

Evaluation of Financial Performance using Fuzzy Techniques

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Abstract: The primary objective of any investment is to create positive value for its investors. Value is represented by the market price of the company's common stock which is in turn is a function of the market forces, fundamental strength and the trend prevailing in the market. Value created varies from company to company. Some of the selected IT companies have created abnormally high value to its shareholders. The rest of the companies have failed to create value to such an extent. Since there are variations in the earnings of the selected top ten IT companies and the variations are found prominent and pronounced, there arose the necessity to rank them and suggest the order of performance, so as to enable the investors to take profitable investment decisions. Ups and downs - volatility in stock market jargon decide the quantum of returns to investors. In order to support and substantiate the decision making ability of the investors, fuzzy analysis which is comparatively more powerful, accurate and purpose serving is used in this article instead of traditional methods which are vague, inaccurate and insufficient to take effective and efficient decisions in the highly volatile stock market.

Keywords: Financial Performance, Profitability, Volatility, Financial ratios, Fuzzy Techniques.

I. INTRODUCTION

Investment in stocks and shares of the companies are carried out by the investors with the view to optimize the profit realized. Fundamental strength as market behaviour decides the price movements which in turn produces impact on the profit earning capacity of investors. Fundamental strength reflects the intrinsic value which is based on internal and external economies enjoyed by the companies. If the price prevailing in the market is above the intrinsic value, the share is deemed as overvalued. If it is below the intrinsic value, the share is deemed as undervalued. Fundamentalists recommend for the purchase of stocks and shares when they are undervalued. They suggest that the investors should unload their holdings when prices are above the intrinsic value. The significant factor that influences the prices as per the fundamental analysis is the availability of information about the global economy, national economy, regional economy, local economy and the company itself. The main part of fundamental analysis is the incorporation and discounting of available information. Technical analysis on the other hand is confined to the behaviour in the market and the trend prevailing therein primarily with the help of charts and the price movements are either justified or anticipated [2, 5].

Price movements are due to either the fundamental strength or the market behavior. Whatever may be the reason for the price movements, the ultimate impact is on the profit earning capacity, measured by oscillating ratios [2]. In this article the researcher introduces the method to analyze and rank the top ten IT companies in the IT sector according to the financial ratios. This method is based on fuzzy techniques.

II. LITERATURE REVIEW

Fuzzy Logic is a form of many valued logic in which the truth values of variables may be any real number between 0 and 1. The term Fuzzy Logic was propounded and introduced by Lotfi Zadeh in 1965 [11]. Fuzzy logic has been applied to many fields from control theory to artificial intelligence [1].

Fuzzification operations can map mathematical input values into fuzzy membership functions and the opposite defuzzifying operations can be used to map a fuzzy output membership functions into a "crisp" output value that can be then used for decision or control purposes [7, 8].

Fuzzify all input values into fuzzy membership functions. Execute all applicable rules in the rulebase to compute the fuzzy output functions. Defuzzify the fuzzy output functions to get "crisp" output values [4].

Evaluating financial performance deal with multiple indicator, attribute or index used to improve the result. However according to Zadeh, by using the advancement of fuzzy system, optimum computerized model can be created to help investor or manager to evaluate stock and financial performance more efficient [6]. Feldman et al., [1] stated that fuzzy Logic is a useful method when it related with mode of reasoning that is estimated rather than exact. On the other hand Lambovska et al., [3] have evaluated investment portfolios with theory of confidence interval and theory of fuzzy subset.



The authors suggested that fuzzy logic can be used as platform for comparison and/or ranking different portfolios and stated that fuzzy could be universal tool to combine several methods [9].

A. Fuzzy Number and Linguistic Variables [4]

Definition: 1

A fuzzy set A in R (real line) is defined to be a set of ordered pairs $A = \{(x, \mu_A(x) / x \in R)\}$, where $\mu_A(x)$ is called the membership function for the fuzzy set.

Definition: 2

A fuzzy set A is called normal if there is atleast one point $x \in R$ with $\mu_A(x) = 1$

Definition: 3

A fuzzy set A on R is convex if for any $x, y \in R$ and $\lambda \in [0, 1]$, we have

$$\mu_A(\lambda x + (1 - \lambda)y) \geq \min \{\mu_A(x), \mu_A(y)\}.$$

Definition: 4

A fuzzy number is a fuzzy set on the real line that satisfies the conditions of normality and convexity.

Definition: 5

A fuzzy number \tilde{a} on R is called positive (negative), $\tilde{A} > 0$, if its membership function $\mu_{\tilde{A}}(x) = 0 \forall x < 0 (x > 0)$.

Definition: 6

We can define triangular fuzzy number A as $A = (a_1, a_2, a_3)$. The membership function of this fuzzy number will be interpreted as follows:

$$\mu_A(x) = \begin{cases} 0 & x < a_1 \\ \frac{x - a_1}{a_2 - a_1}, & a_1 \leq x \leq a_2 \\ \frac{a_3 - x}{a_3 - a_2}, & a_2 \leq x \leq a_3 \\ 0 & x > a_3. \end{cases}$$

Definition: 7

We can define trapezoidal fuzzy number A as $A = (a_1, a_2, a_3, a_4)$. The membership function of this fuzzy number will be interpreted as follows:

$$\mu_A(x) = \begin{cases} 0, & x < a_1 \\ \frac{x - a_1}{a_2 - a_1}, & a_1 \leq x \leq a_2 \\ \frac{a_4 - x}{a_4 - a_3}, & a_3 \leq x \leq a_4 \\ 0, & x > a_4. \end{cases}$$

Definition: 8

A Linguistic variable is a variable whose values are expressed in linguistic terms. The concept of a linguistic variable is very useful in dealing with situations, which are too complex or not well defined to be reasonably described in conventional quantitative expressions.

III. RESEARCH METHODOLOGY AND DATA ANALYSIS

This article employs the fuzzy logic technique adopted from Tavakkoli et al., [9] to assign ranks to the companies on the basis of the financial performance. The researchers have selected IT sector which is offering popular investment

opportunities. Ten top ranking IT companies denoted as $A_1, A_2, A_3, A_4, A_5, A_6, A_7, A_8, A_9, A_{10}$ have been used as given under Table.1. Return on Equity (ROE), Current Ratio (CR), Debt Ratio (DR) and P/E ratio which perfectly reflect the financial performance have been taken for analysis. The data which consists of financial ratios have been obtained from the websites of the respective companies and have been summarized as have been given in Table.3.

TABLE 1 : SELECTED COMPANIES WITH CODES

- A_1 : Tata Consultancy Services (TCS)
- A_2 : Infosys
- A_3 : Wipro
- A_4 : HCL Technologies
- A_5 : Tech Mahindra
- A_6 : Oracle Financial Services
- A_7 : Mphasis
- A_8 : Mindtree
- A_9 : Polaris
- A_{10} : Rolta India

TABLE 2: SELECTED INDICES

Criteria	Types of Fuzzy Number	SUP (x)	Fuzzy Number
ROE	Triangle	$0.7 \leq x < 1$	$\mu_{ROE} = \begin{cases} 1.42x & 0 \leq x \leq 0.7 \\ 1 & 0.7 \leq x \leq 1 \\ 0 & \text{Others} \end{cases}$
Current Ratio	Tripezoid	$1 \leq x < 2$	$\mu_{CR} = \begin{cases} x & 0 \leq x < 1 \\ 1 & 1 \leq x < 2 \\ 3 - x & 2 \leq x < 3 \\ 0 & \text{Others} \end{cases}$
Debit Ratio	Triangle	$x = 0.5$	$\mu_{DR} = \begin{cases} 2x & 0 \leq x < 0.5 \\ 2 - 2x & 0.5 \leq x < 2 \\ 0 & \text{Others} \end{cases}$
P/E Ratio	Triangle	$0.5 \leq x < 2$	$\mu_{PE} = \begin{cases} 2x & 0 \leq x < 0.5 \\ 2 - 2x & 0.5 \leq x < 2 \\ 0 & \text{Others} \end{cases}$

TABLE: 3 LIST OF COMPANIES AND THEIR FINANCIAL PERFORMANCE DURING THE PERIOD FROM 2013 TO 2017

COMPANY	ROE	CURRENT RATIO	DEBT RATIO	P/E
TCS	0.35	3.66	0.004	0.21
INFOSYS	0.32	4.03	0.00	0.17
WIPRO	0.21	2.24	0.022	0.15
HCL TECHNOLOGIES	0.27	2.16	0.01	0.15
TECH MAHINDRA	0.21	1.78	0.02	0.14
ORACLE	0.17	3.79	0.00	0.30

MPHASIS	0.16	3.08	0.06	0.23
MINDTREE	0.21	3.0	0.02	0.19
POLARIS	0.37	1.24	0.02	0.23
ROLTA INDIA	0.20	1.52	0.61	0.08

TABLE 4: POSITION OF IT COMPANIES ACCORDING THE SELECTED INDICES AND THEIR RANKING

Company	ROE	μ_{ROE}	CR	μ_{CR}	DR	μ_{DR}	P/E	μ_{PE}	Min Degree	Rank
A_1	0.25	0.5	3.66	0.00	0.004	0.008	0.21	0.42	0.00	1
A_2	0.32	0.45	4.03	0.00	0.00	0.00	0.17	0.34	0.00	2
A_6	0.17	0.24	3.79	0.00	0.00	0.00	0.30	0.60	0.00	3
A_7	0.16	0.23	3.08	0.00	0.06	0.12	0.23	0.46	0.00	4
A_8	0.21	0.30	3.0	0.00	0.02	0.04	0.19	0.38	0.00	5
A_4	0.27	0.38	2.16	0.84	0.01	0.02	0.15	0.30	0.01	6
A_5	0.21	0.3	1.78	1.22	0.02	0.04	0.14	0.28	0.02	7
A_9	0.37	0.53	1.24	1.00	0.02	0.04	0.23	0.46	0.02	8
A_3	0.21	0.3	0.24	0.76	0.022	0.04	0.15	0.30	0.04	9
A_{10}	0.20	0.28	1.52	1.00	0.61	1.22	0.08	0.16	0.08	10

IV. RESULT

From the result in Table 4, we can very well rank the companies on the basis of their financial performance using fuzzy logic technique. Out of ten top ranking IT companies, the first preference for investment should be given to TCS. Infosys, Oracle, Mphasis, Mindtree, HCL Technologies, Tech Mahindra, Polaris, Wipro, Rolta India were found to be the second to tenth preference for investment respectively.

V. CONCLUSION

This research article evaluates the financial performance and consequently assigns their rank using fuzzy logic techniques. This approach can very well be used as an alternative to the fundamental and technical analysis of investment which are comparatively less reliable and the fuzzy logic techniques used here in are proved to be more reliable guide to the investors in stock market securities [10].

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