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Analysis of Precision Using the Altman Modification, Springate, Zmijewski, and Grover Model for Financial Distress Prediction

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Abstract:

This study measures the accuracy of financial distress predictions by using the Zmijewski, Modified Altman, and Springate, Grover models. This research will take 2013-2017 as test data and compare it with the company's actual conditions in 2018 and 2019 to determine whether the three models can predict the company's financial difficulties to assess the accuracy of the model. This research was conducted using descriptive methods and quantitative approaches. This study took a sample of industries related to Real Estate and Property that were displayed on the Indonesia Stock Exchange (IDX) from 2013-2017 using a purposive sampling technique. Except for the modified Altman and Grover models, the results show discrepancies between the models and apparent accuracy from the 2018–2019 actuals and estimates for 2013–2017. The results of research conducted and tested using Stata 17 show that the model with the lowest accuracy is obtained by Springate with a score of 72%, type error I is 3%, and II is 26%. The second lowest model is obtained by the modified Altman model with a total score of 77% and type I error of 13%. The model with the second highest score was achieved by Grover with a score of 87% and type I error of 13%. The highest model in this test was achieved by Zmijewski with a model accuracy rate of 90% and type I and II errors of 5%.

Keywords: financial distress, the Altman modification, Springate, Zmijewski, Grover.

使用奥特曼修正、弹跳、兹米耶夫斯基和格罗弗模型进行财务危机预测的精度分析

摘要:

本研究使用兹米耶夫斯基、改良型奥特曼和弹跳、格罗弗模型衡量财务困境预测的准确性。本研究将2013-2017年作为检验数据,与公司2018年和2019年的实际情况进行对比,判断三个模型能否预测公司的财务困难,以评估模型的准确性。这项研究是使用描述性方法和定量方法进行的。本研究采用有目的的抽样技术,对2013年至2017年在印度尼西亚证券交易所(IDX)上展示的与房地产和财产相关的行业进行了抽样调查。

除修改后的奥特曼和格罗弗模型外,结果显示模型与2018-2019年实际值和2013-2017年估计值之间的表观准确性存在差异。使用斯塔塔17进行和测试的研究结果表明,精度最低的模型是 由弹跳获得的,得分为72%,类型错误1为3%,II为26%。第二低的模型是通过修改后的奥特曼模型得到的, 总分77%,I类错误13%。得分第二高的模型由格罗弗实现,得分为87%,I类错误为13%。本次测试中模型最 高的是兹米耶夫斯基,模型准确率为90%,I类和II类错误为5%。

关键词:财务困境,奥特曼修改,弹跳,兹米耶夫斯基,格罗弗。

1. Introduction

The increased costs experienced by corporations are attributed to the intensifying competition among them (Susanti et al., 2020). These heightened costs can harm a company's performance, leading to a decline in revenue and eventual financial difficulties, commonly referred to as financial distress (Nasution, 2019). Early stages of corporate bankruptcy, referred to as financial difficulties, often precede financial distress (Susanti et al., 2020). Research conducted by Dewi and Hadri (2017) forecasts financial difficulties in Indonesian businesses and determines that when a company suffers losses for two years, a company is called distress. Platt and Platt (2002) further support the definition of financial distress as a company experiencing negative operating profit.

Research conducted by Kisman and Krisandi (2019) regarding financial distress in the wholesale sector uses sampling with the criteria for companies that have experienced negative income for two years as criteria for financial distress. The China Securities Regulatory Commission establishes special measures, with the first criterion being two consecutive years of negative (Li et al., 2021). So, it can be said that a company, that suffered operating losses for two consecutive years, was classified as a company that was in distress.

In various sectors, especially real estate and property, it is important for companies experiencing financial distress to be further investigated. The Federal Policy Agency deems the Real Estate and Property sector crucial as it can stimulate the activity in multiple economic sectors, impact the development of the financial sector, and reverberate on economic growth and employment. The state of the Real Estate and Property sector showcases a growing number of real estate and property companies. However, a considerable proportion of these companies have also faced failure due to their inability to effectively manage their finances and attain the desired level of profitability (Nasution, 2019).

The property and real estate sector have recently observed three companies face bankruptcy allegations, including Forza Land Indonesia (FORZ), which declared bankruptcy during an open trial on September 12, 2022, and PT Cowell Development Tbk (COWL), which announced bankruptcy on July 6, 2020. PT Hanson International Tbk (MYRX) was declared bankrupt on June 8, 2021 (Afriyadi, 2022). The bankruptcy of Hanson International was a result of delays in fulfilling its obligations to creditors and shareholders due to legal issues faced by MYRX President Director Benny Tjokrosaputro, which had a substantial impact on Hanson's operations, including its obligations to creditors and shareholders, as well as the OJK and the BEI (Rahmawati, 2020). Liputan6.com shares report that Forza Land Indonesia's bankruptcy resulted from the cancelation of the PKPU settlement, which was filed in 2019. PKPU sued PT Cowell Development Tbk, leading to its eventual declaration of bankruptcy. It takes a deeper investigation into financial distress using the right model because in the property and real estate sectors there was a collapse. The earlier a company can identify the signs of financial distress, the better equipped it will be to make necessary improvements (Helastica & Paramita, 2020).

Several factors have been identified to impact financial distress in companies. Factors contributing to a company's financial position include cash flow from operations, debt levels, ability to meet financial obligations, efficient production activities, profitable profit margins, and a reasonably high level of revenue growth. Operating cash flow measures the inflows and outflows of cash in the financial statements from operating, financing, and investment activities. Measurement of the company's ability to finance assets using debt is indicated by leverage. Meanwhile, in determining the ability of the company in short-term liabilities indicated by liquidity, the operating capacity assesses the company's efficiency in using its assets to drive financial performance through the successful execution of its operations. Profitability represents the level of earnings generated by a company over a specific period by marketing its sales products and is a crucial determinant of its success. Finally, sales growth represents an expansion in a company's assets and significantly impacts its ability to achieve profitability and avoid financial difficulties (Wulandari & Jaeni, 2021).

Examining the net income of the property and real estate subsector from 2013 to 2019 sheds light on the industry's financial performance. It is crucial for companies within this sector to effectively manage their operations and adopt appropriate strategies to ensure sustainability (Kusmartono & Rusmanto, 2022).

Figure 1 shows that five companies experienced losses from 2019 to 2019. These companies include PT Evidence Darmo Property (BKDP), PT City Retail Developments (NIRO), PT Cowell Development (COWL), PT Eureka Prima Jakarta (LCGP), and PT Metro Realty (MTSM). Upon examination of their

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financial statements, it can be concluded that BKDP's loss is a result of a higher cost of sales and direct expenses compared to its revenue, which resulted from a decline in operating income.



Figure 1. Representation of firms experiencing financial decline

Additionally, LCGP's negative profit can be attributed to the excess of general and administrative expenses over business income. On the other hand, NIRO's losses resulted from exchange rate fluctuations in 2019 and financial costs in 2018. It is imperative to consider the financial difficulties of a firm to reduce potential losses with the prediction and recognition of financial difficulties, thus enabling the sector to effectively address any financial difficulties that may arise (Abdu, 2022).

2. Literature Review

This study employs four models to assess financial distress, the first of which is the modified Altman model. This model incorporates X1 (WCTA ratio), X2 (RE to TA), X3 (EBIT to TA), and X4 (book value of equity to total debt). The modified Altman model is relevant to this research as the five companies being evaluated have faced a decrease in net income, leading to a decline or negative EBIT for firms such as NIRO, BKDP, MTSM, and LCGP. Additionally, BKDP's insufficient current assets relative to its current liabilities resulted in negative working capital, signifying low liquidity (Barnas et al., 2021). Additionally, the financial statements of these five companies demonstrate a decrease and, in some cases, a negative value for retained earnings, making the modified Altman model appropriate for predicting financial distress. The research of Ade Elza Surachman supports this. According to the author, the modified Z-Score formula is widely recognized for its versatility ability to be applied to various business industries, and applicability in developing countries such as Indonesia (Sinaga et al., 2019).

The next model is Springate, which incorporates four ratios: X1 (WCTA ratio), X2 (net profit before interest and tax to TA), X3 (NBT to current liabilities), and X4 (sales to TA). A model consisting of three ratios, namely Zmijewski, comprises: ROA, leverage, and current asset to current liabilities. In this research, the last model employed is the Grover model, which considers three ratios found in both the Zmijewski and Modified Altman Models, namely the WCTA ratio, EBIT to total assets, and ROA. While a high ROA is desirable, the five companies under examination experienced decreased and even negative net income. Furthermore, the ratio of sales to total assets (TATO), which measures the efficiency, revealed that sales were smaller than total assets, suggesting that the sales generated needed to be optimized from the company's assets (Millatina & Nugroho, 2022). Thus, this study uses four financial distress models, aligning with prior research.

Tahu (2019) conducted a comparative analysis of financial distress in his research, which examined the construction sector's performance in Nashi. The study revealed that four of the eight companies were undergoing financial difficulties. The corrected companies, that experienced financial difficulties, included ADHI, DGIK, WIKA, and WSKT. The lowest level of accuracy is Altman, and the highest accuracy is achieved by Springate (Tahu, 2019). In contrast to the results of Winti and Munandar's research, the most accurate model is Zmijewski for retail companies (Wiranti & Munandar, 2021).

Based on previous research with different levels of accuracy, this study compares 2013 (the year when the property and real estate sector is on the rise) to 2017 (predictions) with 2018 to 2019 (real).

3. Methods and Materials

3.1. Types of Research

This study adopts a descriptive research design and quantitative research. Descriptive research describes the characteristics of a particular phenomenon by using numerical data. The study employs quantitative descriptive analysis, which focuses on clarifying the details of the relationships between independent variables. This research takes data from the IDX website that focuses on the property and real estate sectors from 2013 to 2019, obtained from the Bloomberg Terminal (Wiranti & Munandar, 2021). The data collected from 2013 to 2017 will undergo processing, while the data from 2018 and 2019 will serve as actual data for comparison purposes.

3.2. Population and Sample

Sixty-five companies are the research population. The population in question is a group of people or events to be selected; then, the next step is to be analyzed. The sample in this study is part of the selected population, and this study chose purposive sampling to determine the sample. The sample in this study is based on certain criteria consistent with the purpose of the research to address research problems effectively. As a result, this research involved 39 sampling companies. These selection criteria were based on two factors:

1. Property and real estate companies registered at the BEI (IDX website) from 2013 to 2019;

2. Have a financial report from 2013 to 2019.

In addition, this study incorporates additional sample

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criteria based on the financial distress category, which includes the following criteria:

1. Companies that have experienced negative income for two consecutive years in 2018 and 2019 are categorized as facing financial distress;

2. Companies that did not experience losses for two consecutive years during 2018 and 2019 are categorized as non-financial distress.

3.3. Data Analysis Technique

The first step in this analysis technique is to calculate the variables using data from the Bloomberg Terminal and enter their values into their respective models, and the researchers implement the Zmijewski model, Modified Altman Z-Score, and Springate. The average calculation for each company is then performed (Inayati & Yuliarini, 2022). The assessment criteria defined in the literature will be used to assess the financial conditions based on the average results of each model.

Hypothesis tests such as the Kruskall-Wallis hypothesis test and Mann–Whitney U test are applied using STATA software, which is preferred for its simple command structure and superior regression analysis capabilities to compare the performance of the models. The researchers will then evaluate the accuracy of the models by comparing the average calculated from 2013 to 2017 with the actual results after the prediction by the three models. The justification for using the STATA software lies in its user-friendly interface and proficiency in regression analysis. The researchers will compare the average calculated from 2013 to 2017 with the actual results after the three models predict them and evaluate the models' accuracy.

3.4. Research Model

The research process in this study will be illustrated using the following scheme:



4. Results and Discussion

4.1. Financial Distress Calculation Results

This study took 39 companies as the sample. The presentation of the calculation results for each model in the four research models is as follows:

		authors)	、 I	5
Company Code	Altman	Zmijewski	Springate	Grover
(BAPA)	-	-	(D)	-
(BCIP)	Grey	-	-	-
(BEST)	-	-	-	-
(BIPP)	Grey	-	(D)	-
(BKDP)	-	(D)	(D)	-
(BKSL)	-	-	-	-
(BSDE)	-	-	-	-
(COWL)	Grey	-	(D)	-
(CTRA)	-	-	-	-
(DART)	-	-	(D)	-
(DILD)	-	-	(D)	-
(DUTI)	-	-	-	-
(ELTY)	Grey	(D)	-	-
(EMDE)	-	-	-	-
(FMII)	-	-	-	-
(GAMA)	-	-	(D)	-
(GMTD)	-	-	(D)	-
(GRPA)	-	-	-	-
(GWSA)	-	-	-	-
(JRPT)	-	-	(D)	-
(KIJA)	-	-	-	-
(LCGP)	-	-	-	-
(LPCK)	-	-	-	-
(LPKR)	-	-	-	-
(MDLN)	-	-	-	-
(MKPI)	-	-	-	-
(MTLA)	-	-	-	-
(MTSM)	-	(D)	(D)	-
(NIRO)	-	(D)	(D)	-
(MORE)	-	-	-	-
(PLIN)	-	-	(D)	-
(PWON)	-	-	-	-
(RBMS)	-	(D)	(D)	-
(RDTX)	-	-	-	-
(RODA)	-	-	-	-
(SMDM)	-	-	(D)	-
(SMRA)	-	-	-	-
(APLN)	-	-	-	-

Table 1. Financial distress calculation results (Developed by the

Continuation of Table 1					
(ASRI)	-	-	-	-	

The results table indicates that in the Modified Altman model, 35 companies are classified as nondistressed, while four companies fall into the gray area. The Zmijewski model classifies five companies as distressed and 34 companies as non-distressed. Meanwhile, the Springate model classifies 14 companies as distressed and 25 as non-distressed. Finally, the Grover model classifies all 39 companies as non-distressed. These variations in the results can be attributed to the different formulas used by each model.

As for the sample size of 39 companies, the actual results for the years 2018 and 2019 indicate that five companies were classified as distressed, per the definition of financial distress as two consecutive years of losses (Kisman & Krisandi, 2019). The table details the actual results for 2018 and 2019 and the financial distress predictions made by the four models.

Table 2. Actuals and predictions (Developed by the authors)

Company	Real	Altman	Zmijewski	Springate	Grover
(BAPA)	-	-	-	(D)	-
(BCIP)	-	Grey	-	-	-
(BEST)	-	-	-	-	-
(BIPP)	-	Grey	-	(D)	-
(BKDP)	(D)	-	(D)	(D)	-
(BKSL)	-	-	-	-	-
(BSDE)	-	-	-	-	-
(COWL)	(D)	Grey	-	(D)	-
(CTRA)	-	-	-	-	-
(DART)	-	-	-	(D)	-
(DILD)	-	-	-	(D)	-
(DUTI)	-	-	-	-	-
(ELTY)	-	Grey	(D)	-	-
(EMDE)	-	-	-	-	-
(FMII)	-	-	-	-	-
(GAMA)	-	-	-	(D)	-
(GMTD)	-	-	-	(D)	-
(GRPA)	-	-	-	-	-
(GWSA)	-	-	-	-	-
(JRPT)	-	-	-	(D)	-
(KIJA)	-	-	-	-	-
(LCGP)	(D)	-	-	-	-
(LPCK)	-	-	-	-	-
(LPKR)	-	-	-	-	-

(MDLN)	-	-	-	-	-
(MKPI)	-	-	-	-	-
(MTLA)	-	-	-	-	-
(MTSM)	(D)	-	(D)	(D)	-
(NIRO)	(D)	-	(D)	(D)	-
(MORE)	-	-	-	-	-
(PLIN)	-	-	-	(D)	-
(PWON)	-	-	-	-	-
(RBMS)	-	-	(D)	(D)	-
(RDTX)	-	-	-	-	-
(RODA)	-	-	-	-	-
(SMDM)	-	-	-	(D)	-
(SMRA)	-	-	-	-	-
(APLN)	-	-	-	-	-
(ASRI)	-	-	-	-	-

4.2. The Modified Altman and Zmijewski Model Hypothesis Results

It can be seen from the statistical test results using Stata 17, Prob > |z| is 0.0293. The test results (Prob > |z|is 0.0293) indicate that there are differences between the Zmijewski model and the modified Altman model. The difference can be seen from the value of Prob > |z|smaller than 0.05.

H0: Nilai(Model==1) = Nilai(Model==2)
z = -2.179
Prob > z = 0.0293
Exact prob = 0.0715
Figure 3. The Mann-Whitney test on the modified Altman and
Zmijewski models

4.3. The Springate and Modified Altman Model Hypothesis Results

Based on the tests conducted at state 17, the results revealed a probability of 0.0001. The test results (Prob > |z| is 0.0001) indicate that there are differences between the Springate model and the modified Altman model. The difference can be seen from the value of Prob > |z| smaller than 0.05.

H0: Nilai(Model==1) = Nilai(Model==3)
z = -3.910
Prob > z = 0.0001
Exact prob = 0.0001
Figure 4. The Mann-Whitney test on the modified Altman and
Springate models

4.4. The Modified Altman and Grover Model Hypothesis Results

The test result for the modified Altman and Grover models indicated slight differences between the models as 35 out of 39 samples were categorized as healthy in the modified Altman model (excluding the four gray area companies). In contrast, all 39 companies were categorized as healthy in the Grover model.

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	H0: Nilai(Model==1) = Nilai(Model==4)	Table 3. Financial	distress a	ccuracy result	s (Developed	d by the	
Z =		authors)					
	Prob > z = .		Altman	Zmijewski	Springate	Grover	
	Exact prob = 1.0000			J	~F8		
Figu	are 5. The Mann–Whitney test on the modified Altman and	Correct Prediction	30	35	28	34	
-	Grover models						

4.5. The Zmijewski and Springate Model Hypothesis Results

The results obtained from the analysis performed in state 17 had a probability of 0.0216. The results of 0.0216 show a difference between the Zmijewski model and the Grover model because the H0 hypothesis cannot be rejected because 0.0216 is less than 0.05.

H0: Nilai(Model==2) = Nilai(Model==3) z = -2.359Prob > |z| = 0.0183Exact prob = 0.0332

Figure 6. The Mann–Whitney test on the Zmijewski and Springate models

4.6. The Springate and Grover Model Hypothesis Results

According to results of the statistical test using Stata 17, Prob > |z| is 0.000. The test results (Prob > |z| is 0.0000) indicate differences between the Springate model and the Grover model. The difference can be seen from the value of Prob > |z| smaller than 0.05.

4.7. Comparison of the Modified Altman, Zmijewski, Springate, and Grover Models

The results of the statistical test using Stata 17 show that Prob is 0.0001, which is certainly smaller than the significance level (0.05), so the hypothesis (H0) cannot be rejected. This result implies significant differences in the results obtained from the modified Altman, Zmijewski, Springate, and Grover models. Companies categorized as being in the gray area cannot be included in the accuracy calculation, as their financial health status remains indeterminate.

Model	Obs	Rank sum
1	35	2345.00
2	39	2993.00
3	39	3677.00
4	39	2613.00

Figure 8. The Kruskal–Wallis test of the financial distress model

Table 3. Financial distress accuracy results (Developed by the authors)					
Altman Zmijewski Springate Grover					
Correct Prediction	30	35	28	34	
Grey Area	4	0	0	0	
Sample	39	39	39	39	
Accuracy	77%	90%	72%	87%	
Type Error I	13%	5%	3%	13%	
Type Error II	0	5%	26%	0	

The test already performed from the accuracy calculation, obtained the lowest accuracy model result with type error I 3% and II 26% with the 72% accuracy level is the Springate model. The second lowest accuracy level with type error I 13% and II 0% with the 77% accuracy is the Altman modification model. The second highest accuracy level with type error I 13% and II 0% with the accuracy level 87% is the Grover model. The highest accuracy level in this study with type I error is 5%, and II - 5% with 90% accuracy achieved by the Zmijewski model. The Zmijewski model correctly identifies the financial distress status of companies BKDP, MTSM, and NIRO, as demonstrated in the results:

1. The net income of companies with losses approaching or exceeding the value of total assets.

2. The net income of companies with a near-zero value and total liabilities approaching or exceeding the total assets.

The companies LCGP and COWL do not satisfy the two criteria established by the Zmijewski model. Therefore, they cannot be classified as healthy companies. The company will be classified in financial distress if the company's condition, according to the Altman model, is fulfilled as follows (Safriliana et al., 2020; Al-Khalili & Kaddumi, 2022):

1. A significant disparity exists between working capital values and TA (total asset), or working capital is negative with TA (total assets).

2. A substantial difference is observed between RE and TA, or RE are negative compared to TA.

3. A substantial disparity exists between EBIT and total assets, or EBIT is negative relative to total assets.

4. The debt value approaches or exceeds the equity value or the equity value is negative in relation to debt.

5. The conditions must be satisfied to classify a company as in financial distress officially.

On the other hand, the company will be classified in financial distress if the company's condition according to the Grover model is fulfilled as follows:

1. WC (working capital) or TA (total asset) is negative.

2. EBIT and TA are both negative.

3. Net income and total assets are both negative.

4. All the three conditions must be fulfilled for Springate financial distress categorization are as follows

1. A significant disparity exists between working capital values and total assets, or working capital is negative with total assets.

2. A substantial difference is observed between EBIT and total assets, or EBIT is negative compared to total assets.

3. Current liabilities approach or exceed the net before tax value, or current liabilities are negative with a net before tax.

4. Total assets approach or exceed the sales value, or total assets are negative with sales.

5. The conditions must be satisfied to officially classify a company as in financial distress.

In line with financial distress research by Wiranti and Munandar (2021), using the Grover and Zmijewski models for companies listed on the IDX website from 2015 to 2019 in Indonesian retail companies with results tested, the model with the lowest level of accuracy was obtained using the Grover model, while the Zmijewski model received the highest accuracy. Additionally, this research is also consistent with the research carried out by Wahyudi et al. (2021) on its financial distress research by testing the Altman, Springate, and Zmijewski models on companies registered in the BEI and using the Indonesian manufacturing sector. The study found that the Zmijewski Method was the most accurate among the three methods tested, with an accuracy rate of 100%.

5. Conclusion

This research assessed the accuracy of financial distress predictions by comparing actual outcomes with predicted results. The results indicate that the modified Altman model classified 35 companies as financially healthy and four companies as being in a gray area, while the Zmijewski model categorized five companies as being in financial distress and 34 companies as being financially healthy. The Springate model classified 14 companies as being in financially healthy. Finally, the Grover model classified 39 companies as being financially healthy.

The differences in the results obtained from the various models can be attributed to the differences in the formulas used by each model. Out of the 39 samples analyzed, the research conducted by Kisman and Krisandi (2019) observed that five companies were categorized as being in financial distress in 2018 and 2019. This categorization was based on the criterion of two consecutive years of losses for a company to be financially distressed. The researcher then applied each model's formula and conducted the Mann–Whitney and Kruskal–Wallis tests to analyze the results. After the test, the H0 hypothesis results cannot be rejected so that there is a difference between the two models (the Zmijewski and Altman modification) because the probe value is smaller than its significant value (0.05).

From this study, it was concluded that between each

model and the four models, when viewed from each model (Zmijewski, Altman, Grover, and Springate) there are differences in results after being seen from testing between models using Stata 17. Overall, there are also differences in results for Altman, Springate, Zmijewski, and Grover by the Mann–Whitney and Kruskal–Wallis tests using Stata 17. The test results indicated that the null hypothesis (H0) could not be rejected for all comparisons with a Prob value less than 0.05, suggesting that the differences in results are significant. Finally, the results show that when all four models were tested simultaneously, there were differences in the results between the models.

From the tests carried out with Stata 17, it can be seen that the model that has the lowest accuracy with type I error is 3% and II is 26% and 72% accuracy is the Springate model. The next lowest level of accuracy with type I error is 13%, and 0% for II with an accuracy of 77% is the modified Altman model. The third lowest level of accuracy with error type I 13% and II 0% with an accuracy value of 87% is the Grover model. Furthermore, the highest accuracy rate in this study with type I error was 5% and II 5% with 90% accuracy achieved by the Zmijewski model. Type II error refers to the percentage of error when the model predicts financial distress. Type I error refers to the error that occurs when the sample prediction model does not indicate financial distress, but in reality, the company is in financial distress (Rizkyansyah & Laily, 2018).

The results of this research are expected to contribute to the field of accounting and serve as a reference for future research, especially those investigating financial distress using the modified Altman model (Z-score), Zmijewski (X-score), Springate, and Grover models. The findings can also be used as a benchmark for future research and can benefit parties seeking information related to the research outcomes. For companies, the research can serve as additional information to improve their performance and assess the health conditions of the company, which can assist in the decision-making and policy formulation. For investors, the study can enhance their understanding and knowledge of the property and real estate sectors listed on the Indonesia Stock Exchange and provide useful insights for those who are interested in or have already invested in these sectors. Therefore, this research can improve the accuracy of financial distress predictions, enhance investment decisions, and promote financial stability in the business sector.

6. Limitations and Further Study

The limitation of this research is that this research only focuses on four financial distress models, namely the Altman modification, Zmijewski, Springate, and Grover. This study took the last actual data for 2019 due to the COVID pandemic, which could allow changes in the company's predictions; therefore, the researchers took 2019 before the outbreak of COVID. The research and results of this prediction are focused only on the property and real estate sector, which may 968

be different when used in other sectors. The research on the other sector, as they have different nature, can become further study.

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Authors' Contributions

Jessica Magdalena conceptualized and implemented the study, developed the methodology, conducted the literature review, and wrote the manuscript. Toto Rusmanto provided guidance and lectures throughout the study and assisted with the literature review, methodology, and every aspect of this study.

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