COMPARISON OF FINANCIAL DISTRESS MEASUREMENT MODELS IN TECHNOLOGY COMPANIES ON THE INDONESIA STOCK EXCHANGE IN 2022-2024

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Abstract

The objectives of this study are: (1) to measure the potential financial distress of technology companies listed on the Indonesia Stock Exchange (IDX) during the 2022–2024 period using the Altman Z-Score, Zmijewski X-Score, and Grover G-Score methods; (2) to examine differences in the results among these methods; and (3) to determine the method with the highest level of accuracy. This study employs a quantitative approach using secondary data in the form of annual financial statements. The research sample consists of 29 companies with a total of 87 observations. The results of the analysis using the Altman Z-Score, Zmijewski X-Score, and Grover G-Score indicate that each method identifies three companies as potentially experiencing financial distress, with different company compositions across methods. The Kruskal–Wallis test results also show a statistically significant difference among the methods in predicting financial distress. Based on the accuracy test results, the Grover G-Score method is the most accurate method in this study. This research provides practical implications as an early warning tool for management and investors in assessing the risk of financial distress in technology companies.

Keywords: Financial Distress; Technology Companies; Altman Z-Score; Zmijewski X-Score; Grover G-Score

INTRODUCTION

Investment is one of the important instruments in promoting economic growth, as it functions as a channel for allocating public funds into productive activities, particularly through the capital market, which in recent years has shown significant growth with the continuously increasing number of retail investors in Indonesia. Based on a press release from the Indonesia Stock Exchange, the number of capital market investors successfully exceeded 18 million Single Investor Identification (SID) holders by the end of August 2025.

The increasingly dynamic global economic environment has encouraged the technology sector to become one of the main drivers of growth in many countries, including Indonesia. In Indonesia, the acceleration of digital transformation after the COVID-19 pandemic has strengthened the position of the technology sector in supporting economic activities, ranging from e-commerce services, digital finance, and communication systems to the provision of hardware and software. This growth is reflected in the increasing number of technology companies listed on the Indonesia Stock Exchange (IDX), especially since the implementation of the Indonesia Stock Exchange Industrial Classification (IDX-IC) in 2021, which specifically places the technology sector as a separate category.

Based on data from Statistics Indonesia (BPS) in 2024, 72.78% of the Indonesian population accessed the internet. The greater the number of citizens and online business actors, the larger the impact of technology on consumption, education, public services, and business activities. The period from 2022 to 2024 became an important phase as national economic conditions were relatively stable, marked by Gross Domestic Product (GDP) growth of 5.03% in 2024 and a low inflation rate of around 1.57%, which helped maintain people's purchasing power and price stability.

The dynamics of the business world, which are full of uncertainty, continue to present risks, one of which is the threat of bankruptcy that must be anticipated by all companies, including issuers in the technology sector. The characteristics of technology businesses, which are oriented toward long-term growth, require continuous innovation, and are marked by intense market competition, often create pressure on corporate profitability and liquidity. Many technology companies implement aggressive expansion strategies with high burn rates, thereby sacrificing short-term profitability in order to gain market share. Consequently, the financial structure of these companies becomes vulnerable to financial distress, namely a condition in which a company experiences financial difficulties that may lead to an inability to meet its obligations and, in extreme cases, potentially result in bankruptcy.

Financial statements of technology sector companies listed on the Indonesia Stock Exchange (IDX) for the 2022–2024 period show that losses still dominate most firms. PT GoTo Gojek Tokopedia Tbk (GOTO) recorded large losses in 2022 and 2023, although the loss declined significantly in 2024. A similar pattern occurred at PT Distribusi Voucher Nusantara Tbk (DIVA), which shifted from profit in 2022 to substantial losses in 2023, followed by partial recovery in 2024. Bukalapak.com Tbk (BUKA) also remained in a loss position throughout the period, while PT Global Digital Niaga Tbk (BELI) showed a consistent downward trend in losses. These fluctuations indicate that technology companies face serious financial challenges that increase the risk of financial distress and potential bankruptcy.

Financial distress generally arises when companies experience declining cash flows, reduced revenues, and difficulties in meeting financial obligations. Digital business models require large marketing expenditures, which become a heavy burden when growth slows, further pressuring profitability and liquidity.

One widely used approach to predict bankruptcy risk is financial ratio–based predictive models, such as the Altman Z-Score, Zmijewski X-Score, and Grover G-Score. These models provide early warning signals using historical financial data, although each has different formulas and accuracy levels depending on industry conditions.

The use of Altman Z-Score, Zmijewski X-Score, and Grover G-Score is considered appropriate for assessing financial distress among technology sector companies listed on the IDX during 2022–2024. These models employ key financial ratios, including liquidity, leverage, profitability, and asset efficiency, which reflect the fundamental conditions of technology firms operating in a high–interest-rate and tight–funding environment. Methodologically, Altman and Grover are based on discriminant analysis, while Zmijewski applies a probit regression approach, making their combination a strong triangulation method to compare model outputs and highlight potential differences in distress signals within the same sample period.

Previous studies by Colline (2020) and Salim & Ismudjoko (2021), found differences in model accuracy across sectors, with Altman performing better in coal mining and Grover showing stronger results in public companies. However, no study has specifically compared these three models in the Indonesian technology sector during the post-pandemic period (2022–2024).

Therefore, a research gap remains both theoretically and practically. Theoretically, there is no clear empirical evidence regarding the most suitable bankruptcy prediction model for technology companies. Practically, investors, managers, and policymakers require reliable tools to detect financial risk and ensure business sustainability. This study contributes by enhancing the understanding of the effectiveness of financial ratios in assessing corporate financial conditions, particularly in sectors that are highly sensitive to external factors such as foreign currency exposure and government policies.

Thus, this study aims to analyze and compare the effectiveness of the Altman Z-Score, Grover G-Score, and Zmijewski X-Score models in predicting bankruptcy in technology companies listed on the Indonesia Stock Exchange (IDX) during the period 2022–2024. This study is expected to provide theoretical contributions to enrich the literature on bankruptcy prediction, while also providing practical benefits in assisting financial and investment decision-making in the technology sector, which plays a crucial role in Indonesia.

REVIEW OF LITERATURE

Signaling Theory

The signaling theory was first proposed by Michael Spence in 1973 (Spence, 1973). It explains that signals provided by companies help investors assess the company's condition. Shareholders will use a company's financial information to analyze the opportunities of each company. Healthy businesses will present open and transparent financial reports.

Financial Distress

According to Platt & Platt (2002), financial distress is the process of a company's financial position declining before it goes bankrupt or goes into liquidation. Financial distress occurs when a company is unable to meet its debt obligations due to insufficient funds to continue operating. Financial distress is also characterized by delays in bank payments, declining product quality, and delayed deliveries.

Financial Distress Measurement Model

The bankruptcy analysis model is a technique used to estimate the likelihood of a company experiencing financial problems that could lead to bankruptcy. This model combines several financial ratios that provide a general overview of a company's financial condition. This model identifies early signs of a financial crisis by examining liquidity, leverage, profitability, and operational activities.

Hypothesis Development

Previous studies show that financial distress can affect companies across all sectors and can be measured using Altman Z-Score, Zmijewski, and Grover models. Maninggarjati et al. (2022) found that one coal mining company listed on the Indonesia Stock Exchange (IDX) was in financial distress using Altman, Springate, and Grover models. Liew et al. (2023) reported that 6.25% of Malaysian technology companies were classified as distressed based on the Grover model.

H1: Technology companies listed on the IDX during 2022–2024 may experience financial distress as measured by the Altman Z-Score, Zmijewski, and Grover models.

Several studies indicate that different models produce varying prediction results. Winarso et al. (2020) found significant differences in bankruptcy prediction accuracy among Altman, Zmijewski, Grover, and Springate models in Indonesian coal mining companies. Colline (2020) reported inconsistent bankruptcy conclusions among Altman, Springate, and Zmijewski models in Indonesian retail firms, emphasizing the need for cross-model testing. Similarly, Bunker et al. (2024) found that only the Zmijewski model was significantly associated with financial distress in Indian automotive companies, while Altman and Grover were not, confirming differences in explanatory power among models.

H2: There are differences in prediction results between the Altman Z-Score, Zmijewski, and Grover models in detecting financial distress among technology companies listed on the IDX during 2022–2024.

Oktafiraningsih & Suryaningsum (2024) found that Altman, Grover, and Zmijewski could all classify financial distress in Indonesian property and real estate companies, with Zmijewski showing the highest accuracy (83%). Meanwhile, Salim & Ismudjoko (2021) reported that Altman and Ohlson achieved the highest accuracy (90.91%) in Indonesian coal mining companies. These findings indicate that the most accurate model may vary across sectors and periods, highlighting the need to re-examine which of the Altman Z-Score, Zmijewski, and Grover models is the most accurate in predicting financial distress among Indonesian technology companies during 2022–2024.

H3: There is a method with the highest predictive accuracy among the Altman Z-Score, Zmijewski X-Score, and Grover G-Score in identifying financial distress for technology firms listed on the IDX during 2022–2024.

RESEARCH METHOD

Types and Sources of Data

Type of Data

The type of data used in this study is secondary data, namely data obtained from corporate financial statements. Secondary data are data that have been collected and processed by other parties or organizations. These data are already available and were not collected directly for the purposes of this study, but for the interests of the institutions that originally compiled them. Nevertheless, such data can be reused in other studies either free of charge or at relatively low cost. Sources of secondary data may include websites, journals, books, and other relevant sources.

Data Sources

The secondary data in this study were obtained from audited financial statements of technology companies listed on the Indonesia Stock Exchange (IDX) during 2022–2024, accessed through the official IDX website (www.idx.co.id). Audited reports were used to ensure data reliability, minimize bias, and accurately represent corporate financial conditions. Technology companies were selected due to their strategic role in digital transformation, rapid growth, and high financial risk resulting from aggressive expansion and large funding requirements. Despite often having high valuations, their profitability remains unstable, making financial performance analysis essential for assessing business sustainability and competitiveness. The 2022–2024 period represents the post–COVID-19 economic recovery phase. In 2022, global uncertainty led to cautious investment behavior and the emergence of the *tech winter*. In 2023, high inflation, rising interest rates, and recession risks further tightened liquidity, increasing capital costs and forcing efficiency strategies among technology firms. In 2024, persistently high interest rates and evolving digital regulations continued to influence platform traffic and monetization performance.

Population

Population refers to the entire set of elements in a study, including objects and subjects with specific characteristics (Amin et al., 2023). In this study, the population consists of all technology companies listed on the Indonesia Stock Exchange from 2022 to 2024. The objects of analysis are the companies' financial statements, which provide measurable data to assess financial distress indicators using quantitative methods.

Sample

A sample is a subset of the population that serves as the actual data source in a study (Amin et al., 2023). The sample criteria in this study are as follows:

1. Technology companies listed on the Indonesia Stock Exchange during 2022–2024.
2. Technology companies that consistently published complete financial statements on the IDX during 2022–2024.
3. Technology companies whose financial statements contain complete data required for the financial ratios used in the financial distress prediction models.

The sample used in this study consists of financial statements of technology companies listed on the IDX during 2022–2024. A total of 29 companies met the sampling criteria. The researcher screened technology companies listed on the IDX website and ensured that their financial statements were available and complete.

RESULT AND DISCUSSION

Discussion of Prediction Method Calculation Results

Discussion of Altman Z-Score Calculation Results

In the first method, the Altman Z-Score has the following criteria: if the Z-Score is less than 1.10, the company is indicated to be in the distress zone. However, if the Z-Score is between 1.10 and 2.60, it is in the gray zone, indicating the company is in a financial condition between financial distress and a safe financial condition. The final criterion is for a company with a Z-Score greater than 2.60.

Table 1.
Altman Z-Score Method

Description:

Red	= Distress Zone	Z" < 1.10
Gray	= Gray Zone	1.10 < Z" < 2.60
Green	= Safe Zone	Z" > 2.60

No	Company Name	Code	Altman Z-Score			
			2022	2023	2024	Average
1	Anabatic Technologies Tbk	ATIC	**-0.200**	1.171	1.522	0.831
2	Elang Mahkota Teknologi Tbk	EMTK	18.162	11.062	7.540	12.255
3	Quantum Clovera Investama Tbk	KREN	4.255	3.461	2.654	3.457
4	Multipolar Technology Tbk	MLPT	5.043	2.210	15.649	7.634
5	Metrodata Electronics Tbk	MTDL	6.683	6.074	5.934	6.230
6	Sat Nusapersada Tbk	PTSN	4.223	5.314	4.721	4.753
7	Kioson Komersial Indonesia Tbk	KIOS	20.450	3.653	2.699	8.934
8	M Cash Integrasi Tbk	MCAS	15.329	7.702	4.477	9.169
9	NFC Indonesia Tbk	NFCX	15.536	4.219	2.599	7.451
10	Distribusi Voucher Nusantara Tbk	DIVA	15.055	-0.830	3.408	5.878
11	Sentral Mitra Informatika Tbk	LUCK	5.573	4.623	4.316	4.837
12	Hensel Davest Indonesia Tbk	HDIT	11.500	6.445	6.885	8.276
13	Telefast Indonesia Tbk	TFAS	126.200	24.318	7.153	52.557
14	Digital Mediatama Maxima Tbk	DMMX	44.538	12.673	14.848	24.019
15	Galva Technologies Tbk	GLVA	5.464	5.029	5.503	5.332
16	Bahtera Bumi Raya Tbk	PGJO	104.639	43.234	-0.462	49.137
17	Cashlez Worldwide Indonesia Tbk	CASH	0.797	-0.526	-1.970	-0.566
18	Solusi Sinergi Digital Tbk	WIFI	1.555	1.532	1.583	1.557
19	DCI Indonesia Tbk	DCII	58.421	76.060	60.800	65.094
20	Indointernet Tbk	EDGE	24.619	10.154	5.908	13.560
21	Zyrexindo Mandiri Buana Tbk	ZYRX	5.379	7.039	9.190	7.203
22	Trimegah Karya Pratama Tbk	UVCR	18.108	13.722	4.015	11.949
23	Bukalapak.com Tbk	BUKA	35.998	31.864	16.155	28.005
24	Global Sukses Solusi Tbk	RUNS	14.677	3.137	2.568	6.794
25	Wira Global Solusi Tbk	WGSH	118.005	56.108	16.209	63.440
26	WIR ASIA Tbk	WIRG	9.142	5.814	4.129	6.362
27	GoTo Gojek Tokopedia Tbk	GOTO	3.179	-15.378	-9.740	-7.313
28	Tera Data Indonusa Tbk	AXIO	5.546	6.693	4.285	5.508
29	Global Digital Niaga Tbk	BELI	11.094	17.289	15.092	14.492

The Altman Z-Score analysis was applied to 29 technology companies listed on the Indonesia Stock Exchange during 2022–2024, producing 87 observations. Financial

conditions were classified into three zones: safe (Z" > 2.6), grey (1.1 < Z" < 2.6), and distress (Z" < 1.1). The model functions as an early warning system to identify varying levels of financial risk.

In 2022, most firms were in the safe zone, although ATIC and CASH were in distress, while WIFI was in the grey zone. TFAS recorded the highest score, indicating very strong financial performance. In 2023, financial pressure increased, with GOTO, DIVA, and CASH classified as distressed, while DCII remained in a strong financial position. In 2024, recovery was uneven, as more companies shifted into the grey zone, and GOTO, CASH, and PGJO remained in distress.

Based on the 2022–2024 average scores, most companies were still in the safe zone. However, GOTO, CASH, and ATIC consistently remained in distress, while WIFI stayed in the grey zone, indicating the need for close financial monitoring.

Discussion of the Zmijewski X-Score Calculation Results

In the second method, Zmijewski provides criteria whereby a company with an X-Score below zero is considered healthy. If the resulting X-Score is equal to zero, the company is in the gray zone. Meanwhile, a company is unhealthy or in financial distress if the X-Score is greater than zero.

Table 2.
Zmijewski X-Score Method

Description:

Red	= Distress Zone	X > 0
Gray	= Gray Zone	X = 0
Green	= Safe Zone	X < 0

No	Company Name	Code	Zmijewski X-Score			
			2022	2023	2024	Average
1	Anabatic Technologies Tbk	ATIC	1.025	0.700	0.389	0.704
2	Elang Mahkota Teknologi Tbk	EMTK	-4.288	-3.744	-3.694	-3.909
3	Quantum Clovera Investama Tbk	KREN	-2.967	-2.602	-2.615	-2.728
4	Multipolar Technology Tbk	MLPT	-1.223	-0.231	-0.270	-0.575
5	Metrodata Electronics Tbk	MTDL	-1.996	-1.855	-1.791	-1.880
6	Sat Nusapersada Tbk	PTSN	-2.761	-3.022	-3.042	-2.941
7	Kioson Komersial Indonesia Tbk	KIOS	-3.993	-3.356	-3.358	-3.569
8	M Cash Integrasi Tbk	MCAS	-2.565	-1.965	-1.927	-2.152
9	NFC Indonesia Tbk	NFCX	-2.878	-0.468	-1.250	-1.532
10	Distribusi Voucher Nusantara Tbk	DIVA	-3.905	2.098	-2.087	-1.298
11	Sentral Mitra Informatika Tbk	LUCK	-3.096	-3.079	-3.049	-3.075
12	Hensel Davest Indonesia Tbk	HDIT	-3.703	-2.817	-3.095	-3.205
13	Telefast Indonesia Tbk	TFAS	-2.781	-2.934	-2.500	-2.738
14	Digital Mediatama Maxima Tbk	DMMX	-3.384	-1.650	-2.934	-2.656
15	Galva Technologies Tbk	GLVA	-1.142	-1.386	-1.271	-1.266
16	Bahtera Bumi Raya Tbk	PGJO	-0.930	0.052	2.814	0.645
17	Cashlez Worldwide Indonesia Tbk	CASH	-0.436	-1.849	-0.889	-1.058
18	Solusi Sinergi Digital Tbk	WIFI	-1.274	-1.478	-0.860	-1.204
19	DCI Indonesia Tbk	DCII	-1.926	-2.657	-2.900	-2.494
20	Indointernet Tbk	EDGE	-3.428	-2.101	-1.675	-2.402
21	Zyrexindo Mandiri Buana Tbk	ZYRX	-1.268	-2.270	-3.146	-2.228
22	Trimegah Karya Pratama Tbk	UVCR	-3.785	-3.229	-1.559	-2.858
23	Bukalapak.com Tbk	BUKA	-4.545	-4.002	-3.853	-4.133

24	Global Sukses Solusi Tbk	RUNS	-3.752	-2.482	-2.735	-2.990
25	Wira Global Solusi Tbk	WGSH	-4.674	-4.530	-3.946	-4.383
26	WIR ASIA Tbk	WIRG	-2.889	-2.499	-2.052	-2.480
27	GoTo Gojek Tokopedia Tbk	GOTO	-2.330	5.156	-2.047	0.260
28	Tera Data Indonusa Tbk	AXIO	-1.576	-2.453	-1.684	-1.904
29	Global Digital Niaga Tbk	BELI	-1.084	-0.797	-1.363	-1.081

The Zmijewski X-Score was applied to 29 technology companies listed on the Indonesia Stock Exchange during 2022–2024, producing 87 observations. Companies were classified as healthy when $X < 0$, in the grey zone when $X = 0$, and financially distressed when $X > 0$, based on profitability, leverage, and liquidity indicators. Descriptive statistics show a mean X-score of –2.1080, indicating that most firms were generally in healthy financial condition. However, the maximum value of 5.1555 reflects the presence of companies experiencing significant financial pressure.

In 2022, only Anabatic Technologies Tbk (ATIC) was classified as financially distressed, while Wira Global Solusi Tbk (WGSH) recorded the healthiest condition. In 2023, financial risk increased, with four companies (GOTO, DIVA, ATIC, and PGJO) entering the distress category, and GOTO showing the highest risk level. In 2024, the number of distressed firms declined to two (PGJO and ATIC), although PGJO showed a sharp increase in risk.

Overall, most companies remained financially healthy during 2022–2024. However, ATIC consistently showed distress risk across all three years, PGJO exhibited a worsening trend since 2023, and GOTO demonstrated a sharp but temporary spike in financial risk in 2023, indicating fluctuating financial stability.

Discussion of the Grover G-Score Calculation Results

The Grover method has the following criteria: if a company's G-Score is less than -0.02, it is indicated as experiencing financial distress. If a company's G-Score is greater than -0.02 but less than 0.01, it is in the gray zone. Meanwhile, if a company's G-Score is greater than or equal to 0.01, it is considered healthy.

Table 3.
Grover G-Score Method

Description:

Red	= Distress Zone	$G \leq -0.02$
Gray	= Gray Zone	$-0.02 < G < 0.01$
Green	= Safe Zone	$G \geq 0.01$

No	Company Name	Code	Grover G-Score			
			2022	2023	2024	Average
1	Anabatic Technologies Tbk	ATIC	0.234	3.336	3.148	2.239
2	Elang Mahkota Teknologi Tbk	EMTK	0.694	0.504	0.647	0.615
3	Quantum Clovera Investama Tbk	KREN	0.811	1.035	1.006	0.950
4	Multipolar Technology Tbk	MLPT	2.775	2.817	2.966	2.853
5	Metrodata Electronics Tbk	MTDL	1.907	1.954	1.988	1.950
6	Sat Nusapersada Tbk	PTSN	1.311	1.194	1.079	1.195
7	Kioson Komersial Indonesia Tbk	KIOS	0.398	0.265	0.296	0.320
8	M Cash Integrasi Tbk	MCAS	1.227	1.493	1.435	1.385
9	NFC Indonesia Tbk	NFCX	1.019	1.068	1.451	1.180
10	Distribusi Voucher Nusantara Tbk	DIVA	0.529	-1.456	0.181	-0.249

11	Sentral Mitra Informatika Tbk	LUCK	0.873	0.861	0.726	0.820
12	Hensel Davest Indonesia Tbk	HDIT	0.484	0.571	0.693	0.583
13	Telefast Indonesia Tbk	TFAS	1.045	0.954	1.018	1.006
14	Digital Mediatama Maxima Tbk	DMMX	0.716	0.352	0.640	0.569
15	Galva Technologies Tbk	GLVA	2.397	2.192	2.239	2.276
16	Bahtera Bumi Raya Tbk	PGJO	-0.788	-0.712	-0.017	-0.506
17	Cashlez Worldwide Indonesia Tbk	CASH	3.258	0.962	1.466	1.895
18	Solusi Sinergi Digital Tbk	WIFI	2.075	1.925	2.472	2.157
19	DCI Indonesia Tbk	DCII	1.988	1.670	1.628	1.762
20	Indointernet Tbk	EDGE	1.111	1.789	1.929	1.610
21	Zyrexindo Mandiri Buana Tbk	ZYRX	2.376	1.598	0.977	1.650
22	Trimegah Karya Pratama Tbk	UVCR	0.929	1.002	1.804	1.245
23	Bukalapak.com Tbk	BUKA	0.724	0.523	0.447	0.565
24	Global Sukses Solusi Tbk	RUNS	0.954	1.012	0.929	0.965
25	Wira Global Solusi Tbk	WGSH	0.830	0.599	0.664	0.698
26	WIR ASIA Tbk	WIRG	1.182	1.429	1.669	1.426
27	GoTo Gojek Tokopedia Tbk	GOTO	0.026	-1.506	0.876	-0.201
28	Tera Data Indonusa Tbk	AXIO	2.070	1.779	1.891	1.913
29	Global Digital Niaga Tbk	BELI	0.316	0.933	1.159	0.803

The Grover G-Score was applied to assess financial distress, with companies classified as healthy ($G \geq 0.01$), distressed ($G \leq -0.02$), or at risk/grey zone ($-0.02 < G < 0.01$). Descriptive statistics show a mean score of 1.1612, a maximum of 3.3357, a minimum of –1.5056, and a standard deviation of 0.9151, indicating that most firms were generally healthy, although financial capacity varied significantly across companies.

In 2022, CASH recorded the highest G-Score (3.2582, very healthy), while PGJO had the lowest (–0.7884, distressed). In 2023, financial pressure increased, with GOTO (–1.5056), DIVA, and PGJO classified as distressed, while ATIC achieved the highest score (3.3357). That year, 26 companies were healthy, and three were distressed. In 2024, no companies fell into the distressed category, though one firm entered the grey zone. ATIC again had the highest score (3.1484), and PGJO the lowest (–0.0168).

Overall, the G-Score analysis shows that most technology companies remained financially healthy during 2022–2024, but some firms consistently exhibited financial vulnerability.

Summary of the List of Companies in the Distress Zone Category

Companies in the distress zone category are entities that financially indicate potential financial difficulties based on certain criteria. In this study, the classification of companies into distress zones was based on the results of financial distress measurements based on the average score for the 2022–2024 period using three measurement methods: the Altman Z-Score, the Zmijewski X-Score, and the Grover G-Score. The use of the average value was used to describe the general condition of the company during the study period, so that the classification results were not solely influenced by fluctuations in a single year.

Table 4.
List of Companies in the Distress Zone Category Based on Average Score

Method	Company Name	Code	Average
Altman Z-Score	Anabatic Technologies Tbk	ATIC	0.831
	Cashlez Worldwide Indonesia Tbk	CASH	-0.566

	GoTo Gojek Tokopedia Tbk	GOTO	-7.313
Zmijewski X-Score	Anabatic Technologies Tbk	ATIC	0.704
	Bahtera Bumi Raya Tbk	PGJO	0.645
	GoTo Gojek Tokopedia Tbk	GOTO	0.260
Grover G-Score	Distribusi Voucher Nusantara Tbk	DIVA	-0.249
	Bahtera Bumi Raya Tbk	PGJO	-0.506
	GoTo Gojek Tokopedia Tbk	GOTO	-0.201

Based on the Altman Z-Score method, the companies categorized as financially distressed are Anabatic Technologies Tbk (ATIC), Cashlez Worldwide Indonesia Tbk (CASH), and GoTo Gojek Tokopedia Tbk (GOTO). Using the Zmijewski X-Score method, the table shows three companies in this category: Anabatic Technologies Tbk (ATIC), Bahtera Bumi Raya Tbk (PGJO), and GoTo Gojek Tokopedia Tbk (GOTO). Meanwhile, based on the Grover G-Score method, the companies categorized as financially distressed are Distribusi Voucher Nusantara Tbk (DIVA), Bahtera Bumi Raya Tbk (PGJO), and GoTo Gojek Tokopedia Tbk (GOTO). The table shows that some companies consistently appear in more than one method, particularly GOTO, which is identified as financially distressed in all three methods, thus indicating a relatively stronger risk.

Discussion of Kruskal-Wallis Test Calculation Results

The Kruskal-Wallis test was used to determine whether the financial distress measurement results generated by the Altman Z-Score, Zmijewski X-Score, and Grover G-Score methods showed significant differences. This test was chosen because it is nonparametric, therefore less dependent on the assumption of a normal distribution, and is safer to use when the score values between methods have different distributions. The decision-making criteria used the Asymptotic Sig. value (two-sided test) from the IBM SPSS Statistics 25 version output. If the significance value is greater than 0.05, the difference between the methods is considered insignificant. Conversely, if the significance value is less than 0.05, there is a significant difference between the methods.

Table 5.
Kruskal-Wallis Test

Total N	87
Test Statistic	62.134
Degrees of Freedom	2
Asymptotic Sig. (2-sided test)	.000

Source: IBM SPSS Statistics 25 Version Output.

Based on the Kruskal-Wallis test, a total of 87 data sets were analyzed, originating from 29 companies using three measurement methods during the study period (the values used were the average values for the period 2022 to 2024 for each method for each company). The test results showed a Test Statistic value of 62.134 with degrees of freedom (df) = 2, and

an Asymptotic Sig. value (2-sided test) of 0.000. Since 0.000 < 0.05, it can be concluded that there are significant differences in the results between the Altman, Zmijewski, and Grover methods in measuring financial distress in the technology companies studied.

Table 6.
Pairwise Comparison of Financial Distress Methods

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Zmijewski-Grover	29.483	6.633	4.445	.000	.000
Zmijewski-Altman	52.138	6.633	7.860	.000	.000
Grover-Altman	22.655	6.633	3.415	.001	.002

Source: IBM SPSS Statistics 25 Version Output.

After identifying a significant overall difference, the test continued with pairwise comparisons to examine the differences between the methods individually. The pairwise results showed that the comparison of Zmijewski and Grover yielded a Sig. value of 0.000 with an Adj. Sig. of 0.000, indicating a significant difference between the two methods. The comparison of Zmijewski and Altman also yielded a Sig. value of 0.000 with an Adj. Sig. of 0.000, indicating a significant difference between Zmijewski and Altman. Furthermore, the comparison of Grover and Altman yielded a Sig. value of 0.001 with an Adj. Sig. of 0.002. Because the Adj. Sig. value remained less than 0.05, the difference between Grover and Altman was also significant. These Kruskal-Wallis test results align with previous research by Wahyuni et al. (2024) showed that the measurement results from Altman, Springate, Zmijewski, and Grover differed significantly (significance value <0.05 in the comparison test), confirming that each method can produce inconsistent conclusions for the same company. Based on these overall results, it can be concluded that H0 is rejected and H2 is accepted, as there is a significant difference in results between the Altman Z-Score, Zmijewski X-Score, and Grover G-Score methods in predicting financial distress in technology companies listed on the Indonesia Stock Exchange from 2022 to 2024.

Discussion of Prediction Method Accuracy Test Results

The accuracy test was conducted to determine which financial distress measurement method produced the smallest prediction error during the period 2022 to 2024. In this study, the actual value was defined as the average score for each company from 2022 to 2024 using each method, while the predicted value was the score for the current year (2022, 2023, and 2024). The difference between the prediction and the actual value is then calculated in terms of Absolute Deviation, Square Error, and Absolute Percentage Error. The MAD value is obtained from the average Absolute Deviation, while the MAPE is obtained from the average Absolute Percentage Error. The method with the smallest MAPE is considered the most accurate because it has the lowest average error. The summary results are presented in Table 7.

Table 7.
Accuracy Test Results of Financial Distress Measurement Methods

Method	Mean Absolute Deviation	Mean Squared Error	Mean Absolute Percentage Error
Altman Z-Score	7.614	246.540	0.482
Zmijewski X-Score	0.558	0.916	0.745
Grover G-Score	0.265	0.202	0.429

Source: Processed data, 2025.

Based on calculations across the entire data, the Altman method yielded an average MAD of 7.6138, followed by an MSE of 246.540, and an average MAPE of 0.4822. The relatively large MAD value occurs because the Altman Z-Score scale in this research data is quite wide, resulting in a large absolute difference. The second accuracy calculation using the Zmijewski X-Score yields a MAD of 0.5581, an MSE of 0.916, and the average MAPE was 0.7445. Although the absolute deviation (MAD) appears relatively small, the MAPE is the highest among the three methods, indicating the largest average percentage deviation from the benchmark. The third accuracy calculation using the Grover G-Score method yielded an average MAD of 0.2654 and an average MAPE of 0.4287, the lowest among the three methods, indicating it was the most accurate for predicting financial distress during 2022–2024. This finding aligns with Nurfadillah & Yulianti (2024), who reported that Grover outperformed Altman Z-Score, Springate, and Zmijewski X-Score in Indonesian oil, gas, and geothermal companies, achieving 76% accuracy and the lowest Type II error (24%). Conversely, Salim & Ismudjoko (2021) found Altman Z-Score most accurate for coal companies, highlighting that accuracy rankings vary by industry due to differences in cost structure, profitability patterns, and financial conditions.

Based on MAD and MAPE analysis, H0 is rejected and H3 accepted, confirming that one method achieved the lowest error and highest accuracy. In this study, Grover G-Score demonstrated the highest predictive accuracy for technology companies listed on the Indonesia Stock Exchange during 2022–2024, with predictions closest to actual values and minimal error.

CONCLUSION

Based on the results of a study of 29 technology sector companies listed on the Indonesia Stock Exchange from 2022 to 2024 using the Altman Z-Score, Zmijewski, and Grover methods, the following conclusions can be drawn:

1. Based on the results of financial distress prediction using the Altman Z-Score method, it can be seen that several companies entered the distress zone during the study period, specifically Anabatic Technologies Tbk (ATIC), Cashlez Worldwide Indonesia Tbk (CASH), and GoTo Gojek Tokopedia Tbk (GOTO), which on average remained in the distress category from 2022 to 2024. Meanwhile, based on the Zmijewski method, Anabatic Technologies Tbk (ATIC), Bahtera Bumi Raya Tbk (PGJO), and GoTo Gojek Tokopedia Tbk (GOTO) were indicated to be experiencing financial difficulties and

therefore fell into the distress category. Using Grover's method, companies categorized as distressed are Bahtera Bumi Raya Tbk (PGJO), Distribusi Voucher Nusantara Tbk (DIVA), and GoTo Gojek Tokopedia Tbk (GOTO).

2. The Kruskal-Wallis test results show significant differences between the Altman Z-Score, Zmijewski, and Grover methods in predicting financial distress. This means that the three methods do not produce the same score distribution, so conclusions about a company's condition may vary depending on the method used. The pairwise comparison results also confirm the differences between the methods used.
3. The accuracy test results using MAD and MAPE show that the Grover method produces the lowest error percentage compared to Altman and Zmijewski, thus the Grover method is considered the most accurate method for predicting financial distress in technology companies from 2022 to 2024.

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