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Comparative Analysis of Altman Method Measurement, Springate, Zmijewski and Grover In Predicting Financial Distress

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Abstract

This research aims to find out and analyze conditions financial distress in mining sector companies listed on the Stock Exchange Indonesia for the 2019-2023 period using the Altman Z prediction model Score, Springate, Zmijewski and Grover. The sample companies are: used in this research were 33 companies obtained by purposive sampling and observations for 5 years to obtain the sample size into 165 samples. The type of data used is secondary data, meanwhile data retrieval techniques obtained from historical data of mining companies, financial reports published by the Indonesian Stock Exchange and literature studies. Technique The data analysis used is a parametric statistical test, namely the Paired Sample test t-test and test the accuracy of the prediction model with the condition that the data must be distributed normal. The results of this study show significant differences between Altman, Springate, Zmijewski, and Grover models in predicting financial distress, and the highest level of accuracy achieved by the Zmijewski model with level accuracy of 94%

Keywords: *Financial Distress, Altman Z-Score, Springate, Zmijewski, Grover*

INTRODUCTION

The primary goal of establishing a company is to generate profit, increase sales, maximize shareholder value, and enhance shareholder welfare, thereby ensuring the company's long-term survival and growth. However, this assumption does not always hold true in practice. Companies often face financial distress, which can ultimately lead to bankruptcy (Irman et al., 2022). In a highly competitive business environment, companies are required to continuously innovate, improve performance, and expand operations to remain competitive. A company's ability to compete is largely determined by its performance. Companies that fail to maintain their performance will eventually be driven out of their industry and experience financial distress, potentially leading to bankruptcy.

Bankruptcy is a critical concern for companies as it can significantly impact investments and debt repayments. Hence, accurately predicting financial distress and company performance is crucial (Li et al., 2019). Bankruptcy, or financial distress, occurs when a company faces severe financial difficulties and can no longer continue its operations. It is officially declared by a court decision, requiring the liquidation of the company's assets to pay creditors. Financial distress is defined as a state where a company struggles to meet its financial obligations (Kisman & Krisandi, 2019). Utami and Giovanni (2020) further describe financial distress as corporate failure from various perspectives (e.g., financial, economic, econometric, and legal), representing the overall failure of the company.

According to Azzahra et al. (2024), financial distress is a condition where a company faces financial difficulties due to its inability to meet its obligations, leading to the threat of bankruptcy. Companies experiencing financial distress may still recover, depending on

management's decision making. Given the significant impact of financial distress on companies, especially in the mining sector listed on the Indonesia Stock Exchange (IDX) from 2019-2023, this study aims to analyze and compare the effectiveness of four financial distress prediction models: Altman Z-Score, Springate, Zmijewski, and Grover. The goal is to determine which model provides the most accurate predictions for mining companies during this period. The findings of this study are expected to contribute valuable insights for developing financial risk management strategies in the mining sector.

LITERATURE REVIEW & HYPOTHESIS DEVELOPMENT

Financial Statement

In general, financial statement are reports that contain recording money and transactions that occur in business, both purchasing transactions and sales and other transactions. Financial reports are information about company performance conditions (Handayani, 2018). Financial reports are prepared for know the overall financial condition of the company. Pratiwi and Wiweko (2022) say that a number of ratios can be calculated based on financial statement analysis. Financial ratios are indicators important in explaining the company's strengths and weaknesses. Ratio Finance is defined as a useful corporate financial analysis tool in evaluating the performance of a company through comparative financial data in the fourth headings of the financial report, namely the report of financial position, report profit and loss, and cash flow statements. The company's financial performance shows financial achievements of a company that have been achieved within a certain period of time, which is then written in the company's financial reports.

Bankruptcy

Companies experience financial failure is a company that earns small profits compared to costs capital or the company experiences losses in carrying out business activities. Bankruptcy can occur because all the company's debts exceed fair value total assets or it can be said that the company has negative value (Octavia, 2023).

Bankruptcy must be a concern for various stakeholders in a company, including owners, managers, investors, creditors and business partners, as well as government institutions because the impact of bankruptcy is not only felt by the owner, but also other users of financial reports, such as investors, creditors, and the general economy are also affected. Therefore, Bankruptcy prediction must be carried out as a preventive measure for reduce the level of risk and danger of company bankruptcy.

Altman Z Score

The Altman Z-Score model, developed by Edward I. Altman in 1968, is one of the most widely used models for predicting corporate bankruptcy. Altman identified key financial ratios that significantly correlate with corporate failure, including liquidity, profitability, leverage, solvency, and activity ratios. The model employs Multiple Discriminant Analysis (MDA) to combine these ratios into a single Z-Score, which categorizes companies into safe, gray, or distress zones based on their likelihood of bankruptcy. Altman later modified the model to suit different types of companies, including manufacturing and non manufacturing firms, as well as emerging market firms. The following is the Z-Score equation modified by Altman et al (1995):

$$\mathbf{Z = 6.56X1 + 3.26X2 + 6.72X3 + 1.05X4}$$

Z = bankruptcy index

X1 = working capital / total assets
X2 = retained earnings / total assets
X3 = earnings before interest and taxes / total assets
X4 = Book value of equity / book value of debt

The criteria for healthy and bankrupt companies are based on the Z-Score value of the Modified Altman model, namely

a) If the index value Z < 1.1 then the company is predicted to go bankrupt.
b) If the value of the Z index is 1.1-2.6 then it is included in the gray area (the company is predicted to experience financial problems and potentially going bankrupt).
c) If the Z index value is > 2.6, it is a non-bankrupt company.

Springate S Score

The Springate model, developed by Gordon L.V. Springate in 1978, is another predictive model that uses a combination of financial ratios to assess the likelihood of corporate failure. This model was designed to improve upon earlier models by focusing on Canadian firms. The Springate model incorporates four key financial ratios to calculate an overall score, which indicates the financial stability of a company. It has been found to be particularly effective in various sectors, including retail and manufacturing . The Springate method categorizes companies as experiencing financial distress if the S Score is < 0.862, whereas if the S-Score is > 0.862 the company is categorized as not experiencing financial distress. The Springate method equation formula is:

$$\mathbf{S = 1{,}03A + 3{,}07B + 0{,}66C + 0{,}4D}$$

A = Working capital / total assets
B = Net profit before interest and taxes / total assets
C = Net profit before taxes / current liabilities
D = Sales / total assets

Zmijewski X Score

According to Wulandari and Fauzi (2022), the prediction method produced by Zmijewski in 1983 represents 20 years of research. This method produces the following formula:

$$\mathbf{X = -4.3 - 4.5X1 + 5.7X2 - 0.004X3}$$

X1 = ROA
X2 = Leverage (Debt Ratio)
X3 = Liquidity (Current Ratio)

The ratio return on assets is used to assess how successfully a business generates money from its assets. The higher the current ratio, the less likely it is that the company would experience financial distress. Meanwhile, the debt ratio requires the company's income to exceed debt so that financial distress does not occur. According to Zmijewski (1984), financial difficulty is expected if the X value is greater than 0 or positive. Conversely, a company is expected not to have the potential to incur financial distress or be deemed healthy if it has a value that is less than 0 or negative.

Grover G Score

Grover uses several variables from Altman's research, namely working capital to total assets and EBIT to total assets. Then Grover added ROA in researching company financial distress. The Grover method categorizes a company in a state of financial distress if the G-Score ≤ -0.02, whereas if the G Score ≥ 0.02 then the company is categorized as not experiencing financial distress. The formula for the Grover method equation is:

$$\textbf{G-SCORE = 1,650X1 + 3,404X2 - 0,016 ROA + 0,057}$$

X1 = Working Capital / Total Assets
X2 = EBIT / Total Assets
ROA = Net Income / Total Assets

Based on the theory and empirical findings of previous research, the authors develop the research hypothesis as follows :

H1 = It is suspected that there is a difference in accuracy between the models analysis of Altman Z-Score, Springate, Zmijewskie and Grover in Measuring Financial Distress in Sector Companies Mining listed on the Indonesian Stock Exchange Period 2019 – 2023

RESEARCH METHODS

This research is descriptive quantitative in nature to assess a model. By using descriptive it can be used to explain a phenomenon that occurs or even later the data is used as a detector so that the company can take action by internal parties, while for external parties it can be used as information for making decisions concerning the company. This study uses the dependent variable, namely financial distress, while the independent variables are the Altman model, Springate model, Zmijewski model and Grover model.

The population referred to in this research is the Mining Sector Companies listed on the Indonesia Stock Exchange in 2019-2023, totaling 49 companies. The sample companies are: used in this research were 33 companies obtained by purposive sampling and observations for 5 years to obtain the sample size into 165 samples. The type of data used is secondary data, meanwhile data retrieval techniques obtained from historical data of mining companies, financial reports published by the Indonesian Stock Exchange and literature studies. Technique The data analysis used is a parametric statistical test, namely the Paired Sample test t-test and test the accuracy of the prediction model with the condition that the data must be distributed normal.

Kolmogorov Smirnov Test Analysis

This analysis is a statistical method used to examine the comparison of two or more independent samples with ordinal data forms arranged in a cumulative frequency distribution table with a class interval system. This test does not generate a lot of perceptions among observers where this happens a lot in graphic-based normality tests, besides that testing using this test is also relatively simple. The application of the Kolmogorov Smirnov test if the ordinary test is significant < 0.05 means there is a significant difference and if > 0.05 no significant difference arises, this application also applies to the Kolmogorov Smirnov test. In this test the data is not normally distributed if $p < 0.05$ and the data is normally distributed if $p > 0.05$.

Analysis Of Paired Samples T-Test

Testing of each hypothesis is carried out using statistical tests that are in accordance with the research hypothesis specified in the previous chapter. If the data is distributed normally, then the hypothesis testing of this study uses the paired sample t-test comparative analysis technique. According to Priambodo (2018) This test is a type of mean difference test, which is to test whether there is an average difference between two groups of samples. The decision making in this test is based on a comparison of probability values (Sig. 2-tailed). If the probability (in this case the Sig. 2-tailed value) > 0.05, then there is no significant difference in mean between the two groups of samples. If the probability (in this case the Sig. 2-tailed value) < 0.05, then there is a significant mean difference between the two sample groups.

Analysis Test The Accuracy Of Predictions

The accuracy level of each model is calculated in the following way:

Accuracy Level = (Number of correct predictions / Number of Samples) x 100%

Apart from the accuracy of each model, what is also taken into consideration is the error rate. Errors are divided into two types, namely Type I and Type II. Type I error is an error that occurs when the model predicts that the sample will not experience distress when in fact it is experiencing distress. Type II error is an error that occurs when the model predicts that the sample is experiencing distress when in fact it is not experiencing distress. The error rate is calculated in the following way:

Type I Error = (Number of Type I errors / Number of Samples) x 100%
Type II Error = (Number of Type II errors / Number of Samples) x 100%

RESULTS AND DISCUSSION

The data collected in this study is secondary data in the form of annual reports of mining sector companies listed on the Indonesian stock exchange for 2019-2023. Secondary data can generally be interpreted as data obtained through a second or third party. To obtain data, researchers can download data through www.idx.co.id. Based on the sample criteria mentioned earlier, 33 samples of mining sector companies listed on the Indonesia stock exchange in 2019-2023 were obtained.

Table 1: Descriptive statistics

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Altman	165	-34.99	36.07	3.6343	6.64534
Springate	165	-71.77	6.72	.3542	6.38922
Zmijewski	165	-5.91	9.48	-1.8188	1.88468
Grover	165	-5.04	3.78	.5354	.97907
Valid N (listwise)	165				

Source : SPSS Analysis Results Data Ver. 26 of 2024

Based on Table 1, the purpose of the descriptive statistical test results according to (Sugiyono, 2022) is to see the quality of research data that can be seen from the numbers or values contained in the mean and standard deviation. If the average value is greater than the standard deviation value, the data quality is better. The standard deviation is a measure of the difference between the sample value and the mean. This concludes as the lower the standard deviation, the closer the mean and vice versa, the higher the standard deviation, the more diverse the sample. From Table 4 above, we can see that the descriptive statistical results of the dependent variable have the largest mean value, which is 3.6343 and the largest variable, the standard deviation, which is 6.64534, so the resulting sample will vary.

Altman Z-Score Calculated Data

The results of the analysis using the Altman Z-Score method for mining sector companies listed on the Indonesia Stock Exchange in 2019 are 9 companies (financial distress), then there are 7 companies (gray area) while 17 companies (non-financial distress). In 2020 there were 8 companies (financial distress), then there were 7 companies (gray area), while 18 (non-financial distress). Based on the results of the 2021 analysis, there are 8 companies (financial distress), then there are 3 companies (gray area), while 22 companies (non-financial distress). Based on the results of the 2022 analysis, there are 7 companies (financial distress), then there are 4 companies (gray area), while 22 companies (non-financial distress). In 2023 there will be 6 companies (financial distress), then there will be 4 companies (gray area), while 23 companies (non-financial distress). In the results of the calculation and analysis by including the ratio contained in the Altman Z-Score method multiplied by the coefficient determined according to the formula of the Altman Z-Score method for mining sector companies listed on the Indonesia Stock Exchange for the period 2019-2023, 38 companies experienced difficulties financial distress (financial distress) and obtained 25 companies experiencing financial difficulties with a mild stage (grey area).

Springate S-Score Calculated Data

The results of the analysis using the Springate S-Score method for mining sector companies listed on the Indonesia Stock Exchange in 2019 are 23 companies (financial distress) while 10 companies (non-financial distress). In 2020 there were 24 companies (financial distress) while 9 (non-financial distress). Based on the results of the 2021 analysis, there are 15 companies (financial distress) while 18 companies (non-financial distress). Based on the results of the 2022 analysis, there are 16 companies (financial distress) while 17 companies (non-financial distress). In 2023 there will be 13 companies (financial distress), while 20 companies (non-financial distress). In the results of the calculation and analysis by including the ratio contained in the Springate S-Score method multiplied by the coefficient determined according to the formula of the Springate S-Score method for mining sector companies listed on the Indonesia Stock Exchange for the period 2019-2023, 91 companies experienced difficulties financial distress (financial distress) and obtained 74 companies in healthy conditions (non-financial distress).

Zmijewski X-Score Calculated Data

The results of the analysis using the Zmijewski X-Score method for mining sector companies listed on the Indonesia Stock Exchange in 2019 are 5 companies (financial distress) while 28 companies (non-financial distress). In 2020 there were 5 companies (financial distress) while 28 (non-financial distress). Based on the results of the 2021 analysis, there are 6 companies (financial distress) while 27 companies (non-financial distress). Based on the results of the 2022 analysis, there are 6 companies (financial distress) while 27 companies (non-financial distress). In 2023 there will be 5 companies (financial distress), while 28 companies (non-financial distress). In the results of the calculation and analysis by including the ratio contained in the Zmijewski X-Score method multiplied by the coefficient determined according to the formula of the Zmijewski X-Score method for mining sector companies listed on the Indonesia Stock Exchange for the period 2019-2023, 27 companies experienced difficulties financial distress (financial distress) and obtained 138 companies in healthy conditions (non-financial distress).

Grover G-Score Calculated Data

The results of the analysis using the Grover G-Score method for mining sector companies listed on the Indonesia Stock Exchange in 2019 are 11 companies (financial distress) while 22 companies (non-financial distress). In 2020 there were 6 companies (financial distress), then there were 2 companies (gray area), while 25 (non-financial distress). Based on the results of the 2021 analysis, there are 6 companies (financial distress), then there are 1 companies (gray area), while 26 companies (non-financial distress). Based on the results of the 2022 analysis, there are 4 companies (financial distress) while 29 companies (non-financial distress). In 2023 there will be 4 companies (financial distress), while 29 companies (non-financial distress). In the results of the calculation and analysis by including the ratio contained in the Grover G-Score method multiplied by the coefficient determined according to the formula of the Grover G-Score method for mining sector companies listed on the Indonesia Stock Exchange for the period 2019-2023, 31 companies experienced difficulties financial distress (financial distress) and obtained 3 companies experiencing financial difficulties with a mild stage (grey area).

Paired Sample T-Test

Table 2: Paired Sample T-Test

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Altman - Springate	3.28010	6.97966	.54337	2.20720	4.35299	6.037	164	.000
Pair 2	Altman - Zmijewski	5.45308	8.23994	.64148	4.18646	6.71971	8.501	164	.000
Pair 3	Altman - Grover	3.09896	5.97559	.46520	2.18041	4.01751	6.662	164	.000
Pair 4	Springate - Zmijewski	2.17299	7.41472	.57724	1.03321	3.31276	3.764	164	.000
Pair 5	Springate - Grover	-.18114	6.10426	.47522	-1.11947	.75719	-.381	164	.000
Pair 6	Zmijewski - Grover	-2.35412	2.74072	.21337	-2.77542	-1.93283	-11.033	164	.000

Source : SPSS Analysis Results Data Ver. 26 of 2024

Pair 1 testing shows the value of Sig. (2-tailed) In pair 1, which is between Altman and Springate's model score, is 0.000. The results showed a probability of < 0.05, which means that there was a significant difference between the two sample groups with a 95% confidence level.

Pair 2 testing shows the value of Sig. (2-tailed) In pair 2, which is between Altman and Zmijewski's model score is 0.000. The results showed a probability of <

0.05, which means that there was a significant difference between the two sample groups with a 95% confidence level.

Pair 3 testing shows the value of Sig. (2-tailed) In pair 3, namely between Altman and Grover's model score is 0.000. The results showed a probability of < 0.05, which means that there was a significant difference between the two sample groups with a 95% confidence level.

Pair 4 testing shows the value of Sig. (2-tailed) In pair 4, namely between the Springate and Zmijewski model scores, is 0.000. The results showed a probability of < 0.05, which means that there was a significant difference between the two sample with a 95% confidence level.

Pair 5 testing shows the value of Sig. (2-tailed) In pair 5, namely between the Springate and Grover model scores is 0.000. The results showed a probability of < 0.05, which means that there was a significant difference between the two sample groups. Groups with a 95% confidence level.

Pair 6 testing shows the value of Sig. (2-tailed) in pair 6, namely between Grover and Zmijewski model scores is 0.000. The results showed a probability of < 0.05, which means that there was a significant difference between the two sample groups with a 95% confidence level.

Prediction Model Accuracy Test

a. Altman Z-Score method

Table 3: The prediction accuracy of the Altman model

Total Sample		**Correct Prediction**		**False Prediction**		***Type of Error***	
Distress	6	*Distress*	6	*Distress*	0	Type I	0%
Non Distress	27	*Non Distress*	22	*Non Distress*	5	Type II	19%

Total	33	Total	28	Total	5	
Accuracy Level		**85%**	**Weighted Error Rate**			**15%**

In table 3, it can be seen that the Altman Z-Score model can correctly predict 28 samples out of a total of 33 samples. The Altman Z-Score model did not correctly predict the other 5 samples. From this data, the accuracy of the Altman Z-Score model in predicting financial distress in mining companies was found to be 85%, and the weighted error rate was 15%.

b. Springate method

Table 4: The prediction accuracy of the Springate model

Total Sample		**Correct Prediction**		**False Prediction**		***Type of Error***	
Distress	13	*Distress*	13	*Distress*	0	Type I	0%
Non Distress	20	*Non Distress*	16	*Non Distress*	4	Type II	20%
Total	33	Total	29	Total	4		
Accuracy Level		**88%**	**Weighted Error Rate**			**12%**	

In table 4, it can be seen that the Springate S-Score model can correctly predict 29 samples out of a total of 33 samples. The Springate S-Score model did not succeed in predicting the other 4 samples correctly. From the data, the accuracy of the Springate S-Score model in predicting financial distress in mining companies was found to be 88%, and the weighted error rate was 12%.

c. Zmijewski method

Table 5: The prediction accuracy of the Zmijewski model

Total Sample		**Correct Prediction**		**False Prediction**		***Type of Error***	
Distress	5	*Distress*	5	*Distress*	0	Type I	0%

Non Distress	28	*Non Distress*	26	*Non Distress*	2	Type II	7%
Total	33	Total	31	Total	2		
Accuracy Level		**94%**		**Weighted Error Rate**		**6%**	

In table 5 above, Zmijewski's prediction model can accurately predict as many as 31 out of 33 samples with an accuracy rate of 94%. The remaining 2 samples were predicted incorrectly, the error rate or weighted error rate of this model was 6%.

d. Grover method

Table 6: The prediction accuracy of the Grover model

Total Sample		**Correct Prediction**		**False Prediction**		***Type of Error***	
Distress	4	*Distress*	3	*Distress*	1	Type I	25%
Non Distress	29	*Non Distress*	27	*Non Distress*	2	Type II	7%
Total	33	Total	30	Total	3		
Accuracy Level		**91%**		**Weighted Error Rate**		**9%**	

In table 6 above, Grover's prediction model can accurately predict as many as 30 out of 33 samples with an accuracy rate of 91%. The remaining 3 samples were predicted incorrectly, the error rate or weighted error rate of this model was 9%.

Recapitulation of the results of calculating the accuracy of the prediction model

Tabel 7: Recapitulation of Accuracy of Prediction Methods

Prediction model	**Tingkat Akurasi**	**Weighted Error Rate**	**Type I *Error***	**Type II *Error***
Zmijewski	94%	6%	0%	7%
Grover	91%	9%	25%	7%
Springate	88%	12%	0%	20%
Altman	85%	15%	0%	19%

Based on table 7, it can be concluded that the Zmijewski model is the most accurate method in predicting financial difficulties in mining companies for the period 2019-2023 in Indonesia with an accuracy rate of 94%. Followed by the Grover model with an accuracy rate of 91%, Springate is in third place with an accuracy of 88% and finally Altman Z Score has the lowest accuracy rate among the four methods, which is 85%.

If we look at Type I errors, interestingly three methods (Zmijewski, Springate, and Altman) do not show the existence of Type I Error (0%), which means they do not classify healthy companies as companies experiencing financial distress. Grover has a Type I Error of 25%, which means this method more often misclassifies healthy companies as financially distressed companies than other methods.

In Type II Error, Zmijewski and Grover both have the same Type II Error of 7%, followed by Altman with Type II Error of 19% and Springate with Type II Error of 20%, which means that this method more often misclassifies companies experiencing financial distress as healthy companies compared to Zmijewski, Grover and Altman.

The results of this study are in line with the research of Anastasia and Riza (2023) which stated that Zmijewski is the most accurate model in predicting Financial Distress with an accuracy rate of 67%, followed by Altman and Grover with 65% and Springate with the lowest accuracy of 60% each.

CONCLUSION AND RECOMMENDATION

Based on the results of the research on the comparative analysis of the measurement of the Altman, Springate, Zmijewski and Grover methods in predicting financial distress in mining sector companies listed on the Indonesia Stock Exchange for the 2019-2023 period, it can be concluded as follows: 1) There is a difference in scores assessed from the level of accuracy between the Altman Z-Score, Springate, Zmijewski and Grover models in predicting Financial Distress. Based on the results of the hypothesis test using the Independent Sample t test Asymp value. Sig. (2-tailed) in pairs 1 to 6 shows a < of 0.05, which means that there is a significant difference in each model in predicting financial distress. 2) The Zmijewski model is the most accurate model in predicting the bankruptcy of mining companies listed on the Indonesia Stock Exchange with an accuracy level of 94%, based on the results of the accuracy test that has been carried out, the Zmijewski model correctly predicts the condition of 31 companies from 33 company samples used. For future research, it is expected to add prediction models or use other prediction models such as the Ohlson model, the Zavgren model, the Fulmer model, the Fuzzy model and other models to compare the accuracy of the model in predicting financial distress. In addition, it is suggested that

future research not only makes comparisons but can create a financial distress prediction model.

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