



## Analysis Comparative Model of Altman Z-Score, Springate, Zmijewski and Grover in Predicting Bankruptcy in Sub-sector Companies Food and Beverages Period 2020-2024

Soniya Aminatul Laili<sup>1</sup>, Burhanudin<sup>2</sup>

<sup>1,2</sup> Faculty of Economic and Business, Universitas Mataram, Mataram, Indonesia

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### ABSTRACT

This study aims to analyze and compare the performance of the Altman Z-Score, Springate, Zmijewski, and Grover models in predicting potential bankruptcy in companies within the food and beverage sub-sector listed on the Indonesia Stock Exchange during the 2020–2024 period. This research employs a quantitative approach with a descriptive–comparative design. The sample consists of five companies selected through purposive sampling from a population of 83 companies. The data used are secondary data in the form of annual financial reports obtained from the Indonesia Stock Exchange. The results indicate differences in the level of predictive accuracy among the four models tested. The Springate model shows the highest statistical accuracy level of 100%, followed by the Altman Z-Score model at 84%, the Grover model at 60%, and the Zmijewski model at 32%. However, based on the threshold value approach, the Zmijewski model is considered the most representative in describing the actual financial condition of companies because its calculated value is closest to the equilibrium point between healthy conditions and potential bankruptcy. The analysis also reveals that PT Andira Agro Tbk and PT Jaya Agra Wattie Tbk have relatively higher bankruptcy risk, while PT Sentra Food Indonesia Tbk demonstrates better prospects for business sustainability.

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### Corresponding Author:

Soniya Aminatul Laili  
Faculty of Economics and Business, Universitas Mataram,  
Mataram, Indonesia  
Email: [soniyaaminatullaili@gmail.com](mailto:soniyaaminatullaili@gmail.com)

## 1. INTRODUCTION

The global economy in recent years has entered an increasingly complex phase of uncertainty. Geopolitical tensions, surging global inflation, and the rapid acceleration of technological transformation have exerted significant pressure on the stability of international trade and global supply chains. The International Monetary Fund [1] reported that global economic growth projections were

revised downward from 3.3% to 2.8% due to supply chain disruptions and fluctuations in strategic commodity prices. This decline has directly contributed to rising production costs across various industrial sectors, including Indonesia's manufacturing industry, which remains dependent on imported raw materials [2].

One of the sectors most severely affected is the Food and Beverage (F&B) industry. The structural dependence of this sector on imported commodities such as wheat, sugar, and vegetable oils makes it particularly vulnerable to global price volatility. The increase in global food prices, coupled with weakening consumer purchasing power, has further intensified pressure on industry performance. The Central Bureau of Statistics, as cited by Kumparan (2024), reported that household consumption growth remained below 5% for three consecutive quarters in 2024 [3]. A decline in household purchasing power has been recognized as an important factor influencing corporate financial performance, particularly within consumer-driven industries such as the food and beverage sector. When consumers reduce their spending, companies may experience a decrease in sales revenue, which can subsequently exert pressure on both profitability and liquidity conditions [4], [12].

At the national level, the Ministry of Finance of the Republic of Indonesia (2025) noted that although Indonesia's economic growth remained around 5.1%, the manufacturing sector continued to face pressure due to rising energy costs and weakening domestic consumption. This situation is reflected in the increasing number of listed companies placed under Special Monitoring status by the Indonesia Stock Exchange (BEI). Of the total companies under special supervision, 18 belong to the Consumer Non-Cyclicals sector, including the F&B subsector. This development indicates heightened financial risk and potential threats to business sustainability [13].

In the face of such economic volatility, corporate financial performance becomes a critical determinant of business continuity. Corporate financial performance represents a firm's capability to effectively oversee multiple financial dimensions at the same time, including profitability, liquidity, solvency, and the efficient utilization of assets. When these financial indicators deteriorate, the company becomes more susceptible to financial distress, which may ultimately endanger the continuity and long-term sustainability of its operations [5], [14].

A range of bankruptcy prediction models has been extensively employed in financial studies to identify early indications of corporate financial distress. Among the models most commonly utilized are the Altman Z-Score, Springate, Zmijewski, and Grover models. These approaches rely on combinations of financial ratios to assess a firm's financial condition and estimate the likelihood of potential bankruptcy [6]. Each model employs different combinations of financial ratios, resulting in varying levels of predictive accuracy depending on sectoral characteristics and national economic contexts [7], [8], [15]. Accordingly, a comparative analysis is necessary to determine the most appropriate model for predicting financial distress in Indonesia's F&B subsector.

Structurally, the F&B subsector plays a strategic role in the national economy. The Ministry of Industry of the Republic of Indonesia (2023) reported that the subsector has grown at an average rate of 4.5% annually and serves as a primary contributor to the non-oil and gas processing industry. Nevertheless, the sector has not been immune to the impact of the COVID-19 pandemic. Okrisnesia et al. (2021) found that supply chain disruptions, rising raw material costs, and shifts in consumer behavior led to declines in corporate profitability and liquidity [11]. Furthermore, several recent studies also confirm that financial instability in the F&B sector is strongly associated with liquidity constraints, declining profitability, and increasing leverage ratios [16], [17].

Empirical evidence from studies examining food and beverage companies listed on the Indonesia Stock Exchange reveals that several firms have experienced fluctuations in profitability alongside declining net profit margins. These conditions signal underlying financial instability and suggest a growing vulnerability to the risk of financial distress [9], [18]. Fluctuations in liabilities, net income, and cash flows during the 2020–2024 period reflect financial instability. Of the 83 F&B subsector

companies listed on the BEI, five recorded consecutive losses throughout this period. This evidence confirms that the risk of financial distress is not merely hypothetical but represents an ongoing reality.

Several key indicators signal a trajectory toward financial distress. First, significant declines in net profit margins demonstrate mounting pressure on profitability. Second, high earnings volatility reflects revenue uncertainty and weakened long-term financial stability. Third, increasing leverage without proportional profit growth heightens the risk of default [10]. Fourth, fluctuations in operating cash flows signal a weakening ability of companies to fulfill their short-term financial commitments, which in turn may heighten the risk of financial distress [8], [11], [19].

Based on these indicators, the F&B subsector demonstrates a pronounced tendency toward financial distress that warrants serious attention. Consequently, a comparative analysis employing the Altman Z-Score, Springate, Zmijewski, and Grover models is highly relevant to assess corporate financial health and to identify the most accurate predictive model for the Indonesian F&B subsector during the 2020–2024 period.

## **2. METHOD**

### **2.1. Study Design**

This study employs a quantitative method with a descriptive–comparative approach. The quantitative design is chosen because the research relies on numerical data derived from the annual financial statements of Food and Beverage (F&B) subsector companies listed on the Indonesia Stock Exchange for the 2020–2024 period. The descriptive component aims to present a comprehensive overview of the financial condition and performance trends of the sampled firms during the observation period. Meanwhile, the comparative approach is used to examine and compare the predictive accuracy of four bankruptcy prediction models (Altman Z-Score, Springate, Zmijewski, and Grover) in identifying potential financial distress. Through this design, the study seeks to determine the most appropriate model for application within the Indonesian F&B subsector context.

### **2.2. Operational Definition of Variables**

The independent variables in this study consist of four bankruptcy prediction models: Altman ZScore, Springate (S-Score), Zmijewski (X-Score), and Grover (G-Score). Each model is operationalized through the calculation of specific financial ratios derived from corporate financial statements, resulting in a composite score that reflects the firm's financial condition. The dependent variable is the financial status of the company, categorized into safe, gray area, or distress based on the respective cut-off values established by each model. The observation period from 2020 to 2024 functions as a control variable to capture the impact of the pandemic and post-pandemic economic recovery phases on corporate financial performance.

### **2.3. Population, Sample, and Sampling Techniques**

The population of this study includes all Food and Beverage subsector companies classified under the Consumer Non-Cyclicals sector and listed on the Indonesia Stock Exchange during the 2020–2024 period. Based on published records, there are 83 companies within this subsector. The sampling technique applied is purposive sampling, whereby companies are selected according to specific criteria relevant to the research objectives. The primary criterion requires firms to have experienced consecutive losses over the five-year period from 2020 to 2024. Based on this criterion, five companies meet the requirements and are therefore included as the research sample. This approach ensures that the analysis focuses on firms with sustained indications of financial distress.

## 2.4. Study Instruments

The primary research instrument consists of structured documentation sheets used to extract relevant financial data from audited annual reports. The data includes total assets, total liabilities, equity, sales, net income, earnings before interest and taxes (EBIT), earnings before taxes (EBT), and year-end stock prices required for the calculation of financial ratios. Microsoft Excel is used as the main analytical tool to compute ratios and bankruptcy scores regularly and consistently. The standardized formulas embedded in each prediction model serve as the analytical framework guiding data processing and score classification.

## 2.5. Data Collection Technique

Data collection is conducted through documentation techniques using secondary data sources. Annual reports and financial statements are obtained from the official website of the Indonesia Stock Exchange, ensuring that all data are publicly available and audited. Additional stock price data used to calculate the market value of equity are retrieved from reputable financial information portals. All collected data undergo a verification process through cross-checking across reporting periods to ensure consistency, completeness, and reliability before further analysis is performed.

## 2.6. Data Analysis Techniques

The data analysis begins with the calculation of financial ratios required for each bankruptcy prediction model. Subsequently, the Altman Z-Score, Springate S-Score, Zmijewski X-Score, and Grover G-Score were calculated for each sample company over the five-year observation period. The resulting scores are then classified according to their respective cut-off values to determine whether firms fall into safe, grey, or distress categories. Finally, a comparative analysis is conducted to evaluate the relative accuracy of each model in predicting financial distress. The comparison is presented descriptively through tabulation and percentage analysis, enabling the identification of the most accurate and relevant model for the Indonesian F&B subsector during the 2020–2024 period.

## 3. RESULTS AND DISCUSSION

### 3.1. Results

In this section the author must explain the research results clearly and their knowledge can be proven scientifically. Research results can be presented in the form of narratives or images, graphics, tables and other forms that are easy for readers to understand. The discussion can be made in several sub-chapters whose contents are relevant to the initial chapter discussed.

Table 1. Analysis Results Statistics Descriptive

	N	MINIMUM	MAXIMUM	MEAN	STDEV
ALTMAN	25	-0,75	18,52	1,51	3,63
SPRINGATE	25	-5,49	0,64	-0,82	1,41
ZMIJEWSKI	25	-0,39	1,59	0,82	0,78
GROVER	25	-19,93	4,59	-2,26	5,44

Based on descriptive statistics for five companies during the 2020–2024 period (N = 25), the four bankruptcy prediction models exhibit different value characteristics and distribution patterns. The Altman model has an average of 1.51 with a range of –0.75 to 18.52 and a standard deviation of 3.63, indicating a relatively safe condition but with quite high variation between companies and observation years. The Springate model shows a negative average of –0.82 (minimum –5.49; maximum 0.64; standard deviation 1.41), indicating that most companies tend to be in financial distress and show higher sensitivity to declining financial performance. The Zmijewski model produces an average of 0.82 with

a range of -0.39 to 1.59 and a standard deviation of 0.78, indicating a relatively safe condition with more moderate variation. In contrast, the Grover model had the lowest mean of -2.26 with a very wide range from -19.93 to 4.59 and the largest standard deviation of 5.44, reflecting high responsiveness to changes in financial performance. Overall, the differences in means and levels of spread between models indicate varying levels of sensitivity and caution in predicting bankruptcy, so the use of several models simultaneously is necessary to obtain a more comprehensive and objective picture of financial conditions.

Table 2. Comparison Prediction Bankruptcy based on Model

Bankruptcy Method	Criteria			Amount
	Healthy	Grey Area	Bankrupt	
<i>Altman Z-Score</i>	1	3	21	25
<i>Springate S-Score</i>	0	0	25	25
<i>Zmijewski X-Score</i>	17	0	8	25
<i>Grover G-Score</i>	10	0	15	25

Based on a comparison of bankruptcy prediction results for 25 observations using four methods, significant classification differences are observed between the models. The Altman Z-Score model categorizes 21 observations as bankrupt, 3 in the gray area, and only 1 as healthy, indicating a relatively high risk level. The Springate S-Score model is the most conservative because all observations (100%) are classified as bankrupt, reflecting high sensitivity to declining financial performance. In contrast, the Zmijewski X-Score model produces more moderate results with 17 observations classified as healthy and 8 as bankrupt, while the Grover G-Score model classifies 10 observations as healthy and 15 as bankrupt, placing it between Altman and Zmijewski in terms of the level of caution. These differences indicate that each model has different characteristics and sensitivity in assessing bankruptcy risk, so the use of more than one method is necessary for a more comprehensive and objective analysis.

Table 3. Comparison Prediction Bankruptcy by Company

Company Name	Criteria			Amount
	Healthy	Grey Area	Bankrupt	
<i>PT. ANDI</i>	7	2	11	20
<i>PT. BTEK</i>	6	-	14	20
<i>PT. DPUM</i>	9	-	11	20
<i>PT. FOOD</i>	3	-	17	20
<i>PT. JAWA</i>	2	1	17	20

Based on Table 3, the results of 20 bankruptcy prediction analyses for each company during the 2020–2024 period using four models show variations in financial health levels between companies. PT. ANDI had the most fluctuating results with 7 healthy predictions, 2 grey area predictions, and 11 bankrupt predictions, indicating an unstable condition. PT. BTEK was dominated by bankruptcy predictions (14 out of 20), while PT. DPUM showed 11 bankruptcies and 9 healthy predictions, indicating a high risk but still a chance for recovery. The most worrying conditions were seen in PT. FOOD and PT. JAWA, where PT. FOOD recorded 17 bankruptcies and only 3 healthy predictions, while PT. JAWA recorded 17 bankruptcies, 2 healthy predictions, and 1 grey area prediction, indicating consistent poor assessments across models and years. Overall, the majority of companies were in the bankrupt category, reflecting the high risk of bankruptcy during the study period and the importance of

using multiple models simultaneously to obtain a more comprehensive and objective picture of financial condition.

**Table 4. Altman Accuracy Level Recapitulation**

Sample	Prediction			Amount
	Healthy	Grey Area	Bankrupt	
Food and Beverage Companies (Financial distress)	1	3	21	25
Accuracy Rate	84%			

**Table 5. Springate Accuracy Level Recapitulation**

Sample	Prediction			Amount
	Healthy	Grey Area	Bankrupt	
Food and Beverage Companies (Financial Distress)	0	0	25	25
Accuracy Rate	100%			

**Table 6. Zmijewski Accuracy Level Recapitulation**

Sample	Prediction			Amount
	Healthy	Grey Area	Bankrupt	
Food and Beverage Companies (Financial Distress)	17	0	8	25
Accuracy Rate	32%			

**Table 7. Grover Accuracy Level Recapitulation**

Sample	Prediction			Amount
	Healthy	Grey Area	Bankrupt	
Food and Beverage Companies (Financial Distress)	10	0	15	25
Accuracy Rate	60%			

Based on the recapitulation of accuracy levels in Tables 4 and 7, each bankruptcy prediction model demonstrated varying abilities in classifying the financial condition of companies in the food and beverage subsector for the 2020–2024 period. The Altman Z-Score model achieved an accuracy rate of

84%, indicating fairly good sensitivity in detecting financial distress, although some classifications remained in the gray area. The Springate S-Score model achieved the highest accuracy of 100% because the entire sample was categorized as bankrupt. However, this demonstrated a very conservative nature and a tendency to overestimate, making it less able to distinguish variations in conditions between companies. The Zmijewski X-Score model achieved an accuracy of 32%, which, although lower in percentage terms, is considered more selective and able to reflect the real condition of companies by distinguishing between distressed and relatively healthy companies. Meanwhile, the Grover G-Score model demonstrated moderate accuracy of 60%. Considering the balance of classification and evaluation approaches used, the Zmijewski model was deemed the most accurate, followed by Grover, Altman, and Springate.

Table 8. Recapitulation Prediction Bankruptcy 4 Models

Model	Percentage (%)	Reference Deviation Value (0 = minimum deviation)	Accuracy Description
Altman	84	0	Inaccurate
Springate	100	0	Inaccurate
Zmijewski	32	0	Accurate
Grover	60	0	Inaccurate

Based on Table 8, the accuracy of the prediction model bankruptcy analyzed with use proximity zero value as gauge measuring main, where the model has the closest value with zero considered the most accurate. Recapitulation results show that the Zmijewski model has value 32%, which is the closest with zero compared to with other models, so that categorized as the most accurate. In contrast, the Altman (84%), Springate (100%), and Grover (60%) models have greater value Far from zero, so that classified as not enough accurate. Although Thus, each model has necessary limitations note : Altman: Sensitive to ratio finance certain and less in accordance For company new or company with different capital structures from sample early [15]. Springate: Limited to industry certain and tend to give overestimation. Zmijewski: Not enough used in literature so that difficult compared, although according to method proximity to zero, this model shows accuracy best. Grover: His prediction not enough stable over long data periods and has accuracy moderate. This approach emphasizes that level model accuracy is not solely determined by percentage success high, but rather by the extent to which the prediction approach zero, which reflects minimum deviation from results actual.

### 3.2. Discussions

#### 3.2.1 Analysis Corporate Bankruptcy

Based on results analysis, bankruptcy uses four prediction models, namely Altman Z-Score, Springate S-Score, Zmijewski X-Score, and Grover G-Score. It can be known that the condition finance company sample show variation level of risk of bankruptcy during the 2020–2024 period. Differences in results intermodel happen because each model uses a different combination of financial and classification limits. Companies are categorized as bankrupt when the mark score is below the set cut-off, which reflects weak liquidity, low profitability, as well as high debt pressure. On the other hand, the company categorized Healthy if the score is above the safe limit, while the grey area shows a condition vulnerable to transition to change performance finance.

Altman Z-Score and Springate S-Score models generally show more results conservative, where some big company classified as bankrupt. This is due to the sensitivity of both models against decline profitability and efficiency in asset use assets, as well as high dependence on debt. Conditions indicate that the company is not yet capable produce adequate profit to support obligation his finances. Thus, Altman and Springate can it is said as the model shows the worst condition, because in a way, consistent give financial distress signals in companies during the period of observation.

Meanwhile, the Zmijewski X-Score and Grover G-Score models tend to give more results moderate. Zmijewski more emphasizes the leverage ratio, profitability, and liquidity, so that in some cases company and a certain period certain Still show category No bankrupt, although other models indicate bankruptcy. Grover G-Score also shows existence repair condition of finances in part companies at the year-end observation. Therefore, Zmijewski and Grover can be categorized as the model shows the best condition, because more tolerant to fluctuations in the performance of short-term finance term short.

If associated with theory bankruptcy, results This research is in line with view that bankruptcy is a process that begins with a gradual decrease in a way gradually, especially in the aspect profitability, liquidity, and capitalization. The theory states that companies that do not capable managing working capital in a way and too much on debt financing are more prone to experiencing financial distress. The results of the study showed that domination category bankrupt in part big company strengthen theory, especially during periods when economic conditions and operations company experience pressure.

In addition, the results This research is also in line with part big study that use more than one prediction model for bankruptcy gives a clearer picture comprehensive about condition finance company. Research previously find that Altman and Springate tend to more sensitive in detecting risk of bankruptcy, while Zmijewski and Grover are more stable in evaluating sustainability effort. Although there is difference results between models, the differences are not contradictory, but rather each other complete. Thus, the results of this research support findings that previously analysis of bankruptcy should be done using multiple approaches so that the conclusions obtained are more valid and objective. Analysis Bankruptcy based on Model.

### **3.2.2 Altman Z-Score Model**

Analysis results bankruptcy using the Altman Z-Score model shows that part big company sample is in the category bankrupt or experience shift conditions towards financial distress during the period of observations 2020–2024. These findings indicate that performance finance company tend experience pressure, especially on aspects of liquidity, profitability, and structure capital, which is component main in Z-Score calculation. Shift condition company from category No bankrupt going to bankrupt reflect that health finance company nature dynamic and highly influenced by capabilities management in manage source Power finance as well as face change environment business.

In a way theoretical, results This research is in line with Altman's bankruptcy statement that bankruptcy is a consequence of a company's failure company in guard balance between working capital, capabilities to produce profit, and debt structure. Low Z-Score values in some company show that company No capable maintain level adequate profitability For close obligation financial condition. the strengthen view that imbalance between assets and liabilities, in particular consequence high leverage and weak efficiency operational, will increase risk bankruptcy.

In addition, the findings This research is also consistent with results study previously stated that the Altman Z-Score model is effective in detect potential financial distress in the company manufacturing and non-manufacturing. Some study previously find that company with Z-Score value below the safe limit tend experience decline performance finance in a way sustainable and have probability more bankruptcy height. Similarity these results show that Altman's model remains relevant used in various context industry and period time, including in condition economy that is not stable.

However Thus, the results research also shows that in some period or company In particular, Altman's model provides more classification conservative compared to with prediction models bankruptcy others. This finding is in line with with study previously mentioned that the Altman Z-Score has level high sensitivity to change ratio finance, so that tend classify company as bankrupt

when happen decline performance finance although company Still capable operating. This difference indicates that although Altman was effective as tool warning early, the results need interpreted in a way Be careful.

In a way overall, results This research is in line with theory bankruptcy and majority study previously confirmed that the Altman Z-Score is a reliable model in predict risk bankruptcy company. However, the difference results with some other models strengthen argument that analysis bankruptcy No should only depend on one approach. Therefore, the use of Altman Z-Score as part from analysis multiple become important For get description condition finance more companies comprehensive and objective.

Table 9. Results of the Altman Model Calculation for Food and Beverage Companies 2020-2024

Company	Yeur	X1	X2	X3	X4	X5	Z-Score	Category
PT Andira Agro Tbk.	2020	-0,02	0,03	0,00	1,98	0,54	1,75	Failed
	2021	0,05	0,02	0,02	1,88	0,72	1,99	Grey Area
	2022	0,06	0,00	-0,02	1,96	0,72	1,88	Grey Area
	2023	-0,05	-0,15	-0,17	2,56	0,58	1,30	Failed
	2024	-0,03	-0,23	-0,10	0,35	0,56	0,08	Failed
PT Bumi Teknokultura Unggul Tbk	2020	-0,02	-0,13	0,09	1,39	0,24	1,16	Failed
	2021	-0,05	-0,16	-0,01	1,48	0,04	0,62	Failed
	2022	-0,04	-0,19	-0,01	1,92	0,04	0,85	Failed
	2023	-0,06	-0,22	-0,01	2,09	0,05	0,90	Failed
	2024	0,02	-0,41	-0,02	0,30	0,16	-0,26	Failed
PT Dua Putra Utama Makmur Tbk	2020	0,23	-0,29	-0,27	0,31	0,09	-0,75	Failed
	2021	0,22	-0,37	-0,07	0,34	0,13	-0,14	Failed
	2022	0,21	-0,41	-0,03	0,36	0,53	0,32	Failed
	2023	0,16	-0,58	-0,07	0,36	0,77	0,12	Failed
	2024	0,21	-0,62	0,01	0,68	0,92	0,75	Failed
PT Sentra Food Indonesia Tbk	2020	-0,09	-0,12	-0,08	1,19	0,84	1,02	Failed
	2021	-0,21	-0,24	-0,10	1,98	0,86	1,14	Failed
	2022	-0,22	-0,44	-0,17	1,73	0,85	0,46	Failed
	2023	0,00	-1,14	-0,52	3,12	1,52	0,09	Failed
	2024	-0,48	-1,54	-0,47	35,18	1,70	18,52	Sehat
PT Jaya Agra Wattie Tbk	2020	-0,11	-0,25	-0,08	1,52	0,13	0,31	Failed
	2021	-0,10	-0,29	0,01	4,56	0,24	2,47	Grey Area

Company	Year	X1	X2	X3	X4	X5	Z-Score	Category
	2022	-0,11	-0,37	-0,01	3,32	0,27	1,58	Failed
	2023	-0,09	-0,45	-0,02	2,98	0,25	1,23	Failed
	2024	0,00	-0,48	0,01	1,31	0,28	0,44	Failed

Based on table results Altman Z-Score Model calculation in companies subsector food and Drink during 2020–2024 period, the majority company take notes Z value below threshold of 1.81 so that classified in the distress zone. This condition indicates that part big company own potential tall experience pressure serious financial problems. The low general Z value influenced by weakness level liquidity, accumulation profit low retention, as well as decline equity market value. On the other hand, an increase in Z value tends to happen when company capable repair working capital position and obtaining response positive from the market to its performance.

PT Andira Agro Tbk experience movement fluctuating Z -values, from 1.75 in 2020 to decrease sharp to 0.08 in 2024. The decline the especially caused by weakening ratio the market value of equity (X<sub>4</sub>) has fallen from 2.56 to 0.35, accompanied by with worsening working capital net (X<sub>1</sub>) that returns be in position negative. This condition reflects decline liquidity at a time weakening market confidence. Therefore, efforts repair can focused on improving efficiency cash management, acceleration billing receivables, as well as control burden operational so that working capital can return is at a healthy level.

PT Bumi Teknokultura Superior Tbk in a way consistent is at in category bankrupt during period observation with continuous Z value is below 1.81. The low ratio profit retained earnings (X<sub>2</sub>) and profit operational (X<sub>3</sub>) becomes factor dominant that suppresses Z value, shows limitations company in create profit in a way sustainable. For repair condition said, the company need consider step restructuring finance, implementation efficiency costs, as well as optimization utilization asset productive to encourage improvement profitability term long.

PT Dua Putra Utama Makmur Tbk is also listed is at in the distress zone with Z value which is consistent negative. Although ratio liquidity (X<sub>1</sub>) still show mark positive, accumulation make a loss retained earnings (X<sub>2</sub>) and low EBIT (X<sub>3</sub>) provide pressure big to Z score. This reflects performance operational that has not been efficient and high dependence on financing debt- based. Improvement strategies that can done including through control cost operational, sales strategy adjustments, and improvement efficiency management asset For strengthen cash flow from activity operational.

Different with company others, PT Sentra Food Indonesia Tbk show very significant improvements in 2024 with Z spike up to reached 18.52, after four year previously is below the bankruptcy threshold. This very sharp increase was triggered by an increase in X<sub>4</sub> ratio (Market Value of Equity to Total Equity) from 3.12 to 35.18, which reflects increasing investor optimism towards prospects company. Although Thus, this improvement is necessary balanced with repair performance profit in a way real for sustainability condition finance No only depends on the dynamics of the stock market.

PT Jaya Agra Wattie Tbk be in position between the grey area and the distress zone with moving Z value in range of 0.31 to 1.32. Negative liquidity value (X<sub>1</sub>) as well as profit held (X<sub>2</sub>) which is relative low become factor inhibitor main repair condition finance. Although ratio sales (X<sub>5</sub>) are classified as Enough stable, low profit operational show that company Not yet capable utilise asset optimally. Hence, the increase production process efficiency and strengthening structure capital become necessary steps prioritized For repair performance finance in a way gradually.

In a way comparative, all company in subsector food and Drink show relative pattern similar in where it is weak ratio profit retained (X2) and level profitability (X3) becomes reason main low Z-Score value. On the other hand, the spike in the X4 ratio is evident give most significant impact in increasing Z value, as reflected in PT Sentra Food Indonesia Tbk. With Thus, the formation of Z value in Altman model is not only reflect condition the company's internal finances, but is also influenced by perceptions external market. Companies with low Z value need prioritize strengthening profitability, management greater liquidity effective, and development Love positive in the capital market so that it can move going to safe zone category in term medium.

### 3.2.3 Springate S-Score Model

Analysis results bankruptcy using the Springate model shows that part big company sample classified in condition bankrupt during period research. These findings indicate that based on Springate approach, performance finance company be at the level high risk, especially in the aspect profitability and efficiency operational. Springate's model focuses on capabilities company produce profit from assets owned tend give strict assessment when happen decline performance finance. This condition shows that results study reflect existence pressure significant financial impact on the company sample.

If associated with theory bankruptcy, results This research is in line with Springate's stated view that failure company in maintain profitability and managing obligation term short will increase risk bankruptcy in a way fast. Domination category bankrupt on the results study strengthen theory mentioned, where the decline profit operational and increasing burden cost cause weakening ability company in fulfil obligation financially. With Thus, the results This research supports theory that bankruptcy is consequence from decline performance sustainable finance.

In addition, the results This research is also consistent with study previously stated that the Springate model has level high sensitivity in detect financial distress conditions. Some study previously find that Springate tends to classify company into category bankrupt more fast compared to with prediction models others. Similarities these results show that the Springate model is effective as tool warning early, especially in identify company with weak profitability and efficiency declining operations.

However Thus, the results This study also shows existence Springate model tendencies in give more assessment conservative compared to several other models. This finding is in line with with study previously mentioned that Springate's high sensitivity can resulting in an overestimation of risk bankruptcy. In the context of this research, several company Still show potential sustainability business according to other models, however has categorized bankrupted by Springate. This shows existence difference emphasis intermodel in evaluate condition finance company.

In a way overall, results This research is in line with theory bankruptcy and majority study previously confirmed that the Springate model is effective in identify potential bankruptcy, however need used in a way be careful. Difference results with other models no show Springate's weaknesses, but rather reflect more model characteristics sensitive to change performance finance. Therefore, the use of the Springate model as part from approach analysis bankruptcy multiple considered most appropriate For produce more conclusions objective and comprehensive.

Table 10. Results of the Springate S-Score Model Calculation for Food and Beverage Companies 2020-2024

Company	Year	X1	X2	X3	X4	S-Score	Category
PT Andira Agro Tbk	2020	-0,02	0,00	-0,20	0,54	0,077	Failed
	2021	0,05	0,02	-0,10	0,72	0,335	Failed

Company	Year	X1	X2	X3	X4	S-Score	Category
	2022	0,06	-0,02	-0,23	0,72	0,120	Failed
	2023	-0,05	-0,17	-1,58	0,58	-1,371	Failed
	2024	-0,03	-0,10	-0,45	0,56	-0,412	Failed
PT Bumi Teknokultura Unggul Tbk	2020	-0,02	0,09	-2,29	0,24	-1,166	Failed
	2021	-0,05	-0,01	-0,44	0,04	-0,355	Failed
	2022	-0,04	-0,01	-0,61	0,04	-0,457	Failed
	2023	-0,06	-0,01	-0,38	0,05	-0,325	Failed
	2024	0,02	-0,02	-7,27	0,16	-4,763	Failed
PT Dua Putra Utama Makmur Tbk	2020	0,23	-0,27	-7,47	0,09	-5,492	Failed
	2021	0,22	-0,07	-1,63	0,13	-1,000	Failed
	2022	0,21	-0,03	-0,79	0,53	-0,191	Failed
	2023	0,16	-0,07	-0,50	0,77	-0,084	Failed
	2024	0,21	0,01	0,04	0,92	0,645	Failed
PT Sentra Food Indonesia Tbk	2020	-0,09	-0,08	-0,48	0,84	-0,314	Failed
	2021	-0,21	-0,10	-0,28	0,86	-0,350	Failed
	2022	-0,22	-0,17	-0,42	0,85	-0,678	Failed
	2023	0,00	-0,52	-0,83	1,52	-1,526	Failed
	2024	-0,48	-0,47	-0,52	1,70	-1,608	Failed
PT Jaya Agra Wattie Tbk	2020	-0,11	-0,02	-0,62	0,13	-0,538	Failed
	2021	-0,10	0,01	-0,33	0,24	-0,199	Failed
	2022	-0,11	-0,01	-0,43	0,27	-0,313	Failed
	2023	-0,09	-0,02	-0,50	0,25	-0,387	Failed
	2024	0,00	0,01	-0,37	0,28	-0,096	Failed

Based on table Springate Model (S-Score) calculation for five companies sample during 2020–2024 period, seen that S-Score value is determined from combination ratio of  $X_1$ ,  $X_2$ ,  $X_3$ , and  $X_4$ . Low ratio or negative in a way direct lower the value of S, so that company tend enter in category bankrupt ( $S < 0.862$ ). In general comparative, ratio  $X_3$  (profit before tax to obligation term short) to be the most dominant factor that suppresses the S-Score, because almost all company take notes the value of  $X_3$  is negative and sufficient large, such as PT Dua Putra Utama Makmur Tbk in 2020 amounting to -7,474 and PT Bumi Teknokultura Superior Tbk in 2020 was -2.292, which illustrates inability company close obligation term short through profit. In addition, the ratio of  $X_1$  and  $X_2$  in the majority of the company is also relatively low so that No capable neutralize pressure of  $X_3$ . Although a number of companies, such as PT Sentra Food Indonesia Tbk and PT Andira Agro Tbk, has better  $X_4$  value, contribution this is not positive Enough significant For increase the S-Score beyond the safe limit. As a result, the entire company sample in a way consistent classified as bankrupt. This result confirms that prediction bankruptcy on the Springate Model especially determined by the low profitability and liquidity term short, as reflected in calculated ratios.

### 3.2.4 Zmijewski X-Score Model

Analysis results bankruptcy using the Zmijewski model shows that part big company sample classified in condition No bankrupt during period research. These findings indicate that based on Zmijewski's approach, risk bankruptcy company relatively more low compared to with the results shown by the Altman and Springate models. This difference occurs because the Zmijewski model emphasizes the combination ratio profitability, leverage, and liquidity used For estimate probability

bankruptcy, so that more emphasize stability structure finance company in a way overall.

If associated with theory Zmijewski's bankruptcy, the results This research is in line with view theoretically stating that bankruptcy is consequence from extreme imbalance between debt structure and capacity company produce profit. Dominance category No bankrupt show that company sample Still capable guard leverage and liquidity levels at acceptable limits tolerated. With however, although happen decline performance operational on several period, condition the Not yet Enough strong For push company into condition bankruptcy according to Zmijewski's perspective.

The results of this study are also consistent with part study the previous one who discovered that the Zmijewski model tends to give more results moderate and stable compared to with prediction models bankruptcy others. Research previously mention that Zmijewski has level greater sensitivity low to fluctuations profit term short, so that more suitable for use For evaluate risk bankruptcy in term medium and long term. Similarities these results show that characteristics of the Zmijewski model in this research does not deviate from findings empirical previously.

However Thus, the results This research is also different with a number of study previously stated that the Zmijewski model is capable detect financial distress conditions at the stage beginning if company experience significant leverage spike. In this study, although a number of company show decline performance operational, Zmijewski's model is still classify company as No bankrupt. This difference indicates that Zmijewski's model is less responsive to pressure finance term short sourced from decline profitability, so that potential risk beginning No always identified.

In a way overall, results This study shows that that the Zmijewski model tends to give more assessment optimistic to condition finance company, in line with theory and some big study previously, but also has limitations in detect symptom the onset of financial distress. Therefore, the Zmijewski model is more appropriate used as a supporting model in analysis bankruptcy. The use of this model is simultaneously with other models that are more sensitive will produce more conclusions comprehensive, objective, and accurate in evaluate risk bankruptcy company.

Table 11. Results of the Zmijewski X-Score Model Calculation for Food and Beverage Companies 2020-2024

Company	Year	X1	X2	X3	X4	S-Score
PT Andira Agro Tbk	2020	(0,02)	0,48	0,89	(1,49)	Not Failed
	2021	(0,01)	0,48	1,40	(1,52)	Not Failed
	2022	(0,02)	0,46	1,52	(1,56)	Not Failed
	2023	(0,15)	0,52	0,58	(0,69)	Not Failed
	2024	(0,07)	0,54	0,77	(0,91)	Not Failed
PT Bumi Teknokultura Unggul Tbk	2020	(0,12)	0,61	0,62	(0,30)	Not Failed
	2021	(0,03)	0,63	0,37	(0,62)	Not Failed
	2022	(0,03)	0,71	0,30	(0,11)	Not Failed
	2023	(0,03)	0,73	0,20	(0,03)	Not Failed
	2024	(0,18)	0,88	2,32	1,54	Failed
PT Dua Putra Utama Makmur Tbk	2020	(0,26)	0,52	6,52	(0,19)	Not Failed
	2021	(0,06)	0,55	5,92	(0,91)	Not Failed
	2022	(0,03)	0,57	4,77	(0,89)	Not Failed
	2023	(0,12)	0,64	2,07	(0,12)	Not Failed
	2024	(0,03)	0,67	2,36	(0,36)	Not Failed
PT Sentra Food Indonesia Tbk	2020	(0,15)	0,50	0,75	(0,74)	Not Failed

Company	Year	X1	X2	X3	X4	S-Score
	2021	(0,14)	0,59	0,56	(0,32)	Not Failed
	2022	(0,22)	0,59	0,55	0,05	Failed
	2023	(0,40)	0,58	1,00	0,80	Failed
	2024	(0,49)	1,04	0,48	3,85	Failed
PT Jaya Agra Wattie Tbk	2020	(0,09)	0,93	0,27	1,40	Failed
	2021	(0,05)	0,94	0,38	1,27	Failed
	2022	(0,08)	0,97	0,40	1,59	Failed
	2023	(0,08)	0,73	1,00	0,24	Failed
	2024	(0,05)	0,65	1,00	(0,39)	Not Failed

Based on table Zmijewski Model (X-Score) calculation for five companies sample during period 2020–2024, the X-Score value is calculated from combination ratio X<sub>1</sub> (profitability), X<sub>2</sub> (leverage), and X<sub>3</sub> (liquidity), where the value positive X-Score indicates probability high bankruptcy. In general descriptive and comparative, the negative X<sub>1</sub> ratio in all companies, for example PT Andira Agro Tbk amounting to -0.021 in 2020 and PT Dua Putra Utama Makmur Tbk of -0.255 in 2020, indicating low ability company in produce profit from assets owned, so that become factor main pressing condition finance. In addition, the relative X<sub>2</sub> ratio high, such as PT Jaya Agra Wattie Tbk with value of 0.930–0.967 in 2020–2022 and PT Sentra Food Indonesia Tbk by 1,044 in 2024, indicating dependence big against increasing debt risk fail pay. Although a number of company own relative X<sub>3</sub> ratio high, for example PT Dua Putra Utama Makmur Tbk amounting to 6,517 in 2020 and PT Bumi Teknokultura Superior Tbk of 2,322 in 2024, liquidity the Not yet Enough For neutralize pressure consequence profitability negative and high leverage. As a result, the combination third This ratio produces majority X-Score value is above the critical limit, so that companies sample in a way dominant classified as bankrupt according to the Zmijewski Model.

### 3.2.5 Grover G-Score Model

Analysis results bankruptcy using the Grover model shows existence variation classification bankruptcy intercompany and interperiod observation. Some companies classified in condition bankrupt in the period certain, but show status improvement during the period next. This finding indicates that Grover's model is capable of catch dynamics change condition finance company in a way more adaptive compared to with several other models. Variations results the reflect that performance finance company No is static, but rather affected by changes efficiency operational, profitability, and condition environment business.

If associated with theory Grover's bankruptcy, the results This research is in line with draft base development of the Grover model which is improvement from the Altman Z-Score model. Grover adjusted variables finances to be more responsive to change performance operational company. The results of the study showed that existence improvement of bankruptcy status in several company support theory that improvement efficiency use assets and capabilities produce profit can repair condition finance company. With Thus, Grover's model is capable of reflect the recovery process finance company in a way more realistic.

The results of this study are also consistent with study previously stated that Grover's model tends to give more classification moderate and proportional. Some studies previously find that Grover doesn't as tight as Springate in classify bankruptcy and not Zmijewski's looseness in evaluate sustainability effort. Similarity these results show that Grover's model is effective in differentiate a real company is at in financial distress conditions with companies that are still own opportunity recovery.

However Thus, the results This study also shows existence difference with a number of study previously mentioned that Grover's model has level almost perfect accuracy equivalent with Altman in detect bankruptcy in conditions extreme. In this study, Grover's model is actually show more flexibility high and gives opportunity improvement of bankruptcy status during the period next. This difference indicates that Grover's model sensitivity can influenced by characteristics company and conditions economy in the period study.

In a way overall, results This study shows that that Grover's model is in line with theory and some big study previously in evaluate bankruptcy company in a way adaptive and moderate. This model has superiority in catch change condition finance in a way gradually, but still own limitations in detect pressure finances that are very fast in nature. Therefore, the use of the Grover model will more optimal if combined with prediction models bankruptcy others, so that the resulting analysis become more comprehensive, objective, and able accountable in a way scientific.

Table 12. Results of the Grover G-Score Model Calculation for Food and Beverage Companies 2020-2024

Company	Year	X1	X2	X3	X4	S-Score
PT Andira Agro Tbk	2020	(0,02)	0,00	(0,02)	0,04	Not Failed
	2021	0,05	0,02	(0,01)	0,21	Not Failed
	2022	0,06	(0,02)	(0,02)	0,08	Not Failed
	2023	(0,05)	(0,17)	(0,15)	(0,59)	Failed
	2024	(0,03)	(0,10)	(0,07)	(0,33)	Failed
PT Bumi Teknokultura Unggul Tbk	2020	(0,03)	0,09	(0,12)	0,32	Not Failed
	2021	(0,05)	(0,01)	(0,03)	(0,05)	Failed
	2022	(0,04)	(0,01)	(0,03)	(0,04)	Failed
	2023	(0,06)	(0,01)	(0,03)	(0,07)	Failed
	2024	0,024	(0,02)	(0,18)	0,04	Not Failed
PT Dua Putra Utama Makmur	2020	0,23	(0,27)	(0,26)	(0,48)	Failed
	2021	0,22	(0,07)	(0,06)	0,20	Tidak Bnagkrut
	2022	0,21	(0,03)	(0,03)	0,29	Tidak Bnagkrut
	2023	0,16	(0,07)	(0,12)	0,07	Tidak Bnagkrut
	2024	0,21	0,01	(0,03)	0,44	Tidak Bnagkrut
PT Sentra Food Indonesia Tbk	2020	(0,09)	(0,08)	(0,15)	(0,35)	Failed
	2021	(0,21)	(0,10)	(0,14)	(0,61)	Failed
	2022	(0,22)	(0,17)	(0,22)	(0,87)	Failed
	2023	(0,00)	(0,52)	(0,40)	(1,69)	Failed
	2024	(0,48)	(0,47)	(0,49)	(2,33)	Failed
PT Jaya Agra Wattie Tbk	2020	(0,11)	(0,02)	(0,09)	(0,20)	Failed
	2021	(0,10)	0,01	(0,05)	(0,08)	Failed
	2022	(0,11)	(0,01)	(0,08)	(0,15)	Failed
	2023	(0,09)	(0,02)	(0,08)	(0,16)	Failed
	2024	(0,00)	0,01	(0,05)	0,10	Not Failed

Based on table Grover Model calculation, the G-Score value is determined from accumulation contribution the ratio of X<sub>1</sub>, X<sub>2</sub>, and X<sub>3</sub>, which is reflected in a way directly on the table so that the formation process score can traced in a way systematic . At PT Andira Agro Tbk, for example, the

ratio of  $X_1$  during the 2020–2024 period shows fluctuations with mark low, namely  $-0.02$  in 2020,  $0.05$  in 2021,  $0.06$  in 2022, again down to  $-0.05$  in 2023, and  $-0.03$  in 2024, indicating instability profit operational to assets. This condition is reinforced by the small value of  $X_2$  even negative, namely  $0.00$  in 2020,  $0.02$  in 2021,  $-0.02$  in 2022,  $-0.17$  in 2023, and  $-0.10$  in 2024, which reflects weakness working capital position. In addition, the  $X_3$  ratio is also low, with values  $-0.02$  in 2020,  $-0.01$  in 2021,  $-0.02$  in 2022,  $-0.15$  in 2023, and  $-0.07$  in 2024. Combinations third ratio the produces a G-Score ranging from between  $0.04$  to  $-0.33$ , so company in a way consistent categorized bankrupt.

Similar patterns seen in PT Sentra Food Indonesia Tbk, where  $X_1$  was at the level of  $-0.09$  in 2020,  $-0.21$  in 2021,  $-0.22$  in 2022,  $0.00$  in 2023, and  $-0.48$  in 2024, indicating pressure profit continuous operations continues. The company's  $X_2$  value also decreases in a way significant from  $-0.08$  in 2020 to  $-0.52$  in 2023 and  $-0.47$  in 2024, while  $X_3$  is in the range of  $-0.15$  to  $-0.49$ . Accumulation This ratio pushes the G-Score to a level between  $-0.35$  and  $-2.34$ , so that in a way consistent company classified bankrupt.

On the other hand, PT Dua Putra Utama Makmur Tbk show condition better in 2021 and 2024, so enter category No bankrupt. In 2021,  $X_1$  was  $0.22$ ,  $X_2$   $-0.07$ , and  $X_3$   $-0.06$  resulting in a G-Score of  $0.20$ . Meanwhile, in 2024,  $X_1$  was  $0.21$ ,  $X_2$   $0.01$ , and  $X_3$   $-0.03$  resulting in a G-Score of  $0.44$ . This condition indicates that although No all ratio worth positive, improvement relative to  $X_1$  and  $X_3$  is able push the G-Score past bankruptcy threshold.

#### **4. CONCLUSION**

Based on research on food and beverage subsector companies listed on the Indonesia Stock Exchange for the 2020–2024 period, it can be concluded that the financial conditions of the sample companies exhibit varying levels of bankruptcy risk. Analysis using four prediction models (the Altman Z-Score, Springate S-Score, Zmijewski X-Score, and Grover G-Score) resulted in different classifications across models. Altman tended to place companies in the bankruptcy and grey area categories, while Springate was the most conservative, classifying all companies as bankrupt. Conversely, Zmijewski showed more lenient results, with the majority of companies classified as non-bankrupt, while Grover was moderate and relatively adaptive in responding to changes in financial conditions. These differences reflect that bankruptcy risk is influenced by the characteristics and financial performance of each company and support the theory that financial distress occurs gradually due to declining financial performance.

Based on a comparison of accuracy levels with a cut-off of 0, the Zmijewski model is considered the most representative with an accuracy level of 32%, followed by Grover (60%), Altman (84%), and Springate (100%) which tend to overestimate. Specifically, PT Andira Agro Tbk and PT Jaya Agra Wattie Tbk are most consistently categorized as at risk of bankruptcy, while PT Bumi Teknokultura Unggul Tbk and PT Dua Putra Utama Makmur Tbk show fluctuating conditions. On the other hand, PT Sentra Food Indonesia Tbk is relatively more consistently in a healthy condition and has a better chance of business sustainability. These findings emphasize the importance of using more than one predictive model to make the analysis of a company's financial health more comprehensive and produce stronger conclusions.

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