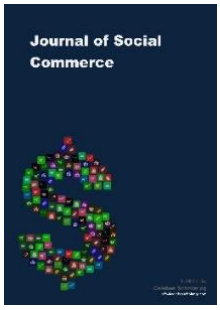

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Bankruptcy Prediction of Software Companies Using Altman Z-Score

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Article History

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Abstract

This study employs a modified Altman Z-Score model to 15 selected companies with the aim to predict bankruptcy risk in the Indian software industry. Working capital to total assets, retained earnings to total assets, earnings before interest and taxes to total assets, and market value equity to book value of total liabilities, aside to the variable sales to total assets ratio, are the four main financial ratios used in the model, which is being altered for non-manufacturing businesses. The analysis is supported using secondary data from 2004 to 2022 that has been collected from financial statements and reliable financial websites. The study classifies businesses according to their financial stability via bibliometric analysis, descriptive quantitative approaches, and cluster analysis. Variations in 3i Infotech consistently displayed signs of financial distress, while companies include Mphasis, Tech Mahindra, and NIIT occasionally fell into a grey area, suggesting intermittent financial uncertainty, the majority of companies stayed in the non-distress group from 2004 to 2021, indicating a low bankruptcy risk. The study suggests the implementation of specific corrective measures, such as comprehensive financial restructuring and better risk-management methods, for businesses that have been identified to be in the distress and grey zones. In addition, to reduce the risk of bankruptcy and ensure long-term financial stability, proactive processes for governance and ongoing monitoring are encouraged.

Introduction

Survival is one of the main goals of any company. Survival is a prerequisite for future growth and profitability. The only way to remain relevant and survive in the highly competitive business world is to consistently review the performance of the company in view of stated goals. Therefore, gathering information pertinent to a company's sustainability is crucial for every organisation. Bankruptcy is generally derived from financial hardship (financial distress) that is started when the company failed to meet payment debts (Ningsih & Permatasari, 2018).

Bankruptcy prediction models have been used in the context for analyzing financial health of the companies in the last more than fifty years. Bankruptcy prediction models have been method for financial analysis since 1932 which ranged from the Fitzpatrick study to William Beaver's t-tests to Altman's Z score which was designed in 1968 (Anuj et al., 2018). The

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probability and quantification of bankruptcy businesses have considerably increased in recent years (Friesenhahn & Kwan, 2020)· As a result, predicting financial health is a major topic of concern in academia, investors, creditors, stockholders, insurer services, tender providers, investment managers, financial institutions, governments, and investors in the capital markets, among others. Therefore, it is desirable to have a well-developed set of guidelines for determining the likelihood of bankruptcy. Two models have been created during the past several decades using discriminant analysis and logistic regression to forecast corporate failure bankruptcy Altman (1968), and Ohlson (1980).

Financial distress, as defined by Ross & Wasterfield (1996), is a situation in which a firm's operating cash flow is unable to cover or satisfy its current responsibilities. Financial distress is described by Plat & Plat (2002) as a stage of declining financial position that takes place before bankruptcy or liquidation. Bankruptcy may cause a company to collapse (go bankrupt). According to Rodoni & Ali (2010), a corporation can go bankrupt due to capital adequacy or a lack of capital, the amount of high debt and interest owed, and suffering losses due to demands of it individual in the market. Rationality, using debt more frequently will result in higher interest payments, which will lower profitability (Sjahrial, 2012).

Altman et al. (2014) recommended multiple discriminant analysis (MDA) as the applicable statistical technique. MDA is a statistical technique used to classify an observation into one of numerous a priori groupings dependent upon the individual features of observations. Hayes et al. (2010) mentioned that Altman Z- score is applied in predicting possible financial hardship of the companies. Swalih et al. (2021) predicted bankruptcy using Altman z score in Automobile industry by taking a subset of companies listed on the NASDAQ. It is evident from the examples as given above that Altman z score is a popular method of analysis and bankruptcy in the context of companies in all sectors of economy. Keeping this in view, this study embodies the analysis of software Indian companies with following objectives:

i. To evaluate the bankruptcy parameter (Altman z- score) of the fifteen Indian software companies.

ii. To analyze similarities among fifteen Indian software companies based on bankruptcy parameters.

iii. To suggest investors about fifteen companies based on its bankruptcy analysis.

Purpose of the Study

Researchers have emphasized the value of the Z-Score in identifying early warning signs of financial distress and assisting timely intervention by managers. Moreover, empirical evidence has revealed the Z-Score's effectiveness in discriminating between financially healthy and distressed firms, thus, providing valuable insights for strategic decision-making. This study will help the revival of financially distressed companies in technology sector by forcing policy makers, investors, corporate governance bodies and other stakeholders to frame revival policies in light of findings of this research. Through the analysis of case studies and empirical data, this research paper illuminates the strategic significance of the Altman Z-Score in guiding managerial decisions and bolstering organizational resilience.

Significance of the Study

This research study is important because it supplies relevant data describing the state of the Indian software industry, the factors affecting financial stability and hardship, and the effect of these indicators on business profitability. The conclusions of the study can be applied by many stakeholder groups in the Indian technology sector to make better choices, and consequently,

by policymakers to enact innovative policies that nurture the industry's sustainable development and extension.

Systematic Literature Review

This section presents the systematic literature review with referred application of Altman Z score in general and in case of software companies in specific. Altman Z score is having different functional form for different sectors of economy. Due case is taken to include as many as application of Altman Z score in systematic review of literature. Otlet (1934) coined the phrase "bibliometric" for the first time. According to his definition, it is "the measurement of all aspects related analysis to the publication and reading of books and documents." Today, it can also be used in quantitative research assessment tasks of academic output to address trends in a certain field of study by examining preexisting materials like books, working papers, thesis, dissertations, published research articles, etc. The goal of bibliometric investigations is to discover and map the intellectual structure of a field of study, or to detect the intellectual networks between scholars Pinto et al. (2014).

Tarighi et al. (2022) studied that the degree of corporate social responsibility disclosure (CSRD) and financial distress risk (FDR) are positively correlated. The organisation with more institutional investors actually experiences a lower probability of financial distress, indicating that better regulatory actions on managers' performance are rewarded with fewer financial defaults. Altman et al. (2016) rival market-based or hazard models outperform Z-Score models in terms of bankruptcy prediction, Z-Score models consistently outperform these models in other research. It is challenging to extrapolate from the findings of rival models without a thorough international comparison.

Shahwan (2015) reported that average corporate governance index (CGI) score indicates that the quality of the CG practices in Egyptian listed companies is quite low. Study findings refute the idea that CG practices and financial performance are positively correlated. Additionally, CG practices and the chance of financial trouble have a negligible negative link. Udin et al. (2017) concluded that the influence of ownership structure on a firm's likelihood of financial crisis is negligible.

Agrawal & Chatterjee (2015) numerous earlier researches have used the modified Jones model (1991), which is thought to be the most effective model for identifying profits management. Younas et al. (2021) PAKCGI has a beneficial effect on the probability of financial difficulty in enterprises. The PAKCGI's positive coefficient suggests that strong business practices lessen the likelihood of financial distress in Pakistan by acting as a trigger. Altman (2018) there have been a tonne of practitioner applications over the past 50 years since the publication of the Z-score model for predicting firm financial distress and bankruptcy, not to mention a tonne of scholarly works that have used the Altman model as a trustworthy and simple to use benchmark.

Ramamonjiarivelo et al. (2015) Public hospitals that fall under the same category as non-profit hospitals and have a high debt-to-asset ratio are more likely to undergo privatization. Study discovered that compared to non- teaching public hospitals, teaching public hospitals are less likely to be privatized. Halteh et al. (2018) The financial crisis that started in the summer of 2007 when the real estate bubble burst had a number of negative effects on the world economy, demonstrating, among other things, that credit institutions' financial troubles are a global social and economic issue that affects businesses everywhere. Kamaluddin et al. (2019) a company's ability to pay off short and long-term liabilities that cause financial trouble decreases as corporate profits go down. Chouhan et al. (2014) to confirm the reliability of such measurements and procedures in other nations, the international application of credit risk

measurement integrates the literature on financial distress measurement. Tarighi et al. (2022) companies with high levels of CSR disclosure struggle to increase their creditworthiness and access to finance, which leads to an increase in financial insolvency. Companies with more institutional owners that publish more CSR data have a lower probability of experiencing financial trouble. Swalih et al. (2021) Indian auto industry is strong and stable, and the country's automakers are not likely to experience financial trouble or insolvency anytime soon. they concluded that the Indian automotive sector is highly strong and healthy after analyzing the Atman Z-Score. Primasari (2017) prediction model, but particularly the Altman Z-Scores, which have the highest R2 analysis, can be utilized to forecast financial distress. Only Grover G-Score models have a t test with an insignificant value, and a F test with a probability larger than one cannot be used to predict company financial distress.

Ikpesu (2019) the firm-specific factors that determine whether a firm in the nation's manufacturing sector is in financial trouble are leverage, liquidity, profitability, firm size, revenue growth, and share price, while making financial decisions, managers and owners of the corporate organisation need to pay close attention to these factors. Succurro et al. (2019) the econometric results are contrasted with more recent classifiers and popular Altman Z-score results for various reference period durations Cındık & Armutlulu (2021). Financial distress is a term used to describe the condition of a company that is experiencing financial difficulties. Finishtya (2019) the hypothesis test, operating cash flow, as measured by cash flow from operational/net sales, is significant for the company's financial distress, profitability, as measured by ROA, is significant for financial distress, and financial leverage, as measured by DER, is not significant for financial distress.

Table 1. Previous research work in Financial and Non- financial sector

Research Paper	Authors	Year of Publication
Manufacturing Companies & Non- manufacturing companies		
Financial Distress Prediction in an International Context: A Review and Empirical Analysis of Altman's Z-Score Model	Edward I. Altman, Małgorzata Iwanicz-Drozdowska, Erkki K. Laitinen, Arto Suvas	2016
Does audit report information improve financial distress prediction over Altman's traditional Z-Score model?	Nora Muñoz-Izquierdo, Erkki K. Laitinen, María-del-Mar Camacho-Miñano, David Pascual-Ezama	2019
Application of Altman Z Score Model on Selected Indian Companies to Predict Bankruptcy	Apoorva D.V., Sneha Prasad Curpod, Namratha M	2019
An application of Altman Z-score model to analyze the bankruptcy risk: cases of multidisciplinary enterprises in Vietnam	Diep Thanh Tung Vo Thi Hoang Phung	2019
A revision of Altman Z-Score model and a comparative analysis of Turkish companies' financial distress prediction	Zeynep Cındık, Ismail H. Armutlulu	2021
Manufacturing Companies		
Testing of Altman's Z - Score model, a Case Study of Dunlop India Ltd.	Partha Ghosh	2013
Predicting Financial Stability of Select BSE Companies Revisiting Altman Z Score	Vineet Chouhan, Bibhas Chandra, Shubham Goswami	2014
The effects of corporate governance on financial performance and financial distress: evidence from Egypt	Tamer Mohamed Shahwan	2015
The analytical study of Altman Z score on NIFTY 50 Companies	Sanesh. C	2016
The effects of ownership structure on likelihood of financial distress: an empirical evidence	Shahab Udin, Muhammad Arshad Khan, Attiya Yasmin Javid	2017
Firm specific determinants of financial distress: Empirical evidence from Nigeria	Fredrick Ikpesu	2018

Identification of Sickness of Some Selected Garment Factories in Bangladesh and Its Remedial Measures: An Application of Altman's Z-Score Model	Md. Abu Sina, Md. Nazmul Huda, Hamayet Hossain, Md. Abdus Sabur	2020
Corporate governance and financial distress: Asian emerging market perspective	Noman Younas, Shahab Uddin, Tahira Awan, Muhammad Yar Khan	2021
A revision of Altman Z-Score model and a comparative analysis of Turkish companies' financial distress prediction	Zeynep Cındık, Ismail H. Armutlulu	2021
A study on the financial soundness of Indian automobile industries using Altman Z-Score	M. M. Swalih, K.B. Adarsh, M.M. Sulphey	2021
Analisis Altman z-score, Grover score, Springate, Dan Zmijewski Sebagai signaling financial distress	Studi Empiris Industri Barang-Barang Konsumsi di Indonesia	2022
Non - manufacturing Companies		
Public hospitals in financial distress	Zo Ramamonjiarivelo, Robert Weech-Maldonado, Larry Hearld, Nir Menachemi, Josué Patien Epané, Stephen O'Connor	2015
Financial distress prediction of Islamic banks using tree-based stochastic techniques	Khaled Halteh, Kuldeep Kumar, Adrian Gepp	2018
Validity of Altman Z-Score Model to Predict Financial Failure: Evidence From Jordan	Sufian Radwan Al-Manaseer1 & Suleiman Daood Al-Oshaibat	2018

In addition, with a view to augment the fact that not much work is being done in the context of application of Altman z score for analyzing bankruptcy prediction of software companies one.

Methods

Context

Substantial consideration has been given to bankruptcy prediction models and the problems related with predicting failure in corporate firms. Corporate bankruptcy prediction has become a very vital issue in finance especially given the fact that so many researchers have given so many different types of prediction model. Altman z-score Model analysis imply to be the best model that attains a very high result of accuracy levels Altman et al. (2013). Not so much studies are available on Software industry and this sector has a very significant role in India's GDP.

In this paper 15 Indian software companies were selected for the bankruptcy prediction and data were taken from 2004 to 2022.The study was based on secondary data that were collected from company web sites, company annual report and Money control. Com. These fifteen software companies were selected based on their availability of financial data, industry relevance, and market prominence. These selected companies, that consist of various kinds of big, medium, and small businesses, provide an in-depth analysis of the industry's financial health. To identify long-term trends in finance, economic cycles, and industry trends, the period 2004–2022 were taken. Under the study, significant events like the 2008 financial crisis, the influence of COVID-19, and digital transformation were also addressed. Ensuring data availability and consistency over this period allows for significant analysis and comparison of financial stability, distress, and recovery patterns. For the data analysis, Excel and SPSS software were used.

Data extraction for review of literature

Database is searched for the application of Altman Z score. The extracted date of research articles in the form of frequency for different key words is given in the table.

The literature review includes articles from the Dimensions database that were published between 2013 and 2022. A set of keyword combinations were used as the initial search criterion to find academic articles relating to the research topic.

Table 2. Frequency of keywords selected in dimension database

	Years									
Keywords	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013
"Altman Z score Model"	47	40	32	29	17	16	12	4	3	1
"Altman Z Score Model" OR "Altman Z Score" OR "Altman Z -Score" OR "Altman's Z-Score Model" OR "Altman's Z-Score Model Approach"	137	145	97	85	64	43	27	16	12	5
"Financial Distress Model" OR "Insolvency" OR "Financial failure" OR "Bankruptcy" OR "Distress"	1,574	1,539	1,253	997	795	689	630	542	505	441
"Altman Z Score Model" AND "Financial Distress"	23	18	15	13	5	6	6	1	0	0
"Financial Distress Model"	5	4	1	3	3	1	1	1	2	1
"Altman Z score Model" AND "Manufacturing companies"	4	5	3	5	2	4	0	0	1	0
"Altman Z score Model" OR "Manufacturing companies"	2,056	1,671	1,455	1,134	762	552	390	313	299	238
"Altman Z score Model" OR "Non- Manufacturing companies"	50	45	35	29	18	20	15	4	5	1
"Bankruptcy Prediction" AND "ALTMAN Z score Model"	5	3	8	6	6	4	3	1	0	1
"Altman Z-score" AND "Financial distress" AND "Non-Manufacturing" OR "Software Companies"	61	75	39	32	16	14	9	6	2	1

The search procedure has been made possible by the introduction of predefined keywords, where field phrases are utilized for TOPIC searching and clever techniques keywords are employed for ABS-TITLE, Full text paper searching, and the pair of words AND/ OR joins the two together. When such keywords are used, only ABS-TITLE papers are taken into account to narrow the results. Although the majority of results are written in English. Since the authors aimed to present a thorough overview of research conducted across selected fields which are Accounting, Auditing and Accountability, Banking, Finance and Investment, Behavior, Commerce, Management, Tourism and services. The search is restricted to the period of 10 years from 2013 to 2022. After screening out the duplicates and irrelevant papers, the final review study has done on the basis of citations of a document.

Altman Z - score and its variables

The growth of any business depends heavily on achieving financial health. A company's financial soundness is determined by its capacity to make regular payments, appropriately fund its activities, and weather emergencies. There are numerous techniques to gauge or show a company's financial health. Owners' equity to total assets ratios and other financial ratios, like

current liquidity ratios, are useful tools for assessing the company's bankruptcy Lace & Sundukova (2010). The Altman Z-score model, also known as an MDA model or multiple discriminant analysis model, was created by Altman (1968) is used to forecast bankruptcy and linear combination of four or five financial ratios that have been weighted by coefficients makes up this multivariate model. It is a very helpful formula that has won the support of many different parties, including investors, financial analysts, consultants, bankers, auditors, management accountants, financial institutions, courts, and database systems.

To predict bankruptcy, Altman model combines five financial ratios in a specific way to get a single figure. This number is referred to as the Z score. It serves as a general scale of how stable business finances are. This figure acts as a general indicator of the financial health or predict the chances of bankruptcy of the company. It is possible to evaluate both manufacturing and non-manufacturing businesses as well as public and private enterprises in the United States and other nations using Altman's Z score plus model Joshi (2019). This Altman Z-score is based on five financial ratios-working capital, Retained earnings, EBIT, equity, sales, and Total Assets Yi (2012); Afrin (2017); Sanesh (2016); Sumathi & Narasimhaiah (2016); Panigrahi (2019); Apoorva & Namratha (2019); Mittal & Singh (2023), etc.

Table 3. Formula develop by Altman model for different companies

Nature of Companies	Formula for Z score	Benchmarks value
Public Manufacturing companies (Edward I. Altman)	Z-Score = (1.2 × X1) + (1.4 × X2) + (3.3 × X3) + (0.6 × X4) + (0.99 × X5)	2.99 (Safe Zone – Low Likelihood of Bankruptcy) 1.81 to 2.99 (Grey Zone – Moderate Risk of Bankruptcy) < 1.81 (Distress Zone – High Likelihood of Bankruptcy)
Private Manufacturing Companies (Edward I. Altman)	Z-Score = 0.717 × X1 + 0.847 × X2 + 3.107 × X3 + 0.42 × X4 + 0.998 × X5	1.23 or less – "Distress" Zone from 1.23 to 2.9 – "Grey" Zone 2.9 or more – "Safe" Zone
Software companies (Edward I. Altman)	Z-Score = 6.56 × X1 + 3.26 × X2 + 6.72 × X3 + 1.05 × X4	2.60 (Safe Zone – Low Likelihood of Bankruptcy) 1.10 to 2.6 (Grey Zone – Moderate Risk of Bankruptcy) < 1.10 (Distress Zone – High Likelihood of Bankruptcy)
Emerging Market Companies (Edward I. Altman)	Z-Score = 3.25 + 6.56 × X1 + 3.26 × X2 + 6.72 × X3 + 1.05 × X4	2.60 (Safe Zone – Low Likelihood of Bankruptcy) 1.11 to 2.6 (Grey Zone – Moderate Risk of Bankruptcy) < 1.11 (Distress Zone – High Likelihood of Bankruptcy)

The five components of the z-score calculation are described below.

X1 = Working Capital ÷ Total Assets

The working capital to total assets ratio measures the company's short-term liquidity.

X2 = Retained Earnings ÷ Total Assets

The retained earnings to total assets ratio measure a company's reliance on debt financing to fund operations, so a higher ratio indicates the company can fund its operations using its earnings rather than borrowings.

X3 = EBIT ÷ Total Assets

The operating income to total assets ratio measures a company's ability to generate operating profits using its assets, meaning that a higher ratio indicates greater profits and asset-utilization efficiency.

X4 = Book value of equity ÷ Total Assets

The market cap to total liabilities ratio measures the potential downside in the market value of equity given the risk of insolvency. Hence, a low market cap relative to its liabilities reflects weak market sentiment regarding the company's outlook.

X5 = Sales ÷ Total Assets

The sales to total assets ratio measure the sales generated compared to a company's asset base. Thus, a higher percentage means more efficiency in producing revenue (and higher profitability due to reduced reliance on reinvestments

Results and Discussion

Descriptive Analysis

Table 4. Heat Map of Altman 'Z' score value of 15 selected software companiesm

Year	3i Info	Birla	HCL	Infosys	Mastek	Mindtree	Mphasis	TCS	NIIT	Oracle Srvs ltd.	Sasken	Sonata Ltd.	Tata	Tech. Mahindra	Wipro Ltd.
2004	2.11	5.35	3.13	6.19	4.18	4.06	7.11	-5.67	3.65	8.93	5.63	7.57	4.03	6.29	3.8
2005	2.18	5.15	3.35	7.97	4.95	3.89	2.55	6.85	3.74	8.23	6.15	7.33	3.85	5.83	4.94
2006	2.86	4.47	3.11	7.98	4.31	4.71	3.04	7.21	3.96	8.02	5.41	7.85	3.79	4.58	4.74
2007	3	3.32	4.26	9.38	5.48	5.98	4.21	6.62	3.28	7.41	5.81	6.96	4.5	6.02	5.08
2008	2.25	5.1	2.98	8.55	4.73	5.53	4.16	6.34	3.53	8.04	5.95	6.71	3.38	6	5.35
2009	1.59	2.07	4.02	9.53	4.48	3.25	5.03	5.72	3	8.56	5.73	6.9	4.84	6.96	2.88
2010	1.5	3.95	4.44	8.85	4.55	5.67	6.1	5.11	3.23	9	5.47	7.8	4.88	3.33	4.03
2011	1.3	4.7	4.33	9.92	4.62	6.91	6.46	5.78	2.26	8.72	7.53	7.39	3.23	3.11	5.32
2012	-0.24	3.08	3.49	10.03	4.65	7.17	6.15	6.44	2.58	9.43	6.91	6.82	3.45	2.7	5.39
2013	-0.24	3.8	4.35	9.48	5.11	7.98	4.71	7.01	1.96	9.3	6.5	6.46	2.65	2.5	5.08
2014	-0.99	3.64	5.64	8.82	4.7	8.37	4.88	7.8	2.16	9.45	6.84	7.43	5.43	5.72	6.02
2015	-3.45	3.81	6.24	8.23	6.62	7.96	5.62	7.45	1.82	5.51	9.24	8.46	6.3	5.44	6.18
2016	-2.76	5.3	6.64	8.31	6.41	6.37	6.06	8.84	2.53	8.38	8.23	8.37	7.45	5.74	6.82
2017	-1.97	4.52	5.82	8.16	7.07	6.78	6.76	9.3	1.82	5.67	5.02	10.18	8.91	5.85	7.15
2018	-3.36	4.33	5.61	8.13	7.16	7.07	6.24	8.97	1.87	8.62	4.94	9.17	9.24	6.02	6.59
2019	-1.81	4.89	5.6	7.59	6.87	7.87	5.5	9.29	5.14	9.69	6.07	10.15	9.83	5.73	6.45
2020	-1.87	5.38	4.11	7.23	6.63	6.07	5.4	8.44	13.16	9.89	5.94	7.36	8.81	6.33	6.35
2021	-0.37	6.38	5.43	7.09	6.6	7.5	6.06	8.01	7.79	10.17	6.21	8.15	8.8	6.4	6.22

Note: The cells with the greatest values are colored green, the lowest values are colored red, and the cells are arranged in descending value order to display a gradient of various hues between green and red.

The changes in financial stability are illustrated by the table 4, Altman Z-score heat map for 15 software companies between 2004 to 2021. Companies with solid financial health, like Infosys, Oracle, and Sonata, regularly display higher Z-scores (green cells), indicating signify their stability and low chances of going through problems. 3i InfoTech, on the contrary hand,

presents a downward trend and negative Z-scores for several years (red cells), highlighting its financial struggles.

The table additionally displays fluctuations in mid-performing firms with Z-scores which get better over time but stay unpredictable, such as Mphasis, Mindtree, and Tech Mahindra. Notably, NIIT enjoys a significant increase in 2020, indicating either a financial turnaround or some other factor enhancing its stability. The above trends highlight the vital importance of focused fiscal strategies, better liquidity control, and increased operational effectiveness—particularly for businesses that are having trouble or exhibiting poor performance.

Table 5. Anova analysis of 15 software companies

ANOVA Analysis: Single factor					
	Z score				
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1098.783	14	78.484	26.123	0.000
Within Groups	766.136	255	3.004		
Total	**1864.919**	**269**			

Source: computation by Author (SPSS output)

As per Table 5, ANOVA results demonstrate significant differences in Z-scores among the 15 software companies (F = 26.123, Sig. = 0.000), confirming variations in financial health. While companies like Infosys and Oracle reveal greater performance, this study will additional analyze the financial strategies contributing to their stability and success. By Understanding these factors, they can provide insights for companies in the gray or distress zones to improve their financial standing.

Table 6. Descriptive statistics of 15 software companies

Descriptive statistics of Z score								
	N	**Mean**	**Std. Deviation**	**Std. Error**	**95% Conf IntrvlMean**		**Min.**	**Max.**
					Lower Bound	**Upper Bound**		
3i InfoTech	18	-0.0150	2.17751	0.51324	-1.0979	1.0679	-3.45	3.00
Birla Soft	18	4.4022	1.02400	0.24136	3.8930	4.9114	2.07	6.38
HCL	18	4.5861	1.15758	0.27284	4.0105	5.1618	2.98	6.64
Infosys	18	8.4133	1.02679	0.24202	7.9027	8.9239	6.19	10.03
Mastek	18	5.5067	1.08336	0.25535	4.9679	6.0454	4.18	7.16
Mindtree	18	6.2856	1.52475	0.35939	5.5273	7.0438	3.25	8.37
Mphasis	18	5.3356	1.23763	0.29171	4.7201	5.9510	2.55	7.11
TCS	18	6.6394	3.32181	0.78296	4.9875	8.2913	-5.67	9.30
NIIT	18	3.7489	2.76269	0.65117	2.3750	5.1227	1.82	13.16
Oracle	18	8.5011	1.27676	0.30094	7.8662	9.1360	5.51	10.17
Sasken	18	6.3100	1.10884	0.26136	5.7586	6.8614	4.94	9.24
Sonata	18	7.8367	1.08891	0.25666	7.2952	8.3782	6.46	10.18
Tata Elxsi	18	5.7428	2.43983	0.57507	4.5295	6.9561	2.65	9.83
Tech. Mahindra	18	5.2528	1.38153	0.32563	4.5658	5.9398	2.50	6.96
Wipro	18	5.4661	1.13072	0.26651	4.9038	6.0284	2.88	7.15
Total	270	5.6008	2.63302	0.16024	5.2853	5.9163	-5.67	13.16

Source: computation by Author (SPSS output)

Table 6 showing the descriptive statistics which insights into the financial health (Z-score) of 15 software companies over 18 years. Infosys (Mean = 8.41) and Oracle (Mean = 8.50) show

the highest average Z-scores, indicating strong financial stability. In compare, 3i InfoTech has the lowest mean Z-score (-0.015), suggesting potential financial distress. The standard deviation (SD) values indicate variability in financial performance, with TCS showing the highest variation (SD = 3.32), while Birla Soft and Infosys display relatively stable performance with lower variability. The 95% confidence intervals suggest that Infosys, Oracle, and Sonata are consistently among the top-performing firms, while companies like 3i InfoTech may need financial restructuring.

Table 7. Multiple comparison of Mean differences of Z score of 15 selected companies

Company Name	1	2	3	4	5	6	7
3i InfoTech (1)	NA	0*	0*	0*	0*	0*	0*
Birla Soft(2)	0*	NA	0.751	0*	0.057*	0.001*	0.107
HCL(3)	0*	0.751	NA	0*	0.112	0.004*	0.196
Infosys (4)	0*	0*	0*	NA	0*	0*	0*
Mastek (5)	0*	0.057*	0.112	0*	NA	0.179	0.767
Mindtree (6)	0*	0.001*	0.004*	0*	0.179	NA	0.101
Mphasis (7)	0*	0.107	0.196	0*	0.767	0.101	NA
TCS(8)	0*	0*	0*	0.002*	0.051*	0.541	0.025*
NIIT(9)	0*	0.259	0.149	0*	0.003*	0*	0.006*
Oracle (10)	0*	0*	0*	0.879	0*	0*	0*
Sasken (11)	0*	0.001*	0.003*	0*	0.166	0.966	0.093
Sonata (12)	0*	0*	0*	0.319	0*	0.008*	0*
Tata Elxsi (13)	0*	0.021*	0.046*	0*	0.683	0.348	0.482
Tech. Mahindra (14)	0*	0.142	0.25	0*	0.661	0.075	0.886
Wipro (15)	0*	0.067	0.129	0*	0.944	0.157	0.821

8	9	10	11	12	13	14	15
0*	0*	0*	0*	0*	0*	0*	0*
0*	0.259	0*	0.001*	0*	0.021*	0.142	0.067
0*	0.149	0*	0.003*	0*	0.046*	0.25	0.129
0.002*	0*	0.879	0*	0.319	0*	0*	0*
0.051*	0.003*	0*	0.166	0*	0.683	0.661	0.944
0.541	0*	0*	0.966	0.008*	0.348	0.075	0.157
0.025*	0.006*	0*	0.093	0*	0.482	0.886	0.821
NA	0*	0.001*	0.569	0.039*	0.122	0.017*	0.043*
0*	NA	0*	0*	0*	0.001*	0.01*	0.003*
0.001*	0*	NA	0*	0.251	0*	0*	0*
0.569	0*	0*	NA	0.009*	0.327	0.068	0.145
0.039*	0*	0.251	0.009*	NA	0*	0*	0*
0.122	0.001*	0*	0.327	0*	NA	0.397	0.632
0.017*	0.01*	0*	0.068	0*	0.397	NA	0.712
0.043*	0.003*	0*	0.145	0*	0.632	0.712	NA

Note: * The mean difference is significant at the 0.05 level (SPSS output)

Table 7 reveals the multiple comparison results of Z-scores for 15 selected software companies, highlighting significant mean differences at the 0.05 level (marked with "*"). The findings indicate that 3i InfoTech consistently shows significant differences with all other companies, reinforcing its financial distress. Companies like Infosys and Oracle shows the strong financial positions, with their Z-scores significantly different from lower-performing firms. Certain mid-tier companies like Mastek, Mindtree, and Mphasis, show fewer significant differences among themselves, suggesting similar financial stability. The above result focus on the need for industry-specific suggestion for gray or distress zones companies. For stressed firms including 3i InfoTech, a targeted recovery strategy focusing on liquidity improvement and risk alleviation is essential. Moreover, the inclusion of trend graphs showing Z-score changes over time, it can

provide deeper insights into financial trajectories, highlighting key turning points for companies.

Cluster Analysis

To ascertain the result of post-doc analysis cluster analysis is carried out using k-means algorithm taking k = 2,3,4. It is evident from the table that when k = 2, all 14 companies are found in second cluster except 3i InfoTech which is under group 1.

Table 8. List of companies under k-means cluster analysis

Cluster 2 (k=2)		Cluster 3 (k=3)		Cluster 4 (k=4)	
Company	Cluster	Company	Group	Company	Group
3i InfoTech	1	3i InfoTech	1	3i InfoTech	1
Birla Soft	2	Birla Soft	2	Birla Soft	2
HCL	2	HCL	2	HCL	2
Infosys	2	Infosys	3	Infosys	4
Mastek	2	Mastek	2	Mastek	3
Mindtree	2	Mindtree	2	Mindtree	3
Mphasis	2	Mphasis	2	Mphasis	3
TCS	2	TCS	2	TCS	3
NIIT	2	NIIT	2	NIIT	2
Oracle	2	Oracle	3	Oracle	4
Sasken	2	Sasken	2	Sasken	3
Sonata	2	Sonata	3	Sonata	4
Tata Elxsi	2	Tata Elxsi	2	Tata Elxsi	3
Tech. Mahindra	2	Tech. Mahindra	2	Tech. Mahindra	3
Wipro	2	Wipro	2	Wipro	3

Table 8 reveals the K-means cluster analysis of 15 software companies into different financial performance groups. 3i InfoTech remains in Cluster 1 across all cluster (k=2, k=3, k=4), highlighting financial distress. In the k=4 cluster, Infosys, Oracle, and Sonata appear as top performers, indicating strong financial stability. Mastek, Mindtree, Mphasis, and others in Cluster 3 shows moderate financial health, while Birla Soft, HCL, NIIT, and similar firms in Cluster 2 remain stable but less dominant. Companies in Cluster 2 and 3 should adopt best practices from Cluster 4 firms to improve financial resilience, while 3i InfoTech (Cluster 1) requires urgent restructuring to avoid further decline.

Managerial Implication of the Study

This paper delves into the managerial implications of the bankruptcy prediction model ‘Altman Z-Score’. The Altman Z-Score has developed as a powerful tool for predicting corporate bankruptcy. This model has providing valuable insights for stakeholders, investors, managers. It is elucidating its significance in guiding strategic decision-making, risk management, and financial planning inside organizations. Instead of taking consideration of the whole framework, managers could, in practice, clarify on multiple ratios employed in the Z" model to figure out the financial strength of the company. According to Adnan Aziz & Dar (2006), Early warning signs of financial failures, can assist a company in taking prompt action to prevent financial insolvency and bankruptcy. Elia et al. (2021) suggest the Z" score model as a critical indication, in an effort to help auditors, financial managers, investors, or lenders make the most effective decisions during a time of crisis.

Piotroski (2000) concluded that firms with lower level of financial distress earned significantly stronger future returns than the highly distressed firms. Mean return for the investor involved

in the high BM assets could be increased by selection of firms that are financially strong. Mohammed (2016), stated that Altman Z score can be used to stock holders for investing options and for managers to make financial decisions. Corporate managers also requisite to determine and maintain the appropriate level of liquidity, leverage, profitability, and revenue growth to ensure smooth operation and continual survival of the organization (Isayas, 2021). Both academics and practitioners ought to employ Altman's Z-score model as a tool to identify insolvency. Banks along with other financial institutions may apply this type of accounting-based model to estimate failures or distress when making managerial choices about supplies, evaluating company loans, or developing investment criteria Charitou et al. (2004). The study also suggests that the companies should regularly estimate Z-score for making strategies to improve their financial position Bal (2015); Apoorva et al. (2019).

Conclusion

Our research analyzed the bankruptcy prediction for the 15 selected software companies. The foremost objective of the research was to recognize natural groups of companies depending on financial performance. In this context, it can be concluded that the thirteen companies out of fifteen companies were performing better and enjoying the safe zone. Birla soft, Infosys, HCL, Mastek, Mindtree, Mphasis, Oracle financial services, Sasken, Sonata, Tata Elxsi, Tech.Mahindra, TCS, Wipro have the strong and healthy financial position on the basis of Z test. The companies Mphasis, Tech.Mahindra, NIIT were also in gray area. In view of Z-score, result the liquidation of the company may not be an unexpected outcome. These companies should take the vital action to improve the Z model. 3i info tech limited company is almost in the bankruptcy zone. It is requiring to maintain the optimum level of investment in working capital.

Based on the research findings, researchers suggested for the financial distress companies may adopt the various steps to come out from this situation such as financial Restructuring, enhancing operational efficiency, Strategic Repositioning, Leadership and Culture Change, Stakeholder Communication and Management, Continuous Monitoring and Adaptation. According to Myers (1977), financially struggling organizations frequently deal with problems like high debt levels, cash flow issues, or reducing revenues. To boost liquidity and stabilize the balance sheet, financial restructuring can include renegotiating loan conditions, looking for additional funding, or trading non-core assets. In order to cut expenditures and enhance earnings, companies should concentrate on improving operational efficiency. This could entail enhancing efficiency with technology, streamlining supply chains, or streamlining processes (Jensen, 1993).

Rumelt (1974), suggested that failing companies frequently need to reassess their strategic direction and adjust to changes in the market. This could entail extending into new markets, modifying the way products are offered, or restructuring business divisions with an emphasis on core skills. During challenging times, it is crucial to promote transparency while interacting with customers, employees, and investors in an effective manner. In accordance to research, companies are more likely to win back stakeholders' trust and support by continuing to actively interact with these individuals and address their challenges (Cornelissen & Werner, 2014). Maintaining open lines for interactions and staying in contact with consumers, workers, and investors is critical in difficult times. According to research, companies that interact with stakeholders and respond to their issues have a greater probability of earning back their support and trust (Cornelissen & Werner, 2014). Businesses facing financial difficulties need to constantly evaluate their performance and alter their plans as appropriate. Studies indicate

companies are better able to emerge from crisis whether they are able to react to changing market circumstances (Eisenhardt & Martin, 2000).

References

Adnan Aziz, M., & Dar, H. A. (2006). Predicting corporate bankruptcy: Where we stand? *Corporate Governance: The International Journal of Business in Society*, *6*(1), 18–33. https://doi.org/10.1108/14720700610649436

Afrin, R. (2017). Analyzing the potential of Altman's Z-score for prediction of market performance and share returns: A case study of the cement industry in Bangladesh. *The AUST Journal of Science and Technology*, *6*(1–2), 1–16.

Agrawal, K., & Chatterjee, C. (2015). Earnings management and financial distress: Evidence from India. *Global Business Review*, *16*(5), 140–154. https://doi.org/10.1177/0972150915597591

Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The Journal of Finance*, *23*(4), 589–609. https://doi.org/10.2307/2325933

Altman, E. I. (2018). Applications of distress prediction models: What have we learned after 50 years from the Z-score models? *International Journal of Financial Studies*, *6*(70), 1–15. https://doi.org/10.3390/ijfs6030070

Altman, E. I., Danovi, A., & Falini, A. (2013). Z-Score models' application to Italian companies subject to extraordinary administration. *Journal of Applied Finance*, *23*(1), 128–137.

Altman, E. I., Iwanicz-Drozdowska, M., Laitinen, E. K., & Suvas, A. (2014). Distressed firm and bankruptcy prediction in an international context: A review and empirical analysis of Altman's Z-score model. *SSRN*. https://doi.org/10.2139/ssrn.2536340

Altman, E. I., Iwanicz-Drozdowska, M., Laitinen, E. K., & Suvas, A. (2016). Financial distress prediction in an international context: A review and empirical analysis of Altman's Z-score model. *Journal of International Financial Management & Accounting*, *28*(2), 131–171. https://doi.org/10.1111/jifm.12053

Anuj, C. S., Narayanan, A., & Nandan, R. (2018). The relevance of Altman Z-score analysis. *International Journal of Research and Analytical Reviews*, *5*(4), 233–240.

Apoorva, D. V., Curpod, S. P., & Namratha, M. (2019). Application of Altman Z-score model on selected Indian companies to predict bankruptcy. *International Journal of Business and Management Invention*, *8*(1), 77–82.

Bal, G. R. (2015). Prediction of financial distress using Altman Z–Score: A study of select FMCG companies. *Indian Journal of Applied Research*, *5*(9), 129–131.

Charitou, A., Neophytou, E., & Charalambous, C. (2004). Predicting corporate failure: Empirical evidence for the UK. *European Accounting Review*, *13*(3), 465–497. https://doi.org/10.1080/0963818042000216811

Chouhan, V., Chandra, B., & Goswami, S. (2014). Predicting financial stability of select BSE companies revisiting Altman Z-score. *International Letters of Social and Humanistic Sciences*, *15*(2), 92–105. http://dx.doi.org/10.18052/www.scipress.com/ILSHS.26.92

Cındık, Z., & Armutlulu, I. H. (2021). A revision of Altman Z-Score model and a comparative analysis of Turkish companies' financial distress prediction. *National Accounting Review, 3*(2), 237–255. https://doi.org/10.3934/NAR.2021013

Cornelissen, J. P., & Werner, M. D. (2014). Putting communication front and center in institutional theory and analysis. *Academy of Management Review, 39*(3), 317–331. https://doi.org/10.5465/amr.2012.0315

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal, 21*(10–11), 1105–1121. https://doi.org/10.1002/1097-0266(200010/11)21:10/11<1105::AID-SMJ133>3.0.CO;2-E

Elia, J., Toros, E., Sawaya, C., & Balouza, M. (2021). Using Altman Z"-score to predict financial distress: Evidence from Lebanese alpha banks. *Management Studies and Economic Systems, 6*(1–2), 47–57. http://dx.doi.org/10.12816/0059150

Finishtya, F. C. (2019). The role of cash flow of operational, profitability, and financial leverage in predicting financial distress on manufacturing company in Indonesia. *Jurnal Aplikasi Manajemen, 17*(1), 110–117. https://doi.org/10.21776/ub.jam.2019.017.01.12

Friesenhahn, S. M., & Kwan, S. H. (2020). Risk of business insolvency during coronavirus crisis. *FRBSF Economic Letter*, Federal Reserve Bank of San Francisco, (30), 1–5.

Ghosh, P. (2013). *Testing of Altman's Z-Score model: A case study of Dunlop India Ltd*.

Halteh, K., Kumar, K., & Gepp, A. (2018). Financial distress prediction of Islamic banks using tree-based stochastic techniques. *Managerial Finance, 44*(6), 759–773. https://doi.org/10.1108/MF-05-2017-0173

Hayes, S. K., Hodge, K. A., & Hughes, L. W. (2010). A study of the efficacy of Altman's Z to predict bankruptcy of specialty retail firms doing business in contemporary times. *Economics & Business Journal: Inquiries & Perspectives, 3*(1), 130–134.

Ikpesu, F. (2019). Firm specific determinants of financial distress: Empirical evidence from Nigeria. *Journal of Accounting and Taxation, 11*(3), 49–56. https://doi.org/10.5897/JAT2019.0342

Isayas, Y. N. (2021). Financial distress and its determinants: Evidence from insurance companies in Ethiopia. *Cogent Business & Management, 8*(1), 1951110. https://doi.org/10.1080/23311975.2021.1951110

Jensen, M. C. (1993). The modern industrial revolution, exit, and the failure of internal control systems. *The Journal of Finance, 48*(3), 831–880. https://doi.org/10.1111/j.1540-6261.1993.tb04022.x

Joshi, P. D. (2019). A study on application of Altman's Z-score model in predicting the bankruptcy of Reliance Communication. *International Journal of 360 Management Review, 7*(2), 35–47.

Kamaluddin, A., Ishak, N., & Mohammed, N. F. (2019). Financial distress prediction through cash flow ratios analysis. *International Journal of Financial Research, 10*(3), 63–76. https://doi.org/10.5430/ijfr.v10n3p63

Lace, N., & Sundukova, Z. (2010). Company's standards for financial soundness indicators. In *The 6th International Scientific Conference "Business and Management 2010"* (pp. 112–117). Vilnius.

Manaseer, S., & Al-Oshaibat, S. D. (2018). Validity of Altman Z-score model to predict financial failure: Evidence from Jordan. *International Journal of Economics and Finance, 10*(8), 181–189. https://doi.org/10.5539/ijef.v10n8p181

Mittal, R., & Singh, N. P. (2023). Liquidity, solvency and profitability of TCS: An empirical analysis. *IUP Journal of Financial Risk Management, 20*(3).

Mohammed, S. (2016). Bankruptcy prediction by using the Altman Z-score model in Oman: A case study of Raysut Cement Company SAOG and its subsidiaries. *Australasian Accounting, Business and Finance Journal, 10*(4), 70–80. https://doi.org/10.14453/aabfj.v10i4.6

Muñoz-Izquierdo, N., Laitinen, E. K., Camacho-Miñano, M. D. M., & Pascual-Ezama, D. (2020). Does audit report information improve financial distress prediction over Altman's traditional Z-score model? *Journal of International Financial Management & Accounting, 31*(1), 65–97. https://doi.org/10.1111/jifm.12108

Myers, S. C. (1977). Determinants of corporate borrowing. *Journal of Financial Economics, 5*(2), 147–175. https://doi.org/10.1016/0304-405X(77)90015-0

Ningsih, S., & Permatasari, F. F. (2018). Analysis method of Altman Z-score modifications to predict financial distress on the company go public sub sector of the automotive and components. *International Journal of Economics, Business and Accounting Research (IJEBAR), 2*(3), 36–44. https://doi.org/10.29040/ijebar.v2i03.339

Ohlson, J. A. (1980). Financial ratios and the probabilistic prediction of bankruptcy. *Journal of Accounting Research, 18*(1), 109–131. https://doi.org/10.2307/2490395

Otlet, P. (1934). *Treatise on documentation: The book on the book*. Brussels, Belgium.

Panigrahi, C. (2019). Validity of Altman's "Z" score model in predicting financial distress of pharmaceutical companies. *Economics and Public Policy, 4*(1), 65–73.

Pinto, M., Pulgarín, A., & Escalona, M. I. (2014). Viewing information literacy concepts: A comparison of two branches of knowledge. *Scientometrics, 98*(3), 2311–2329. https://doi.org/10.1007/s11192-013-1154-4

Piotroski, J. D. (2000). Value investing: The use of historical financial statement information to separate winners from losers. *Journal of Accounting Research*, 1–41. https://doi.org/10.2307/2672906

Platt, H., & Platt, M. B. (2002). Predicting financial distress. *Journal of Financial Service Professionals, 56*(3), 12–15. http://dx.doi.org/10.1007/BF02755985

Primasari, N. S. (2017). Analisis Altman Z-score, Grover score, Springate, dan Zmijewski sebagai signaling financial distress (Studi empiris industri barang-barang konsumsi di Indonesia). *Accounting and Management Journal, 1*(1), 23–43. https://doi.org/10.33086/amj.v1i1.70

Ramamonjiarivelo, Z., Weech-Maldonado, R., Hearld, L., Menachemi, N., Epané, J. P., & O'Connor, S. (2015). Public hospitals in financial distress. *Health Care Management Review, 40*(4), 337–347. https://doi.org/10.1097/HMR.0000000000000051

Rodoni, A., & Ali, H. (2010). *Manajer keuangan* (Edisi pertama). Jakarta: Mitra Wacana Media.

Ross, S. A., Westerfield, R. W., & Jaffe, J. (1996). *Corporate finance* (6th ed.). New York: McGraw Hill Irwin.

Rumelt, R. P. (1974). Strategy, structure, and economic performance. *Harvard Business Review, 52*(1), 93–101.

Sanesh, C. (2016). The analytical study of Altman Z score on NIFTY 50 companies. *IRA-International Journal of Management & Social Science, 3*(3), 15–19. http://dx.doi.org/10.21013/jmss.v3.n3.p6

Shahwan, T. M. (2015). The effects of corporate governance on financial performance and financial distress: Evidence from Egypt. *Corporate Governance, 15*(5), 641–662. http://dx.doi.org/10.1108/CG-11-2014-0140

Sina, M. A., Huda, M. N., Hossain, H., & Sabur, M. A. (2020). Identification of sickness of some selected garment factories in Bangladesh and its remedial measures: An application of Altman's Z-score model. *American Journal of Industrial and Business Management, 10*(12), 1823–1838. https://doi.org/10.4236/ajibm.2020.1012113

Sjahrial, D. (2012). *Pengantar manajemen keuangan* (4th ed.). Mitra Wacana Media.

Succurro, M., Arcuri, G., & Costanzo, G. D. (2019). A combined approach based on robust PCA to improve bankruptcy forecasting. *Review of Accounting and Finance, 18*(2), 296–320. http://dx.doi.org/10.1108/RAF-04-2018-0077

Sumathi, A., & Narasimhaiah, T. (2016). A study on the effect of working capital on the profitability of Infosys. *ICTACT Journal on Management Studies, 2*(3), 368–371. https://doi.org/10.21917/ijms.2016.0047

Swalih, M., Adarsh, K., & Sulphey, M. (2021). A study on the financial soundness of Indian automobile industries using Altman Z-score. *Accounting, 7*(2), 295–298. http://dx.doi.org/10.5267/j.ac.2020.12.001

Tarighi, H., Appolloni, A., Shirzad, A., & Azad, A. (2022). Corporate social responsibility disclosure (CSRD) and financial distressed risk (FDR): Does institutional ownership matter? *Sustainability, 14*(2), 1–28. https://doi.org/10.3390/su14020742

Tung, D. T., & Phung, V. T. H. (2019). An application of Altman Z-score model to analyze the bankruptcy risk: Cases of multidisciplinary enterprises in Vietnam. *Investment Management & Financial Innovations, 16*(4), 181–191. http://dx.doi.org/10.21511/imfi.16(4).2019.16

Udin, S., Khan, M. A., & Javid, A. Y. (2017). The effects of ownership structure on likelihood of financial distress: An empirical evidence. *Corporate Governance: The International Journal of Business in Society, 17*(4), 589–612. http://dx.doi.org/10.1108/CG-03-2016-0067

Yi, W. (2012). Z-score model on financial crisis early-warning of listed real estate companies in China: A financial engineering perspective. *Systems Engineering Procedia, 3*, 153–157. https://doi.org/10.1016/j.sepro.2011.11.021

Younas, N., Uddin, S., Awan, T., & Khan, M. Y. (2021). Corporate governance and financial distress: Asian emerging market perspective. *Corporate Governance: The International Journal of Business in Society, 21*(4), 702–715. http://dx.doi.org/10.1108/CG-04-2020-0119