

# **FINANSIAL DISTRESS PREDICTION USING THE ALTMAN, SPRINGATE, ZMIJEWSKI, AND GROVER MODELS IN PHARMACEUTICAL COMPANIES LISTED ON INDONESIA STOCK EXCHANGE**

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## **ABSTRACT**

The goal of this research is to determine: (1) whether or not the outcomes of the Altman, Springate, Grover, and Zmijewski models for financial distress prediction differ from one another; (2) Which model is the most accurate at identifying financial distress in Indonesian pharmaceutical companies. A comparison of the four forecasting models shows that each model's precision is according to the firm's actual situation. Corporate financial reports posted on the Indonesian Stock Exchange (IDX) website were the source of the data for this research. This research focused on pharmaceutical's companies a list from 2016 to 2018, the Indonesian Stock Exchange (IDX). Purposive sampling was used for the sampling, and eight businesses were chosen as research samples. Data analysis technology uses parametric statistical tests, namely paired samples t-test and prediction model accuracy tests, provided that the data must be normally distributed. This research uses descriptive statistical methods, normality tests, and matched samples to assess the results of four financial distress prediction models and T-test sample analysis methods utilizing the SPSS program. The results of this research show that there are significant differences in the ability of the Altman, Springate, Grover, and Zmijewski models to predict financial distress. The Springate model has a 91.67% accuracy rate, which is the highest.

**Keywords** Financial Distress, Prediction Model, Financial Statement

## **1. Introduction**

Increasingly fierce competition and changing market situations made producers have to be careful in dealing with and make decisions in matters concerning the company. Financial performance could be reflected in the review of the company financial statements with indicators of financial ratios. The company's financial statements are one source of information regarding the company's financial position, performance, and changes. All of this information is essential for supporting sound decision-making. Because the corporation transactions also operations for a particular time are summarized in the financial statements., namely one fiscal year. Indonesia as one of the developing countries with the largest population in Southeast Asia with around 266 million people and is the world's fourth largest of the country. This makes Indonesia a potential market for producers, where one of the main needs of the Indonesian people is in the health sector which is closely related to drugs and the pharmaceutical industry. The increasing supply and demand for drugs in the community makes competition between the pharmaceutical industry increasingly fierce. The pharmaceutical or medicine industry is one of the industries with products that are always in demand by the community. In 2018, the Pharmaceutical Entrepreneurs Association is optimistic about the drug business. If in the past years the pharmaceutical industry could experience double-digit business growth, in the range of 10-15% annually, but now the achievement is still difficult to achieve. There are two problems faced by business players, namely environmental protection regulations carried out by China, a government that is oppressive the production of medicinal raw materials and the yuan currency that has strengthened against the US dollar which affects the price of these raw materials because many raw materials are imported from China. Here are some updates on the development of the pharmaceutical business in Indonesia. For example, PT Merck Indonesia, Tbk expanded its plant by adding production facilities for tablets and capsules. PT Merck Indonesia targets to double its production capacity by 2018. The company's current production capacity is 900 million tablets and capsules per year with 77% utilization or 700 million tablets and capsules in 2015. The expansion will be divided into four stages. In 2015, the expansion began by adding infrastructure capacity in the form of facilities for manufacturing solid products or tablets and capsules, followed in 2017 by the addition of machinery facilities and in 2018 the company added capacity for liquid medicine products. From the various problems faced by several pharmaceutical companies of different types and interests, the company must be better able to anticipate possible mistakes that will adversely affect the company, one of which is financial distress. Companies in Indonesia must be able to compete to face all these conditions and circumstances because otherwise, unpreparedness and inability to compete will cause business activities to be unfavorable and if the company cannot survive, it will make the company's financial situation, unhealthy (*financial distress*) and the worst thing is that it will experience bankruptcy. For pharmaceutical companies that do not have the ability to prepare themselves to face these circumstances, it is possible that they will experience a decline in performance which will have a negative impact if left unchecked and will even cause bankruptcy.

Seeing the current condition of the pharmaceutical business, pharmaceutical companies must be able to maintain their reputation, as evidenced by the company's financial performance. Bankruptcy analysis is carried performed in order to gain early warnings of insolvency (signs of insolvency). The earlier indications of insolvency are discovered, the more advantageous for management since management may make modifications (Mamduh and Halim. 2003: 263). So that bankruptcy does not really happen to the company and the company can plan ahead of time or devise tactics to deal with these difficulties if bankruptcy really befalls the company. Insolvency is typically characterized as a corporation's failure to carry out its operations in order to generate revenues. When a company faces financial problems, which in this research is thought to be in financial distress, it can result in investors, potential investor and creditor are not investing in or lending to the firm. If the corporation does not find a solution to the financial condition problem, it is certain that the company can no longer continue its business or is in bankruptcy. With so many company bankruptcy prediction models, management must choose the most accurate and suitable for its business sector, because if an error in choosing a prediction model will result in errors in company decision making. Several models are used to forecast a company's *financial distress*, namely Grover, Zmijewski, Ohlson, Fulmer, CA-Score, and other models. In this study, the Altman, Springate, Grover, and Zmijewski models were utilized to assess potential bankruptcy.

### **1.1 Objectives**

This research's objective is to define (1) is there any difference in scores among Altman, Grover, Springate, and Zmijewski financial distress prediction models, (2) among some models predicting financial distress in Indonesian pharmaceutical companies, a prediction results can determine which prediction results are most accurate. This study is expected to contribute to literature. Companies can utilize financial distress analysis to estimate the danger of business bankruptcy. For investors, analysis of financial distress is a useful tool for consideration when making an investment decision.

## **2. Literature Review**

Researchers discovered numerous prior studies after completing a literature review. According to a research by Edi and May Tania (2018), All measuring approaches, such as Altman, Springate, Zmijewski, and Grover can be used to predict bankruptcy because they all had a substantial impact on the results. According to The Springate model, which has a 69.7% accuracy rating, is the most accurate according to the coefficient of determination test results, followed by Grover, Altman, and Zmijewski models. According to Barbara Gunawan, Rahadien Pamungkas, and Desi Susilawati's (2017) research, The Zmijewski model is based on the results of the discriminating coefficient test, which has the highest level of accuracy for forecasting scenarios involving financial distress. The Zmijewski model, which is focused more on debt metrics than the other two models, has the greatest R square value among the three models under consideration. According to According to Prihantini, Ni Made Evi D, Ratnasari, M. Maria's (2013) research, The Grover model is the most accurate —100%—of any prediction model, making it the best choice for Companies that production food and beverages and are listed on the Indonesia Stock Exchange (IDX). Zmijewski, Springate, and Altman Z-Score models all have accuracy levels of 90%. According to Rini Tri Hastuti's (2015) research, when the accuracy level of the full sample (which consists of both category 0 and category 1 samples) is calculated, the Altman model produces an accuracy level of 83.7%, Springate produces an accuracy level of 76.81%, Grover produces an accuracy level of 91.30%, and Ohlson produces an accuracy level of 77.9%. In other words, the Grover prediction model in this study had a 91.30% accuracy rate. In her analysis, Enny Wahyu Puspita Sari (2014) found that the Springate model is best suitable for Indonesian transportation industries because of its high accuracy and the low error rate in comparison to other forecasting models. According to earlier research by M. Fakhri Husein and Galuh Tri Pambekti (2014), the Zmijewski model used in this study was more accurate than other forecasting models. The research conducted by each of the following academics uses a number of independent variables from the Altman, Springate, Grover, Ohlson, and Zmijewski models financial forecasting circumstances that are in financial distress.

### **2.1 Financial Statements**

Financial statements produced by the company allow for accountability from each management to the company's stakeholders. Financial reports are intended to offer details and a summary of the firm's financial position and performance for use as a roadmap for making decisions about how to proceed with business operations. According to PSAK No. 1 (IAI, 2017), financial statements are intended to : (1) Present data that is useful to a range of users in making economic decisions about the entity's financial condition, financial performance, and cash flows; (2) Financial statements demonstrate accountability of management for the resources that entrust to them; and (3) Financial statements present information on asset, liability, equity, revenue, and expense, include gain and loss, (4) Financial statements often reflect financial effects and previous events and are not obligated to provide non-financial information, thus they do not always give consumers all the information they may need to make economic decisions. (5) Financial statements also reveal management's actions (stewardship), or accountability of management for resources entrusted to it.

### **2.2. Analysis of Financial Statement**

According to the explanation in PSAK that financial statements not all of the details required by a user, analysis necessary for interpret the financial statement so that they can provide useful information to parties considering the company's performance development. The primary goal of financial analysis, according to Cashmere (2008: 66), is to determine the present financial situation. Knowing the financial situation after thoroughly studying the financial paperwork will disclose whether or not the organization will be able to reach the previously planned targets. Financial statement analysis results would give information that the company's financial ratios show its strengths and flaws, which can only be done by companies that carry out financial administration in accordance with correct accounting principles, so that the resulting balance sheet and income statement are accurate and accountable. The most common ratios include liquidity, activity, solvency, profitability, and market ratios.

### **2.3. The Definition of Financial Distress**

There are numerous viewpoints on Financial Distress that associate it with bankruptcy. However, this is not the case. While financial difficulty is one of the elements that lead to bankruptcy in the context of corporate finance, there are other factors that may induce corporate bankruptcy. The primary determinant of whether a corporation is in financial distress according to Almilia and Kristijadi (2003), is a condition in which a corporation has a negative net operating income for many years and doesn't pay dividends, lay off workers, or eliminate dividend payments for a period of more than one year. Financial difficulty can also be described as a corporation's inability to fulfill past-due financial obligations (Beaver et al., 2011). Elloumi and Gueyie (2001) define financial hardship as a corporation having a net loss for two years in a row. According to Irham Fahmi (2004), there are four (four) types In general research, there are four financial distress categories: A has a very high level of financial difficulty, B has a high level, C has a medium high level, and D has a low level of financial distress.

## **2.4. The Altman Model**

Altman (1968) applies the five financial ratios utilized in Multiple Discriminant Analysis (MDA) are working capital to total assets, retained earnings to total assets, earnings before interest and taxes to total assets, market value of equity to total debt book value, and sales to total assets. The Altman Z-score model is a technique for estimating the financial stability and likelihood of bankruptcy of a corporation. In order to develop a new equation that can be applied to both private and public organizations, the Altman Z-score prediction model was modified multiple times. The Altman Z-score prediction model is accurate in excess of 80% of cases.

## **2.5. The Springate Model**

Gordon L.V Springate (1978) conducted research and created a model for predicting bankruptcy based on the Altman model. Using four financial ratios, the Springate model predicts future concerns with a corporation's finances. With an accuracy of 92.5%. This Springate model is capable of predicting bankruptcy.

## **2.6. The Grover Model**

In 1968, Jeffrey S. Grover using a sample and the Altman Z-score model, introducing thirteen additional financial ratios. From 1982 to 1996, the sample included 70 enterprises, 35 of which were bankrupt and 35 of which were not.

## **2.7. The Zmijewski Model**

Zmijewski (1983) expanded studies in predicting financial distress, adding to the efficacy financial measurements as a technique for determining corporate financial health failure. Zmijewski's prediction model is the outcome of 20-year investigation that has been replicated. Zmijewski (1984) employs liquidity ratio analysis, leverage, and analyzes a company's success. Zmijewski used a sample of 75 insolvent businesses and 73 healthy businesses to forecast the F-Test group ratio indicators are a rate of return, liquidity, leverage turnover, fixed payment coverage, a trend, and stock return volatility, which show significant differences between healthy and unhealthy organizations between 1972 and 1978.

## **3. Methods**

The sort of research involves comparative quantitative research or comparative data analysis approaches in quantitative research utilizing statistics. In research, two types of statistics are utilized for data analysis: descriptive statistics and inferential statistics. This study use inferential statistics, which are statistical techniques used to assess sample data and then apply the conclusions to the population. Inferential statistics are further subdivided into parametric statistics and non-parametric statistics, with parametric statistics being used in this study because one of the test conditions is that the data be regularly distributed. This study's goal is to look at differences in one variable with other variables by only testing whether it is related to other groups. Researchers conduct comparison research because they want to know how to forecast financial difficulty of pharmaceutical companies listed from 2016 to 2018 on the Indonesia Stock Exchange (IDX).

### **3.1. The Population and sample**

The population of this study comprised of nine pharmaceutical corporations registered on the IDX. This research made use of purposeful sampling. The study's sample criteria are as follows :

1. The research sample consists of pharmaceutical firms who went public and are now traded on the Indonesia Stock Exchange until 2018.
2. Pharmaceutical businesses that published full financial disclosures (annual reports) from 2016 to 2018.
3. Pharmaceutical businesses listed on the IDX from 2016 to 2018. Pharmaceutical firms whose fiscal year ends on December 31.

Table 1. Pharmaceutical Firms on the Indonesia Stock Exchange (IDX)

No	Name of Company	Code
1	DaryaVariaLaboratoriaTbk	DVLA
2	IndofarmaTbk	INAF
3	IndustriJamu dan Farmasi Sido MunculTbk	SIDO
4	Kalbe Farma Tbk	KLBF
5	Kimia FarmaTbk	KAEF
6	MerckIndonesia Tbk	MERK
7	Merck SharpDohmePharmaTbk	SCPI
8	PyridamFarmaTbk	PYFA
9	Tempo Scan Pasific Tbk	TSPC

### 3.2. Variable Operationalization

Based on the difference in score and accuracy level in each prediction model, this study will compare four prediction models, Altman, Springate, Grover, and Zmijewski, to determine which prediction model is the most accurate in predicting financial difficulties in pharmaceutical companies listed on the IDX from 2016 to 2018. The following are prediction models along with the measurements used to generate scores on each prediction model :

- 1) Altman Z – Score Model

$$Z' = 0.717X_1 + 0.847X_2 + 3.108X_3 + 0.42X_4 + 0.988X_5$$

Description:

Z' = bankruptcy index

X<sub>1</sub> = working capital or total assets

X<sub>2</sub> = retained earnings or total assets

X<sub>3</sub> = earnings before interest and taxes or total assets

X<sub>4</sub> = book value of equity or book value of total debt

X<sub>5</sub> = sales or total assets.

If the company has a score is less than 1.23, it faces bankruptcy. If the company received a score between 1.23 and 2.90, it was classed as being in the gray area. If the obtained score is higher than 2.90, the company is not in danger of bankruptcy..

- 2) Springate Model

$$Z = 1.03A + 3.07B + 0.66C + 0.4D$$

Description:

A = Working Capital or Total Assets

B = Net Profit before Interest and Taxes or Total As- sets

C = Net Profit before Taxes or Current Liabilities

D = Sales or Total Assets

If the S score is greater than 0.862, the company is healthy; otherwise, the company is sick. The company has been identified as potentially bankrupt.

- 3) Grover Model

$$G\text{-Score} = 1.650 X_1 + 3.404 X_2 - 0.016ROA + 0.057$$

Description:

X<sub>1</sub> = Working capital or Total assets

X<sub>2</sub> = Earnings before interest and taxes or total assets

ROA = net income or total assets

If the score is less than or equal to -0.02 (Z -0.02), the corporation is declared bankrupt. The company is unlikely to go bankrupt if the score is more than or equal to 0.01 (Z 0.01).

- 4) Zmijewski Model

$$X = -4.3 - 4.5 + 5.7 X_1 X_2 - 0.004 X_3$$

Description:

X<sub>1</sub> = after-tax earnings or/total assets

X<sub>2</sub> = total debt or total assets

X<sub>3</sub> = current assets or current liabilities

If the resulting score is larger than 0 (zero), the company is likely to go bankrupt; conversely, if the obtained score is less than 0 (zero), the company is unlikely to go bankrupt.

### 3.3. Variable Operationalization

- 1) Descriptive Statistic,

Descriptive analysis was used to determine the minimum, maximum, mean, and standard deviation values of four financial distress prediction models used by pharmaceutical companies listed on the IDX from 2016 to 2018. The minimum value describes the lowest value of a set of data or samples that have been evaluated. The maximum value describes the greatest value of a set of data or samples that have been studied. The mean value describes the average score of the data / samples examined. The greater a variable's standard deviation, the more dispersed the data in that variable is from its mean value. The lower the standard deviation of a variable, the more clustered the data in that variable at its mean value. Descriptive statistics are valuable as a data analysis technique because they describe current samples without drawing broad generalizations.

1) Normality Test

Widely used to examine ordinal, interval, or ratio scaled data. The parametric equation approaches are used, the normality condition, that the data come from a normal distribution, must be met. When the data is not normally distributed, the sample size is small, and the data is nominal or ordinal in character, non-parametric statistics are used. In this discussion, with a significance threshold of 0.05, the One Sample Kolmogorov-Smirnov test will be employed. If the significance level is greater than 0.05, the data is considered regularly distributed.

2) Hypothesis Test

(a) The Paired Sample T- Test

If the data is regularly distributed, the paired sample t-test can be utilized. The comparative analysis method is utilized to evaluate the hypothesis of this study. This is a mean difference test that looks for a comparison of four sample groupings. In this exam, decisions are made by comparing probability values (Sig. 2-tailed). If the likelihood (in this case, the Sig. 2-tailed value) exceeds a certain threshold, there is no statistically significant difference in the average between the two sample groups. The difference between the two sample groups is considered significant if the probability (in this case, the Sig. 2-tailed value) is less than 0.05. The test was carried out with a 0.05 (5%) significance level.

(b) The Prediction Accuracy Model Test

This test is used to determine the proper and incorrect estimates or to assess the correctness of the dependent variable grouping, namely the group of companies in financial trouble and the group of companies that are not in financial distress. The next step is to compare the prediction results to the sample category in all existing samples. The accuracy level indicates how much percent of the model properly predicts from the total sample. Each model's accuracy level is calculated as follows:

$$\text{Rate of Accuracy} = (\text{a number of correct predictions} / \text{a number of samples}) \times 100\%$$

Aside from the accuracy of each model, the error rate is taken into account. There are two kinds of errors: type I and II. A type I error occurs when the model predicts that the sample will not feel anguish yet it does. A type II error occurs when the model predicts distress but the sample does not experience it. The error rate is calculated as follows :

$$\text{Type I Error} = (\text{a number of type I errors} / \text{a number of samples}) \times 100\%$$

$$\text{Type II Error} = (\text{a number of type II errors} / \text{a number of samples}) \times 100\%$$

#### 4. Data Collection

The documentation method was employed in this study to collect data. This study relied on secondary data. Secondary data sources include financial filings from pharmaceutical companies listed on the IDX between 2016 and 2018. Data for pharmaceutical businesses' Annual financial records are received from the IDX through its website www.idx.co.id. Studying, reviewing, and reading sources in the form of library books, articles relating to the object under study, research journals, past research, and other sources linked to the object under study is also part of library research. Secondary data was obtained in the form of financial statements from pharmaceutical companies registered on the IDX between 2016 and 2018. According to previously mentioned sample criteria, 9 pharmaceutical companies registered on the IDX, however one firm, Merck Sharp Dohme Pharma Tbk, did not between 2016 and 2018, so the selected sample became 8 samples.

Tabel 2. The List of Sample Companies

Company in Distress	Company in Non-Distress
1. <a href="#">PT. Indofarma Tbk</a>	1. <a href="#">PT. Darya Varia Laboratoria Tbk</a>
	2. <a href="#">PT. Industri Jamu dan Farmasi Sido Muncul Tbk</a>
	3. <a href="#">PT. Kalbe Farma Tbk</a>
	4. <a href="#">PT. Kimia Farma Tbk</a>
	5. <a href="#">PT. Merck Indonesia Tbk</a>
	6. <a href="#">PT. Pyridam FarmaTbk</a>
	7. <a href="#">PT. Tempo Scan Pasific Tbk</a>

The sample is classified into companies are classified as distressed or non-distressed based on the criteria listed below :

1. Companies in financial distress (referred to as category 1), defined as having a net loss for two years in a row and the company does not distribute dividends for more than 1 year.
2. Companies that are not in financial distress (after referred to as category 0), the criteria company had not a net loss in two years, and it is from the same year and sector as category 1.

The company included in category 1 in this research is PT Indofarma Tbk as recorded in gain or loss statement and other total income shows a loss of (IDR 18,806,725,775) in 2016, (IDR 56,816,969,124) in 2017, and (IDR 32,736,482,313) in 2018. With a loss for 3 consecutive years PT. Indofarma Tbk can be categorized as a company distressed.

## 5. Results and Discussion

### 5.1. Descriptive Statistics

The descriptive analysis was used to establish the minimum, maximum, mean, and standard deviation of scores from four financial distress prediction models used by pharmaceutical businesses listed on the Indonesia Stock Exchange (IDX) between 2016 and 2018.

Tabel 3. Descriptive Statistics Data

Descriptive Statistics								
	N	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Altman	24	2.41	20374.02	56753.72	2364.7381	1302.36670	6380.26775	40707816.597
Springate	24	0.40	3.79	43.84	1.8268	0.23294	1.14118	1.302
Grover	24	0.09	2.96	28.54	1.1893	0.15718	0.77002	0.593
Zmijewski	24	-5.09	-0.43	-69.37	-2.8905	0.28154	1.37924	1.902
ValidN (listwise)	24							

The outcomes of data processing using the SPSS score Altman model are minimum 2.41, maximum 20374.02, average or mean 2364.7381, and standard deviation value 6380.26775, as shown in table 3. The Springate model has minimum score of 0.40, maximum score of 3.79, average or mean score 1.8268, and standard deviation 1.14118. Grover model's score ranges from 0.09 to 2.96, with an average or mean 1.1893, and standard deviation 0.77002. The Zmijewski model's score ranges from -5.09 to -0.43, with an average or mean -2.8905, and standard deviation 1.37924.

### 5.2. The Normality Test

This test is typically used to quantify ordinal, interval, or ratio scaled data. The One Sample Kolmogorov-Smirnov test, with a significance level of 0.05, will be utilized in this discussion. When the significance threshold approaches 0.05, the data is thought to be regularly distributed.

Tabel 4. The Normality Test (*One Sample Kolmogorov-Smirnov*)

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		24
Normal Parameters <sup>a,b</sup>	Mean	0.000000
	Std. Deviation	2358.08465896
Most Extreme Differences	Absolute	0.172
	Positive	0.110
	Negative	-0.172
Test Statistic		0.172
Asymp. Sig. (2-tailed)		.063 <sup>c</sup>

Table 4 shows that the significance value 0.063, where  $0.063 > 0.05$ , indicating that the data is normally distributed.

### 5.3. The Research Hypothesis Test

This test used to see if there is a difference between two matched dependent samples, specifically whether there is a significant difference in predicting financial distress between the scores of the Altman, Springate, Grover, and Zmijewski prediction models. The decision is based on the Sig Asymptotic (2-tailed) distribution. When the probability (in this case, the Asymp. Sig (2-tailed) value) exceeds 0.05, there is no discernible difference between the two sample groups. If the probability is 0.05, the two sample groups differ significantly.

Tabel 5. The Paired Sample T-Test Results

		Paired Differences					Sig (2-tailed)
		Std. Deviation	95% Confidence Interval of the Difference				
			Lower	Upper			
Pair 1	Altman–Springate	6379.68533	-330.99356	5056.81614	1.814	23	0.083
Pair 2	Altman–Grover	6380.14005	-330.54799	5057.64574	1.815	23	0.083
Pair 3	Altman–Zmijewski	6380.91585	-326.79587	5062.05304	1.818	23	0.082
Pair 4	Springate–Grover	0.53253	0.41272	0.86245	5.865	23	0.000
Pair 5	Springate–Zmijewski	2.33738	3.73030	5.70428	9.887	23	0.000
Pair 6	Grover–Zmijewski	1.97721	3.24481	4.91461	10.108	23	0.000

#### Hypothesis Test-1 (H1)

According to the data in Table 5, the Sig. (2-tailed) in pair 1, specifically the Altman and Springate model scores, is 0.083. These data reveal a probability greater than 0.05, indicating that no substantial difference exists among two sample groups. Based on these findings, it is reasonable to conclude that H1 cannot be accepted and that there is no difference in the scores of the Altman and Springate models in forecasting financial distress because the level of confidence is less than 95%.

#### Hypothesis Test-2 (H2)

The result of pair 2, namely the Altman score and Grover, as shown in table 5, is 0.083. These results reveal that where the probability of these two groups is less than 0.05, indicating no significant difference, it can be assumed that H2 cannot be accepted because its confidence level is less than 95%.

#### Hypothesis Test-3 (H3)

Between scores from Altman and the Zmijewski model in pair 3, the 2-tailed significance level is 0.082, according to the results in table 5. This model's findings have a probability greater than 0.05, indicating that there is no statistically significant difference between the two sample groups. Based on these findings, it is obvious that H3 is unacceptably high; there is no difference in the chance of financial difficulty between the Altman and Zmijewski models because the confidence level is less than 95%.

#### Hypothesis Test-4 (H4)

Table 5 shows that pair 4's Sig. (2-tailed) value is 0.000 for the Springate model score and Grover model. These data reveal a likelihood of 0.005, indicating that the two sample groups differ significantly. Based on these findings, it is possible to conclude that H4 is accepted, implying that a distinction exists in the score to between Springate and Grover models have 95% confidence level on the possibility of financial distress.

#### Hypothesis Test-5 (H5)

Table 5 shows that the Sig. (2-tailed) in pair 5, specifically between the Springate model score and the Zmijewski model is equal to 0.000, these results have a probability  $< 0.05$ , indicating that there is a significant difference between the two sample groups. Because the confidence level is 95%, it is possible to conclude that H5 is acceptable, which means that there is a score difference in forecasting financial hardship between the Springate and Zmijewski models.



**Hypothesis Test-6 (H6)**

Table 5 shows that the Sig. (2-tailed) between the scores of the Zmijewski and Grover models in pair 6 is 0.000. These results suggest a probability of 0.05, indicating a substantial difference between two sample groupings. Because the confidence level is 95%, it can be concluded that H6 is acceptable, which suggests that there is a disparity in scores forecasting the Grover and Zmijewski financial distress model.

**5.4. Accuracy of Prediction Model Test**

The last hypothesis testing is to see how accurate the prediction model is. This stage is carried out in order to achieve the prediction model with the highest degree of accuracy and the least amount of error generated in each prediction model. The outcomes of testing the accuracy of forecasts will be addressed one by one and displayed in the table. The table and explanation that follows are for determining the precision and type error of Altman, Springate, Grover, and Zmijewski model.

**The Altman Model**

This model was subjected to the first test, with the results of the accuracy test and the computation of the Altman Model error rate as follows :

Tabel 6. Altman Model Accuracy Test Results

Year	Correct Prediction	Sample
2016	7	8
2017	7	8
2018	7	8
<b>Total</b>	21	24
<b>Level of Accuracy</b>	87,5%	

Tabel 7. Altman Model Error Rate

	Type I Error	Type II Error
<b>Total</b>	3	0
<b>Number of</b>	3	21
<b>Level of Error</b>	100%	0%

Table 6 displays the outcomes of the test for Altman model accuracy, which describes the overall calculation for 24 samples consisting of category 0 and category 1 samples. The Altman model has a rate of accuracy 87.5%, where a total of 21 samples (3 years) in category 0 (non-financial distress), According to the Altman model prediction results, all data is correct in non-financial distress conditions. As for categories I (financial distress) with a total of 3 samples (3 years), it turns out that from the Altman model's forecast results all sample data are predicted incorrectly, namely in non-financial distress conditions. The Altman model error rate can be seen in Table 7 which shows Error Type I for the Altman model is 100%, and Error Type II is 0%, according to the results of error rate calculation in all categories. This metric displays Altman's prediction error.

**The Springate Model**

This model was subjected to a second test, and the results of the accuracy test and the results of the Springate Model error rate computation are shown below :

Tabel 8. Springate Model Accuracy Test Results

Year	Correct Prediction	Sample
2016	8	8
2017	8	8
2018	6	8
<b>Total</b>	22	24
<b>Level of Accuracy</b>	91,67%	

Tabel 9. Springate Model Error Rate

	Type I Error	Type II Error
<b>Total</b>	0	2
<b>Number of Samples</b>	3	21
<b>Level of Error</b>	0%	9,5%

Table 8 shows the results of the accuracy test using Springate model, which depicts the overall calculation for 24 samples from categories 0 and 1, indicating that Springate model has accuracy rate 91.67%. Total of 21 samples (3 years) in category 0 (non financial distress), it turns out that there are 21 samples in the prediction results of the Springate model, meaning that every sample is accurately predicted, specifically in non-financial distress conditions. For categories 1 (financial distress) with a total of 3 samples for 3 years with in the Springate model's prediction results, 3 samples are forecasted inaccurately, specifically under non-financial crisis conditions. Table 9 shows the Springate Model error rate in two error categories, with Error Type I, being 0% and Error Type II, being 9.5%. The Springate model is said to be still vulnerable to errors in predicting company conditions.

**The Grover Model**

The third test was conducted on the prediction accuracy and Grover model error rate calculations for the Grover model are summarized in the table below :

Tabel 10. Grover Model Accuracy Test Results

Year	Correct Prediction	Sample
2016	7	8
2017	7	8
2018	7	8
<b>Total</b>	21	24
<b>Level of Accuracy</b>	87,5%	

Tabel 11. Grover Model Error Rate

	Type I Error	Type II Error
<b>Total</b>	3	0
<b>Number of Samples</b>	3	21
<b>Level of Error</b>	100%	0%

The Grover Model Accuracy Test Results in Table 10 illustrate the overall calculation for 24 samples with a 3-year period, consisting of category 0 and category 1 samples. According to the table above, the Grover model accuracy rate is 87.5%. Then, a total of 21 samples (3 years) in category 0 (non-financial distress). According to the Grover model prediction results in non-financial distress settings, 21 data items are anticipated to be accurate. All samples in this category can be predicted correctly by the Grover model. Furthermore, for category 1 (financial distress) with a total of three samples across three years, there are three sample data that are inaccurately predicted, particularly under non-financial hardship conditions. For the Grover Model error rate can be seen in Table 1, with the Grover model prediction error rate displaying a 100% result for Error Type I and a 0% result for Error Type II. This shows the error rate of the Grover model's accuracy in recognizing both financial and non-financial distress.

**The Zmijewski Model**

This model was tested, and the result of the prediction accuracy calculation and the calculation of the Zmijewski mode's error rate are shown below :

Tabel 12. Zmijewski Model Accuracy Test Results

Year	Correct	Sample
2016	7	8
2017	7	8
2018	7	8
<b>Total</b>	21	24
<b>Level of Accuracy</b>	87,5%	

Tabel 13. Zmijewski Model Error Rate

	Type I Error	Type II Error
<b>Total</b>	3	0
<b>Number of Samples</b>	3	21
<b>Level of Error</b>	100%	0%

Table 12 displays, the findings of the Zmijewski Model Accuracy Test, illustrating the overall calculation for 24 samples consisting of categories 0 and 1 samples. The table above shows that Zmijewski's model accuracy rate is 87.5%. Then, a total of 21 samples (3 years) in category 0 (non-financial distress), it turns out that from the outcome of the prediction of there are 21 examples in the Zmijewski model for 3 years which are correctly in non-financial distress situations. Then for category 1 (financial distress) with a total of 3 samples (3 years), According to the predicted results of the Zmijewski model, all data as much as 3 sample data are predicted incorrectly, namely in non-financial distress conditions. Table 13 shows the Zmijewski Model's accuracy level, which displays the outcomes of the Zmijewski model error rate in predicting 2 categories, specifically Error Types I and II. The calculation results demonstrate that the Zmijewski forecast has 100% error type I and 0% error type II.

**5.5. The Calculation Results of Prediction Model Accuracy**

The calculation accuracy of the prediction model is carried out partially, where each prediction model is tested for accuracy as previously discussed, the following is a recapitulation of the accuration data of all prediction models :

Tabel 14. Recapitulation of Prediction Model Accuracy

Prediction Model	Level of Accuracy
Altman	87,5%
Springate	91,67%
Grover	87,5%
Zmijewski	87,5%

According to table 14, the Springate Model has the greatest prediction model accuracy percentage at 91.67%. The accuracy level for the Altman model, Grover model, and Zmijewski model is 87.5%.

## 6. Conclusion

1. H1, specifically between the Altman and the Springate model score is 0.083 with a probability greater than 0.05, indicating that no substantial difference exists among the two sample groups. Because the scores of Altman and Springate are same and the level of confidence is less than 95%, so that H1 cannot be accepted; H2, namely the Altman and the Grover model score is 0.083 with a probability of these two groups is less than 0.05. Because indicating no significant difference and confidence level is less than 95%, so that H2 cannot be accepted; H3, namely the Altman and the Zmijewski model score is 0.082 with a probability greater than 0.05, indicating that no statistically significant difference exists between the two sample groups. Because there is no difference in the likelihood of financial distress between the Altman and Zmijewski models with the confidence level is less than 95%, so that H3 cannot be accepted; H4, meaning the Springate and Grover model score, is 0.000 with a probability of 0.05, showing that the two sample groups differ significantly and because there is an implication that a differentiation exists and the confidence level on the probability of financial trouble is 95%, H4 is accepted.; H5, specifically between the Springate and Zmijewski models, is equal to 0.000, these results have a probability of 0.05, suggesting that there is a substantial difference between the two sample groups with a confidence level of 95%, hence it is possible to infer that H5 is acceptable; H6, specifically between the Zmijewski and Grover models, is equal to 0.000, implying a probability of 0.05, demonstrating a significant difference between two sample groupings with a 95% confidence level, implying that H6 is acceptable.
2. The Springate based on the results of an accuracy test of the financial distress prediction model, Springate has the highest accuracy compared to the other financial distress prediction, which is 91.67%, and is the best predictive model for the pharmaceutical company listed on the IDX. The Altman, Grover, and Zmijewski models all have the same level of accuracy, which is 87.5%.

## References

- William H. Beaver, Maria Correia and Maureen F. McNichols , Financial Statement Analysis and the Prediction of Financial Distress", *Foundations and Trends® in Accounting*, Vol. 5 No. 2, pp 99-173, 2011.
- Elloumi, F. and Gueyié, J., Financial distress and corporate governance: an empirical analysis, *Corporate Governance*, Vol. 1 No. 1, pp. 15-2, 2001.
- Bursa Efek Indonesia (IDX), website : <https://www.idx.co.id>
- M. Fakhri Husein and Galuh Tri Pambekti Precision of the models of Altman, Springate, Zmijewski, and Grover for predicting the financial distress, *Journal of Economics, Business, and Accountancy Ventura*, Vol. 17, No. 3, pp 405 – 416, 2014.
- Edy dan Tania, may, Ketepatan Model Altman, Springate, Zmijewski, Dan Grover Dalam Memprediksi Financial Distress, *Universitas Internasional Batam*, Vol.8, No.01, 2018.
- Gunawan Barbara, Pamungkas Rahadien, and Susilawati Desi., Perbandingan Prediksi Financial Distress dengan Model Altman, Grover dan Zmijewski, *Universitas Muhammadiyah Yogyakarta*, Vol.8, No.01, 2017
- Prihantini, Ni Made Evi D, and Ratnasari, M.Maria., Prediksi Kebangkrutan Dengan Model Grover, Altman Z-Score, Springate Dan Zmijewski Pada Perusahaan Food And Beverage Di Bursa Efek Indonesia. *E-Jurnal Akuntansi Universitas Udayana*, 2013
- Rini Tri Hastuti., Analisis Komparasi Model Prediksi Financial Distress Altman, Springate, Grover Dan Ohlson Pada Perusahaan Manufaktur Yang Terdaftar Di Bursa Efek Indonesia Periode 2011-2013. *Jurnal Ekonomi/Volume XX*, No. 03, 2015.
- Enny Wahyu Puspita Sari, Penggunaan Model Zmijewski, Springate, Altman Z-Score dan Grover dalam Memprediksi Kepailitan pada Perusahaan Transportasi Yang Terdaftar di Bursa Efek Indonesia, *E-Jurnal Akuntansi Udayana*, 2015.

- Yuliastary, Etta Citrawati, and Made Gede Wirakusuma. "Analisis Financial Distress dengan Metode Z-Score Altman, Springate, Zmijewski." *E-Jurnal Akuntansi Udayana*, Vol. 6, pp. 379-389, 2014.
- Rahayu, Fitriani, et al., Analisis financial distress dengan menggunakan Metode Altman Z-Score, Springate, dan Zmijewski pada perusahaan telekomunikasi, *Jurnal Manajemen Indonesia*, Vol. 4, No. 1, 2016.
- Priambodo, Dimas, and Adeng Pustikaningsih. "Analisis Perbandingan Model Altman, Springate, Grover, dan Zmijewski dalam Memprediksi Financial Distress (Studi Empiris pada Perusahaan Sektor Pertambangan yang Terdaftar di Bursa Efek Indonesia Periode 2012-2015)." *Jurnal Profita: Kajian Ilmu Akuntansi*, Vol. 6 No. 4, 2018.
- Galuh Tri Pambekti."Analisis Ketepatan Model Altman, Springate, Zmijewski Dan Gover Untuk Prediksi Kebangkrutan (Studi Empiris Perusahan Yang Masuk Dalam Daftar Efek Syariah)". Universitas Islam Negeri Sunan Kalijaga Jogjakarta, 2009.
- Almilia, Luciana Spica and Emanuel Kristijadi,, Analisis Rasio Keuangan Untuk Mem- prediksi Kondisi Financial Distress Perusahaan Manufaktur Yang Terdaftar di Bursa Efek Jakarta, *Jurnal Akuntansi dan Auditing Indonesia (JAAI)*, Vol. 7 pp. 1-27, 2003.
- Altman, EI, Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy, *Journal of Finance* 23: 589-609, 1968.
- Zmijewski, ME, 'Methodological Issues Re- lated to the Estimation of Financial Distress Prediction Models', *Journal of Accounting Re- search*, 22: 59-82, 1984.
- Sands, Earl G.,Gordon l.v. , Springate And Turgut Var."Predicting Business Failure". CGA magazine, 1983.
- Springate, Gordon L.V., Predicting the Possibility of Failure in Canadian Firm.M.B.A. Research Project, Simon Fraser University, 1978.
- Ikatan Akuntan Indonesia (IAI), Standar Akuntansi Keuangan, Salemba Empat, Jakarta, 2017.
- Belkaoui, Ahmed Riahi, Teori Akuntansi, 5<sup>th</sup> Edition. Salemba Empat Jakarta, 2012
- Sugiyono. 2018. Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Alfabeta Bandung, 2018.

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