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Assessment of Top Ranking Companions Using Financial Ratios

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Abstract: Rating of companies is necessary to assess their financial strength and enables the decision makers to understand the financial scenario of their firms. This paper is aimed at rating of companies using different Multivariate Statistical Techniques. Top 500 companies are considered over a period of 2001 to 2004.Fourteen ratios have been selected by considering their importance. Through factor analysis, the pattern of structure of variables is studied; the results are subjected to k-means to explore the underlying group structure. Using different approaches, the companies are graded as A, B and C depending on their performances.

1.0 Introduction

Over the past few decades there has been dramatic increase in the number of companies in India and also healthy competition among them to promote their business in the market. There is a need for periodic assessment of the company's performance to know their position in the market and succeed in the business. Rating is recognized as the benchmark for assessing the performance of the companies. Ratings help companies to proactively manage supply risk, enabling better operational and financial performances. Rating is an opinion, based on comprehensive quantitative and qualitative evaluation of a company's balance sheet strength and weakness, operating performance and business profile. This paper attempts to provide some of the multivariate statistical techniques, which is used to grade the already ranked companies based on certain standardized financial ratios. (Chandrasekaran and Luther, 2002)

1.1. Ratio analysis

The term ***ratio*** refers to the mathematical relationship between two variables expressed in quantitative form. Ratios provides clues to the financial position of a concern, they are indicators of financial strength, soundness, position or weakness of an enterprise. It helps to summaries large masses of financial data and to make judgment about the firm's financial condition. Ratio analysis is one of the tools under the techniques of financial analysis, which is used to study the problems relating to performance of a company and classification of companies into different groups by their performance. (Prasanna Chandra, 1998)

The objective of this paper is to assess the performance of the top ranking companies on the basis of certain financial ratios, with this primary objective, the following approach of assessment has been made. They are:

(i) To determine the number of groups or classes of companies.

(ii) To propose various methods of rating the companies on the basis of certain financial ratios.

To achieve this objective of the study we used the Multivariate techniques such as Factor Analysis, McQueen's k-means and Multivariate Discriminant Analysis.

2.0 Database and Methodology

The sample selected for the study taken from Compendium of top 500 companies in India Published by Business Standard. The data covers both public and private sector companies that are rated as the best in terms of market capitalization from the year 2001 to 2004. Out of 500 companies, the top most 200 companies that are commonly available for all the study period are taken for the study.

2.1. Ratio selection

The number of ratios that can be calculated form a typical set of financial statements is much too large to incorporate in any study. Mahmoud, Judith and Cecillio, (1987) had compiled a maximum of 152 ratios. In this study, 14 ratios are carefully selected that could be best possible to discriminate the companies performances. The ratios selected for this study are given in *Table 2.1*.

Table 2.1 Ratios Selected for the Present Study

Variable	Financial Ratios	Abbreviation
X_1	Debt / Equity	DT _ NW
X_2	Long-tem debt / Equity	LTDT _ NW
X_3	Current Assets / Current Liabilities	CA _ CL
X_4	Profit before interest depreciation tax / Sales	PBIDT _ S
X_5	Profit before interest and tax / Sales	PBIT _ S
X_6	Profit before depreciation and tax / Sales	PBDT _ S
X_7	Profit after tax + Depreciation / Sales	PAT+D_S
X_8	Profit after tax / sales	NP_ S
X_9	Profit after tax / Total Assets	NP _ TA
X_{10}	Net Profit / Net Worth	NP _ NW
X_{11}	Sales / Fixed Assets	S _ FA
X_{12}	Cost of goods sold / Inventory	CGS _ I
X_{13}	Sales / Sundry debtors	S _ SD
X_{14}	Profit before interest and tax / Interest	PBIT _ I

2.2. Factor Analysis

Factor Analysis is a generic term for a family of statistical technique concerned with the reduction of a set of observable variable in terms of a small number of factors. The primary purpose of factor analysis in data reduction is that of reducing data complexity by reducing the numbers

of variables being studies. In particular, it describes the covariance relationship among many variables in terms of few underlying but unobservable, random quantities called factors. Factor model is motivated by the following arguments.

1. To identify those variables within a particular group that are highly correlated among themselves but have small correlation with variables in different groups.

2. To reduce a large number of variables to small number of factors.

2.3. Factor Extraction

Among the several extraction methods the most popular method the Principal Component Analysis is used on the study, to explore the stability of performance of the top ranked companies during the study period. In this method of extraction it is assumed that the method mines linear combination of financial variables, which are correlated among themselves, but uncorrelated between the ratios.

2.4. Factor Rotation

Rotation is used to identify simple structure as well as to make output more understandable and facilitate the interpretation of factors more meaningfully. This method facilitates to name the set of variables on each of factors and also enables us

1. To assess the performance stability of the companies during the study period based on the ratios considered.
2. To estimate values of the common factors called factor scores in the factor model.

3.0 Multivariate Discriminent Analysis

Multivariate Discriminant Analysis (MDA) is a statistical technique used to derive the linear combination of two or more independent variables that will discriminate best between a priori defined group, which is generally, failure or non-failure of a company etc. This is achieved by the Statistical Decision Rule which maximizes the between group variance relative to the within group variance. This relationship is expressed as the ratio of between groups to within group variances. The discriminant analysis derives the linear combination from an equation that takes the following form. (Barbro, Teija, Kaisa and Michiel, 1996)

$$Z = W_1X_1 + W_2X_2 + ... + W_nX_n$$

where Z – Discriminanat score , W_i – Discriminant weights, X_i – Independent variables namely, the financial ratios (Barbro, Teija, Kaisa and Michiel, 1996).

In this research paper, iterative discriminant analysis is used to identify groups and exhibit them graphically and also judge the nature of overall performance of the companies. This process re-allocates the companies that were assigned group labels by k-means cluster at the initial stage. Reallocation is subjected recursively until cent percent classification is attained, by considering the classification of group obtained in iteration ***t*** as the input the next iteration ***t+1***.

With the aforementioned techniques an attempt is made to propose the following three different methods to rate the top ranking companies based on their performance.

Method I: Initially k-means analysis is carried out to partition the data set into k-clusters using the ratios under consideration. Discriminant Analysis is performed to the groups formed by k-means method until cent percent classification is achieved and final group centroids for the converged groups are extracted.

Method II: This is similar to Method I, here the extracted factor scores is used to partition the data set into k-clusters.

Method III: It is assumed that rate of increase of each financial ratio of companies is constant from one year to next. The constant C_k is computed for each category as follows.

$$C_k = \frac{\sum_{i=1}^{b} \left(\frac{ratio_{i+1}(k)}{ratio_i(k)} \right)}{b}$$

For each year the centroids for each group **cratio$_{i+1}$(k)** is worked out and k-means analysis is applied to these groups then Multivariate Discriminant Analysis is performed until cent percent classification is achieved from *iteration* ***t*** to next iteration ***t+1.***

4.0. Results and Discussion

The extraction of factor is carried out by requesting Principal Component Analysis and specifying a rotation. The Eigen values and percentage of variance accounted by each factor and the total variability during the study period is shown in the following *Table 4.1*.

Table 4.1 Eigen Values and Percentage of Variance Explained by Factors

Factor	2001		2002	
	Eigen value	Variance	Eigen value	Variance
1	5.368	38.342	4.727	33.762
2	3.184	22.742	3.639	25.989
3	1.594	11.383	1.539	10.992
4	1.057	7.547	1.083	7.738
Total		**80.014**		**78.481**
Factor	**2003**		**2004**	
	Eigen value	**Variance**	**Eigen value**	**Variance**
1	5.754	41.098	4.501	32.147
2	3.209	22.920	2.488	17.769
3	1.724	12.312	1.764	12.597
4	1.238	8.843	1.573	11.237
Total		**85.173**		**73.750**

From the above table we observe that the total variance explained by the extracted factor are over 70 percent that is relatively higher. Also the factor variance is more or less the same for the study period.

After examining the significant loading for each factoring a factor matrix, we assigned some meaning to the factors based on the patterns of their factor loadings. Thus the extracted four factors named as *Profitability, Leverage, Asset, Utility and Solvency factors* Pinches, Mingo and Caruthers, 1973). The factor loadings of financial variables are presented in the *Table 4.2* and only those ratios with higher loading of are considered significant.

In addition, a new approach of classifying the companies into different groups is attempted that facilitates to visualize the groups and judge the performances based on the financial ratios. Classification of the companies is carried out considering the original variables with the initial groups obtained by **k**-means analysis, which are **3** in the present case.

Application of MDA is repetitive in the present study, that is, re-allocation of companies is subjected from one iteration ***t*** to the next iteration ***t+1*** until cent percent classification is achieved. Appropriate grades are assigned to the companies on the basis of their group mean vectors.

The results of each method for the study period, processed through the proposed algorithms are shown in *Table 4.3*. From the table, it is observed that the performance of companies varies in different years. *Figure 4.1* shows the grouping of companies into 3 clusters for each year of the study period by Method I. Similarly, *Figure 4.2* and *Figure 4.*3 shows the grouping of companies into 3 clusters by Method II and Method III. It is to be noted that Method III starts with base year 2001 with their companies being graded by the Method I. to facilitate interpretation.

Thus, we rated the companies belonging in the first cluster as Grade **A**, and second cluster as Grade **B** and the third cluster as Grade **C**. Companies belonging to Grade **A** category exhibits the higher performance than Grade **B** and Grade **C**. Similarly, the companies belonging to Grade **B** category are better than those of Grade **C** but poorer to Grade **A**. Finally Grade **C** companies are at the lower performance in terms of the importance of some ratios.

From the *Table 4.3* it is interesting to note that Method II and Method III classify companies in a similar way in the data set for the year 2003 after the convergence, even though their initial number of companies varying during these periods.

It shows that in both methods the performances are closer in these years. Interestingly from *Figure 4.2 and Figure 4.3* can be visualized that years shows the same structure.

Table 4.2 Variable rotated Factors

Factor No.	Years		
	Name	2001	2002
1	Profitability	PAT+D_S PBIT_S PBIDT_S NP_S S_SA CA_CL	PAT+D_S PBIT_S PBIDT_S NP_S CA_CL
2	Leverage	LTDT_NW DT_NW	LTDT_NW DT_NW S_FA
3	Asset Utility	S_SD CGS_TI	NP_NW NP_TA PBIT_I
4	Solvency	NP_NW PBIT_I NP_TA	CGS_TI S_SD

Factor No.	Years		
	Name	2003	2004
1	Profitability	PAT+D_S PBDT_S PBIDT_S PBIT_S NP_S CA_CL	PAT+D_S PBIDT_S PBIT_S S_FA NP_S CA_CL
2	Leverage	LTDT_NW DT_NW S_FA PBIT_I	NP_NW NP_TA DT_NW
3	Asset Utility	S_SD CGS_TI	PBIT_I LTDT_NW
4	Solvency	NP_NW NP_TA	CGS_TI S_SD

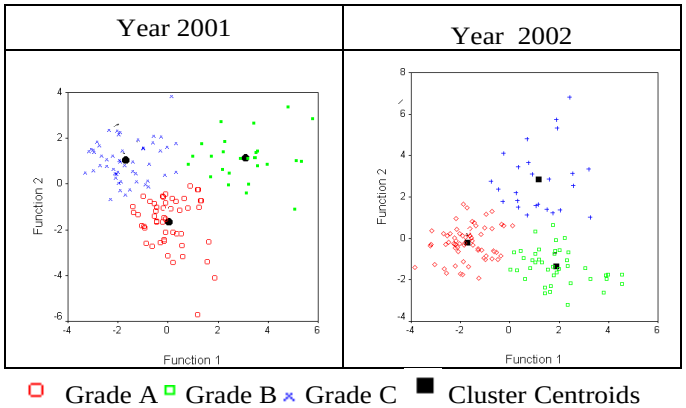
Table 4.3 Number of Companies in Each Group

Method	Year	Initial Group			Converged Group			Number of cycles in each group
		1	2	3	1	2	3	
I	2001	49	28	53	51	27	52	4
	2002	62	47	25	66	42	26	4
	2003	79	44	12	75	45	15	3
	2004	37	27	49	35	32	46	3
II	2001	52	43	35	48	51	31	6
	2002	49	31	54	48	29	57	4
	2003	38	70	27	35	25	75	8
	2004	62	21	30	60	31	22	8
III	2001	42	68	24	42	67	25	3
	2002	38	26	71	35	25	75	8
	2003	61	38	14	66	37	10	4
	2004	60	23	30	60	33	20	8

In order to identify the factors that are mainly responsible for the formation of the groups, perpetual mapping is drawn using the standardized discriminant coefficients and the unstandardised discriminant functions evaluated at the group centroids. From the perpetual map in *Figure 4.4* it is clear that the three groups of rated companies are very well separated and represented in the perpetual map for all the four periods.

The two-dimensional graph (Figure 4.4) clearly indicates that, in the year 2001, Group A is dominated by Asset utility factor, Group B is dominated by Solvency factor and Group C is dominated by Profitability factor. In 2002, Leverage factor dominate the Group A, Asset utility factors dominate the Group B and Profitability factor dominate the factor C. For the years 2003 and 2004, Solvency factor dominates Group A, where as Leverage and Asset utility factors dominate Group B and Profitability factor dominate the Group C. It is interesting to note that in the entire four years Profitability factor dominate the Group C.

Figure 4.1 Clustered Group of Companies (Method I)



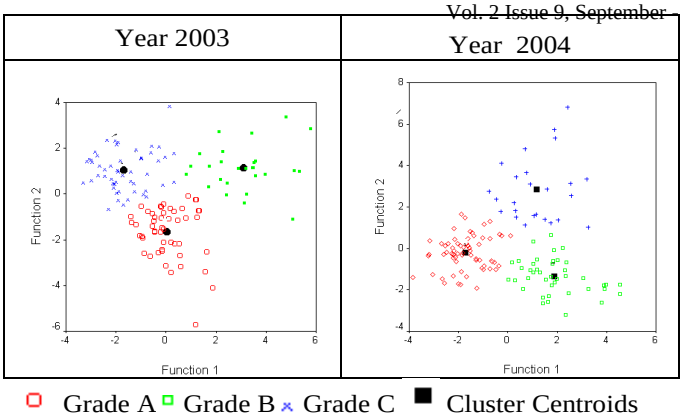
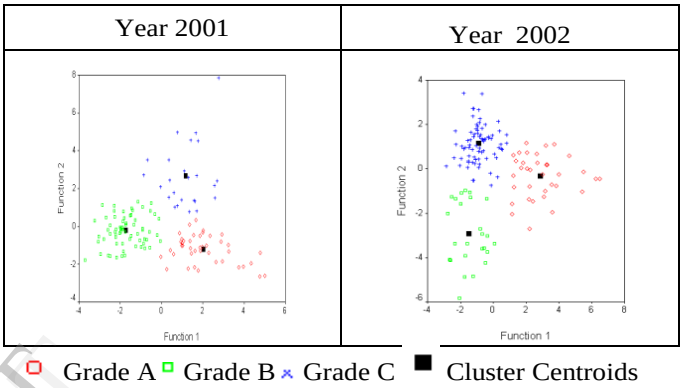


Figure 4.2 Clustered Group of Companies (Method II)



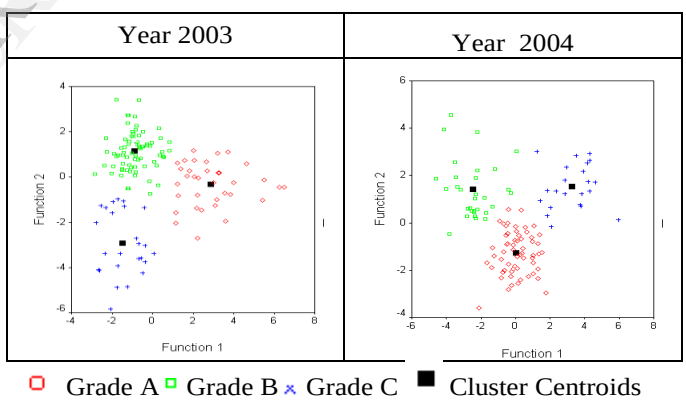
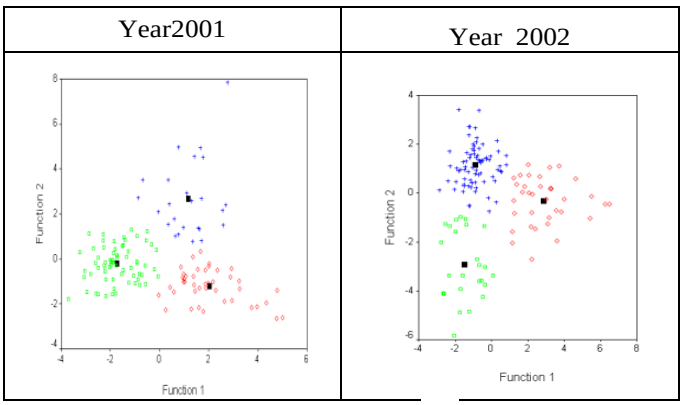


Figure 4.3Clustered Group of Companies (Method III)



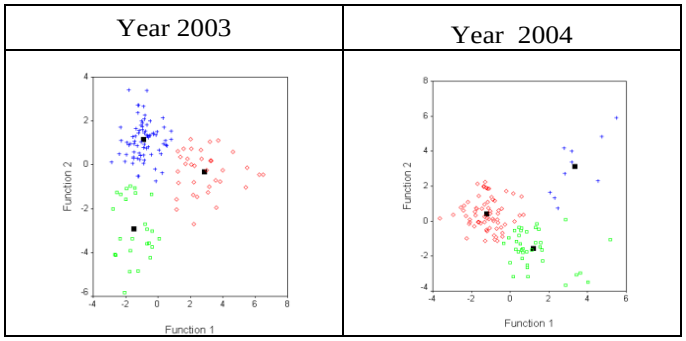
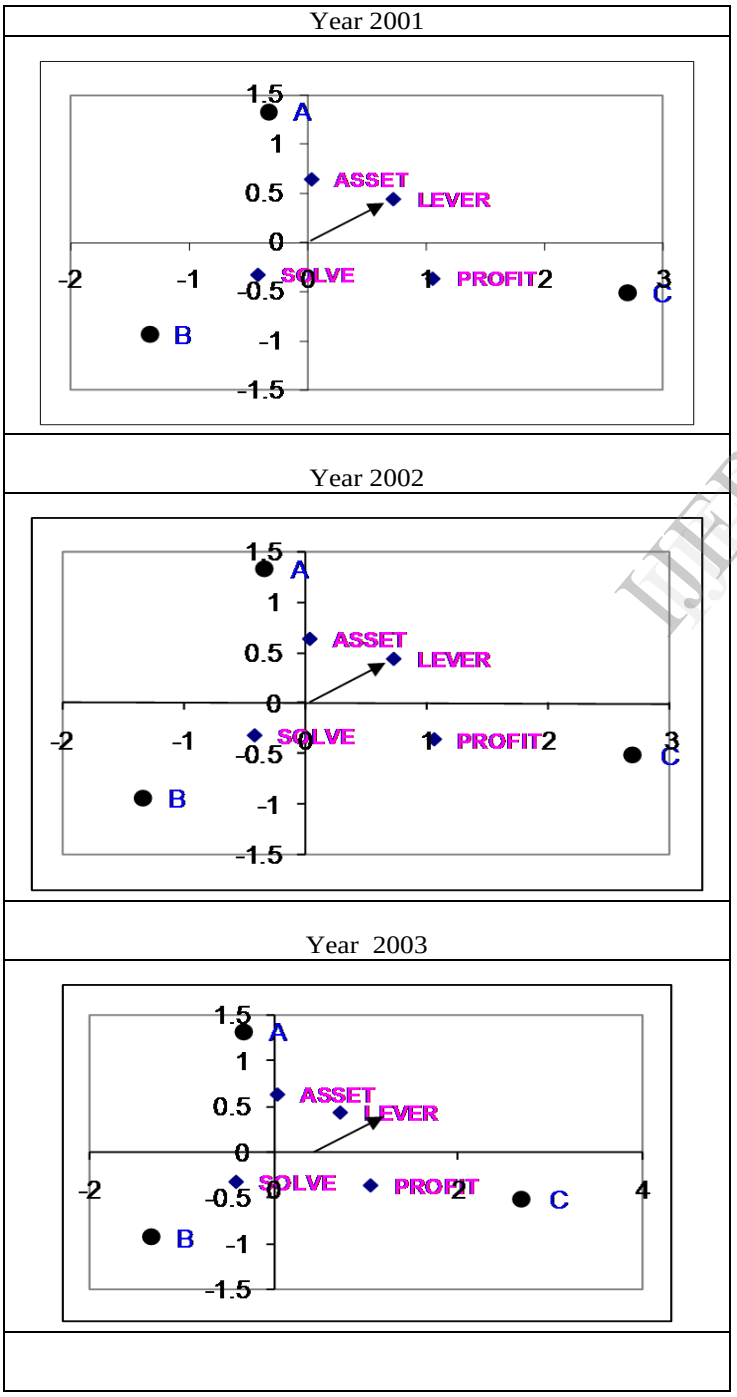
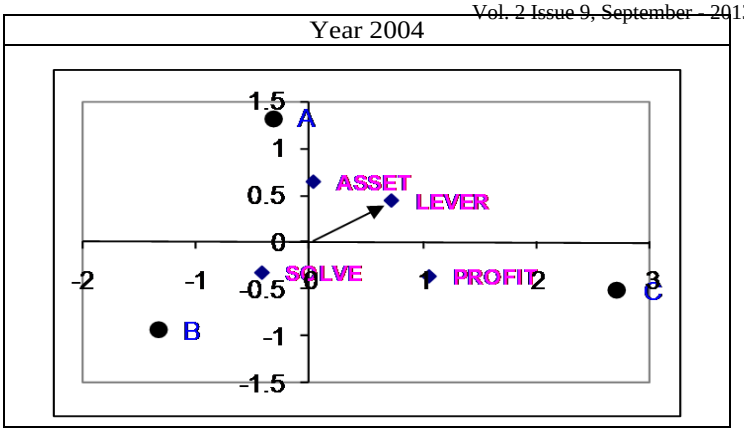


Figure 4.4 Perpetual Mapping of Groups and Factors





5. Conclusions

The assessment of financial performance is necessary to any business to know the condition of a firm. Ratios analysis of financial data of companies provides identification to assess the financial strengths and weaknesses. The results of this study demonstrated the use of Multivariate Statistical Techniques to assess the companies' performance on the basis of rating methods. Financial Analyst can make use of these techniques of rating, and the companies can project the performance on the basis of financial ratios that has been designed in this study.

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