# Prediction of Financial Failure and Judging the Continuity of Economic Unity: A Comparison Between Traditional Methods and Smart Techniques

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**Abstract:** Intelligent techniques and scientific methods are early adopted to warn against failure of bank due to the great role played by the banking sector in many fields, especially in economy and finance. These techniques are developed in order to expose some of the private banks to many of the obstacles and problems that lead to failure and inability to continue. By using the smart techniques of decision trees and the traditional methods (time series) to compare the two methods to find out which is more accurate in predicting financial failure and judging the continuity of economic unity this study, therefore, aimed to predict financial failure and judge the continuity of economic unity. This study can be used as by using the smart techniques of decision trees and the traditional methods (time series) to compare the two methods to find out which is more accurate in predicting financial failure and judging the continuity of economic unity.

## INTRODUCTION

As an attempt to achieving sustainable development, the banking sector (including private banks) is an important economic sector that works to attract more investments and contribute to the diversification of economic resources. Nevertheless, these banks have witnessed certain conditions whether political, security or economic which have negatively impacted their activities. Some of these banks went bankrupt for several reasons most importantly due to weakness of the adoption of these banks on scientific methods in predicting financial failure and governance of the continuity of economic unit. These challenges have necessitated the adoption of intelligent methods and techniques in order to enhance prediction of appropriate decision in a timely manner to prevent bankruptcy and inability to continue to engage in activities. Thus, this study is aimed to make scientific contribution to help banks to adopt intelligent methods and techniques in the field of predicting financial failure and governance for economic development.

The weakness and absence of intelligent techniques and scientific methods to predict the risks of financial failure and its impact on the continuity of its future activity are the challenges to be considered in this study.

Based on financial ratios giving misleading results that cannot be relied upon some Iraqi banks use traditional methods and these traditional methods used to predict financial failure through financial analysis. This is due to increase in the number of banks that has failed to continue in the provision of the continuity of the activity of banks. Therefore, the question that should be asked is: Do the selected banks use scientific methods and intelligent techniques to predict financial failure and judge their sustainability?

### Literature review
**Financial failure:** Khayat examined financial failure using the Sherrord model to predict the financial failure of the local banks in Nineveh Governorate by investigating the continuity of the success and failure of these banks. The study investigated the extent of the bank loans and its negative effects in the national economy. One of the traditional models called the Sherrord model is applied by this study, the banks are adopting the Sherrord approach to predict financial failure and to discover how the companies that adopt it can maintain continuity.

In other word, Rashid and Abbas (2011) investigated financial failure with the aim of devising a model that can predict the financial bankruptcy of banks in Pakistan.

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Using series of financial ratios this study was based on a traditional method of gradual analysis. Just 2 years before the bankruptcy, the study found a model capable of predicting financial bankruptcy of banks at 80% leading to three important financial ratios.

Also, the study of Al-Zubaidi (2017) aimed at predicting the future financial position of Al-Mutasim company and its ability to continue its future work. The study investigated the correlation between the prediction of financial failure and the continuity of economic unity. The traditional methods of Kida Model and a range of financial ratios were employed by the study. The study concluded that the company does not use any predictive models of financial analysis tools to follow necessary measure in facing serious indicators which affect the continuity and survival of the company.

Feng and Li (2009) in another vein investigated the relationship between the views of the auditors on the continuity and prediction made by the administrations of the economically unsuccessful organizations. The Zmijewski Model was adopted in this study to predict the continuity or bankruptcy of the business organization. This study concluded that the managers of the financially unsuccessful organizations are more prone to manipulating predictions which stands as an unrealistic representation of the nature of the entity's business and its financial position. Also, when management earning expectations become greater, auditors are less likely to issue continuous views.

**Smart technology:** On smart technology, the study of Shehada *et al.*, identified the level of Jordanian bank's interest in data mining technology and its importance in the management of banking and accounting operations. The objective is to indicate the level of interest in applying the concepts of data mining in the management of banking operations in Jordanian banks. The study employed a traditional aspect of the field study method and intelligent technical aspect of data mining techniques. The study found that tere is high in the interest of members of the study community in applying the concepts of data mining in banking operations.

Kwon *et al.* (2010) examined the implementation of the business intelligence approach to predict the daily variables of seven prices of financial stocks. This is achieved by comparing the performance of the (traditional) lower squares model and the neural network model to find out which model does a better job of predicting the variables of the selected stock prices. The study employed the adaptation of neural networks (modern techniques) and the model of the lower squares (the traditional method). The study concludes that neural network model works much better in financial forecasting than the lifeline model.

**Theoretical framework:** This study addresses financial failures, continuity, time series and decision trees.

**The concept of financial failure:** Due to the surrounding organizations, the financial failure is a condition facing most economic unit with high risk of failure which is negatively reflected and more likely to fail. The failure is considered as the inability of the organization to pay their obligations on time and increase in debt which resulted to large losses incurred by the organization. Thus, they are exposed to liquidation and bankruptcy (Ahmed and Saleh, 2016). Therefore, Shetty *et al.* (2012) defined financial failure as the state of imbalance facing economic unity because of its inability to pay its short-term obligations on time. In other word, it is the weakness of resources available whether internal or external and the state of imbalance which differs between the casual or permanent balance. The more difficult it is to overcome economic instability, the more structural imbalance it is.

Hansen (2012) states that financial failure is experienced when cash flow cannot pay the obligations incurred by exaggeration with the use of leverage ratios and the intention of the organization is to have high profit. The manifestation shows that an organization is destined to financial failure when it is characterized by weakness and lack of administrative and financial competencies in the management of the activities of the organization. The organization is unable to compete in the market when there is use of traditional methods by some units instead of advanced or/and modern technology. This is applicable in the financial situation of the organization such as increased financial leverage or dependence on short-term loan (Ramo and Al-Wattar). The financial failure is classified into three types.

**Failure of business:** It occurs through a range of problems and disabilities.

**Economic failure:** The failure that occurs when economic unity is not capable of covering costs (Al-Rikabi and Al-Kaabi).

**Administrative failure:** This type of failure is the weakness of the capacity and efficiency of the administrative system of economic unity which result to the inability to control the results of the business, leading to negative results and then to failure (Thamer, 2018).

The following main reasons led to financial failure. Internal causes such as administrative, marketing, financial, productive and technical (Haidarbas, 2013).

External causes such as the conditions surrounding the economic unity that affect them and lead them to financial failure. Examples are, obstacles due to delay of economic unity in the implementation of their plans on

schedule and the challenges of dealing with government departments with importation, impact on the market, fluctuations in exchange rates and their relationship to the financial structure of the organization (Behbood *et al.*, 2011).

**The concept of continuity:** According to Belkaoui (2004), the idea that organization can have a long life despite the great failure of companies which most of them experience with a high rate of continuity requires the economy to be last long enough to meet their commitments and achieve their goals in time. The study stated that until objectives and economic plans and implementing its obligations and activities at present are achieved, the organization will continue its activity for a long period of time. Robert (2009) added that to achieve objectives, organization continues indefinitely, since, the period is sufficient. When presenting the assets and liabilities in the statement of financial position, this assumption is a justification for ignoring the current liquidation values.

The imposition of continuity is characterized by three cases namely, the case where the age of the economic unit is predetermined and the normal natural situation if there are indicators at present that allow the assumption of non-continuity (Radwanhloh, 2013). The external auditors and the economic unit have several indicators that reveal the continuing uncertainty of what can determine the economic viability of the organization.

The indicators that show the uncertainty of the continuity of an organization are financial indicators, internal indicators and the operational indicators (Karim, 2016). According to standard 570, the events and indicators that contribute to assisting the auditor in determining uncertainties about the sustainability of an organization are financial events and operational events.

**Traditional methods of predicting financial failure (the concept of time series):** One of the main and important topics that have a major and active role in contributing to the creation of a predictive model for predicting the future in all areas is the use of time series for process of predicting. Thus, Rashid (2018) defined time series as a set of observations obtained at equal intervals that are regular in some cases and irregular in other cases. According to Jafar (2017), time series is a set of observations that are generated over a period of time. Time series are characterized by data in chronological order and their observations are usually non-independent. They rely on each other and exploit this lack of independence to reach reliable predictions. Additionally, these time series have the most important set of objectives which are (Amin, 2017):

- To obtain an accurate description of the time series of the phenomenon concerned

- Based on the behavior of the time series to use the results obtained for future prediction
- To make appropriate decisions in order not to make mistakes by knowing uncertainty based on time series

The time series also have several methods which include exponential multiplication method a method to be explored by this study. This method is applied for the purpose of predicting time-series data containing a trend. That is the latter value is less or greater than the previous values. This method supports the general trend on different parameters that differ from the real series. The process is based on three equations that are used in accordance with this method which depends on (A and y). In order to apply the value, the first equation is used to refine the time series data and the second is used to calculate the linearity of the data. In the first and second equation, the linear trend is for the purpose of calculating the predictive value in the third equation.

**Intelligent techniques for predicting financial failure (decision trees technology)**
**The concept of decision trees:** Decision trees operate in the form of a conversation as the nature of their coordination is based on integrating and engaging users in interactive exchange. Decision trees are a tool or means used to support decision as they provide a logical series of suggestions in the form of logical measurement. Decision trees are for submitting responses and are tree-shaped pyramid in which each sub node represents an ption between a number of alternatives and each paper node represents a decision. For the purpose of benefiting from it, these decision trees are used to obtain information. This tree starts from the root where action take place first and from this root decision-makers users divide each node repeatedly. The end result is the decision tree in which each branch represents a possible scenario for the resolution and its results in accordance with the tree training algorithm. Kilan (2013) added that these trees are one of the most recent algorithms used in the analysis of data as it is not easy to conceive and assimilate. There are several different concepts of decision trees they are categorized by a repetitive division of representation and are one of the most common methods of representation of works which consists of a set of nodes as a root tree (Dahan *et al.*, 2014). Khantach *et al.* (2018) stated that decision tree method is a method of supervision and learning through the use of input data that is relied upon by the building of tree in order to obtain outputs from the nature of the decisions in the tree. According to Kaminski *et al.* (2018), there are three types of nodes for decision trees namely, decision node, probability node and final node. The advantages of the decision tree are:

- It is an effective algorithm with the ability to deal with lost data
- It is easy to understand and explain
- It has value even with a few data
- It allows the addition of new scenarios and events

In other word, the algorithm of decision trees does not require the distribution of assumptions contrary to classical statistical methods (Quan and Valdez., 2018). From the above findings, the study revealed that the decision trees are advanced techniques that research in an easy and understandable way for users. Additionally, the decision tree has the ability to solve large complex problems in a scientific and easy way by relying on groups of decisions that are in the form of pyramid starting from the base to the final stage. This will be taken from the range of alternatives decisions available. The decision-making process (prediction) will be used by this study given the ability of these trees (DT) to solve complex problems as mentioned particularly in the problems in order to use them in the process of predicting financial failure and governance of the continuity of economic unity.

Therefore, the objective of this study in summary is to predict the financial failure using intelligent techniques and traditional methods of (time series) for the Iraqi private banks in order to give to provide an early warning system for future occurrence. After Math, the proposals of scientific methods and intelligent techniques are submitted for to the specialized bodies of (the Central Bank of Iraq). The use of intelligent techniques and adoption of scientific basis to predict financial failure will raise the capacity of the selected banks. The following steps will be followed to illustrate this general goal: Predicting the financial failure of the selected banks by adopting traditional methods of forecasting (time series), predicting the financial failure of the selected banks through the application of one of the technical tools of data mining, namely decision trees under smart technology, to find out which of the methods between

traditional or smart is more available and accurate with information to help in judging the continuity of banks in the operation.

Thus, the hypothesis of this study states that "There is a relationship between the uses of data mining technology with the application of the algorithm of decision trees and the ability of banks to predict financial failure and to judge the continuity of economic unity predict financial failure and to judge the continuity of economic unity for the selected banks".

## MATERIALS AND METHODS

In accomplishing the theoretical aspect, the deductive approach will be adopted while the applied (experimental) approach is adopted in accomplishing the practical aspect. The following procedures are adopted in this study: data collection, removal of data that represent the variables of the financial indicators, Preprocessing where the CAMELS (5) indicator will be applied as this standard will be adopted as input to traditional methods (time series) and smart techniques (decision trees). Camels are followed for the following reasons (Table 1).

- This is a global standard adopted in the classification and assessment of banks
- Implementation by the central bank of Iraq
- These indicators are meaningful and easy to interpret with ease of access to the components of its indicators

Prediction of the financial failure of the selected banks based on the traditional methods of time series, predicting the financial failure of the selected banks by adopting intelligent techniques such as decision trees which is one of the tools of data mining technique, evaluation and discussion of the result and determining which traditional or intelligent methods are more accurate for prediction, formulation of proposals and recommendations for stakeholders and decision makers.

Table 1: Sample of the 10-year CAMELS benchmark results (Middle East Bank of Iraq)

| Nominal capital fund indicator | Rating ratio | Percentage of total classification | Ratio of non-performing loans to total assets | Profit growth rate | Rate of return on total assets | Rate of return on equity | Legal liquidity ratio | Cash balance ratio |
|---|---|---|---|---|---|---|---|---|
| 13 | 18 | 8 | 1 | -49 | 0 | 16 | 66 | 3 |
| 15 | 50 | 7 | 1 | 185 | 0 | 32 | 59 | 5 |
| 14 | 60 | 8 | 1 | -13 | 0 | 22 | 55 | 5 |
| 14 | 14 | 3 | 0 | -13 | 0 | 16 | 83 | 5 |
| 16 | 0 | 3 | 0 | -18 | 0 | 12 | 78 | 4 |
| 23 | 0 | 2 | 0 | 115 | 0 | 16 | 79 | 4 |
| 26 | 0 | 3 | 1 | 32 | 0 | 17 | 78 | 6 |
| 29 | 0 | 3 | 1 | -14 | 0 | 12 | 81 | 8 |
| 45 | 0 | 1 | 1 | -82 | 0 | 1 | 103 | 4 |
| 42 | 0 | 3 | 1 | 54 | 0 | 2 | 103 | 10 |
| 24 | 14 | 4 | 1 | 20 | 0 | 15 | 79 | 5 |

Preparation of researchers; All figures are in percentages and they shall be adopted as inputs for time series

**Statistical technique:** The MATLAB program is used to predict financial failure in time series based on the double exponential smoothing model and the MATLAB program is also used to predict financial failure using a data mining tool called the decision trees.

**Population of the study:** The population of this study consists of 33 private commercial banks listed in the Iraqi market which are under security while the population of the study represented 8 banks. Table 1 shows the population of banks are as follows.

**Samples of the study:**
* Bank name
* Middle East Bank of Iraq
* Northern Bank
* United Investment Bank
* Bank of Mosul
* Bank of Babylon
* Bank of Baghdad
* Dar Salaam Bank
* Sumer Bank

## RESULTS AND DISCUSSION

**First; traditional methods of predicting financial failure (time series):** Figure 1 illustrates the workflow of time series. The following steps are taken for the times series method.

**Data collection:** The researcher collected the data of the selected banks using the reports available in the Iraqi market for securities.

**Data creation:** This process includes a number of procedures for obtaining the appropriate data following data integration, data cleaning and data processing. This process was adopted in order to access accurate and high quality data in the forecasting process.

**The implementation phase of the CAMELS standard:** This is the stage after the researcher completed the preparation of data as applied by the standard (CAMELS) by relying on five financial indicators where each indicator contains a number of equations.

**Access to the database:** After the equations of the standard (CAMELS) were applied in its five indicators a database containing the results of the standard (Camels) is obtained for a period of 10 years for each indicator. Using time series as shown in Table 2, these results are to be used as inputs to predict. Table 2 shows the results of the 10 year camels benchmark indicators for a sample of banks represented by the middle east bank of Iraq.
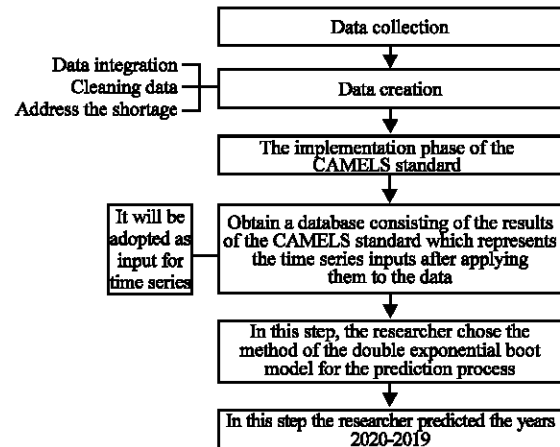


Fig. 1: Action steps for time series; Source: preparation of researchers

Using the dual exponential boot model is the basic reason to reduce the number of views which happened to be 10 views. While the number of views is as large as 200 views or more it is not possible to predict using this model. Thus, the study employed Box-Jenkins model, regression and other predictive model. Table 2 and 3 presents the predicted years (2019, 2020) with final judgment, this study analyzed only the sample of the predicted years, 2020 for the purpose of the extracted results and the lengthy analysis process.

**Middle East Banks:** The Bank of the Middle East received a good evaluation during the year 2020 due to the significant increase in capital adequacy ratio (59.4%), legal liquidity ratio (105.1%), the rating ratio (-2.5%), the total rating of (21%) and a significant decrease in return on equity (7.8%), (10.9%) return on total assets (0%) and profit growth rate (6.5%).

**The Northern Bank:** The Bank of the North received a good evaluation during the year 2020 due to the significant increase in capital adequacy ratio (46.8%), legal liquidity ratio (105.1%), the rating ratio (-9.2%), the total rating of (20.1%) and a significant decrease in return on equity (12.4 and 4.9%) return on total assets (0%) and profit growth rate (-105.6%).

**United Investment Bank:** The Bank of United Investment received a satisfactory assessment during the year 2020 due to the significant increase in capital adequacy ratio (61.1%), classification rate (11.0%), legal liquidity ratio (23.1%), gross rating (19.4%), return on equity (69.4%) and a significant decrease in return on total assets (0%) and profit growth rate (14.9%).

Table 2: Forecast for the year 2019 with the final judgment of the selected banks of the study

| Bank name | Nominal capital fund | Rating ratio | Percentage of total classification | Ratio of non-performing loans to total assets | Profit growth rate | Rate of return on total assets | Rate of return on equity | Legal Liquidity ratio | Cash balance ratio | Final judgment |
|---|---|---|---|---|---|---|---|---|---|---|
| Middle East Bank of Iraq, Northern Bank | 56.4 Strong 1 | 0 Strong 1 | -20.7 Strong 1 | 0 Strong 1 | 8.1 Unsatisfactory 5 | 0 Unsatisfactory 5 | 9.1 Unsatisfactory 5 | 103.7 Strong 1 | 10.2 Unsatis-factory 5 | Good |
| United Investment Bank, Bank of Mosul | 46.7 Strong 1 | 10 Satisfactory 2 | 19.4 Strong 1 | 8.5 Strong 1 | -101.1 Unsatisfactory Strong | 0 1 Satisfactory | 10.8 2 Strong | 93.1 1 Strong | 6.5 1 Unsatis-factory | Good |
| Bank of Babylon, Bank of Baghdad | 59.7 Strong 1 | 10.5 Satisfactory 2 | 17.9 Strong 1 | -7.1 Strong 1 | 11.5 Unsatisfactory Strong | 1.5 1 Satisfactory | 58.1 2 Strong | 36 1 Strong | 2.1 1 Unsatis-factory | Satisfactory |
| Dar salaam Bank | 95.6 Strong 1 | 11.2 Satisfactory 2 | 1.1 Strong 1 | 0 Strong 1 | -18.5 Unsatisfactory Strong | 0 1 Satisfactory | 13.4 2 Strong | 175.5 1 Strong | 38.9 1 Unsatis-factory | Satisfactory |
| Middle East Bank of Iraq, Northern Bank | 92.4 Strong 1 | 12.5 Satisfactory 2 | 0 Strong 1 | 0 Strong 1 | -3.6 Unsatisfactory Strong | 0 1 Satisfactory | 1.1 2 Strong | 72.3 1 Strong | 6.5 1 Unsatis-factory | Good |
| United Investment Bank, Bank of Mosul | 14.9 Strong 1 | 11.3 Satisfactory 2 | 20.2 Satisfactory 2 | 3.0 Strong 1 | 11.2 Unsatisfactory Strong | 0 1 Satisfactory | 7.6 2 Satisfactory | 100.1 2 Strong | 4.0 1 Unsatis-factory | Good |
| Bank of Babylon, Bank of Baghdad | 38.2 Strong 1 | 0 Strong 1 | 1.0 Strong 1 | 0 Strong 1 | 42.7 Strong Satisfactory | 0 1 Strong | 5.3 1 Strong | 159.4 1 Strong | 4.7 1 Strong | Satisfactory |
| Dar Salaam Bank | 69.7 Strong 1 | 0 Strong 1 | 2.7 Strong 1 | 1 Strong 1 | 54.9 Strong Strong | 0 1 Strong | 4.2 1 Strong | 298.3 1 Strong | 8.2 1 Strong | Satisfactory |

Preparation of researchers

Table 3: Forecast for the year 2020 with the final judgment of the selected banks of the study

| Bank name | Nominal capital fund | Rating ratio | Percentage of total classification | Ratio of non-performing loans to total assets | Profit growth rate | Rate of return on total assets | Rate of return on equity | Legal liquidity ratio | Cash balance ratio | Final judgment |
|---|---|---|---|---|---|---|---|---|---|---|
| Middle East Bank of Iraq Northern Bank | 59.4 Strong 1 | -2.5 Strong 1 | 21 Satisfactory 2 | 1 Strong 1 | 6.5 Unsatisfactory 5 | 0 Strong 1 | 7.8 Strong 1 | 105.1 Satisfactory 2 | 10.9 Strong 1 | Good |
| United Investment Bank, Bank of Mosul | 46.8 Strong 1 | 9.2 Satisfactory 2 | 20.1 Satisfactory 2 | 8.6 Strong 1 | -105.6 Unsatisfactory 5 | 0 Strong 1 | 12.4 Satisfactory 2 | 80.8 Satisfactory 2 | 4.9 Strong 1 | Good |
| Bank of Babylon, Bank of Baghdad | 61.1 Strong 1 | 11.0 Satisfactory 2 | 19.4 Strong 1 | -7.1 Strong 1 | 14.9 Unsatisfactory Satisfactory | 0 Strong 1 | 69.4 Satisfactory 2 | 23.1 Strong 1 | 7.2 Strong 1 | Satisfactory |
| Dar Salaam Bank | 98.1 Strong 1 | 11.9 Satisfactory 2 | 1.2 Strong 1 | 1 Strong 1 | -13.3 Unsatisfactory Satisfactory | 0 Strong 1 | 18.5 Satisfactory 2 | 166.9 Strong 1 | 40.1 Strong 1 | Satisfactory |
| Middle East Bank of Iraq, Northern Bank | 96.3 Strong 1 | 11.8 Satisfactory 2 | 0 Strong 1 | 0 Strong 1 | -4.3 Unsatisfactory 5 | 0 Strong 1 | 0.7 Satisfactory 2 | 66.1 Strong 1 | 15.3 Strong 1 | Satisfactory |
| United Investment Bank, Bank of Mosul | 14.4 Strong 1 | 9.9 Satisfactory 2 | 19 Strong 1 | 2.7 Strong 1 | 10.3 Unsatisfactory 5 | 0 Strong 1 | 7.2 Satisfactory 2 | 107.6 Strong 1 | 3.4 Strong 1 | Good |
| Bank of Babylon, Bank of Baghdad | 40.3 Strong 1 | 0 Strong 1 | 1.0 Strong 1 | 0 Strong 1 | 38.9 Strong 1 | 0 Strong 1 | 4.3 Strong 1 | 158.3 Strong 1 | 4.5 Strong 1 | Satisfactory |
| Dar Salaam Bank | 70.6 Strong 1 | 0 Strong 1 | 3.1 Strong 1 | 1 Strong 1 | 47.1 Strong 1 | 0 Strong 1 | 4.2 Strong 1 | 318.4 Strong 1 | 8.3 Strong 1 | Satisfactory |

Preparation of researchers

**Mosul Bank:** The Bank of Mosul received a satisfactory assessment during the year 2020 due to the significant increase in capital adequacy ratio (98.1%), classification rate of (11.9%), legal liquidity ratio (166.9%), total rating of 1.2% (1%), the cash balance ratio (40.1%) and a significant decrease in return on total assets (0%) (18.5%) and profit growth rate (-13.3%).

**Babel Bank:** The Bank of Babel received a satisfactory assessment during the year 2020 due to the significant increase in capital adequacy ratio of (96.3%), classification rate of (11.8%), legal liquidity ratio (66.1%), total rating of 1.2% (0%), the cash balance ratio of (15.3%) and a significant decrease in the rate of return on total assets (0%), return on equity (0.7%) and profit growth rate of (-4.3%).

**Bank of Baghdad:** The Bank of Babel received a satisfactory assessment during the year 2020 due to the significant increase in capital adequacy ratio of (14.4%), classification rate of (11.8%), legal liquidity ratio (66.1%), rating ratio of 9.9%, total rating ratio of 1.9%, the ratio of non-performing loans to total assets (2.7%), legal liquidity ratio (107.6%) and a significant decrease in the rate of return on total assets (0%), return on equity (7.2%) and profit growth rate of (10.3%).

**Dares Salaam Bank:** The Bank of Dares Salaam received a satisfactory assessment during the year 2020 due to the significant increase in capital adequacy ratio of (40.3%), legal liquidity ratio (66.1%), rating ratio of 0%, total rating ratio of 1.0%, the ratio of non-performing loans to total assets (2.7%), legal liquidity ratio (158.3%), growth rate of (38.9%) and a significant decrease in the rate of return on total assets (0%) and return on equity (7.2%).

**Sumer Bank:** Also, the Bank of Sumer received a satisfactory assessment during the year 2020 due to the significant increase in capital adequacy ratio of (70.6%), legal liquidity ratio (66.1%), rating ratio of 0%, total rating ratio of 3.1%, the ratio of non-performing loans to the growth rate (47.1%), legal liquidity ratio (318.4%) and a significant decrease in the rate of return on total assets (0%) and return on equity (7.2%) and the cash balance of 8.3%.

Therefore, the ratio of non-performing loans to total assets and the rate of return on total assets have no effect on the process of evaluating banks and judging their continuity according to the analysis of the results of 2020. Thus, they are unnecessary and can be dispensed. Capital adequacy index, asset quality index (rating ratio, total rating ratio), liquidity index (legal liquidity ratio) and cash balance ratio are the main indicators by which banks

can be evaluated and judged. Therefore, the first objective of this study (predicting financial failure using traditional methods by using time series) is achieved.

**The second; Intelligent techniques is used for predicting financial failure (decision trees technology):** The following figure shows the steps followed for the decision trees:

**Input preparation for the decision trees:** To improve quality and the level of the accuracy this data processing is followed after the process of obtaining the results of the CAMELS standard for 10 years. The process of data preparation is set to be used in decision trees technology. For each indicator, the initialization process was carried out by extracting the average of the CAMELS results for 10 years. A separate file is then used to store the data. Also, for each one value index, the bank of the sample contains nine values. To predict decision trees, CAMELS that are stored in the data file will be relied on as inputs.

**Application of the algorithm of decision trees on the data matrix:** In this stage, the researcher prepared the data for decision trees (inputs) to implement the algorithm of decision trees on the stored data that has been configured.

**Storage and retrieval of results from decision trees:** The process of storing the results is achieved in this stage to facilitate the interpretation and evaluation through the application of the algorithm of decision trees in new matrices. This is carried out in order to accurately determine the potential decisions of the banks sample research.

**Evaluation and interpretation of decision:** This stage involves the evaluation and interpretation of results by interpreting the decisions result from the decision tree with the specific comparison criteria in order to reach the appropriate decision to predict the financial failure of the selected banks and to make a choice between the decisions (alternatives available). The banks evaluated the selected banks, according to the decision trees algorithm by following, the stages of researcher mentioned above. The assessments are shown in Table 4. Therefore, this study achieved the second objective which states that,"financial failure is predicted using smart technologies through the application of a data mining tool called decision trees".

Table 4: Evaluation of the selected banks according to the algorithm of decision trees

| Bank name | Evaluation |
|---|---|
| Middle east bank of Iraq | Good |
| Northern bank | Satisfactory |
| United investment bank | Good |
| Bank of Mosul | Satisfactory |
| Bank of Babylon | Good |
| Bank of Baghdad | Good |
| Dar salaam bank | Satisfactory |
| Sumer bank | Good |

Preparation of researchers

**Third; Interpretation of results and proof of hypothesis by comparison between traditional methods and intelligent techniques:** The results of the traditional methods (Time series) were compared with the results of intelligent techniques of data mining in order to know which methods are more accurate in judging the continuity of economic unity in their activity by using one of its tools, decision trees as presented in Table 5 and 6. Comparison of traditional methods and intelligent techniques. The second objective of the research which is to predict financial failure using smart technologies through the application of a data mining tool, decision trees is achieved by the study.

Comparison of the results of traditional methods with the results of smart technologies. Therefore, there is continuity in the selected banks of this study mentioned in Table 5 and according to what has been analyzed with their differences in terms of the nature of the treatment. The banks that obtained the satisfactory evaluation are in appropriate positions with some imbalance which are able to bear all the fluctuations that occur in the market. There are financial adequacies and there are some minor problems that can be addressed and corrected through the exercise of normal control only.

In order to support the existing control system, the banks that have received a good evaluation, faces some weaknesses and requires it to work with caution, seriousness and in appropriate manner. During this stage of exercising control a follow-up is done in order to overcome the existing risks and weaknesses for the sake of continuity. Both methods are good at predicting financial failure and judging the continuity of economic unity through the results of the comparison between traditional methods and intelligent techniques. Therefore, any method can be used in the banks for forecasting. This study realized that the smart technique of data mining through the use of one of its tools, i.e., the algorithm of decision trees is more accurate in providing information that helps in judging the continuity of banks. Due to many considerations including accuracy, interpretation, understanding and speedin practice, the

Table 5: Comparison of traditional methods and smart technologies

| Traditional methods | Smart technologies |
|---|---|
| In the absence of accurate data, the ability to explain the phenomenon in question is weak | It has the ability to deal with large data lost |
| Using historical data to predict the future | It predicts the future based on current and historical data |
| It is applied to identify the causes and events that lead to the change in phenomena and treatment | It does not know the causes and events that lead to change in phenomena and treatment |
| It is a means or tool for predicting the future | The method applies instrument or means to support decision |
| It gives a precise description of the phenomenon in question | It gives a precise description of the phenomenon concerned |
| In order to predict the future it reveals the knowledge of the rise and fall of the phenomenon | In order to predict, you cannot know the state of the rise and fall of the phenomenon |
| Non-numeric data are not processed | It has the ability to process numerical data |
| Complexity in the account | It is easy to interpret and understand |
| Difficulty in understanding and interpreting | Its accounts are uncomplicated |
| Views need a large number of 150 views or more whereas they are restricted | It is flexible in receiving the number of views (i.e., it has a value whether the numbers of views are large or slightly few) |
| This method does not give the bank a greater chance to continue as the judgment alone takes each year alone | As the rule is not marginally taken for the average total years, it gives the bank a greater chance to continue or not to continue |
| It has complex processors based on exponential equations | It requires more speed to take the rate |
| It needs longer period of time thus, it is slow | Based on the instructions (If-then) conditional, the treatment is easy |
| This method predicts each year on its own which makes it more accurate | As the method depends on the rate, leading to the loss of some data, the method may lose some of its accuracy |

Table 6: Compare the results of traditional methods with the results of smart technologies

| Bank name | Traditional methods (time series) | Smart technologies (data mining technology-decision trees) |
|---|---|---|
| Middle East Bank of Iraq | Good | Good |
| Northern Bank | Good | Satisfactory |
| United Investment Bank | Satisfactory | Good |
| Bank of Mosul | Satisfactory | Satisfactory |
| Bank of Babylon | Satisfactory | Good |
| Bank of Baghdad | Good | Good |
| Dar Salaam Bank | Satisfactory | Satisfactory |
| Sumer Bank | Satisfactory | Good |

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traditional methods of statistical time series are employed. They all have values even with few data and other features of these methods with the results.

Furthermore, the third objective of the study stating that the traditional or intelligent method provides availability of more accurate information which helps to judge the continuity of banks in the operation is achieved. Thus, the hypothesis of the study is proved. The relationship between the use of data mining technology and the use of one of its tools, the decision trees algorithm is significant with the ability of the selected banks to predict financial failure and to judge the continuity of economic unity.

## CONCLUSION

The contribution of this study can be seen from the use of smart technologies and their ability to raise the efficiency of Iraqi private banks in the field of predicting financial failure. It is applied to reduce the challenges faced by private banks such as inability to meet their obligations that leads to bank ruptcy and liquidation and the decision tree algorithm as one of its tool can help to predict financial failure and the ability of banks to continue their activity which are necessary and urgent requirement at the moment.

The important indicators in determining the unit's ability to continue are the that assist the auditor in estimating the continuity of indicators (financial, operational and other) and the indicators and events that indicate uncertainty about the continuity of the economic unit. Also, more accurate information is provided by the intelligent techniques of data mining technology using one of its tools, the decision tree algorithm which helps in judging the sustainability of banks in their operations.

## RECOMMENDATIONS

Financial, operational and other indicators should be considered by the banks in order to judge the bank's sustainability and help them to strengthen and address weaknesses in these indicators. The decision trees algorithm under data mining technique can be used to provide more accurate information, predict financial failure and judge the continuity of Iraqi private banks. Other technologies such as (id3 and c4 algorithm) also have the possibility to be used to achieve the same objectives above.

## LIMITATIONS

The limitations of this study are as follow:

**Spatial boundaries:** The spatial boundaries of this research are private commercial banks listed in the Iraqi market for securities.

**Time limits:** This study is based on the published financial statements of the Iraqi private commercial banks listed in the Iraqi stock exchange for 10 years (2006-2015).

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