

Predictive Analysis of Financial Distress in Construction Service Companies Using the Altman, Springate, Grover, and Zmijewski Models

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ABSTRACT

Purpose: This study aims to compare the results of financial distress classification produced by the Altman Z-Score (Modified), Springate, Grover, and Zmijewski models for service companies in the construction sector listed on the Indonesia Stock Exchange during the 2022–2024 period.

Research Method: The study employed a comparative quantitative approach with a saturated sample of 21 companies (63 company-year observations). Secondary data in the form of annual financial reports were analyzed using the four models and then evaluated through descriptive analysis, Cohen's Kappa, the Friedman test, and the Wilcoxon Signed-Rank test.

Results and Discussion: The results of the study show that the four models produce different classification distributions, with varying levels of agreement among the models. The Friedman test revealed significant differences in classification ($p < 0.001$), indicating that differences in formulas, financial ratios, and threshold values cause each model to provide a different interpretation of the company's financial condition.

Implications: The research findings provide insights for investors, creditors, and management to consider using multiple models when evaluating a company's financial condition.

Originality: The novelty of this study lies in its comparative analysis of four financial distress classification models in Indonesia's construction sector during the post-pandemic period, with an emphasis on the differences in classification results and the degree of agreement among the models.

Keywords: financial distress; altman z-score; springate; grover; zmijewski.

1. Introduction

The construction industry is one of the sectors that contributes significantly to Indonesia's economic growth. In addition to being a key driver of national infrastructure development, this sector plays a role in creating jobs, improving interregional connectivity, and generating a multiplier effect across other economic sectors (Central Bureau of Statistics, 2023). However, during the 2022–2024 period, the construction industry faces various challenges that increase the risk of financial distress, including rising raw material prices, dependence on imported materials, interest rate fluctuations, and high corporate debt burdens. Financial distress refers to a stage of deteriorating financial condition preceding a company's business failure or bankruptcy. This condition is generally characterized by a decline in a company's ability to generate sufficient cash flow to meet its financial obligations, which can be

triggered by weak financial management, operational inefficiencies, or management's inability to respond to changes in the business environment (Saleem *et al.*, 2020, Wijaya & Suhendah, 2023). If not identified early on, financial distress has the potential to undermine business sustainability, hinder the completion of construction projects, and increase the risk of losses for investors, creditors, and other stakeholders.

The causes of financial distress in the construction sector are multifactorial, stemming from both external factors and internal company factors. External factors include the COVID-19 pandemic, which delayed 78.9% of construction projects, with the primary causes being funding constraints (53.8%) and the implementation of large-scale social restrictions (PSBB) (29.6%) (Sari & Suryan, 2021). Fluctuations in construction material prices also rose sharply during the 2022–2023 period, with the Wholesale Price Index (IHPB) for building or construction materials rising by 6.87% year-over-year in December 2022, including a 37.80% increase in diesel prices, cement by 8.52%, and asphalt by 15.37% (Central Bureau of Statistics, 2023). Bank Indonesia also gradually raised the BI 7-Day Reverse Repo Rate from 3.50% in July 2022 to 5.75% in January 2023, reaching 6.00% in October 2023 in response to global inflationary pressures (Bank Indonesia, 2022; 2023). These interest rate hikes increased the cost of working capital loans for construction companies, while global economic uncertainty also contributed to investment delays by business operators (Bisnis.com, 2020). These external pressures heightened the risk of disruptions to project cash flows, rising operating costs, and a decline in companies' ability to maintain financial stability during the construction project completion process.

On the other hand, internal factors influencing financial distress are related to a company's financial condition and managerial capabilities. Susanto & Handoyo (2025) found that leverage has a positive and significant effect on financial distress among construction materials companies during the 2021–2024 period, consistent with the findings of Gunardja *et al.*, (2023), who noted that high debt ratios threaten the liquidity of state-owned construction companies. Low profitability and a decline in asset value are also key indicators of deteriorating financial conditions (Jessica, 2022), while low liquidity indicates an inability to meet short-term obligations (Suryani & Mariani, 2022). Managerial aspects such as weak oversight and project complexity further exacerbate the financial condition of construction companies (Gunardja *et al.*, 2023). For management, investors, creditors, and regulators alike, early identification of indicators of financial distress is crucial to strategic decision-making. However, the results generated by a financial distress model do not automatically indicate the accuracy of predictions regarding a company's actual condition. Predictive accuracy can only be demonstrated if classification results are compared against objective benchmarks, such as bankruptcy, default, delisting, an audit opinion regarding the company's going concern, or negative equity. Therefore, this study views financial distress models as instruments that generate early signals regarding a company's financial condition, rather than as tools that directly prove predictive accuracy in the absence of empirical comparisons (Altman *et al.*, 2017).

Research on financial distress in companies generally uses models based on financial ratios, such as the Altman Z-Score, Springate, Grover, and Zmijewski. These four models have distinct characteristics because they employ different combinations of financial ratios, formulas, and classification thresholds (cutoffs), which can result in different classifications of a company's financial condition, even for the same firm. The Altman model emphasizes the balance of liquidity, profitability, solvency, and activity; Springate is more oriented toward profit-generating capacity; Grover is a simplified version of the Altman model with an emphasis on profitability and asset efficiency; while Zmijewski places greater emphasis on leverage, profitability, and liquidity. Munandar *et al.*, (2023) used

the Altman Z -Score model to analyze companies in the construction subsector for the 2019–2021 period. They found that some companies were classified as experiencing financial distress. In contrast, Alfathan *et al.*, (2025), who applied all four models simultaneously, showed that PT Acset Indonusa Tbk consistently fell into the financial distress category, while several other companies remained in the non-financial distress category.

Beyond the construction sector, studies across various sectors also indicate that the classification results of each model differ according to industry characteristics. Setyorini & Rahayu (2024) reported that, based on the benchmarks used in their study, the Zmijewski and Grover models yielded higher accuracy rates than the Altman model for companies in the infrastructure sector. In the investment and securities services sector, Chandra *et al.*, (2021) reported that the Grover model yielded the best results. In contrast, Wicaksana & Mawardi (2023) found the Altman model to be more dominant among transportation companies. Meanwhile, the Springate model is reported to be more suitable for the retail sector (Sembiring & Sinaga, 2022) and the real estate sector (Arifana & Handayani, 2025), while the Zmijewski model shows better results in the technology sector (Hendiansyah & Natita, 2025). These findings indicate that no single model consistently produces the best classification across all sectors; thus, a model's effectiveness is highly influenced by the financial structure, operational patterns, and business risks specific to each industry.

Although various studies have applied the Altman, Springate, Grover, and Zmijewski models to identify financial distress, several research gaps remain. First, most studies have applied only one or two models, thus failing to provide a comparative overview of the differences in classification results produced by each model. Second, research on the construction sector generally still relies on data from before or during the pandemic, so it does not fully represent industry conditions during the 2022–2024 period, which was characterized by rising material prices, rising interest rates, and the post-pandemic economic recovery. Third, cross-sector research findings indicate that dominant models vary with industry characteristics, so it cannot yet be concluded that a single model is superior across all sectors. Fourth, some studies interpret the consistency of results across models as evidence of accuracy; however, without a benchmark in the form of actual financial distress conditions, the analysis results only indicate differences or the degree of agreement in classification across models, not predictive ability regarding the company's actual condition. Therefore, this study positions the four models as financial ratio-based classification instruments that generate signals regarding a company's financial condition; consequently, the comparison focuses on the classification results produced by each model, rather than on claims of predictive accuracy.

Given this gap, this study aims to analyze and compare the financial distress classification results produced by the Altman Z-Score, Springate, Grover, and Zmijewski models for construction service companies listed on the Indonesia Stock Exchange during the 2022–2024 period, as well as to evaluate the level of inter-model classification agreement. The novelty of this study lies in the simultaneous application of the four models to the construction services sector during the post-pandemic economic recovery period, treating each model as a representation of distinct financial signals based on the characteristics of the ratios used, rather than as a measure of predictive accuracy. Thus, this study is expected to provide a more comprehensive understanding of the variations in financial distress classification results in the construction sector and serve as a reference for investors, creditors, management, and regulators in interpreting information on a company's financial condition more proportionately.

The remainder of this paper is organized as follows. Section 2 provides a literature review and hypothesis development. Section 3 presents the research method and design. Section 4 provides the results and discussion. Section 5 presents Concluding Remarks and Recommendations.

2. Literature Review and Hypothesis Development

2.1 Literature Review

2.1.1 Signaling Theory

Michael Spence first introduced Signaling Theory in his 1973 study titled "Job Market Signaling." This theory explains how parties with more information (management) send signals to parties with less information—such as investors, creditors, regulators, and other stakeholders—to reduce information asymmetry. In the context of financial reporting, financial statements serve as the primary medium for conveying signals regarding a company's economic condition, as they contain information on liquidity, profitability, operations, and capital structure—which form the basis for various parties' assessments of the company's prospects and risks. Therefore, the information contained in financial statements can provide both positive and negative signals regarding a company's financial condition—including indications of financial distress—thereby influencing the economic decision-making of investors, creditors, and other stakeholders.

The Altman Z-Score, Springate S-Score, Grover G-Score, and Zmijewski X-Score models are models for identifying financial distress that use a combination of financial ratios to classify a company's financial condition (Aryo & Trisnaningsih, 2021). Each model uses different ratios, weights, and cut-off values, resulting in distinct representations of financial signals. The Altman model emphasizes the balance among liquidity, profitability, activity, and capital structure, thereby signaling a company's ability to maintain overall financial stability. The Springate model focuses more on the ability to generate operating profit and meet short-term obligations, making it more sensitive to changes in a company's operating performance. The Grover model places greater emphasis on profitability through Return on Assets (ROA), thereby providing signals regarding a company's efficiency in utilizing assets to generate profit. Meanwhile, the Zmijewski model focuses on profitability, leverage, and liquidity, thereby signaling the level of financial risk and the company's ability to meet its obligations.

These differing characteristics mean that a single company may receive different classifications when analyzed using different models, even though all models use the same source of information: the company's financial statements. From the perspective of Signaling Theory, these differences do not indicate that one model is more accurate than another; rather, they reflect that each model captures different dimensions of financial signals based on the ratios used. Therefore, this study utilizes all four models as tools to compare classification results and the degree of agreement among the models in interpreting signals regarding the financial condition of construction service companies, rather than to determine which model has the most accurate predictive ability regarding actual financial distress. These models can still be utilized as early warning tools in the decision-making process, so that investors can use the classification results as a basis for assessing investment risk, creditors can evaluate a company's ability to meet its debt obligations, and regulators and management can use them as a basis for the early identification of potential financial stress in a company (Altman *et al.*, 2017).

2.1.2 Financial Statements

Financial statements are reports that show a company's financial condition during a specific period. Financial statements provide an overview of a company's financial position, performance, and cash flows, which various parties use as a basis for making economic decisions (Kasmir, 2019). In the context of research on financial distress, financial statements are the primary source of information that provides quantitative data on a company's financial condition. This information serves as the basis for calculating various financial ratios used by the Altman Z-Score, Springate S-Score, Grover G-Score, and Zmijewski X-Score models to classify a company's financial condition. Therefore, the quality and completeness of financial statements are critical to the quality of information generated by each financial distress classification model.

A complete set of financial statements in accordance with the Indonesian Financial Accounting Standards (PSAK) consists of:

- Statement of Financial Position;
- Statement of Income and Other Comprehensive Income;
- Statement of Changes in Equity;
- Cash flow statement; and
- Notes to the Financial Statements.

According to Setiawan (2015), financial statements aim to provide information regarding an entity's financial position, performance, and changes in financial position that is relevant, understandable, comparable, and reliable so that it can be used in decision-making. According to the Indonesian Institute of Accountants (IAI), financial statements also aim to provide information regarding an entity's financial position, financial performance, and cash flows that is useful to the majority of statement users in making economic decisions. In line with Signaling Theory, the information contained in financial statements serves as a signal from management to investors, creditors, regulators, and other stakeholders about the company's economic condition. Financial ratios derived from the statement of financial position, income statement, and cash flow statement are then processed by the Altman, Springate, Grover, and Zmijewski models to classify a company's financial condition. Thus, this study utilizes financial statements as the primary data source to compare the classification results produced by each model, rather than to test the accuracy of predictions regarding a company's actual financial distress.

2.1.3 Financial Distress

Financial distress is a condition in which a company experiences a decline in its financial capacity that can escalate into business failure or bankruptcy if not addressed promptly. According to Wijaya & Suhendah (2023), financial distress occurs when a company is unable to meet its financial obligations, experiences difficulties managing cash flow, or faces various internal factors—such as managerial incompetence or operational constraints—that disrupt business continuity. This situation indicates that a decline in a company's financial capacity can generally be detected early through analysis of financial ratios in financial statements, before it escalates into insolvency or bankruptcy (Junaedy, 2023). In practice, financial distress develops gradually, beginning with a decline in financial performance, worsening liquidity and profitability, and rising debt burdens, and ultimately potentially leading to

default or bankruptcy if corrective actions are not taken. A company's financial performance can be assessed through the accounting information presented in its financial statements (Altman *et al.*, 2017). Therefore, financial statement analysis serves as a crucial foundation for identifying early indicators of financial distress.

It is important to distinguish between actual financial distress and the financial distress classifications generated by financial ratio-based models. Actual financial distress is generally indicated by objective indicators, such as failure to meet obligations, default, an audit opinion regarding the company's going concern status, delisting, or negative equity. Financial pressure on a company is generally first reflected in changes in accounting indicators and financial performance before developing into more serious financial distress, making financial statement information the primary source for identifying early indications of financial distress (Amalia *et al.*, 2025). Meanwhile, the model developed by Altman, Springate, Grover, and Zmijewski classifies a company's financial condition based on information contained in financial statements through a combination of specific financial ratios. Thus, the classification results generated by the model reflect indicators of a company's financial condition but do not automatically prove that the company is experiencing financial distress in the absence of objective benchmarks (Altman *et al.*, 2017).

According to Aningtyas *et al.*, (2025), several indicators suggest a company is experiencing financial distress, including:

- Negative cash flow from operating activities for several consecutive periods;
- Negative net income for several periods;
- A low liquidity ratio indicating difficulty in meeting short-term obligations;
- Leverage yang tinggi sehingga beban utang melebihi kemampuan perusahaan;
- Negative working capital;
- Sales that have been consistently declining;
- The company's equity is close to zero or even negative;
- Suspension of dividends or a drastic reduction in dividends;
- A significant decline in stock prices; and
- An audit opinion with an explanatory paragraph regarding the going concern assumption.

In this study, these indicators serve as a conceptual framework to explain the characteristics of companies potentially at risk of financial distress. However, this study does not use these indicators as an empirical benchmark to measure the predictive accuracy of each model. Therefore, the analysis focuses on comparing the classification results produced by the Altman Z-Score, Springate S-Score, Grover G-Score, and Zmijewski X-Score models, as well as the level of inter-model classification agreement based on information from the companies' financial statements.

2.2 Hypothesis Development

The Altman Z-Score model, modified in 1984, uses four financial ratios covering aspects of liquidity, profitability, and solvency to classify companies into the safe zone, the gray area, or the danger zone. Based on signaling theory, the financial ratios in the Altman model signal a company's financial health to stakeholders. Construction companies facing external pressures, such as rising material prices (6.87%) and rising interest rates (up to 6% in 2022–2023), as well as internal pressures in the form of high leverage, low profitability, and low liquidity, are expected to exhibit low Z-Score values. The findings of

Alfathan *et al.*, (2025) indicate the construction industry's vulnerability to financial distress in the post-pandemic era.

H1: *The Altman Z-Score model can predict financial distress among construction service companies listed on the Indonesia Stock Exchange for the 2022–2024 period.*

The Springate model (1978) is a simplification of the Altman model, consisting of four ratios that focus on operating profitability and the ability to meet short-term obligations. This focus makes the Springate model highly sensitive to changes in a company's operating conditions. In the context of signaling theory, this model provides an earlier signal of operational stress. Research by Alfathan *et al.*, (2025) found that the Springate model is the most sensitive in providing early signals of financial distress in construction companies. In line with this, Putri & Nurulrahmatia (2024) state that this model classifies more companies in the construction subsector as bankrupt.

H2: *The Springate S-Score model can predict financial distress among construction service companies listed on the Indonesia Stock Exchange for the 2022–2024 period.*

Grover's model (2001) improves upon Altman's model by adding the Return on Assets (ROA) variable, which reflects a company's efficiency in generating profits from its total assets. According to signaling theory, ROA is an important indicator of management's ability to manage assets. Natania and Suhartono (2024) found that the Grover model achieves the highest accuracy in predicting a company's actual financial condition, and Sari (2025) found that it achieves high accuracy in predicting the net profit of construction companies. Given the decline in profitability in the construction sector during 2022–2023

H3: *The Grover G-Score model can predict financial distress among construction service companies listed on the Indonesia Stock Exchange for the 2022–2024 period.*

The Zmijewski (1984) model uses a probit approach to assess performance, leverage, and liquidity, with a strong focus on the leverage ratio. High leverage sends a negative signal regarding financial risk because it increases interest expenses. Setyorini & Rahayu (2024) and Oktafiraningsih and Suryaningsum (2024) demonstrated this model's high accuracy in the infrastructure and real estate sectors, given the high debt burdens of construction companies during the study period.

H4: *The Zmijewski X-Score model can predict financial distress among construction service companies listed on the Indonesia Stock Exchange for the 2022–2024 period.*

Each model has a different approach, formulation, and criteria. Differences in methodology, the number of ratios, and cutoff points will result in different assessments of the financial condition of the same company. In signaling theory, each model provides a different interpretation of the same signals from financial statements. Previous research by Putri & Nurulrahmatia (2024), Natania & Suhartono (2024), and Alfathan *et al.*, (2025) indicates differences in prediction results and sensitivity levels among models for construction companies and similar sectors.

H5: *There are differences in the financial distress prediction results among the Altman Z-Score, Springate S-Score, Grover G-Score, and Zmijewski X-Score models for service companies in the construction sector listed on the Indonesia Stock Exchange during the 2022–2024 period.*

3. Research Method

3.1 Research Design

This study employs a quantitative approach with a comparative research design. The objective of the study is not to test the predictive accuracy of financial distress models against companies' actual conditions, but rather to compare the classification results generated by the Altman Z-Score, Springate S-Score, Grover G-Score, and Zmijewski X -Score models for service companies in the construction sector listed on the Indonesia Stock Exchange (IDX) during the 2022–2024 period. In addition to comparing classification results, this study evaluates the level of agreement among the models using Cohen's Kappa and tests for differences in classification using the Friedman test, followed by the Wilcoxon Signed-Rank test as a post hoc analysis.

3.2 Population and Sample

The study population consists of all construction services companies listed on the Indonesia Stock Exchange (IDX) during the 2022–2024 period. Based on the IDX Industrial Classification (IDX-IC), these companies fall under the Infrastructure Sector (J), the Building Construction Sub-sector (J2), the Building Construction Industry (J21), and the Building Construction Sub-industry (J211). The research sample was determined using census sampling, meaning all companies that met the criteria were included. Based on 2024 data from the Indonesia Stock Exchange, 21 construction services companies met these criteria. With a three-year observation period (2022–2024), the number of units of analysis in this study was 63 company-year observations.

3.3 Data Collection Techniques

This study uses secondary data obtained through the documentation method. Data were collected by downloading audited annual financial reports from the official websites of the Indonesia Stock Exchange and each company for the period 2022–2024. The data collected included statements of financial position, income statements, statements of changes in equity, cash flow statements, and notes to the financial statements required to calculate the financial ratios in the Altman, Springate, Grover, and Zmijewski models. The completeness of all data was then verified before the scores for each model were calculated.

3.4 Measuring Financial Distress

This study uses four financial distress classification models: the Modified Altman Z-Score (1984), the Springate S-Score (1978), the Grover G-Score (2001), and the Zmijewski X-Score (1984). Each model was calculated using the original formula as developed by its respective creator (Munandar *et al.*, 2023; Gupita *et al.*, 2020; Setyorini & Rahayu, 2024; Mokoginta, 2024). The results of each model were then classified using the cut-off values recommended by that model.

Because the four models have different formulas, score ranges, interpretation directions, and cut-off values, this study did not directly compare raw scores. To ensure the comparability of the analysis, the results of each model were first converted into uniform classification categories, namely:

- 0 = Not experiencing financial difficulties
- 1 = Financial difficulties

In the Altman model, companies in the gray area are treated as a separate category in the descriptive stage; however, for comparative analysis, these companies are grouped according to the classification procedure established by the researcher to ensure all models have comparable categories. This approach was taken because each model has a different number of categories and classification thresholds, making it impossible to compare raw scores directly.

3.5 Data Analysis Techniques

The analysis was conducted in several stages. The first stage involved calculating financial distress scores using the Altman Z-Score, Springate S-Score, Grover G-Score, and Zmijewski X-Score models based on each company's financial statements. The second stage involved classifying each company into either the financial distress or non-financial distress category according to each model's threshold value. Specifically, for the Zmijewski model, the interpretation used was that an X value > 0 indicates the company is experiencing financial distress, while $X < 0$ indicates the company is in a state of non-financial distress (Mokoginta, 2024). This interpretation was applied consistently throughout the analysis and discussion.

The third stage involves comparing the distributions of classification results generated by each model through descriptive analysis. The fourth stage is to measure the level of classification agreement between pairs of models using Cohen's Kappa coefficient. In this study, Cohen's Kappa is used solely to measure the level of classification agreement between models. It is not interpreted as a measure of a model's accuracy, reliability, or superiority. A low or negative Kappa value indicates a low level of classification agreement between models. The fifth step is to test whether there are differences in classification results between models using the Friedman test. If the Friedman test indicates a significant difference, the analysis continues using the Wilcoxon Signed-Rank test as a post hoc test to identify model pairs with significantly different classifications. All statistical tests were performed on the standardized classification categories rather than the raw scores of each model, because each model uses different formulas, score ranges, and threshold values.

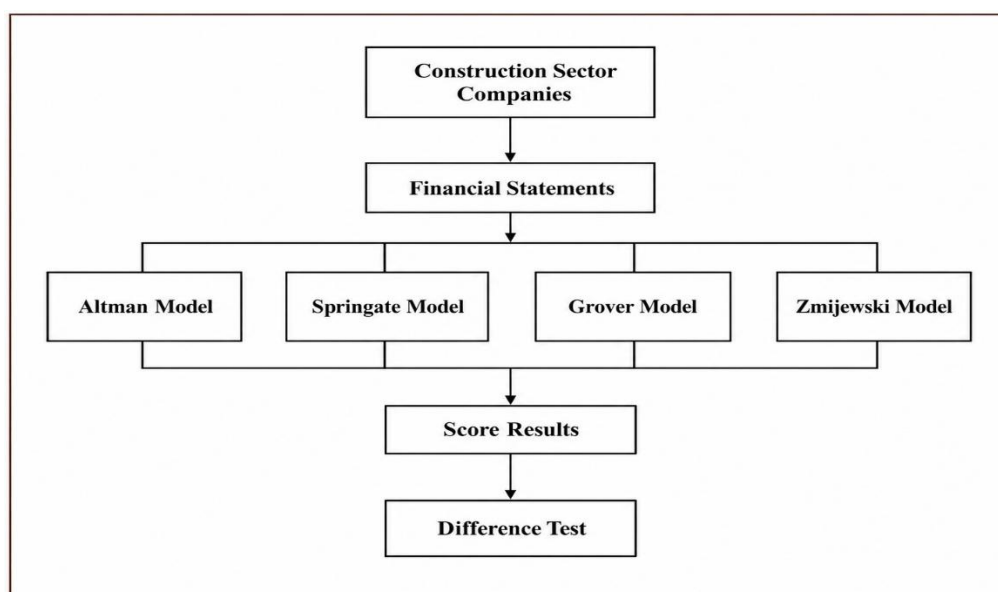


Figure 1. Research Model

4. Results and Discussion

4.1 Analysis Results

Based on Table 1, the results of the Cohen's Kappa test show that the level of classification agreement among the financial distress models varies. The Altman–Grover model pair yielded the highest Kappa value of 0.536 (moderate agreement; $p < 0.001$), followed by Altman–Springate at 0.320 (fair agreement; $p < 0.001$), and Springate–Grover at 0.179 (slight agreement; $p = 0.013$). In contrast, all pairs involving the Zmijewski model yielded negative Kappa values: Altman–Zmijewski (-0.223), Springate–Zmijewski (-0.268), and Grover–Zmijewski (-0.187), with all p -values less than 0.05. Negative Kappa values indicate that the level of classification agreement between models is lower than expected by chance (i.e., agreement less than chance), suggesting differences in classification patterns between the Zmijewski model and the other three models. These differences do not imply that one model is more accurate or superior; rather, they reflect that each model uses a different combination of financial ratios, weights, and cut-off values in evaluating a company's financial condition. Thus, the results of the Cohen's Kappa test in this study only indicate the level of classification agreement among the models and cannot be interpreted as a measure of accuracy, reliability, or predictive ability regarding a company's actual financial distress.

Table 1. Descriptive Statistics for Financial Distress Model Scores

Model	N	Minimum	Maximum	Mean	Std. Deviation
Altman Z-Score	63	-10.756	106.604	5.599	14.696
Springate S-Score	63	-1.503	3.860	0.723	0.855
Grover G-Score	63	-1.556	1.829	0.551	0.656
Zmijewski X-Score	63	-4.732	2.896	-1.609	1.704
Valid N (listwise)	63				

Source: Data processed using SPSS (2026).

4.1.1 Comparative Analysis

Table 2. Level of Agreement in Classification Among Financial Distress Models Based on Cohen's Kappa

Model Couple	Kappa Value	Interpretation of Kappa*	Approx. Sig.
Altman – Springate	0.320	Fair Agreement	0.000
Altman – Grover	0.536	Moderate Agreement	0.000
Altman – Zmijewski	-0.223	No Agreement (Negative Agreement)	0.000
Springate – Grover	0.179	Slight Agreement	0.013
Springate – Zmijewski	-0.268	No Agreement (Negative Agreement)	0.019
Grover – Zmijewski	-0.187	No Agreement (Negative Agreement)	0.000

The classification of interpretations is based on Landis and Koch (1977).

Source: Data processed using SPSS (2026).

Based on Table 2, Cohen's Kappa coefficient was used to measure the level of classification agreement between two financial distress models in classifying companies into the financial distress and non-financial distress categories. Therefore, the Kappa values in this study are not interpreted as measures of accuracy, reliability, or model superiority, but rather indicate the extent to which the two models yield the same classifications for the observed data.

The Altman–Grover pair yielded the highest Kappa value of 0.536 (moderate agreement; $p < 0.001$), indicating that the two models exhibit a moderate level of classification agreement compared to the other model pairs. Meanwhile, the Altman–Springate pair obtained a Kappa value of 0.320 (fair agreement; $p < 0.001$), while the Springate–Grover pair obtained a Kappa value of 0.179 (slight agreement; $p = 0.013$). These results indicate that although all three model pairs exhibit statistically significant agreement, the degree of agreement varies considerably, meaning that the classifications produced by each model are not always identical. This variation may arise because each model uses a different combination of financial ratios, weights, and cut-off values when evaluating a company's financial condition.

Conversely, all pairs involving the Zmijewski model yielded negative Kappa values, namely Altman–Zmijewski (-0.223), Springate–Zmijewski (-0.268), and Grover–Zmijewski (-0.187), with all significance values less than 0.05. Negative Kappa values indicate that the classification agreement among these models is lower than what would be expected by chance (agreement less than chance), suggesting a tendency for classification differences between the Zmijewski model and the other three models. These findings do not suggest that the Zmijewski model is either worse or better than the other models. However, they indicate that this model captures different characteristics of financial condition because it places greater emphasis on profitability, leverage, and liquidity ratios. In contrast, the Altman, Springate, and Grover models place greater emphasis on working capital, activity, and operating profitability.

These results are consistent with Signaling Theory, which states that financial information can generate different signals depending on the indicators used. Since each model uses a different combination of financial ratios, the signals captured regarding a company's financial condition also differ, resulting in varying levels of classification agreement. Thus, the Cohen's Kappa results in this study indicate variations in classification agreement among the models; they do not prove that any one model has a more accurate predictive ability regarding a company's actual financial distress.

4.1.2 Model Sensitivity Analysis

Based on Table 3, the Altman Z-Score model produced the largest score range and standard deviation (14.696) compared to the Springate (0.855), Grover (0.656), and Zmijewski (1.704) models, indicating that the distribution of Altman scores was more varied in the study sample. However, these differences in standard deviation values cannot be interpreted as evidence that the Altman model is more sensitive or superior to the other models, as each model uses different formulas, score scales, and cut-off values. Therefore, the descriptive statistics in this table merely provide an overview of the characteristics of each model's score distribution. Furthermore, the results of the Friedman test showed a p -value of 0.001 ($p < 0.05$), indicating significant differences in classification results among the financial distress models. Thus, the results of the Friedman test indicate that the four models do not yield identical classifications for construction-sector service companies; therefore, further analysis with the Wilcoxon Signed-Rank post hoc test is needed to identify pairs of models with significantly different classifications.

Based on Table 4, the results of the Friedman test show a chi-square value of 82.448 with a significance level of <0.001 ; therefore, H_0 is rejected, and H_5 is accepted. These results indicate significant differences in financial distress classification outcomes across the Altman Z-Score, Springate S-Score, Grover G-Score, and Zmijewski X-Score models for service companies in the construction sector during the 2022–2024 period. These differences indicate that the four models do not produce identical

classifications for the same observations, which may be due to differences in the formulas, financial ratios, weights, and cut-off values used by each model. The mean rank values indicate the order of the scores produced by each model in the Friedman analysis, namely Altman (3.48), Springate (2.84), Grover (2.19), and Zmijewski (1.49).

Table 3. Descriptive Statistics for the Scores of the Financial Distress Prediction Model

Model	N	Minimum	Maximum	Mean	Std. Deviation
Altman Z-Score	63	-10.756	106.604	5.599	14.696
Springate S-Score	63	-1.503	3.860	0.723	0.855
Grover G-Score	63	-1.556	1.829	0.551	0.656
Zmijewski X-Score	63	-4.732	2.896	-1.609	1.704

Source: Data processed using SPSS (2026).

Table 4. Results of the Friedman Test and the Follow-Up Wilcoxon Signed-Rank Test for the Classification of Financial Distress

Analysis	Results
Number of observations (N)	63
Chi-Square (Friedman Test)	82.448
df	3
Asymp. Sig.	<0.001
Mean Rank Altman	3.48
Mean Rank Springate	2.84
Mean Rank Grover	2.19
Mean Rank Zmijewski	1.49

Source: Data processed using SPSS (2026).

Table 5. Results of Further Tests (Wilcoxon Signed Rank Test)

Model Couple	Z	Asymp. Sig. (2-tailed)	Decision
Altman – Springate	-4.409	<0.001	Significantly different
Altman – Grover	-4.484	<0.001	Significantly different
Altman – Zmijewski	-4.827	<0.001	Significantly different
Springate – Grover	-4.679	<0.001	Significantly different
Springate – Zmijewski	-5.785	<0.001	Significantly different
Grover – Zmijewski	-5.751	<0.001	Significantly different

Source: Data processed using SPSS (2026).

However, this order cannot be interpreted as evidence that one model is more sensitive, more conservative, or more accurate than the others; rather, it merely indicates differences in the distribution of the rank results used in the nonparametric test. Furthermore, a post hoc test using the Wilcoxon Signed-Rank Test showed that all model pairs had p-values <0.001, indicating statistically significant differences in classification. This finding indicates that each model provides a different interpretation of a company's financial information, consistent with Signaling Theory, which holds that different combinations of financial ratios yield different signals about financial condition. Thus, the results of the Friedman and Wilcoxon tests indicate differences in classification among the models; however, they cannot be used to conclude that one model has higher accuracy or predictive ability regarding a company's actual financial distress, as this study did not use an objective benchmark for comparison.

4.2 Discussion

4.2.1 Differences in the Classification of Financial Distress Across Models

The results show that the four models yield different classification distributions of financial distress among service companies in the construction sector during the 2022–2024 period. The Altman model classifies 61.90% of observations as non-financial distress, 12.70% as grey area, and 25.40% as financial distress. The Springate model produced a higher proportion of financial distress classifications compared to the Altman model, while the Grover model classified the majority of observations as non-financial distress. Meanwhile, the Zmijewski model produced a classification distribution that differed from the other three models. These differences indicate that each model interprets a company's financial information differently because they use distinct combinations of financial ratios, weights, and cut-off values. Therefore, variations in classification results do not imply that one model is better or more accurate than the others; rather, they reflect the distinct analytical characteristics of each model.

These differences can be explained by the characteristics of the construction sector, which features a debt-based financing structure, long-term project cycles, significant working capital requirements, and high cash flow volatility. The Altman model places greater emphasis on working capital, retained earnings, profitability, and capital structure, making it more sensitive to changes in a company's overall financial balance. Conversely, the Springate model places greater emphasis on the ability to generate operating profits and meet short-term obligations, making it more responsive to declines in operating performance. The Grover model emphasizes asset utilization efficiency through Return on Assets (ROA), while the Zmijewski model focuses more on leverage, profitability, and liquidity. These differences in the focus of the ratios mean that the same company may receive different classifications when analyzed using different models.

The results of this study are consistent with Munandar *et al.*, (2023) and Alfathan *et al.*, (2025), who found that construction companies do not always receive the same classification when analyzed using various financial distress models. However, this study does not aim to determine the most accurate model because it does not compare the classification results with the companies' actual conditions, such as bankruptcy, default, delisting, a going concern audit opinion, or negative equity. Therefore, the results of this study are best interpreted as a comparison of the classification patterns produced by each model.

4.2.2 Differences in Classification Based on the Friedman and Wilcoxon Tests

The results of the Friedman test indicate a significant difference in classification among the Altman, Springate, Grover, and Zmijewski models ($p < 0.001$). These findings suggest that the four models do not produce identical classifications for the same observations. The mean rank values reveal differences in the distribution trends of classification results across the models. However, the mean rank values cannot be interpreted as an indicator that one model is more sensitive, more conservative, or superior to the others, since each model has different formulas, scoring scales, directions of interpretation, and cut-off values. Thus, the results of the Friedman test merely indicate that the classification distributions produced by each model are statistically different.

The results of the Wilcoxon Signed-Rank test reinforce these findings, as all model pairs showed significant differences in classification ($p < 0.001$). These findings indicate that changing the model used can lead to different classifications for the same company. These differences reflect that each model assigns different weights to a company's financial information, thereby leading to differing

interpretations of the financial condition of construction sector service companies. These findings are consistent with those of Alfathan *et al.*, (2025) and Artini & Astika (2024), who also found differences in classification results across models in sectors characterized by complex financing and asset structures.

4.2.3 Implications of Signaling Theory

The research findings support Signaling Theory, which explains that financial statements serve as a medium for conveying signals about a company's economic condition to investors, creditors, regulators, and other stakeholders. However, this study shows that the same signals can yield different interpretations when processed by different financial distress models. This occurs because each model uses a different combination of financial ratios to represent the company's condition. Altman's model captures more signals regarding working capital, retained earnings, and capital structure; Springate's emphasizes signals of operating profitability and the ability to meet short-term obligations; Grover's focuses on asset efficiency through ROA; while Zmijewski's places greater emphasis on leverage and liquidity risks. Consequently, investors may arrive at different risk assessments of the same company depending on the model used.

The practical implication of these findings is that the results of financial distress classification should not be used in isolation as the basis for investment decisions, credit granting, or corporate policy evaluations. Users of financial information need to understand that each model represents only specific dimensions of a company's financial condition and exhibits different sensitivities to industry characteristics. Therefore, the complementary use of multiple models can provide a more comprehensive picture of a company's financial condition than relying on a single model. Furthermore, since this study did not use actual financial distress conditions as a benchmark, the results cannot be interpreted as evidence that one model has more accurate predictive power than the others, but rather as evidence of differences in classification patterns and interpretations of financial signals across models.

5. Concluding Remarks and Recommendation

This study aims to compare the results of financial distress classification produced by the Altman Z-Score, Springate S-Score, Grover G-Score, and Zmijewski X-Score models for service companies in the construction sector listed on the Indonesia Stock Exchange during the 2022–2024 period, as well as to evaluate the level of agreement and differences in classification among the models. The analysis was conducted using four financial ratio-based classification models, followed by Cohen's Kappa, Friedman's test, and Wilcoxon's signed-rank test. The results show that each model produces different classification distributions for the same companies, the level of agreement in classifications between models varies, and there are statistically significant differences in classifications among the four models. These findings indicate that variations in classification results are influenced by differences in the formulas, financial ratios, weights, and cut-off values used by each model, meaning that each model captures different dimensions of a company's financial condition. Therefore, the results of this study cannot be used to conclude that one model has better predictive ability or accuracy than the others because the study did not use actual financial distress indicators as a benchmark.

This study makes a theoretical contribution by strengthening the application of Signaling Theory in the analysis of financial distress. The findings indicate that financial statements can generate different signals when processed using different classification models, meaning that interpretations of

a company's financial condition are influenced by the characteristics of the ratios used in each model. From a practical perspective, the results inform investors, creditors, management, and regulators that relying on a single model may lead to different interpretations compared to using multiple models in a complementary manner. Therefore, the classification results for financial distress should be viewed as supporting information in the decision-making process, not as the sole representation of a company's financial condition.

This study has limitations because it only compares the classification results generated by four financial distress models without using actual financial distress indicators—such as bankruptcy, default, delisting, a going concern audit opinion, or negative equity—as benchmarks. Furthermore, the study focuses only on service companies in the construction sector and covers the 2022–2024 observation period; thus, the results cannot yet be generalized to other industrial sectors. Therefore, future research is recommended to use actual financial distress conditions as a benchmark to evaluate the predictive ability of each model, extend the observation period, incorporate additional classification models such as those by Ohlson, Fulmer, or Taffler, and consider the influence of macroeconomic factors, industry characteristics, and corporate governance to gain a more comprehensive understanding of financial distress classification among companies in Indonesia.

Statement of Use of Generative AI

During the preparation of this work, the author used generative artificial intelligence tools to support the scientific writing process. Grammarly was used to check grammar, refine writing style, and improve clarity in scientific writing. All interpretations, analyses, and conclusions presented in this study are the sole responsibility of the author.

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