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Logistic Regression Model for Evaluating Performance of Construction, Technology and Property-Based Companies in Malaysia

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ABSTRACT

Financial distress refers to a situation where a company is facing significant financial difficulties or is at risk of insolvency. Being able to anticipate financial distress can help companies take proactive measures to address underlying problems, improve their financial health, and avoid bankruptcy. Likewise, investors can use such predictions to make informed decisions about their investments. The aim is to examine the significant factors of financial distress and accuracy model that can be effectively used in practice to analyse the financial distress of a construction, technology, and property-based companies. In this study, the Altman, Springate, Grover and Zmijerski model is used to classify the financial distress among construction, technology, and property-based companies in Bursa Malaysia Market Exchange during the 2017 to 2021. The models employ the logistic regression method to predict multiple financial ratios simultaneously to assess a company's financial distress. The result shows that the most significant financial ratio for Altman Z-Score model is X_1, and X_4 followed by Springate model are X_1, X_5 and X_6 and lastly, Zmijewski are ROA and DR. It also found that 100% accuracy of the Grover model suggested method has an acceptable efficiency to predict financial distress followed by Altman, Springate and Zmijewski model.

1. Introduction

In Malaysia, there are many sectors listed in Bursa Malaysia. The Bursa Malaysia Main Market which is the prime market for established companies that have met the standards in terms of quality, size and operations. Potential issuers for the Main Market must demonstrate that they have achieved minimum profit track record or minimum size measured by market capitalization. Based on the market capitalization based on companies' sector information, the construction is 1.83%, technology is 5.70% and property is 3.44% [1]. Since the outbreak of the coronavirus disease 2019

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(Covid-19), Malaysia is no exception as the outbreak of Covid-19 has adversely affected the industry and this industry continues to encountered severe challenges. Many companies experienced financial challenges during the pandemic. The decline in revenue and increased operating costs due to health and safety measures put financial strain on businesses. Companies faced difficulties in meeting their financial obligations, paying employees, and sustaining profitability Some even faced financial distress, bankruptcy or had to resort to layoffs and downsizing. Financial distress refers to a situation where a company is facing significant financial difficulties or is at risk of insolvency. In Malaysia, companies that have classified as Practice Note 17 (or known as PN17) companies under the protection of Section 276 of the Company Act 1965 is refer to the companies that failed to meet the minimum capital or equity and companies' shareholders' funds. This is to monitored by the regulatory body to address financial distress and predict bankruptcy [2]. According to a report released by [1], the market capitalization in the sector of construction, technology and property is less than 6%. So, the study of financial distress in these sectors allowed the researcher to investigate the risk financial factors impacting these sectors and at the same time provides a valuable information for auditors, creditors, and investors in assessing their performance of companies.

The prediction of financial distress has been one of the most challenging issues and many studies have been conducted to design the models to predict the bankruptcy of companies. There are many ways to predict the company's financial crisis, each of which is important for investors and other financial institutions to make decisions in the investments. The most widely used models for bankruptcy prediction was created by Altman [3] that examined more than 20 financial indicators and chose the five most appropriate indicators that can signal potential insolvency in Altman Z-Score model. Other significant studies include Zmijewski [4], Zavgren [5], Lau [6] Shirata [7], Ohlson [8] and the Shumway [9] model. Rahmawati [10] study accuracy of financial distress using modified Altman z-score method, Springate, and Zmijewski in the telecommunication industry. The result shows that the Springate method is more accurate compared with two methods. Zainuddin *et al.,* [11] used the Altman's Z-Score Model to explain the optimal capital structure, the financial ratio trends, and the financial health of listed technology companies. This study found that the listed technology companies in Malaysia is heavily dependent on debt financing which is almost 70.0 per cent to finance their assets. Hertina and Kusmayadi [12] analyse the financial distress and accuracy by comparing the Altman Z-Score method, the Springate method, the Zmijewski method, and the Grover. The result shows that the accuracy level of Altman Z-Score of 72.22%, Springate 66.67%, Zmijewski and Grover of 83.33%. Supitriyani and Azwar [13] determine the most accurate bankruptcy predictions among Springate, Altman, Grover and Zmijewski models and identified the Altman model is the most accurate prediction model in predicting bankruptcy with the highest degree of accuracy compared to other models. Wibowo [14] study to identify the highest level of accuracy in the financial distress prediction model in property and real estate sector companies by using the Altman Z-Score, Springate, Zmijewski and Grover models. The study identified the highest level of accuracy in the property and real estate sector is the Springate model, followed by the Grover, Zmijewski and Altman Z-Score models.

Logistic regression is a statistical model appropriate for developing bankruptcy-prediction models. Nayan *et al.,* [15] study using the logit model and Altman's z-score model in predicting failed and non-failed industrial product firms in Malaysia and found the performance of the two models using accuracy rate, type I error, and type II error and concluded that the logit model outperformed Altman's z-score model, with a higher accuracy rate and lower type I and type II error values. Similarly, studied conducted by Abd Rahim *et al.,* [16] to determine the financial covariates that can distinguish distressed firms from healthy ones by comparing the partial least squares discriminant analysis (PLS-DA) and logit model and the results showed that both Logistic Regression and PLS-DA

performed similarly in classifying distressed firms from healthy ones. Study by Ali *et al.,* [17] on construction sector in Malaysia using Logistic Regression analysis found that the significance of financial ratio was the solvency and accuracy rate is 71.4% to predict financial distress. Singh and Singla [18] predict the bankruptcy using Altman Z-Score model by using Logistic Regression. The study found that the overall correct classification rate increases to 81.10% when the model is re-estimated by using the recent data and further to 87.83% when logistic regression is applied to re-estimate the model. Dirman [19] study the impacts of profitability, liquidity, leverage, firm size, and free cash flow in financial distress by using multiple regression. This study found that the profitability variable has a positive effect on financial distress while liquidity, leverage, and free cash flow do not have the effect financial distress and firm size variables have a negative effect on financial distress. Nayan *et al.,* [20] continued to analyse the bankruptcy prediction by comparing three model by using logit regression. They found that all three models are significant but the third model is better compared to the other two models. Fateh *et al.,* [21] study the critical financial issues in Malaysia's construction industry by conducted a questionnaire surveys. It showed that the most of the respondents agreed that the issue was troublesome if the payment did not go through on time will lead to financial issues. Kumar *et al.,* [22] developed prediction model based on financial ratios for listed companies across various sectors in India using binary logistic regression technique. They identified the most significant financial ratio was coverage ratio, net profit margin and number of days in working capital ratio while the logistic regression model was found 96.80% fit of the model.

In view of the above, the present study is designed to contribute in the existing literature by providing evidences for evaluating performance of Construction, Technology and Property-Based Companies in Malaysia. In this study, the 4 models are used to compare and various financial ratios i.e., liquidity, profitability, efficiency, and Leverage have been considered as explanatory variables to measure the probability of financial distress by using logistic regression method.

2. Methodology

2.1 Hypotheses Development

This study is to compare the results of financial distress prediction model listed in PN17 and healthy of Construction, Technology and Property-Based Companies from Bursa Malaysia. The comparing model to measure financial distress prediction model is Altman Z-score, Springate S-score, Grover G-score, and Zmijewski ZM-score model. The model has the highest level of accuracy means that the model can be used to predict financial distress experienced by the Construction, Technology, and Property-Based Companies so that it can be used as an indicator for those who use financial statement information such as investors, creditors, auditors, management companies and others to make informed decisions that did not experience loss. Figure 1 shows the research model framework for this study where the data taken from companies' sector which are Construction, Technology and Property in Bursa Malaysia in PN17 and public listed category. The Altman Z-Score, Springate S-Score, Grover G-Score and Zmijewski ZM-Score models is used to classify the companies there is financial distress or non-financial distress based on an equation of model discussed. Then, the Logistic Regression model by SPSS Software is used to analyse which significant financial ratio and accurate model in predicting financial distress. Thus, the proposed hypothesis is as follows:

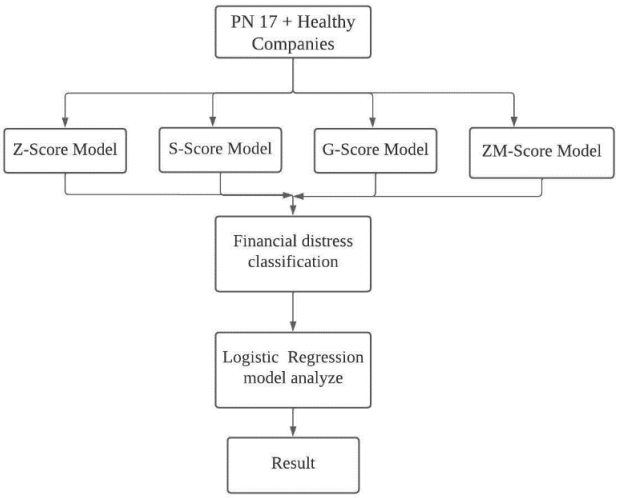

Fig. 1. Research Model Framework

H1: Grover G-score model have the highest accuracy rate as a result compared with Altman Z-score, Springate S-score, and Zmijewski ZM-score model in predicting financial distress of Construction, Technology, and Property-Based Companies in Bursa Malaysia in the period 2017-2021.

2.2 Data Collection

This study uses the secondary data of 290 in Construction, Technology, and Property-Based Companies which are listed in Bursa Malaysia during a period of 2017-2021. The data taken from the companies which are public listed and PN17 category. The data was analysed from the information on the financial report, such as the balance statement, profit and loss statement, and sales report.

Figure 2 illustrates the analysis of this study. The financial ratios have been chosen as an independent variable, while financial distress classification based on model discussed acts as a dependent variable for the Logistic Regression analysed. The classification based on the indicator used as 1 = distress and 0 = non-distress.

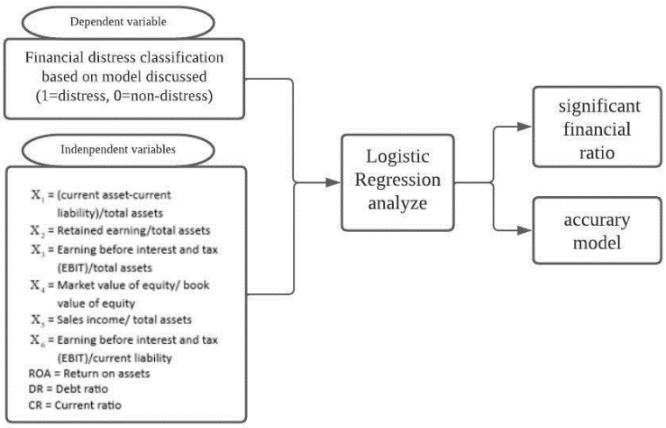

Fig. 2. Analysis Model

The categorized financial ratios included in this study were shown in Table 1 as follow;

Table 1
Selected Financial Ratio Used

No	Selected Ratio	Abbreviations	Measure
1	Current asset	CA	Liquidity
2	Current liability	CL	Liquidity
3	Total Asset	TA	profitability
4	Retained earning	RE	profitability
5	Earnings before interest and tax	EBIT	profitability
6	Market value of equity	MV	Liquidity
7	Book value of equity	BV	Liquidity
8	Sales income	S	Efficiency
9	Current liability	CL	Liquidity
10	Debt ratio	DR	Leverage
11	Return on Assets	ROA	profitability
12	Current ratio	CR	Liquidity

Based on the model, the Altman S-Score used the financial variables of (current asset-current liability)/total assets, retained earnings/total assets, earnings before interest and tax (EBIT)/total assets, market value of equity/ book value of equity and sales income/ total assets (X_1, X_2, X_3, X_4 and X_5), while Springate S-Score used (current asset-current liability)/total assets, earnings before interest and tax (EBIT)/total assets, earnings before interest and tax (EBIT)/current liability and sales income/ total assets (X_1, X_3, X_6 and X_5). The Grover G-Score used the financial variables of (current asset-current liability)/total assets, earnings before interest and tax (EBIT)/total assets and return on assets (X_1, X_3, and ROA), while Zmijewski ZM-Score used variables which is return on asset (ROA), debt ratio (DR) and current ratio (CR). Finally, the result will discuss the most significant variables and the accuracy model is better. The distress and non-distress of firms were classified based on Grover G-Score and Zmijewski ZM-Score descriptor zones discussed in the mathematical equation section.

2.3 Mathematical Model Equations

2.3.1 Altman Z-score model

Altman [3] was the first person to apply multiple discriminant analysis. The rationale for Altman to use discriminant analysis was to analyse the limitations of ratio analysis through its methodology, which is based on deviation. This means that each ratio is tested separately, and the effect of a combination of several ratios is only considered based on financial analysis. The Altman model analysis is a tool/method used to predict a company's financial condition and performance, as well as it is prospects. The Altman model has applied five financial ratios to predict a company's bankruptcy an equation is as follows:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + X_5 \quad (1)$$

Where X represents the variables listed, which are;

X_1 = (current asset-current liability)/total assets
X_2 = Retained earnings/total assets
X_3 = Earnings before interest and tax (EBIT)/total assets
X_4 = Market value of equity/ book value of equity
X_5 = Sales income/ total assets

Based on the Altman formula, the company is classified into three categories with the following descriptor zones:

Z-Score < 1.88 →critically bankrupt (distress zone)
Z-Score > 2.99 →healthy (safe zone)
1.81 < Z-Score < 2.99 →potential bankrupt (grey zone)

2.3.2 Springate S-score model

Springate [23] conducted research on a model to predict a company's potential financial distress. According to Lam *et al.,* [24] the Springate model is a model that was developed using multi discriminant analysis. Initially, Springate model used 19 financial ratios, but after testing, four ratios were selected. The Springate model can predict bankruptcy with an accuracy value of 92.5% and the following formula as below:

$$S = 1.03X_1 + 3.07X_3 + 0.4X_5 + 0.66X_6 \quad (2)$$

Where X represents the variables listed, which are;

X_1 = (current asset-current liability)/total assets
X_3 = Earnings before interest and tax (EBIT)/total assets
X_5 = Sales income/ total assets
X_6 = Earnings before interest and tax (EBIT)/current liability

Based on the Springate formula, the company is classified into dua categories with the following descriptor zones:

S-Score >= 0.862 → healthy (safe zone)
S-Score < 0.862 → high risk bankrupt (distress zone)

2.3.3 Grover G-score model

The Grover method is a method used to predict bankruptcy, this method was created by Jeffrey S. Grover by designing and reassessing the Altman Z-Score method. Jeffrey S. Grover used samples according to the Altman Z-Score model in 1968. The Grover has applied three financial ratios to predict a company's bankruptcy. The Grover equation is as follows [25]:

$$G = 1.650X_1 + 3.403X_3 + 0.016ROA + 0.057 \quad (3)$$

Where X represents the variables listed, which are;

X_1 = (current asset-current liability)/total assets
X_3 = Earnings before interest and tax (EBIT)/total assets
ROA = Return on assets

Based on the Grover model formula, the firm is classified into three categories with the following descriptor zones:

G ≤ -0.02 → bankrupt
G ≥ 0.01 → non-bankrupt
-0.02 ≤ G ≤ 0.01 → grey area

2.3.4 Zmijewski ZM-score model

Financial distress model produced by Zmijewski [4], uses liquidity ratio analysis, leverage, and measures the performance of a company. The Zmijewski equation is as follows:

$$\mathrm{ZM} = -4.3 - 4.5\mathrm{ROA} + 5.7\mathrm{DR} + 0.004\mathrm{CR} \tag{4}$$

Where the variables listed represents are;

ROA = Return on assets
DR = Debt ratio
CR = Current ratio

Based on the Zmijewski model formula, the firm is classified into a category with the following descriptor zones:

G > 0 → bankrupt
G < 0 → non-bankrupt

2.3.5 Logistic regression model

Logistic regression has found two broad applications in applied research: classification (predicting group relationship) and profiling (differentiating between two groups based on certain factors). Let event Y be the financial distress's emergence (marked as Y=1) and the non- emergence (marked as Y=0). In general, the logistic regression model has the form [26];

$$\log\left(\mathrm{P}/\left(1-\mathrm{P}\right)\right) = \beta_0 + \beta_1\mathrm{X}_1 + +\beta_2\mathrm{X}_2 + \ldots + \beta_\mathrm{n}\mathrm{X}_\mathrm{n} \tag{5}$$

where *p* is the probability of the outcome of interest, β_0 an intercept term, β_i the coefficient associated with the corresponding dependent (explanatory) variable $X_i, X = (1, X_1, X_2, \ldots, X_n)$ and $\beta = (\beta_0, \beta_1, \beta_2, \ldots, \beta_n)'$.

The probability of the outcome of interest, *p*, is expressed as a non-linear function of the predictors in the for

$$\mathrm{P} = \frac{1}{1 + \mathrm{e}^{-\left(\beta_0 + \beta_1\mathrm{X}_1 + +\beta_2\mathrm{X}_2 + \ldots + \beta_\mathrm{n}\mathrm{X}_\mathrm{n}\right)}} \tag{6}$$

Eq. (6) ensures that the right-hand side will always lead to values within the interval [0, 1]. This is called the logistic response function. In Eq. (5), the expression

$\log\left(\mathrm{P}/\left(1-\mathrm{P}\right)\right)=\mathrm{odds}$ which can be written as $\mathrm{P}=\frac{\mathrm{odds}}{1+\mathrm{odds}}$ (7)

Hence, in logistic regression, one estimates the log of probability odds, also known as the logit, by a linear combination of the predictor variables. The logit takes on values from $-\infty$ to $+\infty$.

Taking exponentials of both sides of Eq. (5) leads to

$$\mathrm{P}=\frac{\mathrm{e}^{\mathrm{X}\beta}}{1+\mathrm{e}^{\mathrm{X}\beta}} \quad (8)$$

3. Result and Discussion

From the study above, the result based Logistic Regression on Altman Z-Score, Springate S-Score, Grover G-Score and Zmijewski ZM-Score model can be found as follow;

Table 2
Financial Distress Prediction Model

	Distress	Non-Distress
Altman Z-Score Model	43	247
Springate S-Score Model	147	108
Grover G-Score Model	180	110
Zmijewski ZM-Score Model	119	171

Table 2 shows the Financial Distress Prediction Model classify based on Altman Z-Score, Springate S-Score, Grover G-Score and Zmijewski ZM-Score model. The table above shows that out of the 290 companies studied in the period 2017-2021, the prediction of financial distress for Altman Z-Score was 43 companies, Springate S-Score is 147 companies, Grover G-Score is 180 companies and Zmijewski ZM-Score was 119 companies. The results are based on the indicator of the model discussed above.

3.1 Logistic Regression Analysis

Based on the Logistic Regression analysis in SPSS software, the result of this study as follows. The Omnibus Tests of the Model Coefficients in Table 3 showed that the significance value for all models is 0.000, which is less than the threshold of 0.05, for the five independent variables in the Altman Z-Score model, the four independent variables in the Springate S-Score model while for the three independent variables in the Grover G-Score and Zmijewski ZM-Score model.

Table 3
Omnibus Tests of Model Coefficients

Model	Z-Score	S-Score	G-Score	ZM-Score
Chi-square	235.742	349.017	188.548	289.749
df	5	4	3	3
Sig.	.000	.000	.000	.000

Table 4 shows the Model Summary for all models. The Nagelkerke R Square is a goodness of fit measure that describes how well the statistical models fit the data. The results show that the Nagelkerke R Square value is 1.000 for the Grover G-Score model, indicating that 100% of the financial distress variable cases are explained by the three independent variables (X_1, X_3, and ROA)

used in this study followed by the Altman Z-Score model shows that the Nagelkerke R Square value for Altman model is 0.962 that indicated 96.2% of the financial distress variable cases are explained by the three independent variables (X_1, X_2, X_3, X_4 and X_5) used in this study and the remaining of 3.8% are explained by other external factors. Then, Springate model that shows the Nagelkerke R Square value is 0.952, indicating that 95.2% of the financial distress variable cases are explained by the three independent variables (X_1, X_3, X_5 and X_6) used in this study. The remaining 4.8% are explained by other external factors. Lastly, the Zmijewski model shows that the Nagelkerke R Square value is 0.852, indicating that only 85.3% of the financial distress variable cases are explained by the three independent variables (ROA, Debt Ratio and Current Ratio) used in this study. The remaining 14.7% are explained by other external factors. These results suggest that the Grover G-Score model performs better compared to others model.

Table 4
Model Summary

	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
Altman Z-Score	14.573[a]	.556	.962
Springate S-Score	35.994 [a]	.700	.952
Grover G-Score	.000 [a]	.478	1.000
Zmijerski ZM-Score	102.902 [a]	.632	.852

The Hosmer and Lemeshow Test in Table 5 presented for all models. The Hosmer and Lemeshow Test determines if the observed values align with the predicted values to assess the goodness of fit for the model. Based on the table, Hosmer and Lemeshow Test results show a significance value of 1.000 for Altman Z-Score and Grover G-Score while Springate S-Score was 0.010 and 0.000 for Zmijewski ZM-Score model. This indicates that the logistic regression approach can anticipate the value of observations since the significance value is greater than 0.05. A significance value above 0.05 suggests that the expected and perceived values are close, indicating a good fit for the model. As a result, the Altman Z-Score and Grover G-Score model are accepted since it matches with the observational data.

Table 5
Hosmer and Lemeshow Test

	Z-Score	S-Score	G-Score	ZM-Score
Chi-square	.017	20.159	.000	48156.385
df	8	8	8	8
Sig.	1.000	.010	1.000	.000

Table 6 presents the Classification Table for Altman Z-Score and Springate S-Score model. The logistic regression approach resulted for Altman model in an overall Percentage Correct of 99.7%, indicating that the model can correctly predict 99.7% of financial distress values. The proportion of 99.6% represents the classification correctness for healthy companies. There are 1 observation errors in the financial distress group and 244 observations that can be accurately forecasted. The proportion of 100% represents classification correctness for financially distressed companies. There are 0 observation errors and 45 observations that can be accurately forecasted. For the Springate S-Score model model, the logistic regression approach resulted in an overall Percentage Correct of 99.0%, indicating that the model correctly predicts of financial distress values. The proportion of 98.2% represents classification correctness for healthy companies. There are 2 observation errors in the financial distress group and 108 observations that can be accurately forecasted. The proportion of

99.4% represents the classification correctness for financially distressed companies, with 1 observation error and 179 observations that can be accurately forecasted.

Table 6
Classification Table[a] for Atlman and Springate Model

Observed	Z-Score			S-Score		
	Predicted			Predicted		
	Healthy	Distressed	Percentage Correct	Healthy	Distressed	Percentage Correct
Healthy	244	1	99.6	108	2	98.2
Distressed	0	45	100.0	1	179	99.4
Overall Correct			99.7			99.0

a. The cut value is .500

Table 7 shows the Classification Table for Grover G-Score and Zmijewski ZM-Score model. For the Grover G-Score model, the logistic regression approach resulted in an overall Percentage Correct of 100%, indicating that the model correctly predicts of financial distress values. Meanwhile, the Zmijewski model, the logistic regression approach resulted in an overall Percentage Correct of 98.3%, indicating that the model can predict 98.3% of financial distress values correctly. The proportion of 100% represents classification correctness for healthy companies. There are 0 observation errors in the financial distress group and 171 observations that can be accurately forecasted. The proportion of 95.8% represents the classification correctness for financially distressed companies, with 5 observation error and 114 observations that can be accurately forecasted.

Table 7
Classification Table[a] Grover and Zmijerski Model

Observed	G-Score			ZM-Score		
	Predicted			Predicted		
	Healthy	Distressed	Percentage Correct	Healthy	Distressed	Percentage Correct
Healthy	261	0	100.0	171	0	100.0
Distressed	0	29	100.0	5	114	95.8
Overall Correct			100.0			98.3

a. The cut value is .500

The logistic regression equation for all model as follows. Table 8 shows the Logistic Regression equation for Altman Z-Score and Springate S-Score was;

Table 8
Variables in the Equation for Altman and Springate Model

	Z-Score					S-Score				
	B	S.E.	Wald	df	Sig.	B	S.E.	Wald	df	Sig.
X_1	-7.422	3.166	5.497	1	.019	-26.297	6.585	15.947	1	.000
X_2	-6.171	2.281	7.312	1	.003					
X_3	-23.714	11.111	4.555	1	.033	-57.487	22.623	6.457	1	.011
X_4	-2.420	.929	6.781	1	.001					
X_5	-6.380	3.005	4.507	1	.034	-9.466	2.209	18.360	1	.001
X_6						-19.508	5.622	12.041	1	.000
Constant	7.955	2.950	7.274	1	.007	21.848	4.724	21.394	1	0.00

Altman Z-Score Equation;

$$\log\left(P/\left(1-P\right)\right) = 7.955 - 7.422X_1 - 6.171X_2 - 23.714X_3 - 2.420X_4 - 6.380X_5 \quad (9)$$

Considering the above information, it can be said that an increase in X_1. X_2, X_3, X_4 and X_5 corresponds to a decrease in the probability of bankruptcy. These estimates provide information about the relationship between the independent and dependent variables. Specifically, for every one-unit increase in X_1. X_2, X_3, X_4 and X_5, there is a negative relationship in the log-odds of financial distress respectively. From that, it can be concluded that the only X_2, and X_4 are significant, which is less than the p-value 0.005.

Springate S-Score Equation;

$$\log\left(P/\left(1-P\right)\right) = 21.848 - 26.297X_1 - 57.487X_3 - 9.466X_5 - 19.508X_6 \quad (10)$$

Based on the equation, it can be explained for every one-unit increase in X_1. X_3, X_5 and X_6, there is a 26.297, 57.487, 9.466 and 19.508 decrease in the log-odds of financial distress respectively. From that, it can be concluded that the all variables are significant which is less than the p-value 0.005 accept X_3.

Table 9
Variables in the Equation for Grover and Zmijerski Model

	G-Score					ZM-Score				
	B	S.E.	Wald	df	Sig.	B	S.E.	Wald	df	Sig.
X_1	-752.780	7268.214	.011	1	.918					
X_3	-1776.355	17908.75	.010	1	.912					
ROA	-4.931	75.652	.004	1	.948	-1.266	.198	40.801	1	.000
CR						-0.387	.315	1.511	1	.219
DR						2.244	.398	31.852	1	.000
Constant	-37.417	371.593	.010	1	.920	-2.013	.564	12.760	1	.000

Meanwhile, Table 9 shows the Logistic Regression equation for Grover-Score and Zmijewski ZM-Score as follow;

Grover G-Score Equation;

$$\log\left(P/\left(1-P\right)\right) = -37.417 - 752.780X_1 - 1776.36X_3 - 4.931ROA \quad (11)$$

Considering the above information, it can be said that an increase in X_1. X_3, and ROA corresponds to a decrease in the probability of bankruptcy. These estimates provide information about the relationship between the independent and dependent variables. Specifically, for every one-unit increase in X_1. X_3, and ROA, there is a decrease in the log-odds of financial distress. It can be concluded that there is no significant variable, which is all variables is greater than the p-value 0.005.

Zmijewski ZM-Score Equation

$$\log\left(P/\left(1-P\right)\right) = -2.013 - 1.266ROA + 2.244DR - 0.387CR \quad (12)$$

It is considering that an increase in ROA and CR corresponds to a decrease in the log-odds of financial distress. For every one-unit increase in ROA and CR, there are a decrease in the log-odds of financial distress respectively. Meanwhile, for every one-unit increase in DR, there is a 2.411 increase in the log-odds of financial distress. Based on the table, it can be concluded that the significant variable was ROA and DR are significance which is less than the p-value 0.005.

3.2 Accuracy Model Test

Based on the results of the evaluation, an accuracy test was employed to determine the accurate prediction of the companies, using the following equation:

$$\text{Accuracy Test} = \frac{\text{no of prediction}}{\text{number of sample}} \times 100\% \tag{13}$$

Table 10
Accuracy Model Test

	Altman Z-Score Model	Springate S-Score Model	Grover G-Score Model	Zmijewski ZM-Score Model
Accuracy Model Test	99.7%	99.0%	100%	98.3%

Upon calculating the accuracy test using the formula above, it is found that the most accurate model in predicting financial distress of the companies listed on the Bursa Malaysia is the Grover G-Score model with the highest percentage gain of 100% tested accurate follows by Altman Z-score, Springate S-Score and Zmijewski ZM-Score model.

4. Conclusion

The financial distress prediction plays a crucial role for investors, financial managers, and creditors for them to make the right decision to invest, manage and lends money respectively. The financial distress of the company needs to be identified to avoid the company being declared as bankrupt. Based on this study shows that there are no significant relationship variables and financial distress prediction in Grover model but Grover model is better compared to others and indicated that 100% fit the data of the financial distress variable cases are explained by the three independent variables (X_1, X_3, and ROA) used. The findings from logistic regression analysis also revealed that the significance relationship financial ratio and predicted financial distress for all model as follows;

i. Altman Z-Score model is X_1, and X_4 significantly effected financial distress
ii. Springate S-Score model is X_1, X_5 and X_6 significantly effected financial distress
iii. Zmijewski ZM-Score are ROA and DR significantly effected financial distress

This study also contributes to the growing body of knowledge on the business failure prediction model in many ways. Apart from that, statistical result of the study can provide broader perspective on the financial distress problem and causes. For instance, stakeholders may pay extra attention on some elements that can affect the company's performance based on financial ratio that cause the financial distress. The prediction model from this study can assist them in making informed decisions regarding investment in companies in the future.

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