



Use of Data Mining for the Assessment of the Mudaraba Performance Risk in the Light of Macroeconomic Factors¹

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Abstract: In this article, we present an approach to evaluate a Mudaraba project financed by the Islamic bank, taking into account macroeconomic indicators for the estimation of performance and risk. For conventional banks, interest rate credit is the main source of income. On the other hand, for Islamic banks, the interest rate is prohibited by Islamic religion, and so they derive directly their profitability from the return of investment projects based on the Mudaraba.

The goal is to develop a model based on the algorithms of the data mining to evaluate a Mudaraba investment project. This mathematics model, which is being developed based on previous data from similar projects, is composed of several key elements, including the performance of the project and the macroeconomic factors.

To assess the performance risk of the Mudaraba project, all these elements are being inserted using data mining techniques and algorithms, which initially allow the use of non-supervised classification methods to group these projects according to common factors (which allow them to be successful or not); then in a second phase using predictive techniques to build a predictive model for the risk of return. The model allows evaluating the project financed by the Islamic bank and represents an important means that will help the managers to make decisions on its realization or rejection. It is a tool to classify projects that should be financed according to priorities governed by the volume of gains and losses represented by the performance indicator.

Keywords : Profitability, risk, data mining, Mudaraba , macroeconomic factors, classification methods, predictive techniques.



Introduction:

With the advent of globalization and its economic environment of opening up trade, markets have become bound and interdependent between them and macroeconomic factors have a strong influence on the performance of activities in different sectors. In this context, classical finance is obviously impacted and requires a framing of certain financial institutions such as the central bank. The same goes for Islamic banks which have even more limitations and stricter rules (to be in agreement with Islamic religion) which makes them vulnerable to different risks of liquidity and operational efficiency

In addition, the promotion of youth entrepreneurship to improve the economic level of a country is a major development lever for governments in order to foster the development of the business climate and the employment market, which will help to reduce the unemployment rate, especially that of

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graduates, still very high. Thus, there is a fair share of the risk between the various stakeholders of the commercial activity through the principle of sharing profits or losses. Therefore, an accompaniment of the Islamic bank and its implication are more present in a constructive partnership to promote the success of the investment project. Where the interest of this article, which present an approach to evaluate a Mudaraba project financed by the Islamic bank, taking into account the macroeconomic indicators for the estimation of the risk of performance of a project.

The expected goal is the correct distribution of risks and the exclusion of interest rate as the main constituent to assess the performance and the risk incurred in a Mudaraba project financed by the Islamic bank response to certain recommendations of the Islamic Mujamaa al Fikh. Nowadays the most used tool not Islamic bank to lend funds to their customers is Mudaraba. It is also a means that contributes to the proliferation of financing of important projects that can be a real engine of economic development. It is a funding formula that is encouraging for the practical entrepreneurs for the banks but may present different risks to the bank and to the customer as well. When the Islamic bank funds a Mudaraba project, its goal is to generate a future profitability. The investment is financially translated into capital investment in order to purchase the means necessary to carry out activities for the development and the acquisition of operating resources for a return and financial performance.

In this research we first study the possibility of correlation between one of the macroeconomic indicators and the performance of the product Mudaraba.

In a second part, we will be interested in the use of K-Means for classification and grouping of the macroeconomic factors close to them to assemble them in clusters to check the economic climate and see if it is conducive to the investment.

In a third phase, the macroeconomic factors that have a direct impact on the performance of the Mudaraba investment project will be sought through logistical regression. At the end of this research we will go out with a model that will describe the performance behavior of the product Mudaraba with characteristic benchmarks that inform the investor on the dimension of the risk in this case for support for the upstream decision based on a concrete simulation of the macroeconomic environment of the investment.

1. Mudaraba product

1.1 Définition and concept

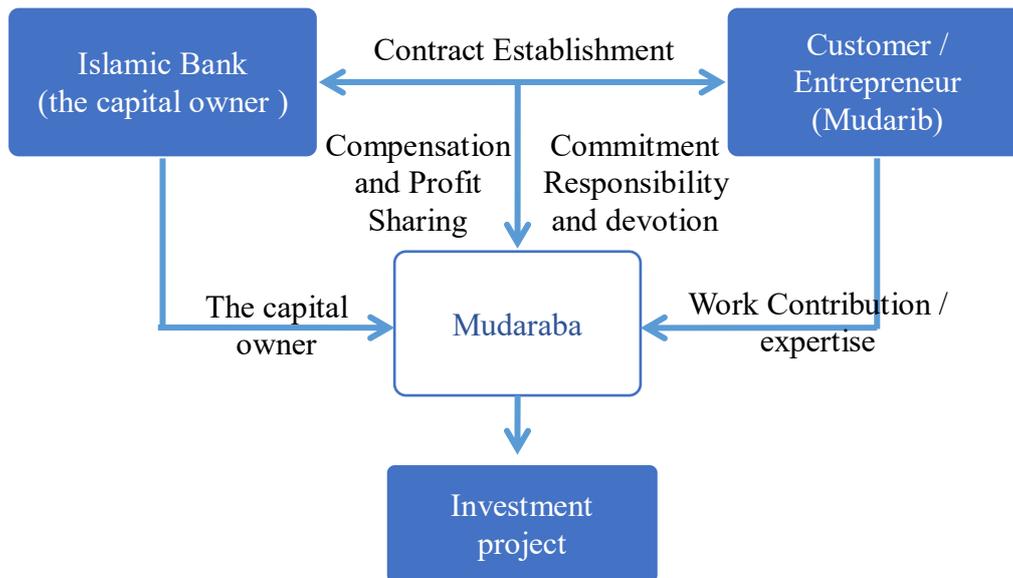
Mudaraba is an Islamic financial product that is represented by a partnership agreement between the Islamic bank and the entrepreneur.

In this agreement, the Islamic bank plays the role of the investor who finances the project in its integrity and the entrepreneur is responsible for its management. The pact may stipulate conditions and restrictions in the activity of the entrepreneur, the place and the time.

The Mudaraba contract also illustrates the division of the remuneration set at the beginning for the sharing of profits. In the event of a loss the entrepreneur loses only his work and his time devoted to the activity of the project, the bank in no case can claim the funds invested beforehand.

On the other hand the bank has the right to control the operations of the activity at all times and to do even a follow-up of the project since its launch.

1.2 descriptive scheme Mudaraba



Fig(1) : Scheme Mudaraba

2. Performance of the investment Mudaraba:

In a Mudaraba contract, Islamic banks do not act as mere lending agencies, but are rather actively involved in the operation of commercial activity by exercising the direct ownership of tangible assets and investment operations. But since the commercial operations for the Mudaraba project are based on the principle of the prohibition of interest rate and the secondary market of debt, the performance is perceived or calculated in a different way based solely on the income and costs of the Mudaraba project.

a) Return :

Performance is the main criterion for evaluating the project. Profitability is the return potential and profit that encourages investment since it is the objective and the reason for the project that also allows to cover the expenses and to pay the shareholders. The return is calculated based on the income generated by the project and the cost of the investments.

$$\text{Return} = \text{Income} - \text{Cost of Investment}$$

$$\text{Ret.} = \text{Inc.} - C_I$$

b) Income (Inc.) :

Income is the financial flow (cash flow) generated by the investment project for a time interval. Income raises the investor's interest and encourages it to develop the idea of investment. It is also equivalent to a turnover achieved by the sale of a volume of products during a given period.

$$\text{Inc} = \text{PU} * \text{Qty}$$

c) The cost of investment:

The total costs of the project's foundation from its initiation through its development to its self-financing capacity are the investment costs. The calculation of the investment costs differs from one

project to another but can be expressed by the following expression: $CI = \text{Invest. Initial} + \text{First Material Price} + \text{Operating Charges} + \text{Taxes}$

3. Risk of performance of the Mudaraba project:

3.1 Risk of management and market:

3.1.1- Risk of management:

As in the Mudaraba contract, the Islamic bank on its side invests by supplying all of the capital, the entrepreneur must ensure on his side the management and supervision of the project. It is a contract based on the principle of profit and loss sharing:

Profits are shared according to a pre-established ratio. The financial losses are entirely borne by the bank except in case of negligence, or bad execution of the contract, this principle of sharing generates risks related to the morality of the customers, since it is the Mudarib that is responsible for the management of the project and may not declare all the gains to the bank.

As a result, the Islamic bank runs the risk of return because the bank's results derive directly from the profitability of the projects based on the Mudaraba, whereas for the classical banks the credit bearing interest is the main source of income.

3.1.2- Market risk

The Islamic bank is also threatened by the risk of the market rate as it tries to offer its applicants an interesting remuneration that follows the evolution of the market rate. While the changes in the latter may result in a loss due to fluctuation in daily prices.

"Market risk is defined as the impact of market variable value changes on the value of positions taken by the institution. It is divided into risk of rate, exchange risk, risk of price variation (volatility) and liquidity risk," according to Esch L. et al. The risk of market price fluctuations is related to supply and demand on the market. This risk has an impact on contracts that are already priced and directly affect their value as well as their financial results.

3.2 The risk linked to macroeconomic factors :

Islamic financing is above all a method of financing, thus vulnerable to fluctuations in macroeconomic factors, which exposes it to risk of liquidity and capital in particular the case of Mudaraba projects. The macroeconomic factors influence both the business climate and the financial performance.

Among the macroeconomic factors, there are 2 important factors that have been considered in this study, namely inflation and economic growth:

- Inflation: it is a indicator of decreasing the value of money that results in an increase in prices and that strikes the global economy of the country. Inflation may have different causes such as the increase in the money supply, can be caused by the rising prices of imported goods, or by the imbalance of supply and demand.
- Inflation which for monetary reasons of depreciation of the currency or other can lead to the increase in prices and generate an increase in costs of return which is negatively reflected on the performance of a project
- Economic growth: which is the index of GDP variation from one year to the next which is supposed to measure the evolution of economic activity. The generation of financial flows is paramount for the continuation of the investment project and its evolution over time.
The increase in activity flows is promoted with strong economic growth improving wealth and setting up a climate of confidence reducing uncertainty about future incomes, inciting production and stimulating the development of investment.

- The growth of GDP leads to an increase in the public investment source of activities of the economic fabric and of a large number of companies which energizes the market and develops the income of the projects.

Finally, the risk is almost present in the determination of profitability through uncertainty as to the income and costs of Mudaraba products.

The high-scale uncertainty of macroeconomic factors related to turbulence in international financial places (due to globalization and to the international political system) represents a risk of return and a risk of capital losses of investment projects in the case of Mudaraba.

4. Datamining:

4.1- Définition and concept

Data mining is a science based on the process of analyzing data using techniques of recognition and detection of correlation and trend of a mass of information to extract the most relevant information engulfed in the databases.

Data mining uses the statistics rules with mathematical algorithms to evaluate events and analyze the links between the data to conclude on the trend of the data and the correlation between the information. Data mining uses different processes with analytical tools that allow the data to be searched and searched to determine the associations, relationships and to take out the real information so that it can be built and developed models that can describe the behavior of an activity or predict future risks..

4.2- Data mining Tasks :

1. Supervised Auto Classification:

- A method of examining the characteristics of a newly presented object to assign it to a class of a predefined set.
- The generated model allows to predict or estimate the missing or incorrect value with the classification model as a reference.

2. Unsupervised Auto Classification:

- Method that aims to identify the sets of elements that have certain common similarities without basing themselves on the preset classes.

Classification (supervised)	Clustering (not supervised)
Number of known classes	Number of Unknown Classes
Used to classify future data	Used to understand and explore current data

5. Exploitation of data mining in Islamic finance

The use of data mining in Islamic finance can help reduce risk and help extract the performance data of several Mudaraba projects to be able to analyze them and infer them from high-risk behavior and elements. Susceptive analysis can be used to make forecasts for future investment and to reach better conditions for the success of future Mudaraba projects with a minimum of risk. To do this, the datamining offers structured methodologies and tools for the exploitation of the information volumes in order to get out with conclusive results. The exploitation of data to extract the useful information goes through varieties of functions

1. Principle of not supervised k-Means analysis

The k-means algorithm assigns each point in a cluster whose center (centroid) is closest. The center is the average of all points in the cluster, its coordinates are the arithmetic mean for each dimension separately from all points in the cluster that is to say each cluster is represented by its center of gravity. Like the other algorithms of classification not supervised, it uses a criterion of minimizing intra-class distances and maximizing inter-class distances, but giving a certain degree of belonging to each class for each observation

Algorithm : K-means

Enter

A set of N data, noted by x;

Number of groups requested, noted by k;

Exit

A partition of K groups $\{C_1, C_2, \dots, C_k\}$

Start

1- Random C_k center initialization

Repeat

2- Assignment: generate a new partition by assigning each object to the group with the closest

center; $x_i \in C_k \forall j |x_i - \mu_k| = \min_j |x_i - \mu_j|$

With μ_k the center of the K class;

3- Representation: Calculate the centers associated with the new partition;

$$\mu_k = \frac{1}{N} \sum_{x_i \in C_k} x_i$$

Up to convergence of the algorithm to a stable partition;

End

2. Principle of analysis supervised by logistical regression:

This analysis allows to explain a categorical variable by one or more qualitative or quantitative variables

- Predict a categorical Y variable from a collection of explanatory variables $X=(X_1, X_2, \dots, X_p)$
- The Data

Logistics Regression

- The goal : to model $p(x) = p(Y = 1 | X = x)$
- Procedure : We modelize $\text{Log} \left(\frac{p(x)}{1-p(x)} \right) = \beta_0 + \beta_1 x_1$ then we deduce value of $p(x)$ by :

$$p(x) = \frac{\exp(\beta_0 + \beta_1 x_1)}{1 + \exp(\beta_0 + \beta_1 x_1)}$$
- l'expression $\frac{p(x)}{1-p(x)}$ called l'Odds,
- That is, the chance that the event $Y=1$ will happen, $0 < Odds < +\infty$

6. Empirical Study:

Modélisation du risque du rendement par régression logistique:

The current context of this empirical study is the development of a predictive model of the performance risk of a Mudaraba investment related to fluctuations in Macro-economic factors. At first using the methods not supervised the algorithms of the datamining will allow to group these projects according to common factors (success or not).

In a second phase, the predictive techniques will help to build a predictive model for the performance risk.

Before further elaborating the approach to estimating the performance risk of the project Mudaraba and performing a modeling. The influence or impact of macroeconomic variables should be seen on the success or failure of the investment.

For this purpose the theoretical choice of variables will be made from a study with a k-means which consists in grouping, in a non supervised way, a set of observations of different investments (successful and failed) by reporting the macroeconomic factors of the period.

To this end, an empirical study with the k-Means method was carried out on a sample of 330 observations of economic factors such as Inflation, GDP and money supply. .

3. Study of the correlation between macroeconomic factors and the return Mudaraba

The objective is to assess the relationship between macroeconomic factors and the risk of return Mudaraba . The following representation describes this relationship:

Results & Interpretations :

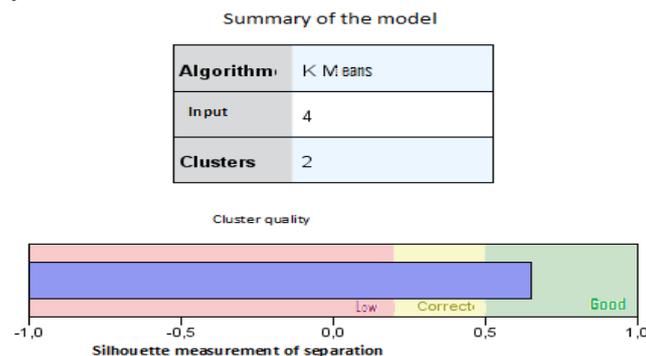
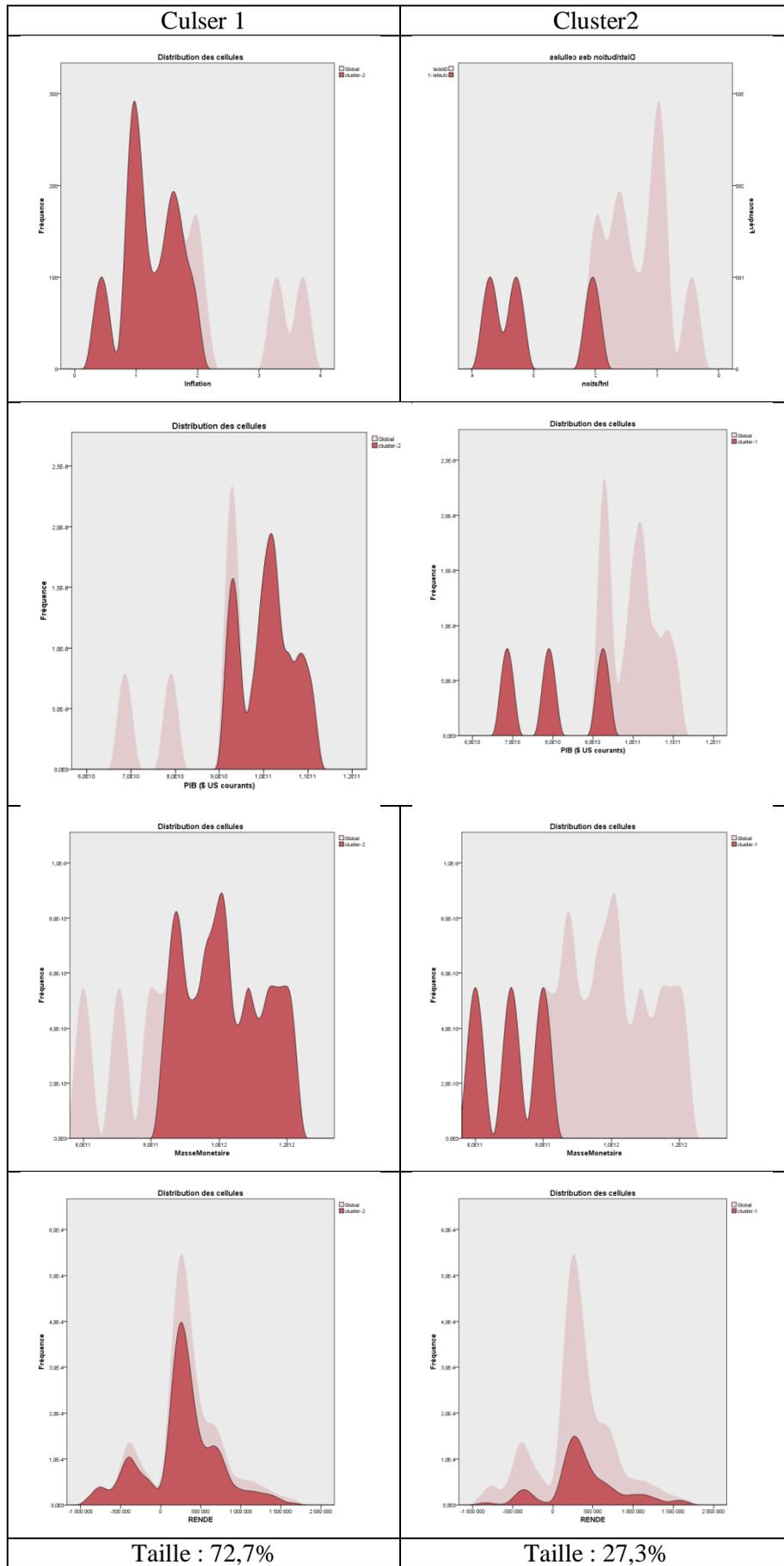


Fig (2): Clusters quality

The model is represented and described by the chart above.

The model reflects a good quality as the indicator comes to the green area.



This table shows that:

- Cluster 1 groups the values of inflation between 0,9 and 1,9, the GDP values between 1,0 E11 and 1,05E11, the money supply between 8,5E11 and 1,0E12 and the yield between 250000 and 500000 with a frequency max of 4,04E4.
- Cluster 2 carries the value of inflation to 3, the values of GDP <1,0E11, the monetary amount to 8,5E11 and the return of investments does not exceed a maximum of 1,0E4

So it can be concluded that in the case of cluster 1 with corresponding macroeconomic values there is no risk of return incurred for the investment Mudaraba.

While it is the opposite for cluster 2 or investment Mudaraba can run a certain yield risk.

4. Application of logistical regression for forecasting

The K-Means method showed the macroeconomic factors well influence the yield of Mudaraba investments, but does not allow to go out with a model . Then where the need to solicit logistical regression in the estimation of the parameters of the model .

Résults & Interprétations :

The results of the predictive power of this model will be represented in the following tables

Test of Hosmer-Lemeshow

Step	Khi-Chi-deux	ddl	Sig.
1	18,480	8	,018

Summary of models

Step	-2log- vraisemblance	R-deux de Cox & Snell	R-deux de Nagelkerke
1	179,807 ^a	,565	,756

Variables in the Equation

	A	E.S.	Wald	ddl	Sig.	Exp(B)	IC for Exp(B) 95%	
							Lower	Higher
Return	,000	,000	22,074	1	,000	1,000	1,000	1,000
GDP\$UScourants	,000	,000	26,897	1	,000	1,000	1,000	1,000
Etape 1 ^a Inflation	12,028	2,328	26,700	1	,000	167410,291	1747,286	16039852,940
Money Supply	,000	,000	24,446	1	,000	1,000	1,000	1,000
Constant	-90,949	16,978	28,694	1	,000	,000		

Its provided by the table above show inflation is the only factor influencing that is to that every change in the value of inflation will impact the return on investment Mudarab: So the coefficients of the discriminating function obtained using the SPSS software are:

$$\text{Log}\left(\frac{p(x)}{1-p(x)}\right) = -90,949 + 12,028x_{\text{Inflation}}$$

$$p(y = 1 | X = x_{\text{inflation}}) = \exp\left(\frac{-90,949 + 12,028x_{\text{Inflation}}}{1 + \exp(-90,949 + 12,028x_{\text{Inflation}})}\right)$$

Model Validation :

a) Table of classification

The classification results are presented in the following table

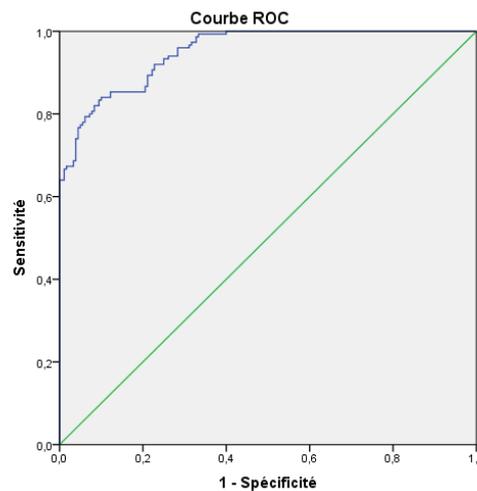
Classification table^a

	Observations	Forecast		
		INVES		Percentage correct
		0	1	
Step 1	0	165	15	91,7
	1	28	122	81,3
	Percentage global			87,0

a. Value of césure est ,500

This table allows us to see that the logistical regression has a good ranking rate (TBC) is 87% so the value of the error in the order of 0.13 %. At this stage of analysis, we can conclude that our model is correct.

b) Curve ROC (Receiving Operating Curve)

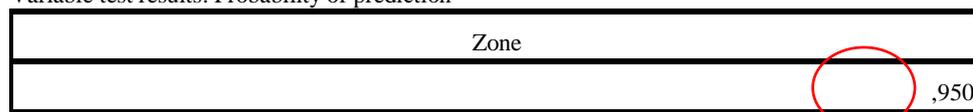


The ROC curve depends only on the ranking of the values, the more the two distributions are separated, the closer the ROC curve to the carr so the result is very satisfactory confirms that our model is good.

c) surface under ROC(AUC)

This area under known AUC (Area Under Curve) is a measure of the perf of a score and the quality of discrimination of the model

Variable test results: Probability of prediction



We note by Z the zone AUC :

in this case : $0,9 < Z < 1$ so la discrimination of our model is excellent

So in conclusion, we found a clear influence of inflation on the investment performance of Mudaraba.

Conclusion

This study has made it possible to verify that the performance of a Mudaraba investment can possibly be influenced by macroeconomic factors; confirmed by the presence of a relationship between the performance risk of the Mudaraba product and the macroeconomic factors of the empirical study.

We have shown through this driving approach to preventive nature that the bank can have a visibility on the position of its performance according to macroeconomic factors, before the signing of the contract, which will reduce the risk of return Mudaraba related to the national economy. Our research was crowned by a modelling with logistic regression. The model illustrates that the Islamic bank can make sure if the Mudaraba investment project can succeed or not before putting a capital at the disposal of the Entrepreneur (Mudarib)

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