Altman Z-Score

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1 Introduction

Investors use various tools to arrive at investment decisions. Volatility in the financial resources of the firms may adversely affect the investors. As such investment decision must be taken rationally and prudently. One tool that helps investors to make prudent decisions is the Altman's Z score Model. It is an important tool that predicts the financial health of companies and categorizes them in three zones that are 'safe, 'gray' and 'distress'. This methodology can be used to predict the chance of a business organization to move into bankruptcy within a given time, which is mostly about 2 years. It is a multivariate formula, which is highly popular and is used by a variety of stake holders. It uses multiple corporate income and balance sheet values to measure the financial health of a company.

1.1 Estimation of the formula

The Z-score is a linear combination of four or five common business ratios, weighted by coefficients. The coefficients were estimated by identifying a set of firms which had declared bankruptcy and then collecting a matched sample of firms which had survived, with matching by industry and approximate size.

Altman applied the statistical method of discriminant analysis to a dataset of publicly held manufacturers. The estimation was originally based on data from publicly held manufacturers, but has since been re-estimated based on other datasets for private manufacturing, non-manufacturing and service companies.

The original data sample consisted of 66 firms, half of which had filed for bankruptcy. All businesses in the database were manufacturers, and small firms with assets of $<$ \$1 million were eliminated.

- **Z score Estimation For Public Manufacturing companies:**

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5.$$

where, X_1 = Working Capital / Total Assets. Measures liquid assets in relation to the size of the company.

X_2 = Retained Earnings / Total Assets. Measures profitability that

reflects the company's age and earning power.

X_3 = Earnings Before Interest and Taxes / Total Assets. Measures operating efficiency apart from tax and leveraging factors. It recognizes operating earnings as being important to long-term viability.

X_4 = Market Value of Equity / Book Value of Total Liabilities. Adds market dimension that can show up security price fluctuation as a possible red flag.

X_5 = Sales / Total Assets. Standard measure for total asset turnover (varies greatly from industry to industry).

Zones of Discrimination:

$Z > 2.99$ -"Safe" Zone

$1.81 < Z < 2.99$ -"Gray" Zone

$Z < 1.81$ -"Distress" Zone

- **Z-score estimation for Public Non Manufacturing companies**

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

where, X_1 = (Current Assets Current Liabilities) / Total Asset

X_2 = Retained Earnings / Total Assets

X_3 = Earnings Before Interest and Taxes / Total Assets

X_4 = Book Value of Equity / Total Liabilities

Zones of Discrimination:

$Z > 2.6$ -"Safe" Zone

$1.1 < Z < 2.6$ -"Gray" Zone

$Z < 1.1$ -"Distress" Zone

1.2 Accuracy and effectiveness

In its initial test, the Altman Z-Score was found to be 72% accurate in predicting bankruptcy two years before the event. In a series of subsequent tests covering three periods over the next 31 years, the model was found to be approximately 80%–90% accurate in predicting bankruptcy one year before the event.

Later, the Z-scores gained wide acceptance by auditors, management accountants, courts, and database systems used for loan evaluation. The formula's approach has been used in a variety of contexts and countries, although it was designed originally for publicly held manufacturing companies with assets of more than $1 million. Later variations by Altman were designed to be applicable to privately held companies (the Altman Z'-Score) and non-manufacturing companies (the Altman Z"-Score).

Neither the Altman models nor other balance sheet-based models are recommended for use with financial companies. This is because of the opacity of financial companies balance sheets and their frequent use of off-balance sheet items. There are market-based formulas used to predict the default of financial firms, but these have limited predictive value because they rely on market data (fluctuations of share and options prices to imply fluctuations in asset values) to predict a market event.

2 Problem

In this project we collected the financial details of companies which are required to calculate the z score such as total assets,working capital etc of all the NIFTY 50 companies and observed the bankruptcy condition of each of the 50 companies and also sector wise over 3 years.

Companies	Sector	Status20	Status19	Status18
'Bajaj Auto Ltd.'	'Automobile'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Hero MotoCorp Ltd.'	'Automobile'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Eicher Motors Ltd.'	'Automobile'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Mahindra & Mahindra Ltd.'	'Automobile'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Maruti Suzuki India Ltd.'	'Automobile'	'Safe Zone'	'Safe Zone'	'Safe Zone'

Figure 1: Automobile Sector

Companies	Sector	Status20	Status19	Status18
'Grasim Industries Ltd.'	'Cement'	'Distress Zone'	'Distress Zone'	'Distress Zone'
'Shree Cement Ltd.'	'Cement'	'Gray Zone'	'Safe Zone'	'Safe Zone'
'UltraTech Cement Ltd.'	'Cement'	'Gray Zone'	'Distress Zone'	'Distress Zone'

Figure 2: Cement Sector

Companies	Sector	Status20	Status19	Status18
'ITC Ltd.'	'Cigarettes'	'Safe Zone'	'Safe Zone'	'Safe Zone'

Figure 3: Cigarettes Sector

Companies	Sector	Status20	Status19	Status18
'Hindustan Unilever Ltd.'	'Consumer Goods'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Britannia Industries Ltd.'	'Consumer Goods'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Nestle India Ltd.'	'Consumer Goods'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Titan Company Ltd.'	'Consumer Goods'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Asian Paints Ltd.'	'Consumer Goods'	'Safe Zone'	'Safe Zone'	'Safe Zone'

Figure 4: Consumer Goods Sector

Companies	Sector	Status20	Status19	Status18
'Oil & Natural Gas Corporation Ltd.'	'Energy'	'Distress Zone'	'Distress Zone'	'Distress Zone'
'NTPC Ltd.'	'Energy'	'Distress Zone'	'Distress Zone'	'Distress Zone'
'Power Grid Corporation of India Ltd.'	'Energy'	'Distress Zone'	'Distress Zone'	'Distress Zone'
'Bharat Petroleum Corporation Ltd'	'Energy'	'Distress Zone'	'Gray Zone'	'Gray Zone'
'Indian Oil Corporation Ltd'	'Energy'	'Gray Zone'	'Gray Zone'	'Gray Zone'
'Reliance Industries Ltd.'	'Energy'	'Distress Zone'	'Distress Zone'	'Distress Zone'
'GAIL (India) Ltd.'	'Energy'	'Safe Zone'	'Safe Zone'	'Safe Zone'

Figure 5: Energy Sector

Companies	Sector	Status20	Status19	Status18
'Larsen & Toubro Ltd.'	'Engineering'	'Safe Zone'	'Safe Zone'	'Safe Zone'

Figure 6: Engineering Sector

Companies	Sector	Status20	Status19	Status18
'UPL Ltd.'	'Fertilizer'	'Gray Zone'	'Gray Zone'	'Safe Zone'

Figure 7: Fertilizers Sector

Companies	Sector	Status20	Status19	Status18
'Axis bank'	'Financial Services'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'HDFC Bank'	'Financial Services'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'ICICI Bank'	'Financial Services'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Indusind Bank'	'Financial Services'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Kotak Mahindra Bank'	'Financial Services'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Bajaj Finance'	'Financial Services'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Bajaj Finserv Ltd.'	'Financial Services'	'Safe Zone'	'Gray Zone'	'Gray Zone'
'Housing Development Finance Corporation Ltd.'	'Financial Services'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'State Bank of India'	'Financial Services'	'Safe Zone'	'Safe Zone'	'Safe Zone'

Figure 8: Financial services Sector

Companies	Sector	Status20	Status19	Status18
'HCL Technologies Ltd.'	'Information Technology'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Infosys Ltd.'	'Information Technology'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Tata Consultancy Services Ltd.'	'Information Technology'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Tech Mahindra Ltd.'	'Information Technology'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Wipro Ltd.'	'Information Technology'	'Safe Zone'	'Safe Zone'	'Safe Zone'

Figure 9: Information Technology Sector

Companies	Sector	Status20	Status19	Status18
'Zee Entertainment Enterprises Ltd.'	'Media & Entertainment'	'Safe Zone'	'Safe Zone'	'Safe Zone'

Figure 10: Media And Entertainment Sector

sector	safe20	gray20	Distress20	safe19	gray19	Distress19	safe18	gray18	Distress18
Automobile	5	0	0	5	0	0	5	0	0
cement	0	2	1	1	0	2	1	0	2
Cigarettes	1	0	0	1	0	0	1	0	0
Consumer Goods	5	0	0	5	0	0	5	0	0
Energy	1	1	5	1	2	4	1	2	4
Engineering	1	0	0	1	0	0	1	0	0
Fertilizers	0	0	1	0	0	1	1	0	0
Financial Services	8	0	0	7	1	0	7	1	0
Information Technology	5	0	0	5	0	0	5	0	0
Media and Entertainment	1	0	0	1	0	0	1	0	0
Metals and Mining	1	2	2	1	2	2	1	2	2
pharmaceutical	3	0	0	3	0	0	3	0	0

Table 1: Caption

Companies	Sector	Status20	Status19	Status18
'Hindalco Industries Ltd.'	'Metals & Mining'	'Gray Zone'	'Gray Zone'	'Gray Zone'
'Vedanta Ltd.'	'Metals & Mining'	'Distress Zone'	'Distress Zone'	'Distress Zone'
'JSW Steel Ltd.'	'Metals & Mining'	'Gray Zone'	'Gray Zone'	'Gray Zone'
'Tata Steel Ltd.'	'Metals & Mining'	'Distress Zone'	'Distress Zone'	'Distress Zone'
'Coal India Ltd.'	'Metals & Mining'	'Safe Zone'	'Safe Zone'	'Safe Zone'

Figure 11: Metals And Mining. Sector

'Cipla Ltd.'	'Pharma'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Dr. Reddy's Laboratories Ltd.'	'Pharma'	'Safe Zone'	'Safe Zone'	'Safe Zone'
'Sun Pharmaceutical Industries Ltd.'	'Pharma'	'Safe Zone'	'Safe Zone'	'Safe Zone'

Figure 12: Pharma Sector

From the table it can be observed that companies in some sectors are performing comparatively better.The companies in sectors like energy,cement falls into gray and distress zone as we move from 2018 to 2020. The compa-

nies in Metals Sector are also in a bad situation as only 1 out of 5 companies is in the safe zone.The companies in Automobile,Financial services and Information Technology seems to be working fine as they continue to be in safe zone year after year.

3 Bankrupt Companies

To check the efficiency of ALTMAN Z Score we took 5 companies that almost went bankrupt or completely bankrupt in the recent past.The following are the five companies where we calculated the z score using the 2018 financials.It has shown that 3 companies are in distress zone and one of the company is in very bad position with negative score of around -17 i.e Alok Industries.

YESBANK almost went completely bankrupt but slowed down after Reserve Bank-led bailout plan under which SBI picked up 49 per cent equity in the once-storied private sector lender.DEWAN HOUSING did went bankrupt in December 2019.But the 2018 financials predicted it to be in gray zone.The z score is good enough to predict the bankruptcy after 2 years as there are no financials available we did this for 2018.The remaining three companies future was predicted correctly by the z score.

	Companies	Years	Z_Score	Status
1	'JET AIRWAYS'	2018	-2.51143237…	'Distress Zone'
2	'RELIANCE COMM'	2018	-0.57282672…	'Distress Zone'
3	'ALOK INDUSTRIES'	2018	-17.5449381…	'Distress Zone'
4	'DEWAN HOUSING'	2018	1.180355674…	'Gray Zone'
5	'YESBANK'	2018	3.397409570…	'Safe Zone'