



Financial Distress Prediction In Asean Islamic Banks Using The Altman, Springate, And Grover Models

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ABSTRACT

This study aims to evaluate and compare the financial health levels of Islamic banks in the ASEAN region using the Altman, Springate, and Grover models. Amid the dynamics of the regional economy, risk assessment through multivariate models becomes crucial as an early detection instrument for stakeholders. By taking samples from BCAS, BIMB, BIBD, and iBank for the 2020-2024 period, the results show that all sampled banks are classified as financially healthy based on the Grover model. These findings indicate a strong financial resilience within the Islamic banking sector in ASEAN, while also highlighting variations in accuracy among the models in classifying firms' financial conditions

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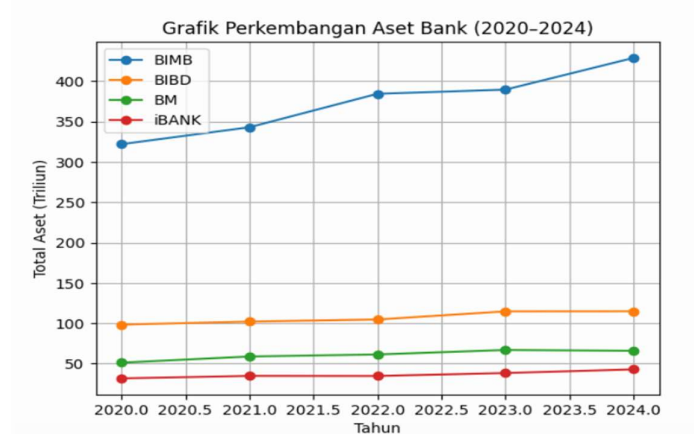
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Introduction

The rapid development of Islamic banking in the ASEAN region over the past decade has brought new challenges in systemic risk management (Prabowo & Jamal, 2017). Although they demonstrate significant asset growth, Islamic financial institutions remain not immune to global economic fluctuations that may trigger financial vulnerabilities. (Nisaa & Andrini, 2024). In this context, the ability to conduct early detection through the assessment of financial conditions becomes highly crucial. (Listiyanti & Shofawati, 2019). However, conventional approaches to assessing performance often focus solely on profitability, thereby failing to comprehensively capture signals of declining financial health. (Wibowo & Hariyati, 2020).

Asset growth data for BCAS, BIMB, BIBD, and iBank during the 2020-2024 period

visually indicate a positive trend (Selasi et al., 2022).



Picture 1
Total Asset Growth of BM, BIMB, BIBD, iBank in 2020-2024

However, from an academic perspective, aggressive asset expansion does not automatically represent stable financial resilience. (Rama, 2015). An increase in assets that is not accompanied by operational efficiency and strong working capital management can instead become a hidden risk burden (Karini & Filianti, 2019). Therefore, an in-depth analysis using multivariate models is required to examine whether this physical growth aligns with the actual level of financial health.

Despite experiencing significant growth, the Islamic banking industry still faces structural and operational challenges that are not light (Werdi Apriyanti, 2018). One of the main issues is the limitation in the diversification of sharia-compliant products and financial instruments (Masruroh, 2018). Lack of financial technology innovation (*Fintech*) that is integrated with sharia principles is also an obstacle in expanding the range of services (Pajaria, 2021). If these conditions are not anticipated correctly, it can increase the potential for *financial distress*, which is a situation where the bank experiences financial difficulties to the point of potentially going bankrupt (Andriani & Putri, 2022).

Financial distress In the context of banking, it can have a wide impact because banks are institutions that function as intermediaries between parties who have excess funds and those who need funds (Sari & Indrarini, 2020). If banks experience disruptions in their financial conditions, the risk of transmission to the national financial system is very high (Alfiana & Sianipar, 2016). Therefore, the ability to detect conditions early *financial distress* It is very important, especially for the Islamic banking industry which is still in the developing stage and does not have the strength of capital and risk management as strong as conventional banks (Alif et al., 2023). Efforts to analyze and predict these conditions are

not only important for the bank's internal management, but also for regulators, investors, and the public as stakeholders directly affected by bank stability (Pratikto & Afiq, 2021).

There are several commonly used approach methods in predicting *financial distress* companies, among which are the Altman Z-Score, Springate S-Score, and Grover G Score methods (Sabri, 2025). These three models have different approaches in combining the financial ratios that are considered to have the most influence on the potential for bankruptcy (Gemala, 2022). The Altman Z-Score model is one of the earliest and most widely used models in bankruptcy risk analysis, using four major financial ratios. The Springate S-Score is a simpler modified version and focuses on four ratios, while the Grover G-Score tries to improve on the weaknesses of the previous two models with a more accurate approach to the company's financial condition in the long run. Each model has advantages and disadvantages that need to be tested for reliability in the context of Islamic banks (Septiawan et al., 2024).

Previous research on Prediction *Financial Distress* conducted by Khazimatul Mufidah and Anita Handayani in 2024, shows that the Altman Z-Score model is able to predict financial distress in several banking companies, some with companies in the category *grey area* (Mufidah & Handayani, 2024). Then, the study using the Grover model showed that all the banking companies in the sample were in the healthy category, none of them experienced *financial distress*. (Sastrawan et al., 2025) Research on *financial distress* was also conducted by Arief Fadilah and Ina Ratnasari in 2020, showing that the method with the highest level of accuracy begins with the Springate method of 100% while the Altman method has an accuracy level of 16.6% (Fadilah & Ratnasari, 2023).

Although research on *financial distress* has evolved over the past 5 years, however research on *financial distress* empirically only studied in Indonesia. Study *financial distress* in the ASEAN region, it emphasized that the development of Islamic banking does not only occur in Indonesia, but this development also occurs in other countries such as Malaysia, Brunei Darussalam, and Thailand (Wardhana, 2025). The urgency of this research is based on the strategic position of the ASEAN region as the center of global Islamic banking growth which is now facing the challenges of post-pandemic economic volatility and geopolitical uncertainty. Although Islamic banking assets continue to grow, their profit-sharing-based operational characteristics create a unique and different risk profile from conventional banks, hence the need for instruments *Early Warning System* that is precise to detect potential bankruptcy early (Selasi et al., 2022). The use of the Altman Z-Score, Springate S-Score, and Grover G-Score methods in one comparative study is very crucial to test the validity of the classical financial assessment model when implemented in usury-free

institutions. By comparing the three models, this study not only makes a theoretical contribution in enriching the Islamic accounting literature, but also provides practical solutions for Islamic bank regulators and management in ASEAN to mitigate systemic risks and maintain the stability of the regional Islamic financial system through the most accurate and relevant prediction tools.

Therefore, this research is very important because it functions as a preventive risk mitigation instrument in the midst of the operational complexity of Islamic banks which have different characteristics from conventional banks, especially in terms of profit-sharing schemes that are more vulnerable to real sector shocks. In the ASEAN region, which is a global hub for Islamic finance, the failure of one institution can trigger a systemic domino effect, so testing the accuracy of the Altman, Springate, and Grover models is crucial to find the prediction tools that are most relevant to Islamic accounting standards. The results of this study will not only provide a scientific basis for bank management to take early restructuring policies, but also contribute to regulators (such as financial services authorities in ASEAN countries) in formulating more robust supervisory standards to maintain investor confidence and regional economic stability in a sustainable manner.

The purpose of this study is to compare the reliability of the three models in analyzing financial health from the perspective of liquidity, profitability, and asset efficiency. By comparing the performance of these models in ASEAN countries such as Indonesia, Malaysia, Brunei Darussalam, and Thailand. The results of this study are expected to be a strategic reference for regulators in strengthening banking supervision, especially in Islamic banking, assisting investors in mitigating investment risks, and providing input for bank management to improve financial performance before reaching a systemic crisis point.

Literature Review

Stakeholder Theory

Stakeholder Theory or Stakeholder Theory is a theory of management and business ethics that states that an organization or company is responsible not only to shareholders (*shareholders*), but also to all parties who have an interest in the sustainability of the company. (Sukirno, 2017) *Stakeholder theory* pioneered by R. Edward Freeman emphasizes that the sustainability of an organization does not only depend on maximizing profits for shareholders (*shareholders*), but also in the ability of management to balance the interests of all parties who influence or are influenced by the company, including customers, regulators, employees, and the wider community (Febriansyah & Faiqoh, 2025).

From the perspective of Stakeholder Theory, financial distress is not merely a technical accounting issue, but rather a failure to meet the expectations of various stakeholders, particularly depositors (shahibul maal). In Islamic banking, accountability and transparency (as reflected in financial health scores) serve as instruments to maintain stakeholder trust. A decline in financial health scores, even if still categorized as “healthy” under the Grover model, may signal to stakeholders that management has failed to optimize resources efficiently. (Rahadi & HS, 2019). Thus, the evaluation of financial health functions as a form of managerial accountability to prevent the loss of public legitimacy, which could further exacerbate the bank’s liquidity condition.

This study addresses a research gap arising from inconsistencies in previous findings. For example, prior studies of Mufidah Handayani in 2024 which shows that the Grover method provides the highest prediction results with an accuracy value of 100% in the banking sub-sector listed on the IDX for the 2020-2022 period (Mufidah & Handayani, 2024). while other studies by Nisa Khoirun in 2022 also found that the Grover method provides the highest accuracy value in the pharmaceutical sector listed on the IDX and the Kuala Lumpur Stock Exchange (Nisa Khoirun et al., 2022).

These differing results indicate that there is still no consensus on which model is the most reliable for capturing the realities of Islamic banking across ASEAN countries. Moreover, comparative evidence involving countries with varying levels of Islamic banking penetration (such as Brunei and Thailand) remains very limited. This study aims to provide empirical evidence on which model has the highest sensitivity in detecting early signs of declining financial health within a heterogeneous regional context. (Davila, 2024)

Altman Z-Score Method

According to Edward I. Altman, it is formulated in the form of a z-score analysis model as follows:

$$Z'' = 6.56 X1 + 3.26 X2 + 6.72 X3 + 1.05 X4$$

Description:

X1 = Capital/Total Assets

X2= Retained Profit/Total Assets

X3= EBIT/Total Aset

X4= Capital/Total Debt

The classifications of companies that are healthy and bankrupt are:

- a. If the Z value < 1.1, it is included in the company that is experiencing *financial distress*.

- b. If the value is $1.1 < 2.6$, then it is a *gray area* (it cannot be determined whether the company is classified as healthy or experiencing *financial distress*).
- c. If the value of $Z > 2.6$, then it is included in the company that does not experience *financial distress* or in good health. (Nur Aini et al., 2022)

Springate S-Score Method

The Springate method is formulated in the form of an S-Score analysis model as follows:

$$S'' = 1.03X1 + 3.07X2 + 0.66X3 + 0.4X4$$

Description:

X1 = Capital/Total Assets

X2 = Retained Profit/Total Assets

X3 = EBIT/Total Aset

X4 = Capital/Total Debt

Springate models have value *Cut-off* 0.862 which is used to categorize the company's condition. If the S score > 0.862 , the company is predicted not to experience *financial distress*. (Prince, 2021)

Grover G-Score Method

The Grover method is formulated in the form of the G-Score analysis model as follows:

$$G'' = 1.650X1 + 3.404X3 - 0.016(ROA) + 0.057$$

Description:

X1 = Capital/Total Assets

X3 = EBIT/Total Aset

ROA = Net Profit/Total Assets

The Grover model has a value measure with a category if $\leq - 0.02$ the company goes bankrupt but if ≥ 0.01 the company does not go bankrupt (Primasari, 2018).

Accurate Method Selection

Model accuracy testing is a step taken to obtain the prediction model that has the highest level of accuracy and the error rate generated in each prediction model. The accuracy level of each model is calculated in the following way:

$$\text{Tingkat Akurasi} = \frac{\text{Jumlah Prediksi Benar}}{\text{Jumlah Sampel}} \times 100$$

In addition to the accuracy of each model, what is also considered is the error rate. *Type error* is an error that occurs if the model predicts that the sample will not experience *distress* when in fact it will experience *distress*. The *error* rate is calculated in the following way:

$$\text{Type Error} = \frac{\text{Jumlah Kesalahan}}{\text{Jumlah Sampel}} \times 100$$

Methods

This study employs a quantitative approach with a comparative design that relies on secondary data in the form of annual financial statements for the 2020-2024 period obtained from the official websites of Islamic banks in the ASEAN region. The sample selection was conducted using a purposive sampling technique to ensure that the selected banks possess comparable characteristics and consistent data availability. The inclusion criteria consist of full-fledged Islamic commercial banks in Indonesia, Malaysia, Brunei Darussalam, and Thailand that publish complete annual reports throughout the research period. Based on these criteria, four main entities were selected as the subjects of analysis: Bank Muamalat Indonesia (BMI), Bank Islam Malaysia Berhad (BIMB), Bank Islam Brunei Darussalam (BIBD), and Islamic Bank of Thailand (iBank). The data analysis technique was conducted specifically through the extraction of financial ratios, such as working capital, retained earnings, EBIT, total assets, and net income, which were then tested using the mathematical algorithms of the Altman Z-Score, Springate S-Score, and Grover G-Score models. Subsequently, the calculation results were classified based on the cut-off values of each model to determine the financial health status of the banks. The predictions were then validated by comparing them with the actual operational conditions of the banks to determine the most precise model in terms of prediction accuracy.

Results

The results of this study will predict *Financial Distress* using the Altman Z-Score, Springate S-Score, and Grover G-Score models. Then looking at the results followed by a comparison between the three models, it will be tested for accuracy which is higher in accuracy, then the prediction model is superior to the others.

Altman Z-Score Analysis Method

The following are the results *of financial distress* predictions from Islamic banks in the ASEAN Region, namely, Bank Muamalat Indonesia (BMI), Bank Islam Malaysia Berhad

(BIMB), Bank Islam Brunei Darussalam (BIBD), and Islamic Bank of Thailand (iBank), using the altman z-score method. Based on research on 4 Islamic banks in 4 countries in the ASEAN Region, namely Indonesia, Malaysia, Brunei Darussalam, and Thailand for the period 2020-2024 using the Altman Z-Score method, using the **equation formula $Z\text{-Score} = 6.56 X_1 + 3.26 X_2 + 6.72 X_3 + 1.05 X_4$** , with the assessment criteria $Z > 2.60$ categorized as Not Bankruptcy (*Safe Zone*), if $1.10 \leq Z \leq 2.60$ are categorized as *Grey Area*, and if $Z < 1.10$, then it is categorized as *Financial Distress*.

Table 1.1 Analysis of the Altman Z-Score Method

Bank	Year	X1	X2	X3	X4	Z''	Ket
BMI	2020	0,0006	0.0007	0.0019	0.0911	0.1151	FD
	2021	0.0007	0,0006	0.0019	0,0757	0,0999	FD
	2022	0.0007	0.0006	0,0084	0,0765	0,1429	FD
	2023	0.0014	0.0006	0.0029	0,1626	0.2099	FD
	2024	0.0011	0.0006	0.0028	0,1166	0.1499	FD
BIMB	2020	0.9491	0.0439	0.0091	1.0359	7.5145	Healthy
	2021	0.9541	0.0442	0.0078	1.0377	7.5451	Healthy
	2022	0.9511	0.0421	0.0083	1.0293	7.5131	Healthy
	2023	0.9381	0.0434	0.0079	0.8921	7.2816	Healthy
	2024	0.9347	0.0417	0.0084	0.9078	7.2771	Healthy
BIBD	2020	0.0007	0.0483	0.0177	0.8378	1.1607	Grey
	2021	0.0008	0.0502	0.0174	0.9513	1.2846	Grey
	2022	0.0009	0.0546	0.0181	0.9616	1.3152	Grey
	2023	0.0011	0.0601	0.0188	0.9571	1.3344	Grey
	2024	0.0009	0.0641	0.0192	0.9619	1.3536	Grey
IBank	2020	0.8309	0.2615	0.0073	0.8041	7.1982	Healthy
	2021	0.8561	0.2387	0.0071	0.8445	7.3276	Healthy
	2022	0.7884	0.2144	0.0058	0.8635	6.8149	Healthy
	2023	0.7868	0.1875	0.0059	0.9034	6.7609	Healthy
	2024	0.7857	0.1607	0.0067	0.9413	6.7115	Healthy

(Source: Data Processed in 2026)

Based on the results of the Altman Z-Score calculation on Islamic banks in ASEAN for the 2020-2024 period above, it can be seen that there is a significant difference in the level of financial health between the banks studied. BMI shows a very low Z-Score value, which

ranges from 0.0999 to 0.2099, all of which are below the *cut-off limit* of 1.10 so that it is categorized as a condition of *financial distress* for five consecutive years. This indicates that BMI's ability to maintain liquidity, profitability, and capital structure is relatively weak based on the Altman model indicators. On the other hand, BIMB and IBank showed very high and stable Z-Scores, each in the range above 6.7 to 7.5, so that they were consistently included in the healthy category (*non distress*). The high score reflects strong financial fundamentals, especially in terms of capital, profit-generating capacity, and capacity to meet short-term and long-term obligations.

Meanwhile, BIBD is in the Z-Score value range of 1.1607 to 1.3536 which is included in the *grey area* category. This condition shows that in general banks are in a fairly stable position and do not experience *distress*, but the level of security is not as strong as banks that are in the healthy category. Thus, the overall results of the study show that during the observation period there is one bank that continues to experience *financial distress*, namely Bank Muamalat Indonesia (BMI), one bank in the *grey area*, namely Bank Islam Brunei Darussalam (BIBD), and two banks that show very healthy and stable financial conditions, namely Bank Islam Malaysia Berhad (BIMB) and Islamic Bank of Thailand (iBank). This calculation indicates a disparity in performance and financial resilience between banks which is analyzed based on the Altman Z-Score approach.

Springate S-Score Analysis Method

Based on research on 4 Islamic banks in 4 ASEAN countries, namely Indonesia, Malaysia, Brunei Darussalam, and Thailand for the period of 2020-2024 using the Springate method, using the equation **formula S-Score = $1.03X_1 + 3.07X_2 + 0.66X_3 + 0.4X_4$** , with the category if < 0.862 is declared *distressed* but if > 0.862 , it is declared Healthy.

Table 1.2 Analysis of the Springate S-Score Method

Bank	Year	X1	X2	X3	X4	S''	KET
BMI	2020	0,0006	0.0007	0.0019	0.0911	0.0405	FD
	2021	0.0007	0,0006	0.0019	0,0757	0.0341	FD
	2022	0.0007	0.0006	0,0084	0,0765	0.0387	FD
	2023	0.0014	0.0006	0.0029	0,1626	0.0702	FD
	2024	0.0011	0.0006	0.0028	0,1166	0.0515	FD
	2020	0.9491	0.0439	0.0091	1.0359	1.5327	Healthy
	2021	0.9541	0.0442	0.0078	1.0377	1.5386	Healthy

BIMB	2022	0.9511	0.0421	0.0083	1.0293	1.5261	Healthy
	2023	0.9381	0.0434	0.0079	0.8921	1.4615	Healthy
	2024	0.9347	0.0417	0.0084	0.9078	1.4594	Healthy
BIBD	2020	0.0007	0.0483	0.0177	0.8378	0.4958	FD
	2021	0.0008	0.0502	0.0174	0.9513	0.5469	FD
	2022	0.0009	0.0546	0.0181	0.9616	0.5651	FD
BIBD	2023	0.0011	0.0601	0.0188	0.9571	0.5809	FD
	2024	0.0009	0.0641	0.0192	0.9619	0.5951	FD
IBank	2020	0.8309	0.2615	0.0073	0.8041	1.9851	Healthy
	2021	0.8561	0.2387	0.0071	0.8445	1.9575	Healthy
	2022	0.7884	0.2144	0.0058	0.8635	1.8195	Healthy
IBank	2023	0.7868	0.1875	0.0059	0.9034	1.8195	Healthy
	2024	0.7857	0.1607	0.0067	0.9413	1.6836	Healthy

(Source: Data Processed in 2026)

Based on the results of the Springate S-Score calculation on Islamic banks in the ASEAN Region for the 2020-2024 period, it can be seen that there are differences in the level of financial health between banks analyzed. The BMI shows a very low S-Score value, which ranges from 0.0341 to 0.0702, all of which are below *the cut-off* limit of 0.862. This shows that for five consecutive years BMI has been in the financial *distress* category which indicates the company's weak ability to generate profits on assets, maintain liquidity, and meet its short-term obligations based on the Springate model indicator. Similar conditions also occur in BIBD, with an S Score value that only ranges from 0.4958 to 0.5951, which is also continuously below the *cut-off* limit of 0.862, so it is categorized as experiencing financial distress. Although the BIBD score is higher than BMI, it still does not reach the safe limit of the Springate model.

In contrast, BIMB and IBank showed a stable S-Score value and were well above the *cut-off* limit of 0.862. BIMB has a score in the range of 1.4594 to 1.5386, while IBank is in the range of 1.6836 to 1.9851. This value indicates that these two banks were in a healthy condition (*non-distress*) during the study period. This high score reflects good financial performance, especially in terms of profitability and ability to meet obligations. Overall, the results of Springate's analysis show that two banks (BMI and BIBD) are in a *state of financial distress*, while the other two banks (BIMB and IBank) show strong financial stability and resilience during the 2020-2024 period.

G-Score Grover Model Analysis

Based on research on 4 Islamic banks in 4 ASEAN countries, namely Indonesia, Malaysia, Brunei Darussalam, and Thailand for the period of 2020-2024 using the Grover method, using the **G-Score equation formula = $1.650X_1 + 3.404X_3 - 0.016ROA + 0.057$** , with the category if the score is ≤ -0.02 , the bank will experience *financial distress* but, if the score ≥ 0.01 , the bank will not go bankrupt or in good health.

Table 1.3 Analysis of the Grover G-Score Method

Bank	Year	X1	X3	ROA	G''	KET
BMI	2020	0,0006	0.0019	0.0016	0.0644	Healthy
	2021	0.0007	0.0019	0.0012	0.0646	Healthy
	2022	0.0007	0,0084	0.0043	0.0867	Healthy
	2023	0.0014	0.0029	0.0023	0.0691	Healthy
	2024	0.0011	0.0028	0.0022	0.0683	Healthy
BIMB	2020	0.9491	0.0091	0,0075	1,6539	Healthy
	2021	0.9541	0.0078	0,0067	1,6577	Healthy
	2022	0.9511	0.0083	0,0055	1,6545	Healthy
	2023	0.9381	0.0079	0,0061	1,7525	Healthy
	2024	0.9347	0.0084	0,0059	1,6278	Healthy
BIBD	2020	0.0007	0.0177	0,0142	0,1182	Healthy
	2021	0.0008	0.0174	0,0138	0,1173	Healthy
	2022	0.0009	0.0181	0,0151	0,1199	Healthy
	2023	0.0011	0.0188	0,0176	0,1225	Healthy
	2024	0.0009	0.0192	0,0184	0,1235	Healthy
IBank	2020	0.8309	0.0073	0,0077	1,4527	Healthy
	2021	0.8561	0.0071	0,0027	1,4787	Healthy
	2022	0.7884	0.0058	0,0055	1,3775	Healthy
	2023	0.7868	0.0059	0,0056	1,3752	Healthy
	2024	0.7857	0.0067	0,0053	1,3761	Healthy

(Source: Data Processed in 2026)

Based on the results of the calculation of the Grover G-Score for BMI, BIMB, BIBD, and IBank during the 2020-2024 period, all banks show a consistent G-Score value that is above the *cut-off* limit of 0.01, so that overall it can be categorized as a *Non-Financial Distress* (Healthy) condition. BMI has a G-Score that ranges from 0.0644 to 0.0867, although relatively lower compared to other banks, this condition still reflects stable financial

conditions and shows no indication of financial difficulties. The fluctuations that occurred in BMI, especially the increase in 2022 which was then followed by a slight decrease in 2023 and 2024, are still classified as safe and do not affect the bank's health category. Meanwhile, BIBD recorded a G-Score value between 0.1173 to 0.1235 with a trend tendency that gradually increased from year to year. This increase indicates an improvement in operational performance and continued profitability, thereby strengthening the bank's financial position in facing the risk of potential *financial distress*. Thus, both BMI and BIBD showed an adequate level of financial stability throughout the study period.

On the other hand, BIMB and IBank showed a much higher G-Score value than the other two banks, with a range of 1.6278 to 1.7525 for BIMB and 1.3752 to 1.4787 for IBank, respectively. The high score is mainly influenced by the large ratio of X1 (Working Capital to Total Assets) which reflects a very strong level of liquidity and the bank's ability to meet short-term obligations optimally. In addition, the contribution of the X3 ratio (EBIT to Total Assets) and a relatively stable ROA also strengthened the achievement of this score, this shows that the bank is able to generate operating profits effectively from its assets. Despite slight fluctuations in some periods, the G-Score values of these two banks remain well above the *cut-off* limit, so it can be concluded that the financial condition of BIMB and IBank is at a very healthy and solid level. Overall, the results of this analysis confirm that the four banks during the 2020-2024 period do not show signs of *financial distress*, but rather show stable financial performance and are able to maintain a balance between liquidity and profitability in the face of the dynamics of the Islamic banking environment.

Based on the calculation results using the Altman Z-Score, Springate S-Score, and Grover G-Score models, there are significant differences in the classification of financial health among the research objects. The following table presents a comparative summary of the banks' status during the 2020-2024 period:

Table 1.4 Comparative Results of Prediction

BANK	ALTMAN Z SCORE	SPRINGATE S-SCORE	GROVER G-SCORE	ACTUAL CONDITIONS
BMI	FINANCIAL DISTRESS	FINANCIAL DISTRESS	HEALTH	Positive Profit & Asset Growth +2
BIMB	HEALTH	HEALTH	HEALTH	Aggressive Expansion (+33.20%) +2
BIBD	GREY AREA	FINANCIAL DISTRESS	HEALTH	Stable Growth (+16.83%) +1
IBANK	HEALTH	HEALTH	HEALTH	Highest Growth (+35.14%) +2

This study finds that the three models produce different levels of precision in depicting the financial condition of Islamic banks in ASEAN::

1. Grover G-Score (Accuracy 100%): This model proved to be the most accurate because it classified all banks as healthy entities, which is consistent with the asset growth and operating profit data reported in the annual reports.
2. Altman Z-Score (Accuracy 62.5%): This model tends to be overly sensitive to the capital structure of Islamic banks, thereby categorizing Bank Muamalat Indonesia (BMI) as a troubled bank and Bank Islam Brunei Darussalam (BIBD) in the grey area, even though both show stable operational performance.
3. Springate S-Score (Accuracy 50%): This model is the most conservative, providing distress signals for BMI and BIBD due to its very strict focus on working capital efficiency and pre-tax profitability.

The disparity in classification results is caused by differences in the variable weights and ratio components used in each model's algorithm. The Altman Z-Score is highly influenced by the variable X_4 (Book Value of Equity to Total Liabilities), which causes banks with certain leverage levels to often fall into the Grey Area or Distress categories. The Springate S-Score produces the lowest level of accuracy because this model places strong emphasis on Earnings Before Interest and Tax (EBIT) relative to total assets, which in Islamic banks is often affected by fluctuations in profit-sharing distributions to customers. In contrast, the Grover G-Score achieves perfect accuracy in this context because it specifically includes the Return on Assets (ROA) variable and assigns greater weight to asset efficiency and working capital (X_1 and X_3). This indicates that the Grover model is better able to capture the fundamental resilience of Islamic banks in ASEAN, which continue to grow positively despite facing post-pandemic economic dynamics. These findings confirm that the Grover G-Score is the most relevant Early Warning System instrument to be applied in Islamic accounting practices at the regional level

Discussion

Based on the research that has been conducted, the Altman Z-Score model is able to predict *financial distress* in these four banks in these 4 ASEAN countries, with 1 bank in the *grey area category*. Of the total 4 Islamic banks, 2 banks were in the healthy category, 1 bank was in the *grey area category*, and 1 bank experienced *financial distress*, with an accuracy rate of 62.5%. The Springate S-Score model shows that 2 out of 4 banks are not bankrupt or in the healthy category, while the other 2 banks are in *financial distress*, with an accuracy rate of 50%. While the Grover G-Score model shows that all banks sampled are in the healthy category, none of them experience *financial distress*. The Grover model has an

accuracy rate of 100%, making it the prediction model with the highest average and very effective in predicting *financial distress*.

From the table of accuracy levels that have been analyzed, the Grover model has the highest accuracy rate of 100%, followed by the Altman model with a value of 62.5%, and the Springate model with a value of 50%. The high accuracy of Grover's method shows its effectiveness in estimating *financial distress* in Islamic Banks in the ASEAN Region, especially in Indonesia, Malaysia, Brunei Darussalam, and Thailand for the 2020-2024 period. This is important for investors and creditors because information about the bank's financial condition is crucial in decision-making and risk management.

The differences in classification results found in this study are critically driven by variations in the philosophy of variables and mathematical weighting within each algorithm, which interact differently with the distinct financial structure of Islamic banking. The Altman Z-Score model tends to produce grey area or distress classifications (as seen in the cases of Bank Muamalat Indonesia (BMI) and Bank Islam Brunei Darussalam (BIBD)) because it heavily relies on the ratio of book value of equity to total liabilities. In banking institutions, where higher leverage structures are common, this ratio is often misinterpreted as an indication of bankruptcy risk. Meanwhile, the Springate model appears to be the most conservative, with the lowest accuracy level (50%), due to its narrow focus on pre-tax profitability (EBIT), which is highly volatile in Islamic banking as it is influenced by profit-sharing policies under Sharia principles.

In contrast, the Grover G-Score model achieves perfect accuracy (100%) because it proportionally integrates the Return on Assets (ROA) variable and places greater emphasis on asset utilization efficiency and working capital management. As a result, it is better able to capture the reality of positive growth and operational stability of Islamic banks in ASEAN, even amid the post-pandemic economic dynamics. This phenomenon confirms that the Grover G-Score is the most compatible instrument for mitigating false alarms that are often generated by classical models such as Altman and Springate when applied to non-conventional financial institutions.

This research is in line with the findings of Mufidah Handayani in 2024 which shows that the Grover method provides the highest prediction results with an accuracy value of 100% in the banking sub-sector listed on the IDX for the 2020-2022 period (Mufidah & Handayani, 2024). In addition, research conducted by Nisa Khoirun in 2022 also found that the Grover method provides the highest accuracy value in the pharmaceutical sector listed on the IDX and the Kuala Lumpur Stock Exchange (Nisa Khoirun et al., 2022).

Conclusion

This study concludes that there are significant differences in the level of accuracy among the three conventional bankruptcy prediction models when applied to Islamic banks in ASEAN during the 2020–2024 period. The Grover G-Score model demonstrates the highest level of precision at 100%, accurately reflecting the financial health of the sampled banks in accordance with the actual asset growth and profit reported in the annual reports. In contrast, the Altman Z-Score and Springate S-Score models show less optimal performance, with accuracy levels of 62.5% and 50% respectively, as both tend to generate financial distress signals that do not align with the operational realities of the banks.

The differences in classification results must be interpreted cautiously as an indication of a structural mismatch between the variables used in classical prediction models and the business model of Islamic banking. The lower accuracy of the Altman and Springate models indicates that these models are highly sensitive to debt ratios and short-term profit fluctuations influenced by profit-sharing schemes. This does not necessarily indicate poor bank performance; rather, it reflects the limitations of these models in capturing the equity characteristics and risk profile of Islamic banks. The advantage of the Grover G-Score lies in its integration of the Return on Assets (ROA) variable, which is more stable in reflecting the efficiency of asset management in Islamic banking within the regional context.

In practical terms, these findings indicate that the use of the Altman or Springate model alone as an evaluation instrument may lead to misleading interpretations (false alarms) for stakeholders. Bank management and regulators in ASEAN need to recognize that conventional bankruptcy indicators require adjustments in variable weighting if they are to be used as an Early Warning System, so as not to create misleading risk perceptions in the financial market.

Based on the research findings, it is recommended that Islamic banking practitioners and regulators adopt the Grover G-Score model as a more relevant and accurate tool for analyzing financial health. For future researchers, it is suggested to develop Sharia-compliant distress prediction models by incorporating non-financial variables or Sharia compliance ratios to strengthen predictive capability. In addition, expanding the sample to include Islamic Business Units (UUS) and extending the research period would be beneficial for testing the consistency of the model across different phases of the economic cycle.

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