisions through development of a new model for scoring of financial analysis results of credit demands ratings in a digital environment. This model, named as Scoring Model, gives credit officers the opportunity to clearly see the financial analysis interpretations in addition to obtaining a credit score. Thus, simultaneous possession of the

relationship between the credit score and financial interpretation would give credit officers the chance to make the most suitable high value decisions.

A. Credit Risk

The most remarkable and significant risk among bank's considerations is credit risk. Credit risk appears as a consequence of conditioned financial transactions or agreements between funders and fund users [1].

Credit transactions require banks to make the right decisions about the credibility of debtors. These decisions may not always right or the credibility of debtors may decrease over time due to various circumstances. Thus, credit risk, the most essential risk to which banks are exposed, is the situation in which the debtor does not obey the requirements of the agreement [2].

In the second half of the 1990s, banks and advisers began to develop credit risk models, the aim of which was to rate potential losses according to detected secrecy levels [3]. The approach based on risk rating and assessment was rated in the most suitable way by obtaining data from efficient sources, from which pricing was carried out, and the capital structure of the bank was maintained [4].

Credit risk models are key factors in pro-detections, for determining the probabilities of quantitative or combined and default scores of debtors [5].

B. The Root of Computer Software that can Make Logical Inferences

When mentioning the logical inference of computers, the first thing that comes to mind is that computer software uses human mind-like behaviors. There are many languages used in programming computer software, the net result of this process is the emergence of artificial intelligence that has many sub-branches.

Artificial intelligence research began to make computers that adopted some human-like behaviors and abilities. This research aimed to abolish the dependency on human reasoning and judgement abilities at the basic level [6].

C. Using Computer Software in Credit Rating

It has become inevitable that computer software would be used in credit demands rating as well as almost every field in our lives. It is almost impossible to say there is computer software that can make faultless ratings. Only when environmental, economic, governmental and other such significant similar agents' conditions are stable, even standard, such computer software developed for making these transactions would make sensible decisions. Computer software to be developed from this perspective can only make faultless decisions if revolutionary moves are made in the operation of accounting systems.

Manuscript received January 10, 2016; revised February 26, 2016. This study was compiled from the postgraduate thesis of the first author under second author's consultancy.

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When we review the literature, besides traditional methods, some studies have formed other models using financial ratios and statistical analysis techniques regarding predicting probable financial failures of credit requesting firms.

II. FORMATION OF A NOVEL CREDIT RATING MODEL

In this stage of the study, a credit rating model was developed based on interpreting then scoring financial schedule analyses. This model, which was developed under the name Scoring Model, is structured such that it analysis and interprets financial tables using computer software. It was aimed to reach results about the credibility of credit demand firms as if it were interpreted and scored by a professional analyst in the range of determined criteria.

The scoring model is literally computer software; the starting point of structure was to prevent and abolish troublesome and inefficient stages in interpretations of financial analysis. In the first beginning, it was thought to abolish the requirements for financial analysts and design the system to meet the needs of information users who have no information and experience in interpreting financial analyses; however, it was subsequently developed to be successful solely in credit demand rating, in an exact manner.

A. Introducing the Scoring Model and Model Mediator Software

This model aims to interpret findings obtained from two succeeding financial periods' balance sheets and income table units by implementing comparative table analyses, vertical analyses, ratio analyses, and cash flow table financial analysis techniques, then finally, so that these results can be seen in future perspectives.

This computer software, which was based on interpreting then scoring financial tables analyses, was not programmed with a programming language, it was designed using Microsoft Excel in order that users who are not computer programmers could add interpretations. Programming language requires occupational information and experience, and at the same time, it blocks the ability to edit the codes being used. Fig. 1 shows how the Scoring Model works and its principles.

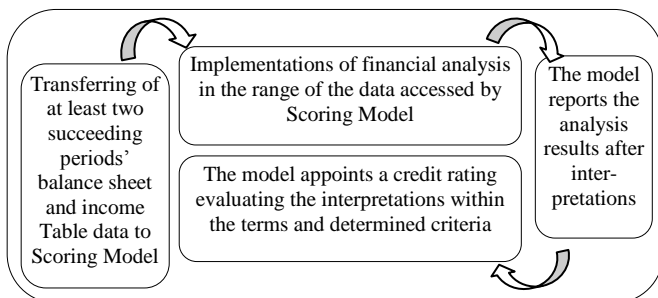


Fig. 1. Working principle of the scoring model.

Despite the fact that financial analysis interpretations are made by the Scoring Model, such software is not able to create a sentences for a report. Thus, suitable pre-prepared sentences and statement structures were added to a database meaning that the Scoring Table could now create interpretations with numbers of paragraphs by choosing and placing the right sentence to the right place.

No matter who or what implements financial analyses, it is inevitable that the same results will be reached. However, the interpretation stage may vary according to the person who operates this process. The important point here is to provide as much data as possible about the firm to the related person who comes into contact for the first time with a financial analysis method, by forming cause-result relation and interpreting. Simply because our model consists of software, there would be no doubt that the model makes its decisions in an apparent, neutral, and fair way.

With the profitability, financial structure, management success, liquidity, and debt discharging situation of debt requesting firm, possible problems future problems could present as a consequence of analyses implemented on a firm's financial tables by the Scoring Model. Thus, the credit decision will have been made according to the firm's financial dimension with the obtained credit rating.

B. Formation of Algorithm Regarding Credit Rating

While the Scoring Model appoints the credit rating of a researched firm it proceeds according to nine basic levels.

Level 1: User to access the financial table data of two succeeding periods of credit requesting firm

Level 2: Transferring these data to pages in order to implement each analysis technique on different pages

Level 3: Implementation of each analysis technique on its own page

Level 4: transfer of items the interpretations of sub items in comparative table and vertical analyses, of them to its own pages. For example; transferring data of 'accounts receivable' to 'AR' page.

Level 5: Determining of suitable interpretation in the database according to determined criteria.

Levels 6-8.: To point out that, a numbers of score are obtained according to each paragraph interpreted

For example, in an interpretation of an item that consists of 3 paragraphs.

1st Paragraph, for the good of the firm; (3Points) (Liquid structure is good)

2nd Paragraph, for the bad of the firm; (-1 Points)(Debt discharging power is weak)

3rd Paragraph, for the bad of the firm;(1 Points)(Profitability is weak)

When comparing this interpretation with result, the rate of this three-paragraphs unit would be: $(3) + (-1) + (1) / 3 = 1$.

In the Scoring Model, every sentence or word equals a particular point. In every analysis, first the software scores within its working process and then, for example, while analyzing 'Operation Profit,' which consists of three paragraphs, a rate is appointed for each and then these rates are averaged and finally one rate regarding 'Operation Profit' would be given. In the interpretation mechanism, first sentences and paragraphs are scored then these data are combined and one interpretation is obtained from those. Instead of separately determined interpretations, a user would obtain one rate for each unit.

Level 9: A credit rating is appointed by averaging arithmetical points determined for all analysis techniques and obtaining one rate for each analysis by averaging all sub units. For example;

$$\text{Comparative Analysis (C)} : (\text{AR Point} + \text{s Point}) / 2$$

- Accounts receivable (AR) : Interpretation point
- Stocks (S): Interpretation Point
- Vertical Analysis (D) : (AS Points + RS Points) / 2
- Asset structure (AS): Interpretation Point
- Resource structure (RS) : Interpretation Point
- CREDIT RATE : (C Point + I Points) / 2

The time passed during all these processes consists solely of accessing financial table data by the program. At the time financial table data are accessed by the program we would have achieved the credit rating. Fig. 2 shows the flow scheme of the Scoring Model.

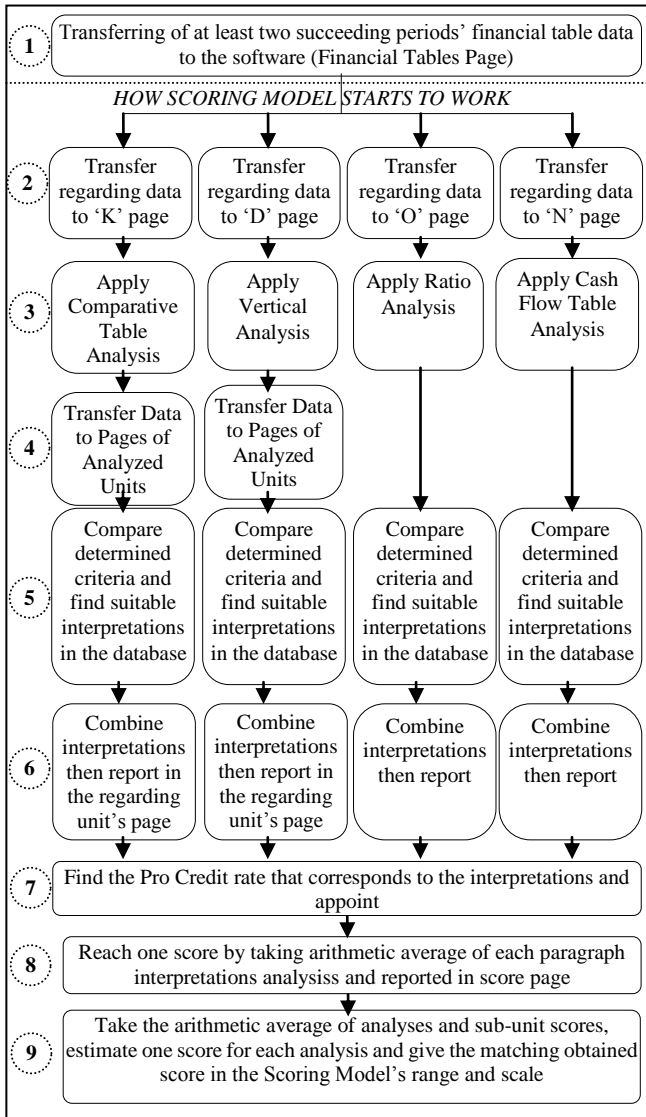


Fig. 2. Flow scheme of scoring model.

Table I shows the minimum and maximum value that each analysis technique could achieve, including sub-units.

In Table I, determining the minimum and maximum points of main and sub units, generally '-1' was expected as minimum and '3' was expected as the maximum point. In the table, we generally follow an order like '-1_0_1_2_3_' and we keep these gaps tighter when analyzing ratio analyses and cash flow table analyses. Data obtained from all of these analyses are 'high', 'normal,' and 'low' for each unit. Thus, although there is no detailed interpretation mechanism in this analysis, it was aimed to compare ratios in the mentioned resources and the ratio of the debt requesting firm. After the

calculation of all of these main and subunit points, the credit requesting firm would have a score in the range of minimum '-1' and maximum '3' point.

TABLE I: MAXIMUM AND MINIMUM POINTS OF ANALYSIS TECHNIC IN SCORING MODEL

Analysis Techniques Applied and Units	Score Range
Comparative Analysis Total Point	Total Score of Sub Units / 6
Trade accounts receivables unit	-1 _ 0 _ 1 _ 2 _ 3
Stocks unit	-1 _ 0 _ 1 _ 2 _ 3
Tangible fixed assets unit	-1 _ 0 _ 1 _ 2 _ 3
Current assets unit	-1 _ 0 _ 1 _ 2 _ 3
Shareholders equity unit	-1 _ 0 _ 1 _ 2 _ 3
Operating profit unit	-1 _ 0 _ 1 _ 2 _ 3
Vertical Analysis Total Point	Total Score Sub-Units / 3
Assets distribution	-1 _ 0 _ 1 _ 2 _ 3
Resource distribution	-1 _ 0 _ 1 _ 2 _ 3
Assets-Resource Relation	-1 _ 0 _ 1 _ 2 _ 3
Ratio Analysis Total Point	Total Score of Sub Units / 7
Current ratio	-1 _ 1 _ 3
Liquidity ratio	-1 _ 1 _ 3
Cash ratio	-1 _ 1 _ 3
Leverage ratio	-1 _ 1 _ 3
Net profit margin	-1 _ 1 _ 3
Operating profit margin	-1 _ 1 _ 3
Debt ratio	-1 _ 1 _ 3
Cash Flows Table Analysis Total Points	Total Score of Sub Units / 2
Cash fund resource	-1 _ 2 _ 3
Cash fund using	-1 _ 2 _ 3
Credit Request Firm Model Score	Total Score of Main Units / 4

C. Formation of Criteria Regarding Rating

Interpretation mechanism created according to the determined criteria of the Scoring Model is shown in Figure 3.

"x" Unit Interpretation Mechanism		AR
Interpretation 1st. Paragraph	IF(AND(E15>35;E165>65;D165>D15*7;E165>E15))	D2
	IF(AND(E22>200;E15>35;D22*5<D9;E165>30))	G7
Interpretation 2nd. Paragraph
Interpretation 3rd. Paragraph

Fig. 3. Criteria interpretation mechanism.

In the example, the working process of the program is proceeding for each unit in the same logic. Just because the interpretation was formed for paragraphs first, detection of suitable a analysis result for interpretation was carried out at this stage. The software gives the user a chance to see the first paragraph of the particular interpretation by bringing the interpretation or interpretation point named 'D2' when comparing a particular financial analysis stated to criteria determined from the point of 1. If the financial table does not provide the criteria at point number 1, and again does not provide the criteria at number 2, it will continue and by researching lower lines. If no criteria are suitable for the financial table of the firm, the interpretation field would

remain empty without an interpretation. In addition, under any circumstances, the researching order of criteria will not change in any way.

Exemplifying the interpretation of criteria table in Fig. 3; the first paragraphs of interpretation of comparative table analysis performed on accounts receivable unit will be shaped as below:

Formula Line

“IF(AND(E15>35;E165>65;D165>D15*7;E165>E15))”

Interpretation Address Stated to Formula
D2

Definitions:

E15 = Short Turn Account Due Unit Changing percentage

E165= Gross Sale Unit Changing Percentage

D15 = Short Turn Account Due Unit Absolute Gap

D165= Gross Sales Unit Absolute Gap

D2= “Why this rise is due to is in sales”

Reading of the Formula:

IF E15 is higher than 35 **AND** E165 is higher than 65 **AND** D165 is higher than sevenfold of D15 **AND** E165 is higher than E15 then **IT IS** D2.

Additionally, the cell name of each line is different for each analysis technique. For example; ‘B15’ stated in any statement under vertical analyses is different from ‘B15’ stated under ratio analyses. First, which analysis technique is being used should be detected then the reference in the interpretation address should be considered. In this case, we should look at B15 cell in ‘D’ page then we should search for an interpretation address regarding the unit’s database. Briefly, criteria were coded to pages analyzed, and interpretation addresses were added regarding a unit’s database page. After all of these stages, the Scoring Model software determines the credit rating value ranges (Table II).

TABLE II: MODEL RATE RANGE

Model Rate Range				
-1.00	0.00	0.70	1.20	3.00
Weak	Low	Medium	Good	Excellent

TABLE III: SCORING MODEL SCALE

Scoring Model Scale		
-1.00	0.00	Financial tables are not considerable for credit
0.00	0.70	It is unfavorable to give credit
0.70	1.20	Credit can be given in the expert’s opinion
1.20	3.00	Credit can be given

The credit rating obtained is marked by the Scoring Model for the corresponding point. For example, a firm that obtains 0.95 points is found between ‘0.70’ and ‘1.2’

After the range obtained in Scoring Model Scale, the financial investigation stage of credit decision would have been terminated.

Without doubt, it would be wrong to take the decision of credit only considering financial tables. Remembering former stages, the financial analysis stage is the resource of financial investigation, so qualitative investigation resources

must be reviewed after the Scoring Model. Although a very healthy financial table is measured positively in terms of credit rating, the negative appearance of a firm’s owner may lead to negative decisions. There is actual way after credit rate proposed by Scoring Model in Fig. 4.

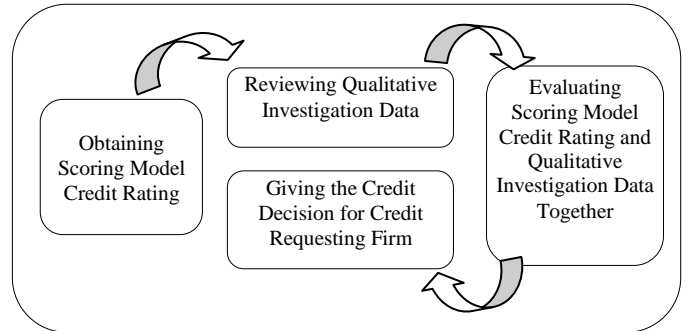


Fig. 4. Credit Decision after model.

We aimed to test the model by comparing the Scoring Model credit rating with credit officer’s credit ratings. The views of different experts who worked in eight different banks were taken, then we scored 32 different credit ratings.

TABLE IV: COMPARING CREDIT EXPERT’S RATE AND MODEL’S RATE

Company Names	Credit Representative Points								Model Point	Model Success rate*
x1 Company	3	3	3	3	3	3	3	3	3	8/8
x2 Company	4	3	4	4	4	4	4	4	4	7/8
x3 Company	2	2	2	3	3	2	3	3	3	4/8
x4 Company	2	1	2	2	2	1	2	2	2	6/8

* If credit rates of each representative is expected as true

According to the findings, comparing the rates of the Scoring Model and expert’s credit rates, the success rate of the Scoring Model was 78%. In addition to that, from the data from the forms offered to credit experts, it was detected that there were some package programs that can give credit ratings to customer’s demand. However, experts gave their decisions according to their own experience. This was because computer software needs a lot of information at the same time; it is necessary to access qualitative data in addition to financial data. Furthermore, they need to research the current upcoming information in interbank investigation databases. Information regarding unpaid bank checks and irregular credit payments in the past simultaneously affect credit ratings. Thus, even one single missing datum might cause software not to finish a credit investigation.

D. Limitations of Scoring Model

In credit ratings, it is not possible to have human-intelligence-like software to make credit rating decisions, at least for now. Even though current software is not perfect at operating within real-time banking, it is developed to produce the best possible result. In this context, the Scoring Model can give the best results providing the conditions below:

- 1) The necessary data should be given to the Scoring Model
- 2) The Scoring Model predicts some numbers in financial tables, which may lead to faulty results because it is not

exact. Thus, the most accurate data possible should be given in estimated units.

- 3) Financial tables should be offered after required corrections in inflationary time.
- 4) The model may be affected by possible currency differences.
- 5) It gives effective results when market conditions and economical factors are stable.
- 6) It was developed according to the State's policy regulations.

III. CONCLUSION

In this study, the authors tried to develop a novel credit rating model in ratings of credit demands, which is crucial to today's banking system. Unfortunately, no other studies have evaluated financial analyses techniques together in the literature, which has created a need for models that evaluate all analysis techniques.

While the applicability of credit demands in the digital environment is researched, we tried to show that financial analysis interpretations might be effective in credit analyses. The aim here is not to develop the criteria, but to show the probability of making credit rating with this method based on financial analysis interpretations.

In the criteria determining period of this study, we tried to reach the former financial data once given by banks; however, it was concluded that giving the balance sheet to a 3rd party was found unfavorable by a decision of the general directorate. Because of this, a sample financial table was created in lieu of the non-provided financial table data, and the bank was asked to rate these samples as a credit requesting firm's demand. To the result of this study, the success rate of the model was seen as 78%. Thus, further development is only possible if banks provide the data rated by them. It would be more suitable to first have previously decided financial tables and then creating new models. Scientifically, it is possible to take credit decisions under some standards. It is possible to see the future success or failure of firms credit requests is determined by ratings made by computer software.

All the studies are products that aim to evaluate analysis results. This model was coded open to give an opportunity to change criteria. Here the criteria are not binding, it was cited that we could decide about credit with more and wider parameters, and it is possible to do it in the digital environment. However, because our criteria were formed by

benefitting from previous articles, they are limited because such resources are limited. Instead of using sparse resources, the failure chance can be reduced to 0 with criteria formed by a professional team and financial analyst, without exceptions.

As a result, the efforts of Scoring Model's, which can operate on computers that have any version of Microsoft Excel installed, to evaluate financial investigation results adapted to the database in a credit company's software with qualitative investigation resources, can easily constitute the next level of this study.

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