



Bankruptcy Prediction in Indonesian Retail Firms: Altman and Springate Models

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Abstract. Indonesia's retail subsector has faced considerable financial challenges due to fluctuations in purchasing power, widespread store closures, and intense competition from the e-commerce ecosystem. This study examines and compares the accuracy of the Modified Altman Z-Score (Z"-Score) and Springate (S-Score) models in predicting bankruptcy among retail subsector companies listed on the Indonesia Stock Exchange (IDX) during 2019–2024. A comparative quantitative approach with purposive sampling was employed. The sample comprised eight daily consumer-goods and apparel/department-store retailers, yielding 48 firm-year observations; specialized electronics retailers were excluded to avoid inventory-cycle bias. Classification performance was evaluated using a confusion matrix—accuracy, sensitivity, specificity, precision, and F1-score—and the McNemar test was used to assess whether the models differed significantly. The Springate model achieved 97.92% accuracy (47 of 48 observations correctly classified), with 100.00% sensitivity, 96.77% specificity, 94.44% precision, and a 97.14% F1-score. The Altman Z-Score model achieved 91.67% accuracy (44 of 48 observations correctly classified), with 94.12% sensitivity, 90.32% specificity, 84.21% precision, and an 88.89% F1-score. Although Springate produced higher numerical accuracy, the McNemar test yielded a p-value of 0.655 (> 0.05), indicating no statistically significant difference between the two models. Both models are effective early-warning instruments for stakeholders.

Keywords: Altman Z-Score; Bankruptcy Prediction; Confusion Matrix; Financial Distress; Retail Subsector.

1. INTRODUCTION

The dynamics of global and domestic business competition, together with uncertainty in the external environment, continue to encourage industry participants to optimize financial and operational management strategies. Indonesia's retail sector, an integral part of the Consumer Cyclical category, plays a strategic role in supporting the national economy. Household consumption contributes more than 50% of Indonesia's gross domestic product (GDP) (DDTCNews, 2022). However, companies in this sector are highly sensitive to economic cycles, inflation, and changes in consumer preferences and behavior (Bodie et al., 2021; Damodaran, 2012). The Distress Alert report issued by Alvarez & Marsal (2024) revealed that 44% of issuers listed on the Indonesia Stock Exchange (IDX) were under financial pressure, of which 20.8% were in the retail sector and recorded performance declines of up to 25%. Furthermore, 46% of retail companies exhibited structural weaknesses in their balance sheets, operating performance, or both. These pressures have been intensified by the rapid growth of the digital economy and e-commerce transactions. Bank Indonesia (2025) reported that e-commerce transaction value reached IDR 453 trillion in 2023 and increased to IDR 487 trillion in 2024. The e-Conomy SEA 2024 report stated that Indonesia's e-commerce gross merchandise value (GMV) reached USD 90 billion, accounting for 75.6% of the national digital economy (Google et al., 2024).

This digital transformation has significantly disrupted conventional brick-and-mortar retailers. Financial distress was clearly reflected in PT Hero Supermarket Tbk's (HERO) closure of all Giant outlets in July 2021 after recording a net loss of IDR 1.21 trillion in 2020 (The Jakarta Post, 2021). PT Matahari Department Store Tbk (LPPF) and PT Ramayana Lestari Sentosa Tbk (RALS) also closed dozens of stores as an efficiency measure in response to weakening purchasing power and declining profit margins (Sulistiyowati, 2024; Pranata, 2025). Conversely, retailers that effectively implemented omnichannel strategies—such as PT Sumber Alfaria Trijaya Tbk (AMRT), PT Midi Utama Indonesia Tbk (MIDI), and PT Mitra Adiperkasa Tbk (MAPI)—were able to maintain financial stability (Rachman, 2023). To anticipate business-failure risk, an early-warning instrument based on financial-ratio analysis is needed. Two of the most popular and widely tested multivariate bankruptcy-prediction models are the Altman Z-Score model (Altman, 1968) and the Springate model (Springate, 1978). Despite extensive testing, prior studies have produced inconsistent findings, creating a research gap. Hapsari and Putri (2022), Ramadhani et al. (2023), and Kusuma and Pertiwi (2022) found the Altman Z-Score model more accurate in detecting bankruptcy. In contrast, Nugroho and Kurniawati (2022), Effendi (2018), and Putri et al. (2023) concluded that the Springate model was superior. Putra and Liana (2023), meanwhile, reported no significant difference between the two models.

Modified Altman Z"-Score Model (1995): Designed for non-manufacturing companies and bond issuers, this model removes the sales-turnover variable to avoid sectoral bias (Altman, 2000; Viciwati, 2020):

$$Z'' = 6.56 X_1 + 3.26 X_2 + 6.72 X_3 + 1.05 X_4$$

Where: X_1 = Working Capital / Total Assets; X_2 = Retained Earnings / Total Assets; X_3 = EBIT / Total Assets; X_4 = Book Value of Equity / Total Liabilities. Classification thresholds: $Z > 2.60$ (Healthy/Safe Zone); $1.10 < Z < 2.60$ (Grey Zone); and $Z < 1.10$ (Distress Zone).

Springate S-Score Model (1978): Developed by Gordon L. V. Springate using linear discriminant analysis (LDA), this model selected four principal ratios from 19 ratios tested (Springate, 1978):

$$S = 1.03 X_1 + 3.07 X_2 + 0.66 X_3 + 0.40 X_4$$

Where: X_1 = Working Capital / Total Assets; X_2 = EBIT / Total Assets; X_3 = EBT / Current Liabilities; X_4 = Sales / Total Assets. Classification thresholds: $S > 0.862$ (Healthy); $S < 0.862$ (Bankrupt/Distressed).

Based on this background, the study aims to: (1) analyze the accuracy of the Altman Z-Score model in predicting bankruptcy among IDX-listed retail companies; (2) analyze the accuracy of the Springate model in predicting bankruptcy among IDX-listed retail companies; and (3) empirically test whether the two models differ significantly in accuracy using a confusion-matrix approach and the McNemar test over the dynamic 2019–2024 period, covering the pre-pandemic, COVID-19 pandemic, and post-pandemic eras.

2. RESEARCH METHOD

Data Type and Sources

This study uses a descriptive-comparative quantitative design. The secondary data consist of audited annual financial statements and summary financial ratios from eight retail companies listed on the IDX during 2019–2024 (Nazir, 2013; Sugiyono, 2019).

Population and Research Sample

The study population comprised 33 companies in the IDX Retailing subsector. Purposive sampling was applied using the following criteria: (1) continuously listed on the IDX during 2019–2024; (2) not delisted or suspended; (3) published complete audited financial statements denominated in Indonesian rupiah; and (4) specifically operated in daily consumer-goods retailing (supermarkets/groceries) or apparel/department stores characterized by high inventory turnover. Specialized electronics and gadget retailers were excluded to avoid bias in working-capital calculations caused by slow-moving inventory (Sekaran & Bougie, 2016). Based on these criteria, eight issuers were selected, producing 48 observations (8 issuers $\times$ 6 years).

Table 1. Research Sample of IDX Retail Subsector Companies.

No.	Issuer	Company Name	Primary Business Line
1	ACES	PT Aspirasi Hidup Indonesia Tbk (ex Ace Hardware)	Home Furnishings & Lifestyle
2	HERO	PT DFI Retail Nusantara Tbk (ex Hero Supermarket)	Supermarket, Guardian, IKEA
3	MPPA	PT Matahari Putra Prima Tbk	Hypermarket & Supermarket (Hypermart)
4	MIDI	PT Midi Utama Indonesia Tbk	Minimarket & Supermarket (Alfamidi)
5	RALS	PT Ramayana Lestari Sentosa Tbk	Department Store & Fashion
6	AMRT	PT Sumber Alfaria Trijaya Tbk	Minimarket (Alfamart)
7	RANC	PT Supra Boga Lestari Tbk	Premium Supermarket (Ranch Market)
8	LPPF	PT Matahari Department Store Tbk	Department Store & Fashion

Source: Processed data (2026).

Determination of Companies' Actual Conditions

Actual conditions (ground truth) were determined independently without using the Altman or Springate formulas. Referring to Whitaker (1999) and Lau (1987), a company was categorized as financially distressed when it had negative working capital for at least two consecutive years and/or recorded consecutive negative operating income (EBIT) and net income. A company was categorized as healthy when it did not meet these criteria.

Data Analysis Method

The data analysis was conducted in three main stages:

Score Calculation and Binary Conversion: Z and S scores were calculated for each observation. For the Altman model, the grey zone was objectively converted into a binary classification: $Z'' < 1.85$ was classified as Distressed, while $Z'' > 1.85$ was classified as Healthy (Altman & Hotchkiss, 2006).

Confusion-Matrix Evaluation: Classification-performance metrics were calculated as follows (Fawcett, 2006):

$$\text{Accuracy} = (TP + TN) / (TP + TN + FP + FN)$$

$$\text{Sensitivity (Recall)} = TP / (TP + FN) \mid \text{Specificity} = TN / (TN + FP)$$

$$\text{Precision} = TP / (TP + FP) \mid \text{F1-Score} = 2 \times (\text{Precision} \times \text{Recall}) / (\text{Precision} + \text{Recall})$$

McNemar Difference Test: Differences in statistical performance were tested using paired samples, focusing on discordant cells (McNemar, 1947; Agresti, 2013; Ghozali, 2018):

$$\chi^2 = (|b - c| - 1)^2 / (b + c)$$

If the p-value < 0.05 , the difference in accuracy between the two models is statistically significant.

3. RESULTS AND DISCUSSION

Based on the analysis of the 2019–2024 financial statements, the fundamental conditions of the eight sample companies were clearly differentiated. ACES, AMRT, MIDI, RALS, and LPPF generally demonstrated solid post-pandemic financial performance, whereas HERO, MPPA, and RANC experienced prolonged financial pressure.

Table 2. Actual Conditions of Sample Companies (2019–2024).

Issuer	2019	2020	2021	2022	2023	2024	Summary of Actual Status
ACES	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Consistently Healthy (6 Years)
HERO	Distress	Distress	Distress	Distress	Distress	Distress	Consistently Distressed (6 Years)

MPPA	Distress	Distress	Distress	Distress	Distress	Distress	Consistently Distressed (6 Years)
MIDI	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Consistently Healthy (6 Years)
RALS	Healthy	Distress	Healthy	Healthy	Healthy	Healthy	Mostly Healthy (Distressed in 2020)
AMRT	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy	Consistently Healthy (6 Years)
RANC	Healthy	Healthy	Healthy	Distress	Distress	Distress	Healthy 2019–2021, Distressed 2022–2024
LPPF	Healthy	Distress	Healthy	Healthy	Healthy	Healthy	Mostly Healthy (Distressed in 2020)

Source: Processed data (2026).

Altman Z-Score and Springate Calculation Results

The six-year individual score calculations revealed trends in financial stability and transitions in company health. Table 3 summarizes the calculation results and annual prediction accuracy.

Table 3. Annual Bankruptcy-Prediction Summary (2019–2024).

Year	Sample Size	Model Altman Z-Score		Model Springate S-Score	
		Correct Predictions	Accuracy (%)	Correct Predictions	Accuracy (%)
2019	8	7	87.50%	8	100.00%
2020	8	6	75.00%	8	100.00%
2021	8	7	87.50%	7	87.50%
2022	8	8	100.00%	8	100.00%
2023	8	8	100.00%	8	100.00%
2024	8	8	100.00%	8	100.00%
TOTAL	48	44	91.67%	47	97.92%

Source: Processed Data (2026).

Classification-Performance Evaluation (Confusion Matrix)

Classification accuracy was evaluated using a confusion matrix for 48 observations, consisting of 17 actually distressed *observations* and 31 actually healthy observations, as presented in the following tables.

Table 4. Confusion Matrix for the Altman Z-Score Model.

Actual Condition	Altman Model Prediction		Total Observations
	Predicted Distress	Predicted Healthy	
Actually Distressed (17)	16 (TP)	1 (FN)	17
Actually Healthy (31)	3 (FP)	28 (TN)	31
Total Predictions	19	29	48

Source: Processed data (2026).

Table 5. Confusion Matrix for the Springate Model.

Actual Condition	Springate Model Prediction		Total Observations
	Predicted Distress	Predicted Healthy	
Actually Distressed (17)	17 (TP)	0 (FN)	17
Actually Healthy (31)	1 (FP)	30 (TN)	31
Total Predictions	18	30	48

Source: Processed data (2026).

Based on the matrix elements above, the comparative performance of all indicators is summarized in the following table.

Table 6. Comparison of Bankruptcy-Classification Performance Indicators.

Indicator	Formula	Model Altman Z"-Score	Model Springate S-Score	Performance Difference
Accuracy	$(TP + TN) / \text{Total}$	91.67% (44/48)	97.92% (47/48)	+6.25% (Springate)
Sensitivity / Recall	$TP / (TP + FN)$	94.12% (16/17)	100.00% (17/17)	+5.88% (Springate)
Specificity	$TN / (TN + FP)$	90.32% (28/31)	96.77% (30/31)	+6.45% (Springate)
Precision	$TP / (TP + FP)$	84.21% (16/19)	94.44% (17/18)	+10.23% (Springate)
F1-Score	$2 \times (P \times R) / (P + R)$	88.89%	97.14%	+8.25% (Springate)

Source: Processed data (2026).

Significance Test of Differences (McNemar Test)

A paired McNemar test was conducted to determine whether the 6.25% difference in accuracy was statistically significant. The cross-tabulation of discordant pairs is presented in the following table.

Table 7. Paired Classification Cross-Tabulation: Altman and Springate.

Model Altman Z"-Score	Model Springate S-Score		Total Observations
	Springate Correct	Springate Incorrect	
Altman Correct	44	0	44
Altman Incorrect	3	1	4
Total Observations	47	1	48

Source: Processed data.

McNemar Statistical Test Results:

Discordant pairs: $b = 0$ (Altman correct, Springate incorrect) and $c = 3$ (Springate correct, Altman incorrect).

McNemar statistic (chi-square with continuity correction): 1.333.

Asymptotic significance (p-value): 0.655

Statistical decision: Because the p-value (0.655) > 0.05, H_0 was accepted and H_3 was rejected.

4. DISCUSSION

Performance and Accuracy of the Altman Z-Score Model (91.67% Accuracy)

The findings support the acceptance of the first hypothesis (H1). The Altman Z"-Score model achieved 91.67% accuracy, correctly classifying 44 of 48 observations. Its principal strength lies in the high weights assigned to X3 (EBIT / Total Assets, coefficient 6.72) and X1 (Working Capital / Total Assets, coefficient 6.56). For distressed retailers such as HERO and MPPA, consecutive operating losses sharply reduced X3 to negative values, causing the Z-score to fall well below the critical threshold of 1.10. This finding is consistent with Hapsari and Putri (2022) and Ramadhani et al. (2023).

Nevertheless, the Altman model produced three false positives, particularly for PT Midi Utama Indonesia Tbk (MIDI) during 2019–2021. This outcome was attributable to Alfamidi's store-expansion strategy, which intensively used short-term supplier trade payables. This operating pattern made net working capital technically negative even though MIDI generated substantial operating cash flows and sales. Because the Altman Z-Score heavily penalizes negative working capital, it tended to classify MIDI as being in the distress zone.

Performance and Accuracy of the Springate Model (97.92% Accuracy)

The findings support the acceptance of the second hypothesis (H2). The Springate model achieved an outstanding accuracy rate of 97.92% with perfect sensitivity of 100.00%, detecting all 17 distressed observations without error. Springate's advantage in the retail sector arises from its inclusion of X4 (Sales / Total Assets) and X3 (EBT / Current Liabilities). Retail business continuity depends heavily on asset turnover and inventory turnover. When sales volumes decline because of e-commerce disruption or store rationalization, the Springate model's X4 ratio responds sensitively. In addition, X3, which links earnings before tax to current liabilities, closely reflects a retailer's ability to settle short-term obligations to trade vendors. This result reinforces the findings of Effendi (2018), Nugroho and Kurniawati (2022), and Putri et al. (2023), who emphasized Springate's responsiveness to operating-liquidity pressure in retail businesses.

Comparative Evaluation and Implications of the McNemar Test

Testing of the third hypothesis (H3) showed that although the Springate model recorded higher numerical accuracy (+6.25%), the McNemar test demonstrated that the difference was not statistically significant ($p = 0.655 > 0.05$). Therefore, H3 was rejected. Methodologically, this finding confirms that the Altman Z-Score and Springate models have relatively equivalent reliability and predictive capacity when applied to Indonesian consumer-retail issuers. From the perspective of signaling theory, both models successfully transform raw financial-statement

data into highly credible predictive signals (Connelly et al., 2011). The Springate model offers simpler calculations and a clear binary classification, making it suitable for rapid screening. The Altman Z-Score, meanwhile, provides additional analytical value through its identification of a transitional grey zone, allowing management to implement corrective measures before financial deterioration becomes permanent.

5. CONCLUSION

Based on the data analysis and discussion, the following conclusions were drawn. First, the Altman Z"-Score model was highly accurate in predicting bankruptcy among IDX-listed retail subsector companies during 2019–2024, achieving 91.67% accuracy (44 of 48 observations correctly classified), 94.12% sensitivity, and an 88.89% F1-score. Second, the Springate model achieved superior numerical performance, with 97.92% accuracy (47 of 48 observations correctly classified), perfect sensitivity of 100.00%, specificity of 96.77%, and an F1-score of 97.14%. Third, although Springate's numerical accuracy exceeded Altman's (97.92% versus 91.67%), the McNemar test produced a p-value of 0.655 (> 0.05), demonstrating that the difference was not statistically significant. Both models are therefore reliable early-warning instruments for bankruptcy risk in the Indonesian retail industry.

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