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# VALIDATING Z SCORE MODEL FOR EVALUATING FINANCIAL HEALTH OF SELECTED INDIAN COMPANIES

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**Abstract**
The success of the company is highly dependent on its financial health. A business cannot thrive in a cut-throat environment without consistent financial health. Various types of ratios like profitability, liquidity and solvency and various Models have been used for ascertaining the financial health of the companies. Altman Z Score Model is one of the most popular model, which is used for this purpose in this study. The main objective of this study is to classify the selected twenty five companies according to their distress level using Discriminant analysis based on Altman Z Score Model for the period of ten years (2008-09 to 2017-18). Descriptive and Causal research designs have been used for this purpose. It has been found that Retained Earnings to Total Assets and EBIT to Total Assets are the most important determinants in discriminating the selected companies within the three categories of possible Non-Distress Zone Companies, possible Grey Zone companies and possible Distress zone companies and according to both the selected techniques, Vijay Textiles Ltd. is classified in Possible Distress Zone. Thus, this company should reduce its long term debt and give more weightage to Equity to overcome this situation.

**Keyword:** Financial Health, Altman Z Score Model, Discriminant Analysis

## 1. INTRODUCTION:

The success of the company is highly dependent on its financial health. A business cannot thrive in a cut-throat environment without consistent financial health. Every business owner needs to understand how to assess the financial health of a company and how to enhance it in order to remain competitive and expand as an organization. A company's ability to invest more in its goods and services can help it draw in more customers if its financial situation improves. It becomes very difficult to survive for a very long term without the element of profitability. Thus, it can be said that the importance and maintenance of financial health should not be overstated. Ratio analysis is widely used technique for determining financial health of the various companies. Various types of ratios like profitability, liquidity and solvency and various Models have been used for ascertaining the financial health of the companies. Altman Z Score Model is one of the most popular model, which is used for this purpose in this study. In addition of this model, Discriminant Analysis has been also used to classify the companies according to their distress level.

## 2. LITERATURE REVIEW:

- **Mavengere (2015)** studied the case of Z manufacturing firm of Zimbabwe to examine corporate bankruptcy and earning manipulation of firm using the Altman Z Score and Beneish M Score Model. The study revealed that the firm was in grey zone for one selected year and for the remaining three years, It was in the financial distress zone, while Beneish M Score revealed that financial statements of two years might had been manipulated. The study concluded that use of both models could save investors from incurring substantive losses from their investment.
- **Pradhan (2014)** estimated the Z Score of three banks of the Indian banking sector in this study. The findings revealed that the Z Score value of Oriental Bank of Commerce was the highest amongst the mentioned three banks. This study emphasized the usage of back propagation Neural Network for predicting bankruptcy for public sector banks in India.
- **Marvadi & Savani (2020)** studied on identifying probable fraudulence for the selected pharmaceutical companies. This study was aimed to demystify the earnings management practices of selected pharmaceuticals companies in India. It was found that majority of the selected companies confirm the results of Beneish M Score Model for being fraudulent companies for almost all the years of study. From the result of the study, it was also suggested that investors and stakeholders should take care of while investing in Lupin Ltd. and Divi's Lab Ltd.
- **Marvadi (2016)** explored an interest in accessing the corporate financial distress in selected steel companies in India using Altman's Model for ten years' time periods 2006-07 to 2015-16. It was found that 1 company falls into too healthy zone, 4 companies fall into the healthy zone and 5 companies fall into the bankruptcy zone. The study concluded that the selected steel companies' overall financial health was found to be satisfactory during the study period.
- **Sanesh (2016)** conducted an analytical study of Altman Z Score on NIFTY 50 Companies excluding banks and financial companies in order to identify the solvency of the selected companies. The findings of this study revealed that the majority of the selected companies were in safe zone. Only 9 companies and 5 companies were in grey zone and distress zone respectively. The study concluded that Altman Z score Model depicts a likelihood of solvency and not a prediction, which might help management to improve for successful conduct of business.

## 3. RESEARCH METHODOLOGY:

### 3.1 RESEARCH DESIGN

The study uses Descriptive and Causal research designs.

### 3.2 RESEARCH OBJECTIVES

**Objective 1:** To Calculate the value of Altman Z Score in order to identify the financial health of the selected companies.
**Objective 2**: To Classify the companies according to their distress level using discriminant analysis based on Altman Z Score Model.
**Objective 3**: To Provide the valuable suggestions to the investors in selection of the companies at the time of making an investment decision.

### 3.3 SAMPLING DESIGN

Five leading sectors i.e. Automobile, IT, Oil and Gas, Pharmaceutical and Textile of the Indian Economy have been selected for this study and Five companies from each of the selected sectors have been chosen based on data availability using purposive sampling, for uniform periods of ten years from 2008-09 to 2017-18.

**Table -1 Name of the Selected Companies**

| Sr. No. | Name of Companies | Sector |
|---|---|---|
| 1 | Tata Motors Limited | Automobile |
| 2 | Bajaj Auto Limited | |
| 3 | Ashok Leyland Limited | |
| 4 | TVS Motor Company Limited | |

| | | |
|---|---|---|
| 5 | Sundaram Clayton Limited | |
| 6 | Wipro Limited | IT |
| 7 | Infosys Limited | |
| 8 | Tata Consultancy Services Limited | |
| 9 | Tech Mahindra Limited | |
| 10 | Mindtree Limited | |
| 11 | Bharat Petroleum Corporation Limited –Now Maharatna (BPCL) | Oil and Gas |
| 12 | GAIL (India) Limited | |
| 13 | Oil and Natural Gas Corporation Limited (ONGC) | |
| 14 | Indian Oil Corporation Limited (IOCL) | |
| 15 | Hindustan Petroleum Corporation Limited (HPCL) | |
| 16 | Cipla Limited | Pharmaceutical |
| 17 | Sun Pharmaceutical Industries Limited (SPIL) | |
| 18 | Lupin Limited | |
| 19 | Dr. Reddy's Laboratories Limited | |
| 20 | Divi's Laboratories Limited (Divis) | |
| 21 | Arvind Limited | Textile |
| 22 | Grasim Industries Limited | |
| 23 | Raymond Limited | |
| 24 | Vardhman Textiles Limited | |
| 25 | Vijay Textiles Limited | |

### 3.4 SOURCES OF DATA

This study is purely based on the secondary data collected from published annual reports, selected companies' websites and BSE and NSE's websites.

### 3.5 RESEARCH TECHNIQUES

(A) ALTMAN Z SCORE MODEL FOR FINANCIAL HEALTH

Altman developed the Model known as the Z Score in the year 1968 to predict the possibility of the company going bankrupt in the next two years by the examining financial health of the company. It is a Multiple Discriminant Analysis (MDA), which is primarily used to distinguish between surviving and failing companies using data from annual financial statements. It has the ability to discriminate between financially distressed companies and non-distressed companies.

The Altman Z Score model uses the following formula to detect bankruptcy using weights assigned to $X_1$, $X_2$, $X_3$, $X_4$ and $X_5$.

**Z- Score** = $\mathbf{1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5}$

Where;

$X_1 = \frac{Working\ Capital}{Total\ Assets}$

$X_2 = \frac{Retained\ Earnings}{Total\ Assets}$

$X_3 = \frac{EBIT}{Total\ Assets}$

$X_4 = \frac{Market\ Value\ of\ Equity}{Book\ Value\ of\ Total\ Liability}$

$X_5 = \frac{Sales}{Total\ Assets}$

The following table -2 shows the Range Classification of Z Score.

*Table -2 Range Classification of Z Score*

| Value of Z Score | Interpretation |
|---|---|
| Z Score > 2.67 | Non distress Zone |
| 1.81 < Z Score < 2.67 | Grey Zone |
| Z Score < 1.81 | Distress Zone |

### (B) DISCRIMINANT ANALYSIS

Here, Discriminant Analysis has been carried out to classify the companies according to their Distress Score based on the value of the Altman Z Score Model.

The Following discriminant analysis model has been used to validate the results of the Altman Z Score Model.

**Distress Level** = $\alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5$

Where, $\alpha$ = Alpha

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ - Beta Coefficients

**Table-3 Discriminant Analysis Model's Description**

| Variables | Description |
|---|---|
| **Dependent Variable** | |
| Distress Score: (Dummy Variable) | • Z Score below 1.81 is coded as 2<br>• Z Score between 1.81 to 2.67 is coded as 1<br>• Z Score above 2.67 is coded as 0 |
| **Independent Variables:** | |
| $X_1$ | Working Capital / Total Assets (WCTA) |
| $X_2$ | Retained Earnings / Total Assets (RETA) |
| $X_3$ | EBIT/ Total Assets (EBITTA) |
| $X_4$ | Market Value of Equity / Book Value of Total Liability (MVEQBVTL) |
| $X_5$ | Sales / Total Assets (SALETA) |

## 4. DATA ANALYSIS AND INTERPRETATION:

### 4.1 Altman Z Score Model

The following table- 4 shows the value of the Z Score for the selected 25 companies for the selected ten years' time periods (2008-09 to 2017-18).

**Table -4 Value of the Altman Z - Score for the selected Indian Companies**

| No. | Name of Companies | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Tata Motors Ltd. | 2.21 | 2.31 | 2.37 | 4.78 | 2.52 | 2.75 | 3.04 | 3.76 | 3.30 | 3.12 | 3.02 |
| 2 | Bajaj Auto Ltd. | 5.30 | 7.12 | 12.34 | 9.04 | 10.67 | 9.83 | 11.63 | 15.48 | 15.98 | 14.56 | 11.20 |
| 3 | Ashok Leyland Ltd. | 2.83 | 2.85 | 3.62 | 2.60 | 2.00 | 1.60 | 2.72 | 4.19 | 4.53 | 4.81 | 3.18 |
| 4 | TVS Motor Company Ltd. | 3.18 | 3.59 | 4.51 | 3.83 | 3.58 | 4.13 | 4.93 | 5.62 | 6.02 | 7.00 | 4.64 |
| 5 | Sundaram Clayton Ltd. | 2.74 | 3.07 | 2.42 | 2.20 | 2.32 | 2.95 | 4.90 | 8.00 | 7.79 | 6.76 | 4.32 |
| 6 | Wipro Ltd. | 5.06 | 8.35 | 8.84 | 7.17 | 6.53 | 7.82 | 7.40 | 7.54 | 7.59 | 7.67 | 7.40 |
| 7 | Infosys Ltd. | 17.46 | 27.10 | 29.45 | 20.09 | 18.12 | 14.17 | 14.89 | 14.02 | 15.10 | 15.82 | 18.62 |
| 8 | TCS | 11.85 | 12.60 | 20.38 | 17.38 | 18.71 | 20.23 | 19.66 | 18.78 | 28.08 | 24.72 | 19.24 |
| 9 | Tech Mahindra Ltd. | 10.8 | 4.92 | 4.12 | 3.71 | 4.14 | 7.07 | 25.9 | 8.32 | 7.71 | 7.82 | 8.46 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 8 | | | | | | 5 | | | | |
| 10 | Mindtree Ltd. | 3.91 | 9.17 | 7.54 | 6.72 | 9.87 | 11.21 | 14.09 | 11.35 | 8.82 | 11.41 | 9.41 |
| 11 | BPCL | 4.98 | 4.67 | 3.46 | 3.86 | 4.60 | 4.60 | 4.76 | 4.16 | 4.54 | 4.67 | 4.43 |
| 12 | GAIL | 6.08 | 5.48 | 5.17 | 4.00 | 3.54 | 3.49 | 3.57 | 3.14 | 2.75 | 3.02 | 4.02 |
| 13 | ONGC | 4.02 | 3.91 | 2.89 | 4.59 | 2.34 | 4.40 | 4.94 | 3.69 | 4.87 | 2.87 | 3.85 |
| 14 | IOCL | 4.17 | 4.66 | 3.63 | 2.83 | 2.84 | 2.62 | 2.89 | 2.59 | 3.40 | 3.66 | 3.33 |
| 15 | HPCL | 4.07 | 3.98 | 2.69 | 2.94 | 3.11 | 3.45 | 3.87 | 3.51 | 4.36 | 4.04 | 3.60 |
| 16 | Cipla Ltd. | 5.60 | 7.98 | 11.45 | 13.50 | 10.85 | 9.47 | 8.85 | 10.58 | 11.64 | 11.79 | 10.17 |
| 17 | SPIL | 4.04 | 30.40 | 8.76 | 28.06 | 31.92 | 15.72 | 7.76 | 11.74 | 7.83 | 6.60 | 15.28 |
| 18 | Lupin Ltd. | 4.72 | 6.85 | 17.59 | 7.65 | 10.03 | 15.68 | 23.53 | 22.34 | 10.45 | 12.68 | 13.15 |
| 19 | Dr. Reddy's Laboratories Ltd. | 5.86 | 6.86 | 6.67 | 6.62 | 6.56 | 7.16 | 7.53 | 8.25 | 9.03 | 6.34 | 7.09 |
| 20 | Divi's Laboratories Ltd. | 21.51 | 26.79 | 14.36 | 12.32 | 15.38 | 15.45 | 16.64 | 37.41 | 23.07 | 18.62 | 20.16 |
| 21 | Arvind Ltd. | 1.73 | 2.01 | 2.04 | 2.23 | 1.97 | 2.52 | 2.79 | 2.79 | 2.97 | 3.25 | 2.43 |
| 22 | Grasim Industries Ltd | 4.20 | 9.85 | 8.99 | 9.12 | 7.29 | 6.60 | 7.58 | 6.21 | 9.43 | 6.85 | 7.61 |
| 23 | Raymond Ltd. | 1.31 | 2.18 | 1.79 | 2.21 | 1.70 | 2.13 | 2.58 | 2.33 | 2.28 | 2.50 | 2.10 |
| 24 | Vardhman Textiles Ltd. | 1.59 | 2.00 | 2.38 | 2.03 | 2.15 | 2.42 | 2.67 | 3.13 | 3.75 | 3.86 | 2.60 |
| 25 | Vijay Textiles Ltd. | 1.56 | 1.63 | 1.22 | 1.02 | 1.21 | 1.20 | 1.00 | 1.30 | 1.46 | 1.28 | 1.29 |

From the above table-4, It has been found that the value of the Z Score is between 1.81 to 2.67 for Tata Motor Ltd. in the years 2009, 2010, 2011 and 2013, Ashok Leyland Ltd. for the years 2012, 2013 and 2014, Sunadram Clayton Ltd. for the years 2011, 2012 and 2013, ONGC for the year 2013, IOCL for the year 2014, Arvind Ltd. for the years 2010, 2011, 2012, 2013 and 2014, Raymond Ltd. for the years 2010, 2012, 2014, 2015, 2016, 2017 and 2018, Vardhman Textiles Ltd. for the years 2010, 2011, 2012, 2013 and 2014. Thus, all these companies are in Possible Grey Zone for these years. Value of the Z score is below 1.81 for Arvind Ltd. in the year 2009 only, Raymond Ltd. for the years 2009, 2011 and 2013, Vardhman Textiles Ltd. for the year 2009 and all the selected years of Vijay Textiles Ltd. Thus, these companies are in possible Distress Zone for these years while for remaining periods, they are in possible Non Distress Zone. Bajaj Auto Ltd., TVS Motor Company Ltd., Wipro Ltd., Infosys Ltd., TCS, Tech Mahindra Ltd., Mindtree Ltd., BPCL, GAIL, Cipla Ltd., SPIL, Lupin Ltd., Dr. Reddy's Laboratories Ltd. and Divi's Laboratories Ltd. are Possible Non Distress Zone Companies for the selected years of the study.

### 4.2 Discriminant Analysis

In order to classify the companies according to their distress level, Discriminant analysis has been carried out on selected twenty five companies for the periods of the ten years (2008-09 to 2017-18).
The Following table -5 shows the result of Group Statistics.

*Table - 5 Group Statistics*

| Z Score Coding | Variable | Mean | Standard Deviation | C.V. |
|---|---|---|---|---|
| **0 (Possible Non-Distress Zone Companies** | WCTA | 0.1800 | 0.2127 | 1.1818 |
| | RETA | 0.6104 | 0.1994 | 0.3267 |
| | EBITTA | 0.1701 | 0.1082 | 0.6358 |
| | MVEQBVTL | 10.1001 | 10.9225 | 1.0814 |
| | SALETA | 1.2224 | 0.7891 | 0.6455 |

| | | | | |
|---|---|---|---|---|
| **1 (Possible Grey Zone Companies)** | WCTA | 0.0218 | 0.1593 | 7.2981 |
| | RETA | 0.3646 | 0.0733 | 0.2011 |
| | EBITTA | 0.0799 | 0.0464 | 0.5808 |
| | MVEQBVTL | 1.1695 | 0.9126 | 0.7803 |
| | SALETA | 0.8605 | 0.2750 | 0.3196 |
| **2 (Possible Distress Zone Companies)** | WCTA | 0.2210 | 0.1690 | 0.7649 |
| | RETA | 0.2349 | 0.1018 | 0.4332 |
| | EBITTA | 0.0535 | 0.0531 | 0.9927 |
| | MVEQBVTL | 0.2783 | 0.2946 | 1.0584 |
| | SALETA | 0.4553 | 0.1609 | 0.3535 |
| **Total** | WCTA | 0.1622 | 0.2109 | 1.3000 |
| | RETA | 0.5564 | 0.2164 | 0.3890 |
| | EBITTA | 0.1516 | 0.1070 | 0.7057 |
| | MVEQBVTL | 8.3676 | 10.4851 | 1.2531 |
| | SALETA | 1.1300 | 0.7481 | 0.6620 |

The variable with the highest value of Coefficient of Variation indicates the least consistency, while the lower value of Coefficient of Variation indicates the most consistency. From the above table-5, it has been found that RETA is the most consistent variable and WCTA is the least consistent variable for the possible Non-Distress zone and possible Grey zone companies. For possible Distress zone companies, SALETA and MVEQBVTL is the most and the least consistent variable respectively. However, in terms of variability, the standard deviation of MVEQBVTL seems to vary a lot within all three categories of companies.

The Following table - 6 shows the result of Wilk's Lambda.

*Table - 6 Wilk's Lambda*

| **Test of Function(s)** | **Wilks' Lambda** | **Chi-square** | **Df** | **Sig.** |
|---|---|---|---|---|
| 1 through 2 | 0.380 | 236.890 | 10 | 0.000 |
| 2 | 0.931 | 17.416 | 4 | 0.002 |

The values of Wilk's Lambda of function 1 & 2 are 0.380 and 0.931 respectively, which indicates the significance of both the discriminant function, which is tested using Chi-square test with 10 degree of freedom for function 1 and 4 degree of freedom for function 2 at 5% level of significance. Since, the p-value is less than 0.05 for both the functions, it can be inferred that the discriminant function 1 and 2 are significant and hence, it can be used for further interpretation of the results.

The Following table - 7 shows the result of Unstandardized Canonical Discriminant Function Coefficients.

*Table -7 Unstandardized Canonical Discriminant Function Coefficients*

| **Function** | WCTA | RETA | EBITTA | MVEQBVTL | SALESTA | (Constant) |
|---|---|---|---|---|---|---|
| **1** | -1.454 | 8.671 | -3.125 | 0.005 | 1.614 | -5.982 |
| **2** | 5.792 | -1.721 | -1.065 | 0.013 | 0.336 | -0.308 |

From the above table - 7 Unstandardized Discriminant Function can be written as:

Estimated Discriminant Function 1:

Score 1 = -5.982 – 1.454 WCTA + 8.671 RETA – 3.125 EBITTA + 0.005 MVEQBVTL +1.614 SALETA

RETA followed by EBITTA, SALETA, WCTA and MVEQBVTL are found to be the best predictors of bankruptcy Z Score of above discriminating function 1.

Estimated Discriminant Function 2:

Score 2 = -0.308 + 5.792 WCTA – 1.721 RETA – 1.065 EBITTA + 0.013 MVEQBVTL + 0.336 SALETA

WCTA followed by RETA, EBITTA, SALETA and MVEQBVTL are found to be the best predictors of bankruptcy Z Score of above discriminating function 2.

The Following table - 8 shows the result of Classification Matrix.

*Table - 8 Classification Results*

| | | CODE | Predicted Group Membership | | | Total |
|---|---|---|---|---|---|---|
| | | | possible Non-Distress Zone Companies | possible Grey Zone Companies | possible Distress Zone Companies | |
| Original | Count | possible Non-Distress Zone Companies | 175 | 26 | 2 | 203 |
| | | possible Grey Zone Companies | 1 | 28 | 3 | 32 |
| | | possible Distress Zone Companies | 0 | 4 | 11 | 15 |
| | % | possible Non-Distress Zone Companies | 86.2 | 12.8 | 1.0 | 100.0 |
| | | possible Grey Zone Companies | 3.1 | 87.5 | 9.4 | 100.0 |
| | | possible Distress Zone Companies | 0.0 | 26.7 | 73.3 | 100.0 |

This table - 8 is also called confusion table or classificatory table. It indicates that out of 203 observations of Category-0, 175 are correctly classified as in Category-0, whereas, 26 are wrongly classified as in category-1 and 2 are wrongly classified as in category 2. Similarly, out of 32 observations of Category-1, 28 are correctly classified as in Category-1, whereas, 1 is wrongly classified as in Category-0 and 3 are wrongly classified as in category-2. Similarly, out of 15 observations of Category-2, 11 are correctly classified as in Category-2, whereas, 0 is wrongly classified as in Category-0 and 4 are wrongly classified as in category-1. Thus, out of total 250 observations, 214 observations are correctly classified by the discriminant function. Therefore,

The Hit ratio= $\frac{\text{No.of correct predictions}}{\text{Total number of cases}} = \frac{214}{250} = 0.856$

Hence, the Hit Ratio is 85.60%.

In order to find out whether both the models give same result or not, Comparison of results of Z Score and Discriminant Analysis Model have been carried out as follows in table -9.

**Table -9 Comparison of Z Score Model and Discriminant Analysis**

| Name of Companies | Criteria | Years | | | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | |
| 1.Tata Motors Ltd. | Z score | GZ | GZ | GZ | NDZ | GZ | GZ | GZ | NDZ | GZ | NDZ | GZ |
| | DA | GZ | GZ | GZ | GZ** | GZ | GZ | GZ | GZ** | GZ | GZ** | GZ |
| 2.Bajaj Auto Ltd. | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| 3.Ashok Leyland Ltd. | Z score | NDZ | NDZ | NDZ | GZ | GZ | DZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | NDZ | GZ | GZ | GZ** | GZ** | GZ** | NDZ | NDZ | NDZ |
| 4.TVS Motors Company Ltd. | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | ND | ND | ND | ND | NDZ | ND | ND | ND | ND | ND | NDZ |

| Name of Companies | Criteria | Years | | | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | |
| | | Z | Z | Z | Z | | Z | Z | Z | Z | Z | |
| 5.Sundaram Clayton Ltd. | Z score | NDZ | NDZ | GZ | GZ | GZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | DZ** | GZ** | GZ | GZ | GZ | GZ** | GZ** | GZ** | NDZ | GZ** | GZ |
| 6.Wipro Ltd. | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| 7.Infosys Ltd. | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| 8.Tata Consultancy Services Ltd. | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| 9.Tech Mahindra Ltd. | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | GZ** | GZ** | GZ** | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| 10.Mindtree Ltd. | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| 11.BPCL | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| 12.GAIL | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| 13.ONGC | Z score | NDZ | NDZ | NDZ | NDZ | GZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | GZ** | GZ** | NDZ** | NDZ | NDZ | NDZ | NDZ | GZ** | NDZ |
| 14.IOCL | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | GZ | NDZ | GZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | NDZ | NDZ | GZ** | GZ | NDZ | GZ | NDZ | NDZ | NDZ |
| 15.HPCL | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | GZ** | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| 16.Cipla Ltd. | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | ND | ND | ND | ND | NDZ | ND | ND | ND | ND | ND | NDZ |

| Name of Companies | Criteria | Years | | | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | |
| | | Z | Z | Z | Z | | Z | Z | Z | Z | Z | |
| 17.Sun Pharmaceutical Industries Ltd. | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | GZ** | NDZ |
| 18.Lupin Ltd. | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| 19. Dr. Reddy's Laboratories Ltd. | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| 20.Divi's Laboratories Ltd. | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| 21.Arvind Ltd. | Z score | NDZ | GZ | GZ | GZ | GZ | GZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | DZ** | DZ** | GZ | GZ | GZ | GZ | GZ** | GZ** | GZ** | GZ** | GZ |
| 22.Grasim Industries Ltd. | Z score | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| | DA | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ | NDZ |
| 23.Raymond Ltd. | Z score | DZ | GZ | DZ | GZ | DZ | GZ | GZ | GZ | GZ | GZ | GZ |
| | DA | GZ** | GZ | GZ** | GZ | GZ** | GZ | GZ | GZ | GZ | GZ | GZ |
| 24.Vardhman Textiles Ltd. | Z score | DZ | GZ | GZ | GZ | GZ | GZ | NDZ | NDZ | NDZ | NDZ | GZ |
| | DA | DZ | DZ** | DZ** | GZ | GZ | GZ | GZ** | GZ** | GZ** | NDZ | GZ |
| 25.Vijay Textiles Ltd. | Z score | DZ | DZ | DZ | DZ | DZ | DZ | DZ | DZ | DZ | DZ | DZ |
| | DA | DZ | DZ | DZ | DZ | DZ | DZ | DZ | DZ | DZ | DZ | DZ |

DA= Discriminant Analysis, NDZ= Possible Non Distress Zone, GZ = Possible Grey Zone, DZ= Possible Distress Zone

As per the result of discriminant analysis, Change in possibility of company being converted from NDZ to GZ, NDZ to DZ and GZ to DZ have been summarized as below.

- The above table indicates that Tata Motors Ltd. in the years 2012, 2016 and 2018, Ashok Leyland Ltd. in the years 2015 and 2016, Sundaram Clayton Ltd. in the years 2010, 2014, 2015, 2016 and 2018, ONGC in the years 2011, 2012 and 2018, Tech Mahindra Ltd. in the years 2010, 2011 and 2012, HPCL in the year 2011, SPIL in the year 2018, Arvind Ltd. in the years 2015, 2016, 2017 and 2018, Vardhman Textile Ltd. in the years 2015, 2016 and 2017 have been converted to GZ from NDZ.
- In 2009, Sundaram Clayton and Arvind Ltd. has been shifted from NDZ to DZ.

- Arvind Ltd. for the year 2010 and Vardhman Textiles Ltd. for the years 2010 and 2011 have been converted from GZ to DZ.
- As per the Z Score Model, Sundaram Clayton Ltd. and Arvind Ltd. are found to be in possible Non-Distress Zone but according to the estimated Discriminant Model, they have the probability of being classified as in possible Grey Zone as 60% (Probability greater than 0.5). These companies fall in the possible Grey Zone because of their higher retention ratio. This leads to their lower market price which contributes to their less popularity among the shareholders as an investment alternative.
- According to Discriminant Analysis, Vijay Textiles Ltd. is classified as probable Distress Zone Company; Tata Motors Ltd., Sundaram Clayton Ltd., Arvind Ltd., Raymond Ltd. and Vardhman Textiles Ltd. are classified as possible Grey Zone while all other selected companies are classified as possible Non Distress Zone Companies in most of the years of study.

**Note:** As Wilk's Lambda for function 1 is less as compared to function 2, hence, Function 1 has been considered.

## 5. FINDINGS AND CONCLUSION:

- Based on ten years average value of Altman Z Score, Vijay Textile Ltd. is a probable Distress Zone company; Arvind Ltd., Raymond Ltd. and Vardhman Textile Ltd. are possible Grey Zone companies while all other selected companies are possible Non Distress Zone companies.
- According to Discriminant Analysis, Vijay Textiles Ltd. is classified as possible Distress Zone Company; Tata Motors Ltd., Sundaram Clayton Ltd., Arvind Ltd., Raymond Ltd. and Vardhman Textiles Ltd. are classified as possible Grey Zone Companies while all other selected companies are classified as possible Non Distress Zone Companies for the most of selected years of study.
- According to both Altman Z Score Model & Discriminant Analysis, Vijay Textiles Ltd. is classified in possible distress zone companies. This company uses larger portion of long term borrowing in its capital structure to take advantage of financial leverage, which reduces market price of the share. Thus, this company should reduce its long term debt and give more weightage to Equity to overcome this situation.
- Finally to conclude, Retained Earnings to Total Assets and EBIT to Total Assets are the most important determinants in determining the financial health of the selected Companies.

## ❖ SUGGESTIONS:

- Investment is a long-term decision because it requires a huge amount of savings and sometimes it is lifetime savings for the middle-class person. A wrong investment decision leads to harsh results for the economic condition of any person. thus, it is suggested to investors and stakeholders to ensure the financial condition of any company before making an investment. Retained Earnings and Earnings before Interest and Tax amount need to be evaluated to get a clear picture of the capital structure of the company.
- Investors can rely on Retained Earnings and EBIT disclosure to classify the companies according to their distress level, which might be useful for taking various investment decisions.

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