



Managing Bank Loans By Using Neural Networks Ramadan Mahmood Ramo^{1,*}, Nima Abdullah AL-Fakhry²

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Abstract

This study aims at recognizing the role of neural networks in deciding administrative decisions in banks. To achieve the aims, the study developed a suggested model that depends on artificial neural networks as a stabilization tool to support loans management decisions. The Descent Conjugate Gradient algorithm is adopted to build the suggested model through checking loan demands according to the various banking instructions. The results showed that using such techniques in administrative business was a success through evaluating loan demands and deciding the most appropriate ones, with the possibility of refusing or accepting the agent's demand, and also the possibility of deciding the loans which were demanded more than the other types.

Keywords:

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1. INTRODUCTION

Managing loans is a major part of banks and funding companies which offer loans to agents to meet their financial needs. This is because it gains profits for the companies and advantages for agents. Thus, one of the most important things that face banks and agents is how fast getting a loan process goes, with taking into consideration the risks that result from offering loans. Fraud in loans is a fast-spreading issue in the system. Economical crises made a vast number of indebted people trick their standards only to get a loan. Although loaning achieves strategic and operational efficiency, there was a need to make some changes in the administrative business through replacing the human analyst by programs which depend on artificial intelligence to achieve speeding up accomplishing the work by analyzing thousands of documents, in addition to reducing errors, and accuracy in

accepting or refusing the offers according to bank instructions[2].

2. Loan concept

The loan language: It is the credit and it is intended for those services provided to customers, according to which individuals, institutions and establishments in the community are provided with the necessary funds, provided that the debtor undertakes to pay that money, its interests, the currencies owed on it and the expenses in one go or in installments on specific date. We conclude that borrowing operations depend on three elements: [6]

1- Trust: In order for the trust factor to be achieved, the customer must provide the bank with guarantees whose financial value exceeds the value of the loan.

2- Duration: It is the term for which the borrower benefits from the loaned funds. This period is determined after signing

the loan agreement.

3- Fulfillment of the repayment: the fulfillment by returning what he has borrowed plus interest.[6]

3. The importance of loans

Loans are very important in economic life and can be summarized in the following points [4]

1. Bank loans are considered the main resource that the bank relies on to obtain its revenues, as it represents the bulk of its uses in addition to the interests and commissions received by the bank, which represent another source of its revenues.
2. Loans enable banks to contribute to and advance economic activity, as they work to create employment opportunities, increase purchasing power, and improve the standard of living of the community.
3. Achieve economic development with regard to foreign loans in order to cover the need for foreign currencies that are used in the import process.
4. Granting loans means, of course, giving confidence to customers.

4- Advantages of Neural Networks in Loan Management [3][9]

1. Lower Operational Cost: Lending companies are able to reduce their operational costs more effectively by handling more applications within the same timeframe. Inevitable, Neural Networks is helping to boost profitability and competitiveness.
2. Avoidance of Delay: Lending processes are enhanced when delay of applications are greatly reduced Neural Networks helps processors to take quick actions if a processes is not following an established plan.
3. Accuracy: The algorithm mostly is built and tested on several application data to tune its accuracy for delivery. Neural Networks helps to streamline human verification operations.
4. Biases: not prone to biases like humans, making it more dependable. Approval of credit facilities can be judged by humans based on inclination of interest which may not fully comply with the lending policy established in the

organization. Neural Networks helps to remove emotional dependencies while evaluating the need of a credit offer.

5- Conjugate Gradient Descent Neural Network

It is a conjugate gradient algorithm which is known as classic optimization algorithm. Its main idea is to blend the conjugation between conjugate gradient in downgrading and optimization to form a group of conjugations among converging data. The idea of optimization in downgrading conjugate comes from using the gradient from the current position downwards in the research, because it is the fastest direction to the current target. This network is useful in linear and not linear issues, and very successful in optimality issues[1]. One main characteristic of this network is getting sufficient information, in addition to the type of trust area, the ability to achieve high convergence and offering perfect results compared to optimization methods, Figure (1) show the architecture of conjugate gradient descent neural network [8].

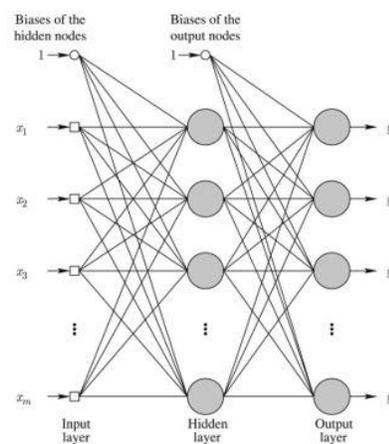


Figure 1: Conjugate Gradient Descent Neural Network[8]

6- PAM Cluster Technique

PAM works like all clustering techniques, in an iterative manner, the clusters and its traits replace with certain traits to measure the cluster quality and the partitioning process continues to extent the partitioning process cannot lead to any change or improvement in the clusters formed. Segmentation groups objects around k -medoids, k is predetermined. The algorithm takes the form of going up a steep hill, the clusters are starting empty, and the object that produces the best aggregation is chosen, and with a

simple swap of each repeated or convergent object around the mean, objects are added one by one and k medoids are selected to determine the new mean at each step to reduce the target function used. The steps of algorithms[5].

1. Initialization: select k from data points randomly and choose (n) as averages
2. Mapping step: associate each data point with the nearest medoid.
3. Update step: It is done for each medoid and each data point and the total cost is calculated (ie the average difference for all data points).
4. Repeat the replacement process in steps 2 and 3 until the stage where there is no change in the values is reached.

PAM Clustering goes through two phases, the first phase is called the construction phase, in which the starting objects are selected and chosen randomly to be the mean, and the variance matrix is calculated to group the objects to the nearest medoid, the second phase is the switching phase using a simple swap process. For each recursive field object i and a non-field object j are selected to get the best cluster[7]. Figure (2) show the PAM phases

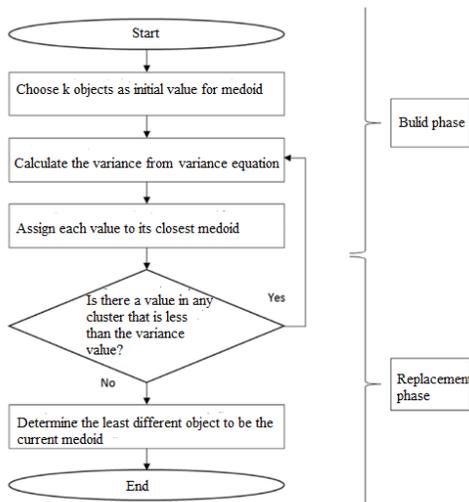


Figure 2: PAM technique Phase[7]

7- Practical Section

When bank experts review loan demands, they consider many factors related directly to such demands. Such factors are essential basics for loans. Based on them, banks take final decisions to offer or refuse loans. The most

important varieties are illustrated in table (1). Accordingly, the design of the neural network depended successfully through a clear understanding of the problem and how to take a decision about the most affecting incoming varieties. The bank data group included 125 demands for different loans, from which, 85 ones were used in training, and 40 ones were used in the test. 7 affective variables were counted for in loan decision, as shown in the following table 1, table 2 show the data using

Table 1: Loan decision factors

Variable	Description	Recoding
X1	Age	1 if the age less than 25 year, 0 otherwise
X2	Account type	1 if have account, 0 otherwise
X3	Income	1 if have income, 0 otherwise
X4	Warrantor	1 if the loan applicant have a Warrantor, 0 otherwise
X5	Loan size	1 if high incomes, 0 otherwise
X6	loan type	1 if Real estate, 2 for agricultural, 3 for small projects
X7	Interest	2 if interest, 0 otherwise

The purpose of using neural network was to realize the most affective records in the decision of offering loans and disposing restrictions that weaken and disrupt the work of the model (delete them). This is concerning stage one. In stage two, which is PAM cluster, we take results obtained from neural networks (outputs) as inputs for phase one of PAM which is the building phase. From the work of the network, it turned out that the most powerful parameters in making decisions related to offering the loan are the amount of the loan, its type and counting average contrast matrix, then relate every point to the nearest average (medoid), that each value of client variables (loan demanders) like (income, age, amount and type of loan) gather around the average nearest to it. This process is repeated until finishing processing and checking all data. This is the substitution process, which is the second phase that PAM cluster goes through.

0	0.007	10	3	1	1	1	1
0	0.007	10	2	0	2	1	1
0	0.005	3	3	1	1	2	1
0	0.005	5	1	1	0	2	0
0	0.007	10	2	0	2	1	1
0	0.005	3	3	1	1	2	1
1	0	8	1	1	1	1	1
1	0	8	3	1	1	2	1
0	0.005	3	3	1	1	2	1
0	0.005	5	1	1	0	1	1
0	0.007	10	2	0	2	1	1
0	0.005	3	3	1	1	2	1
0	0.007	10	2	0	2	1	1
0	0.005	3	3	1	1	2	1
0	0.007	10	3	1	1	1	1
0	0.005	8	2	0	2	1	1
0	0.005	3	3	1	1	2	1
0	0.005	5	1	1	0	2	0
0	0.007	10	2	0	2	1	1
0	0.005	3	3	1	1	2	1
1	0	8	1	1	1	1	1
1	0	8	3	1	1	2	1
0	0.007	6	3	1	1	2	1
0	0.005	5	1	1	0	2	0
0	0.007	10	2	0	2	1	1
0	0.005	6	3	1	1	2	1
0	0.007	10	3	1	1	1	1
0	0.005	8	2	0	2	1	1
0	0.005	3	3	1	1	2	1
0	0.005	5	1	1	0	2	0
0	0.007	10	2	0	2	1	1
0	0.005	3	3	1	1	2	1
1	0.007	8	1	1	1	1	1
1	0.007	8	3	1	1	2	1
0	0.005	3	3	1	1	2	1
0	0.005	5	1	1	0	1	1
0	0.007	10	2	0	2	1	1
0	0.005	3	3	1	1	2	1

The neural network used conjugate gradient descent and also the equation special for PAM algorithm to help the bank in making a decision related to offering the loan and what kind of loan is the priority?. The suggested network consist of an input, hidden and an output layer. After several tests by the two researchers, it turned out that the appropriate network

consisted of the number of inputs, the hidden layer that consisted of 3 nodes, and one output, as in figure (3).

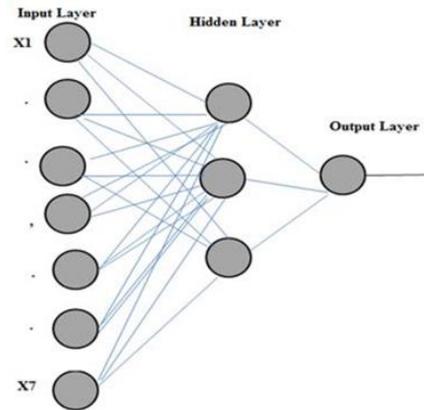


Figure 3: The suggestion network architecture

Sigmoid sign was used in the neural network:

$$\text{Sigmoid}(x) = 1 / (1 + \exp(-x)) \dots\dots(1)$$

Where the data entered comes out as it is without change, so exponential functions were used to improve the outputs during the training process, so that if the value is far from the real output, the value is modified through the use of the PAM cluster.

8-The work steps:

a-Network Training:

The weights of the networks are initialized, so the network is configured for training. Training cases are used to adjust the weights by reducing the prediction made by the network, in order to track the best set of weights that reduce the mean squared error, the algorithm allocates the error backwards across the inner layer of the network and the network evolves through a number of execution times and uses the error to adjust the weights.

b-Network Testing:

After completing the training. The network was simulated on the test set (that is, cases that the network had not seen before). The results were very good; The network was able to classify most of the cases in the test set, It turns out that there is not much difference between the actual output and the target output.

c-Feed back:

Considering the outputs of the neural network as inputs to the second stage of the work, which is the PAM cluster, to get more pure results to get the right decision without any external interference

9-Results:

The results were divided into 68% as training data, while the rest was considered as test data. After executing the model in 3000 cycles, the results showed that the bank offers loans (if cash is available) in the first place to real estate-loan demanders and to those with high income who provide sponsor with stable income, preferably those who have a bank account. In the second place come loan demanders for purposes of small projects, especially those who are between 25 – 30 years old. As for agricultural loans, most of banks offer loans to farmers without interest or commission only to encourage farmers because this benefits the country's economy. Figure (4) illustrate this.

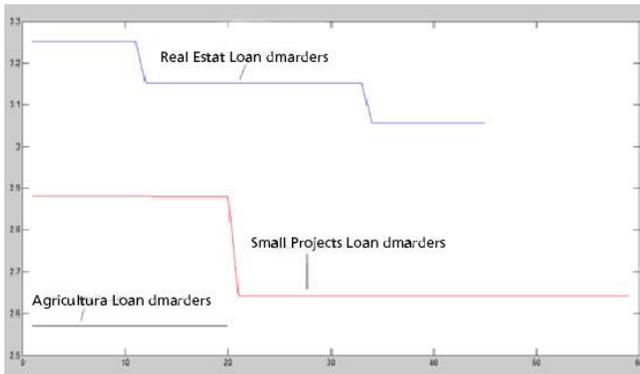


Figure 4: Results of Executing the Model

In figure (4), we notice that real estate loans come in the first place although small projects are greater in number. In the third place come the agricultural loan demanders.

10. Discuss the results:

The research was concerned with developing the decision making mechanism for granting bank loans and the priority of who would it be? The researchers used a model of the neural network and the PAM cluster technique, and the loan requests were filtered, and given the short time, the model was able to perform in a superior and very useful way if compared to other methods that depend on Decision

making manually or using other networks.

Despite the intriguing findings, the study faced some limitations. The main difficulty was to determine the best possible set of model parameters. For example, the model requires basic knowledge of loan applicants and their guarantors, as well as there are no fixed and justified ways to set the parameter values that the model needs, so the decision-making team needs a period of time.

11. Conclusions

1. Extent of clarity and accuracy of the results using the suggested model
2. Applying PAM technique resulted in producing the main basis that is used many times in the same weigh to establish the entity the cluster circle around that to enable us find more interesting groups to pay attention to and study.
3. The process of arranging data and preparing them by using artificial neural networks help decision makers take right decisions to offer loans to clients.
4. The model used by the researchers through blending artificial neural networks with PAM cluster technique surpassed the traditional methods of offering loans techniques to the worthy.

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إدارة القروض المصرفية باستخدام الشبكات العصبية

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الخلاصة:

تهدف هذه الدراسة إلى التعرف على دور الشبكات العصبية في اتخاذ القرارات الإدارية في البنوك. ولتحقيق الأهداف ، طورت الدراسة نموذجًا مقترحًا يعتمد على الشبكات العصبية الاصطناعية كأداة استقرار لدعم قرارات إدارة القروض. تم اعتماد خوارزمية Descent Conjugate Gradient لبناء النموذج المقترح من خلال فحص طلبات القروض وفقًا للتعليمات المصرفية المختلفة. وأظهرت النتائج أن استخدام مثل هذه الأساليب في الأعمال الإدارية كان ناجحًا من خلال تقييم طلبات القروض وتحديد أنسبها ، مع إمكانية رفض أو قبول طلب الوكيل ، وكذلك إمكانية تحديد القروض التي تم طلبها أكثر من الآخر. أنواع.

الكلمات المفتاحية: الشبكات العصبية- إدارة القروض