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An Assessing The Performance Of Companies Using F-Score And Z-Score With Artificial Neural Networks

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ABSTRACT

This research examines how to assess financial performance of a corporation holistically by integrating the use of both the Piotroski F-Score and Altman Z-Score with an ANN (Artificial Neural Network) analytical method. It looks at 15 firms in the Nifty Auto Index over the timeframe of 2021 to 2025 through the application of several statistical techniques using secondary data: descriptive statistics, correlation analysis, one-way ANOVA, trend analysis and ANN modeling. Key findings show that (1) financial performance, as measured by the F-Score, is very variable year to year, while measured using the Z-Score, financial stability is stable over time; therefore, (2) a weak relationship exists between the two F-Scores due to disparate influencing factors for financial performance and financial stability. The ANN model does not strongly associate financial performance with financial risk. Overall, the research will allow investors/credit rating agencies/financial analysts with investment interests in this sector located within India, to more readily assess the health of their investments within a dynamic environment.

Keywords: *Piotroski F-Score, Altman Z-Score, Artificial Neural Network, Financial Performance, Financial Distress, Automobile Sector, Nifty Auto Index.*

INTRODUCTION

Financial stability has become a critical factor in evaluating companies for analysts, investors, and stakeholders in an environment where the global economy is evolving rapidly and competition is increasing rapidly. Traditional approaches to financial ratio analysis have been beneficial, but they may not sufficiently represent the overall health of an organization. Thus, integrated financial scoring models such as the Altman Z-Score or the Piotroski F-Score have gained traction.

The Altman Z-Score is a quantitative method used to evaluate the likelihood of bankruptcy of a corporate entity through the use of multiple financial ratios that reflect liquidity, profitability/leverage, solvency, activity and grouping these ratios into a single number. A lower Altman Z-Score indicates a greater probability of bankruptcy and hence, greater financial instability whereas a higher score indicates financial stability.

On the other hand, the Piotroski F-Score is an accounting-based measure of financial strength and is measured on the basis of nine (9) separate accounting criteria relating to profitability, leverage, liquidity and operating

efficiency. This score can be utilized in identifying companies having strong and/or improving fundamental processes.

The use of artificial neural networks (ANNs) is becoming more popular in finance and business, as they are capable of detecting complex and nonlinear relationships between variables that traditional methods may not be able to see. ANNs improve their ability to accurately predict outcomes by utilizing historical data and consequently, can provide more accurate measures of corporate performance.

This research combines traditional financial measures (i.e. Z-Score and F-Score) with ANN-based modelling to develop an effective means for rating companies in the Indian automotive industry; this integration of classical finance measures with ANNs increases the accuracy of assessing companies' overall financial health and therefore, improve the decision-making process of both investors and analysts.

OBJECTIVES OF THE STUDY

- To compute and interpret the Altman Z-Score and Piotroski F-Score for selected companies over the period 2021–2025.
- To analyze the variations and differences in F-Score and Z-Score among the selected companies.
- To develop, classify, and validate an Artificial Neural Network (ANN) model using F-Score and Z-Score for effective financial performance classification.
- To offer practical insights and recommendations for enhancing financial management practices based on the study's findings.

NEED OF THE STUDY

- To overcome the limitations of traditional financial performance evaluation methods
- To improve the accuracy of predicting corporate financial distress and overall performance.
- To integrate established financial scoring models with advanced machine learning techniques.
- To equip investors, analysts, and policymakers with more reliable tools for decision-making.
- To meet the increasing demand for data-driven financial analysis in modern corporate settings.
- By combining the F-Score and Z-Score with Artificial Neural Networks, this study aims to develop a robust hybrid framework for assessing company performance and financial stability.

SCOPE OF THE STUDY

- Piotroski F-Score is used to measure the company's financial health, while the Altman Z-score is used to evaluate the likelihood of failure.
- This research paper combines these two scores into an ANN framework to help improve prediction reliability and continuity of the areas studied.
- The area that will benefit from this methodology includes emerging markets like India and the automobile industry. It will also provide investors and those looking to build a portfolio with useful comparative data.
- In addition, this ANN framework may provide credit rating agencies with a more effective way to evaluate a company's financial health and performance.

PROBLEM OF THE STUDY

- Common financial analysis techniques are grounded in simple and direct ratio analyses and many of these same techniques fall short of providing the user with a complete picture of a firm's financial well-being.
- Existing models that are widely utilized today include the Altman Z-Score and the Piotroski F-Score, both of which rely on simple linear assumptions and historical data which can limit their ability to accurately predict future outcomes.
- Further, existing models do not adequately portray the complex and non-linear relationships that exist in actual financial settings.
- Investors and analysts today face challenges associated with the combination of numerous financial variables to formulate accurate investment decisions.
- Unfortunately, integrated approaches that combine traditional financial models and advanced analytical techniques do not currently exist.
- This research study is aimed at developing and providing a more accurate measure of a firm's financial performance and predict future success by combining the Z-Score with the F-Score and Artificial Neural Networks (ANN).

REVIEW OF LITERATURE

Numerous research studies have researched how to foresee financial difficulty, along with evaluating how well businesses perform financially related to the auto industry, using conventional and modern methods. Research, such as that done by Chavda and Mehta (2022), Singh (2024) and Karthikeyan et al. (2021), used the Altman Z-Score to evaluate whether automobile companies have financial stability; using the Altman Z-Score, financial health of these automobile companies ranged from financially distressed to financially safe (low risk) companies. Kumar and Sarkar (2024) demonstrated that Tata Motors is recovering financially using the Altman Z-Score and Piotroski F-Score; they determined that using both of these scores is beneficial when making investments regarding Tata Motors. Similarly, Joshi and Sharma (n.d.) developed an effective way to evaluate the financial strength of companies within the auto and electric vehicle industries and assist with making investment decisions by using the Piotroski F-Score.Recent studies in finance have focused on implementing artificial intelligence (AI) and machine learning (ML) to predict distress. Several researchers have reported that hybrid ML and neural network models are more accurate than traditional prediction methodology (Zhu, 2023, Wu et al., 2021, Aranha & Bolar, 2021, Duan & Ren, 2023). Kristanti et al. (2023), Aydin et al. (2022), and Zizi et al. (2022), stated that more advanced algorithms such as Random Forests, Decision Trees, and Logistic Regression can effectively identify financially distressed organizations. Collectively, these studies suggest that traditional finance models are significantly enhanced by incorporating AI-Based methods, which improve accuracy in predicting risk and provide better strategic decision making in the automotive sector.

RESEARCH METHODOLOGY

A systematic, structured, and evidence-based approach was utilised to examine the financial position and performance of the selected auto manufacturers for this study. The research design features clearly described data collection methods and sample selection criteria to facilitate an appropriate level of representativeness and relevance within the overall study. The selected companies were subjected to secondary financial data analysis within the defined timeframe. The analytical tools used in this study include correlation analysis to determine

relationships between variables; one-way ANOVA to determine whether there were statistically significant differences among groups of observations; and Artificial Neural Network (ANN) modelling to identify complex non-linear relationships between input and output variables as well as to enhance the ability of these types of model to provide accurate predictions. The use of these three analytical methods will allow for a more in-depth analysis of the results obtained from the data set, thereby assisting in forming a reliable basis for evaluating the financial health of corporations operating in the dynamic automotive industry.

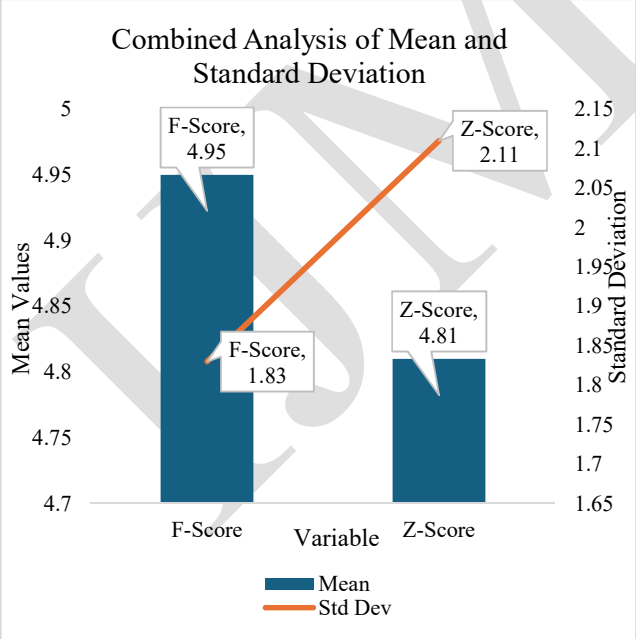
DATA ANALYSIS & INTERPRETATION

Descriptive Statistics

Table: Descriptive Statistics of F-Score and Z-Score

Variable	Count	Mean	Minimum	Maximum	Std. Dev.
F-Score	73	4.95	1.00	8.00	1.83
Z-Score	74	4.81	1.24	13.52	2.11

Chart: Combined Analysis of Mean and Standard Deviation



The average financial performance of most organisations is moderate with an average F-score of 4.95; further from an average Z-score of 4.81 suggests a general state of financial stability and low risk of bankruptcy. the standard deviations are moderate indicating that the sampled organisations demonstrate a suitable level of consistency in terms of financial performance and stability across the sample.

Correlation Analysis

Table: Correlation between F-Score and Z-Score

Variable	F-Score	Z-Score
F-Score	1.00	-0.11
Z-Score	-0.11	1.00

A correlation analysis reveals that there is almost no linear relationship between the F-Score and Z-Score for the selected companies. That is, the correlation is weak (-0.11), and therefore suggests an almost non-existent relationship between financial performance and financial stability. The results indicate that the F-Score and Z-Score measure independent constructs of the overall financial position of companies, and therefore are important to consider independently of one another for the assessment of a company's total financial position.

ANOVA Analysis — F-Score Across Years

Table: Summary Results for F-Score Across Years

Year	Count	Sum	Average	Variance	Std. Dev.
2021	14	48	3.43	3.03	1.74
2022	14	78	5.57	3.49	1.87
2023	15	79	5.27	2.07	1.44
2024	15	92	6.13	2.12	1.46
2025	15	64	4.27	2.21	1.49

Table: ANOVA Results for F-Score Across Years

Source	SS	df	MS	F-Value	p-value
Between Groups	67.32	4	16.83	6.56	0.00016
Within Groups	174.46	68	2.57	—	—
Total	241.78	72		—	—

The statistical significance of the variation in financial performance between the years is confirmed by a calculated F-value of 6.56 compared to a critical value at the 0.05 level of significance of 2.51, and an associated p-value of 0.00016. Therefore, since both the calculated F-value is greater than the critical F-value, and the p-value is less than .05, this indicates that external influences including differing economic conditions, changing market dynamics, and/or changing company strategies were able to influence variations in performance from year to year throughout this study series.

ANOVA Analysis — Z-Score Across Years

Table: Summary Results for Z-Score Across Years

Year	Count	Sum	Average	Variance	Std. Dev.
2021	14	58.79	4.20	8.33	2.89
2022	15	69.63	4.64	4.34	2.08
2023	15	71.32	4.75	3.62	1.90
2024	15	76.08	5.07	3.42	1.85
2025	15	80.66	5.38	3.08	1.75

Table: ANOVA Results for Z-Score Across Years

Source	SS	df	MS	F-Value	p-value
Between Groups	11.54	4	2.89	0.64	0.635
Within Groups	310.76	69	4.50	—	—
Total	322.30	73	—	—	—

There is a low F value at 0.64, as well as a high p value at 0.635 which also supersedes the significance level of 0.05 which indicates that there is no significant difference between the financial stability of these companies and their contact methods using the Z score across different years. Therefore the company's financial stability has remained relatively stable over the study period; therefore, the companies have been resilient to fluctuations in their economy during the study period.

FUTURE RESEARCH

- To improve the broad applicability of findings, future research should involve increased sample sizes by investigating organizations across different industries.
- A longer time period of investigation will allow researchers to analyze long-term patterns in order to provide stronger and more reliable findings based on historical data.
- Utilizing additional financial and non-financial measures such as macroeconomic indicators or conditions of the stock market will allow for a fuller understanding of a company's ability to achieve superior investment returns.
- By utilizing more advanced machine learning techniques such as deep learning or hybrid methods beyond artificial neural networks (ANN), researchers could increase the accuracy of their forecasts.
- Future studies should seek to develop up-to-date models for real-time forecasting of an organization's financial success, using data that is continuously changing or dynamic.

CONCLUSION

Using a combination of three methods to evaluate the financial stability and performance of 15 companies in the Nifty Auto Index between 2021 – 2025 (Piotroski F-score, Altman Z-score and Artificial Neural Networks or ANN). The results indicate that while the majority of companies showed overall moderate performance and strong

stability, the company's performance was highly variable from year to year and the company's stability remained stable; furthermore, this trend was confirmed through ANOVA, correlations and ANN analyses.

The results of the analysis show that there is a weak correlation between financial performance and financial stability; therefore, these two aspects of the company must not only be assessed separately but are affected by different factors.

In terms of overall financial health improvement, financial stability was consistently improved across all companies regardless of the company's position in relation to other companies in the same sector showed considerable variation in the company's financial performance.

Overall, the 15 companies in the automobile sector indicated that the company's financial health was solid; that the company showed increasing financial stability and that the company exhibited control over its risk.

Using the 3 methods to evaluate the financial stability and performance of 15 companies in the Nifty Auto Index created a comprehensive evaluation framework, thus providing a resource for investors, portfolio managers, credit rating agencies, and policymakers regarding companies involved in the automobile sector of India.

The researchers suggest conducting further research to include additional financial variables and the use of more advanced deep learning models to further enhance the company's financial predictive ability.

LIMITATIONS OF THE STUDY

- The examination focuses solely on fifteen businesses represented by the Nifty Auto Index (Nifty) so conclusions made are not applicable to the overall industry.
- This research has been limited to a sample size of 15 businesses using Secondary Financial Data (SFD) as the only data source, and therefore may have inaccuracies when compared to reality.
- Five years may not be sufficient time period to completely identify long-term trends in financial growth.
- The Artificial Neural Network (ANN) is constructed with a limited number of variables and may therefore potentially lack predictive validity due to restrictions created by limitation in number of input variables.

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