

## Sukuk Rating Prediction using Voting Ensemble Strategy

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### ABSTRACT

Islamic finance development has grown into a focal point in many countries across the globe. Sukuk, in particular, an Islamic investment product that has received growing attention from sovereigns, multinational and national organizations from both developed and emerging economies. Its uses has been aimed to finance investments in a varieties of economic activities and development projects. Despite the promising look of Sukuk, currently there is lack of studies had been to examine and predict the rating of the Sukuk. As a result, many practitioners adopted the conventional bond hence ignore the fact that these two instruments are different in nature. In order to fill the gap in the literature, it is the aim of this research to develop an ensemble model that can be used to predict Sukuk rating. The effectiveness of the proposed models were evaluated using dataset on Sukuk issuance for domestic from 2006 to 2016. The results indicate that the overall performance of the ensemble model is fall short behind the induction decision tree (IDT) model. However, the class precision of the ensemble model improved, particularly in predicting the lowest rating of Sukuk.

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## 1. INTRODUCTION

The development of the Sukuk market has triggered the issue of Sukuk rating. As indicated in the previous studies, rating is essential for the corporation that issue Sukuk as well as for investors. This is due to the contribution of rating in providing a general picture of credit worthiness of a particular Sukuk. Having a good rating tends to enhance the demand of these instruments. The rating not only reflects risk and expected performance of the sukuk, but also beneficial and assist the investor specifically banks which invest in that particular security in measuring capital charge for this investment.

However, currently there has been a challenge for the company to regularly update and assess the rating of the Sukuk through rating agencies. This is due to high cost associated with performing credit assessments, hence impelled the necessity to acquire a model for Sukuk rating prediction. Such high cost is contributed by the large amount of time and human resources to conduct comprehensive analysis on the risk status of the company based on various aspects needed by the rating agencies. This highlight how valuable Sukuk rating prediction for investment market.

Data mining has become an increasingly important component in financial sectors. The number and variety of applications has been growing rapidly in the last decade, and it is predicted to continue to grow. Recently, the use of ensemble methods has been the highlight in the trade and academic literature in manufacturing and health sectors. However, the speed of its use had been lacking of financial and economics

domain in general, let alone Islamic finance. Therefore, it is the aim of this paper to improve previous study on Sukuk rating prediction by incorporating various Sukuk structures through the use of data mining technique, particularly ensemble method.

## 2. ISSUES IN SUKUK RATING

An important consideration in structuring sukuk is Shariah applicability for the sukuk to be traded on the exchanges. Unlike conventional bonds, sukuk should set approval from Shariah board as Shariah compliance marketable securities before being issued in the market. The Shariah board assesses the structure of the transaction and determine on its compliance with Shariah prior to the launch of sukuk [1].

Related to sukuk ratings, rating agencies, however, only give an opinion on the credit aspect linked with the instruments. Since the rating agencies argued that Shariah-compliant nature of sukuk is neutral from a credit perspective, the rating assigned to sukuk does not imply any confirmation on Shariah compliance. According to Moody's [2], the rating only addresses the expected loss of an investment associated with the promise. The key substance of evaluating this sukuk is the return or profits, the cash flow payment as well as the risk of the instruments. The agencies believe that Shariah is an expert opinion; hence the rating agencies do not comment on Shariah unless it influences the credit risk [2]. This position is consistent with rating agencies' long-held position that a rating does not constitute a recommendation to buy, sell or hold a particular security [3].

There is a possibility that other Shariah scholars take different views of other Shariah advisors with regard to the compliance of the sukuk. Nevertheless, this fact would not be affect to the obligation's enforceability, since it is determined by the commercial law instead of Islamic law. This circumstance also does not influence rating unless it affects the risk of the sukuk. Nevertheless, the transaction liquidity may be affected, as investor tent to reluctant to invest in the transaction that has been argued were not compliant with Shariah [1].

## 3. SUKUK VERSUS CONVENTIONAL BOND

Sukuk and conventional bond securities have some similarities such as fixed term maturity, coupons and they are both traded in the secondary market. Tariq [4] mentioned that Sukuk has a similar function with bonds, which is to enable companies to raise capital, however in a Shariah-compliant fashion, whilst at the same time expanding the investor base and offering investment opportunities for new groups. Though, to some extent, theoretically there should be some differences in rating methodologies for bond and Sukuk because these two instruments are different in nature. Bonds are contractual debt obligations whereby the issuer is contractually obliged to pay to bondholders, on certain specified dates, interest and principal.

On the other hand, according to AAOIFI Standard no.17 [5], Sukuk are certificates of equal value that represent an undivided interest in the ownership of an underlying asset, usufruct and services or assets of particular projects or special investment activity. The Sukuk holder also has a claim to the underlying assets as is also the case with normal conventional bonds should the issuer default on payments. Consequently, Sukuk holders are entitled to share in the revenues generated by the Sukuk assets, as well as to share in the proceeds of the realization of the assets. Sukuk certificates are unique in the way that the investor becomes an asset holder, hence should bear the risk of its underlying assets. Sukuk certificate holders carry the burden of these unique risks.

Another major difference between Sukuk and conventional bond is in terms of the investment risks. Sukuk is associated with a risk termed as Shariah compliance risk, which is essential during the structuring stage based on the available Islamic finance contracts. Nonetheless, Sukuk has some similarities to conventional bonds because they are structured with physical assets that generate revenue. The underlying revenue from these assets represents the source of income for payment of profits on the Sukuk. According to AAOIFI [5], Sukuk are issued on various transaction contracts. These Sukuk are Ijara, Murabaha, Salam, Istisna, Mudaraba and Musharaka, Muzara'a (sharecropping), Muqasa (irrigation) and Mugharasa (agricultural partnership). However, the last three types are rarely used in the market. Those structures will affect the coupon payment method as well as the risk characteristics. The different nature of bonds and Sukuk in terms of their respective credit risk exposure causes the need for different ratings assessment.

## 4. DATASET AND METHODS

### 4.1. Sukuk Issuance Dataset

The training sample is based on the rating of the Sukuk announced by several rating agencies from 2006 to 2016 for domestic market. The rating in this study partially adopted the categorical order given by

Moody's [2], and categorised the rating into 4 class. The categories adopted in this study is AAA (as the best rating), AA, A, and BBB (as the lowest rating). In order obtain reasonable sample size, Sukuk evaluation was collected based on their historical rating. In other words, the sample was taken from every rating announcement or rating affirmation date. For example, Sukuk X has been assigned AAA rating in the first issuance on June 2009. Subsequently on June 2010, rating agency announce rating affirmation (AAA). However, it is possible due to several factors, the rating is then downgraded in Jun 2011 to AA. As such, this study collect each Sukuk rating announced as different samples. In this study, 320 samples had been collected to be used as dataset for the prediction model.

#### 4.2. Variable Selection

In this study, the variable selection was based on previous study conducted by Altman [6]. The most common variables used in previous studies which important and relevant to Sukuk rating were included in the building the prediction model. According to previous research, liquidity, profitability and leverage ratios are also constantly used and considered to be some important indicators for bond rating prediction. Some studies consider qualitative variable as additional information of the company, such as subordination, guarantee status, or tax burden.

Market variables such as credit spread, stock price volatility, or GDP are rarely used by bond rating previous studies. However, Niklis, Doumpos, and Zopounidis [7] and Hajek and Michalak [8] believe that a market variable is an important indicator to capture the situation of the company or particular security. As such, the market variable is included in the prediction model.

#### 4.3. Ensemble Model Development

The use of ensemble methods has been increasing in the past few years [9], [10]. The main objective of an ensemble method is to train multiple base learners to solve the same problem [11]. This is different to the ordinary model development approach which aimed to build one learner from the training dataset. In ensemble method, the aim is to construct a set of learner and combine them, hence called multiple classifier systems [11]. One of the main advantage of using ensemble method is to address the weaknesses of each classifier algorithm, since the generalization ability of an ensemble is often much stronger than of base learners [14].

In this study, an ensemble strategy is adopted to construct a model that best predict the rating of a Sukuk. In evaluating the models, in this research the authors do not limit the term 'best' is to the highest accuracy. Instead, we focused on constructing a model that could best explain and predict the feature of 'BBB' rating, as the lowest rating with greater risk, as compared to other higher ratings.

Figure 1 shows the process of ensemble model development undertaken in this research.

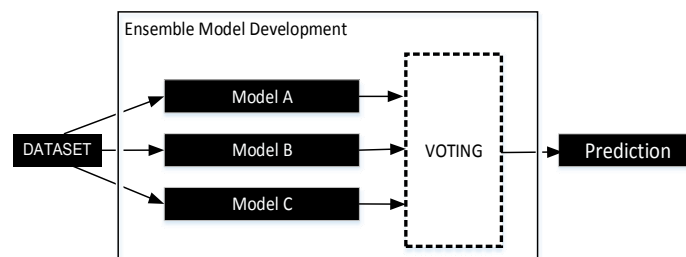


Figure 1. Process of ensemble model development

## 5. RESULTS AND ANALYSIS

This study adopted three main base learner algorithms, namely Induction Decision Tree (IDT), Naïve Bayes, and Rule induction. Prior to adoption of the ensemble strategy, the performance of each base learner algorithms was assessed. If there are  $n$  total ratings to be predicted, then the accuracy is stated as:

$$Accuracy = \frac{n - \#errors}{n} \times 100\% \quad (1)$$

Table 1 shows the summary of the performance accuracy of all base learners algorithms, including the ensemble method. As can be seen in Table 1, the highest performance accuracy is calculated for Induction Decision Tree (IDT) algorithm with 90.38%.

Table 1. Performance Accuracy of Selected Models

Model	Accuracy (%)
Ensemble	83.78
Induction Decision Tree	90.38
Naïve Bayes	68.06
Rule induction	72.83

To further examine the performance of the models, a detail assessment on the class precision was undertaken in this study. This is to ensure that the main purpose of this study, i.e. a model that could best explain and predict the feature of ‘BBB’ rating, is achieved.

Figure 2 shows the comparison of class precisions among the models developed in this study. Despite a lower performance accuracy of ensemble model (see Table 1) as compared to IDT model, this model has proven to have the best ability to predict the rating with the highest risk, which is BBB in this study.



Figure 2. Comparison of class precision for each model

In addition, it is interesting to note on the decision tree generated from IDT algorithm included in this ensemble model. One of the benefits of adopting decision tree in knowledge discovery is to visualize the path to each decision, or often called as rule induction. For every path from the root node of the tree to one of its leaves can be translated into a rule by connecting the tests along the path to form the antecedent part, and selecting the leaf’s class prediction as the class value. As can be seen in Figure 3, the extracted rules for the BBB ratings in this study can be articulated into the rule: “If the company produces industrial product, and the book value per share is less than equal to 0.367, and the total asset value is less than equal to 578.627, then the rating of the sukuk is BBB”. Such set of rules can then be simplified to improve its comprehensibility to a human user, and possibly its accuracy [12], [13].

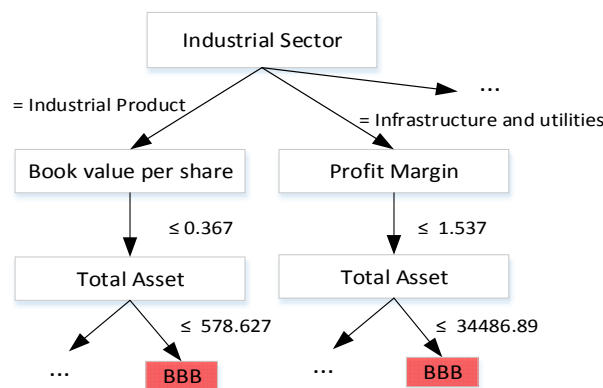


Figure 3. Extracted rules from decision tree model included in voting ensemble strategy

Similarly, another rule that can be observed in Figure 2 is the rule for the company in infrastructure and utilities sectors. The rule can be articulated into: "If the company is in infrastructure and utilities sectors, and the profit margin is less than equal to 1.537, and the total asset value is less than equal to 34484.89, then the rating of the sukuk is BBB". Hence, these rules have provide some insights for the investors and rating agencies in looking into the process of determining the Sukuk rating.

## 6. CONCLUSION

This study adopted the ensemble strategy to predict corporate Sukuk ratings. From the performance accuracy, the result shows that IDT has better performance as compared to other base learner algorithms and ensemble model. However, it is interesting to note that when it comes to the class precision, ensemble model has better predicting ability to identify the rating with the highest risk, which in this study is BBB. These findings are expected to enrich the literature and have practical implications. This model is expected to be useful for the rating agencies to perform a shadow rating, for issuing companies and fund managers to conduct their own credit analysis for risk management and trading purposes. In addition, these models can be of use to banks that rely on rating systems in order to improve the risk-assessment techniques, pricing strategies, and provisioning levels as require in Basel III.

Empirical results are also expected to contribute a wealth of knowledge to the development of Islamic finance while encouraging analysts and academic researchers to develop other potential research related to this topic. Future research is needed to compare the asset-backed Sukuk and the asset based Sukuk. In addition, it is noted that the issue of guarantee status has not been extensively explored in this study. Yet, there are various types of guarantee status or binding agreements in accordance with the structure of Sukuk. Hence, future research is needed to further study the role of various types of this guarantee status so as to give a better picture with regard to Sukuk credit risk profile.

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