BUILDING AN OPTIMAL PORTFOLIO USING SHARPE'S SINGLE INDEX MODEL: AN EMPIRICAL STUDY WITH REFERNCE TO INDIAN CAPITAL MARKETS

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Abstract: This research paper aims to build an optimal portfolio by using Sharpe's Index Model. The study employs the data from - Bombay Stock Exchange - popular Index "Sensex". The stock prices during 1st January 2019 to 31st December 2019 are considered for the study. Various measures such as mean return, Beta coefficient, Excess return, Standard deviation, Variance, Cut off rate, Proportion of investment, Portfolio Return and risk are computed. The results showed that, twenty one stocks were bullish during the study period and benefitted investor with positive returns consistently and nine stocks showed negative trend/returns. Therefore, the study brings into play those 21 stocks with positive returns to determine the cut off rate. Further, application of Sharpe's Index model highlighted the stocks to be used for constructing the optimal portfolio. As per the results obtained from the model, Optimal Portfolio is built by selecting ten stocks which are above the cut off rate. This paper throws light on the method of constructing the portfolio and its application, which indeed is beneficial not just for investors but also for other market participants in selecting stocks to form a portfolio and maximize their return.

Key Words: Portfolio, Mean return, Beta, Standard deviation and Sharpe Index Model.

JEL Classification: G1, G11, G110.

I. INTRODUCTION

Investment in financial terms refers to "employment of funds in financial assets" in which the return is expected over a period of time either in the form of dividend or interest or capital appreciation of stock. Since, the return expected is to be realized in the future, there is always an element of uncertainty. This uncertainty is termed as risk. Return and Risk are considered to be the two faces of investment coin and therefore investors analyse both these factors while taking investment decision. . It is crucial for the investors, issuers and market makers to understand the dynamics of the capital market (Archana & Lakshmi, 2019). There are various categories of investors based on their risk taking attitude, such as high risk avoiders, medium risk avoiders and low risk avoiders. Investment in individual security is always riskier. Hence, the saying "Do not Put all your eggs in One Basket" (Warren Buffet, 2015). Thus, people intend to diversify their risk by investing in more than one security or a group of securities, which is known as a "Portfolio". Portfolio helps in diversifying the risk, as more number of securities added to a portfolio helps in maximizing return. Constructing a portfolio is a challenging, complex and intricate task. Before, attempting to build a portfolio, every Investor is required to be decisive on vital things such as the amount of investable funds, duration of investment, objective of investment, attitude towards risk and return etc. Apart from it, they must also decide on crucial things such as which securities are to be selected for portfolio and proportion of funds to be invested in each stock. Various models such as Markowitz model, Sharpe Index model and Multi Index model can be used to build a portfolio. Among them, Sharpe's Index model is considered to be effective, simple and easy method compared to other two as the other models requires huge number of inputs, and are complex in nature to calculate. Since, large inputs are required for other models, computing also takes longer time and by then the nature of securities can change. Therefore, this paper attempts to build a portfolio by using Sharpe's Single Index model. The review of the works done is discussed in second section, the third and fourth section divulges into the research objectives and methodology followed, data is analysed and interpreted in fifth section and the paper concludes by making concluding remarks in sixth section.

II. REVIEW OF LITERATURE

S. Poornima and Aruna P Remesh (2015) constructed an optimal portfolio by using Sharpe's single index model by considering during the period from January 2010 to December 2015 with special reference to Banking and IT sector. In total 20 stocks selected from each industry and examined the sharpe's single index model by calculating excess return, beta, variance and cut off rate, further portfolio is constructed by selecting three stocks and their proportion of investments in each stocks.

R Nalini (2014) carried out the portfolio construction and proportion of investment in each stock by using Single Sharpe Index model of fifteen companies from Bombay stock exchange during 2009 to 2014. The methodology used for the study to attain the cut off rate are individual Stock Return, Beta, Systematic and Unsystematic risk, Market variance and residual variance, excess return. Out of 15 stocks, 4 stocks are selected to construct a portfolio based on cut off rate and also has given the weightage of investment in each stocks by using single sharpe index model.

Mokta Rani Sarker (2013) examined the 164 companies by considering monthly closing prices to construct a portfolio by using Sharpe index model during July 2007 to June 2012 from Dhaka stock exchange. The objective of the paper was to construct a portfolio and proportion of investments by calculating cut off rate and also to suggest investors and market makers to make better decisions in portfolio. Portfolio was constructed by selecting 33 stocks, out of 164 stocks based on SIM model. Further, the researcher has analyzed by calculating Portfolio Alpha, Beta, Risk and return.

Dharmalingam N and Balanaga Gurunathan, K (2016) explored with an objective to construct an portfolio and also to know the proportion of investment in each stocks using Sharpe index model with specifically to sugar and metal industry from 1st April 2012 to 31st March 2016 from National stock exchange. Total 19 companies were selected from National stock exchange based on simple random sampling. Finally, researcher constructed a portfolio of 12 stocks based on cut off rate and weightage of investment in each stock by using single index model this might help investors to make better decisions.

Deepak Kumar D (2013) documented the research paper with an objective to construct an optimal portfolio by Sharpe single index model of banking sector from January 2011 to December 2012 from Bombay stock exchange. The ten top Banks were selected for the study based on PE ratio and the methodology such as Return, Standard deviation, Beta, Unsystematic risk and Market variance were used. Finally, the three Banks were selected to construct a portfolio by using Sharpe single index model and also highlighted that investing in portfolio is always a better option than investing in individual stocks that diversify risk and maximize return.

Saurabh Singh and Jayant Gautam (2014) used Sharpe index model to construct a portfolio and proportion of investment in individual stocks of Banking sector during January 2009 to December 2013. Ten banks were selected from the National stock exchange and CNX Bank price Index. Based on the cut off rate calculated by SIM model, two banks were used to construct a portfolio. The study highlighted that the Sharpe index model is simple and easy compared to Markowitz model.

S Subashree and M Bhoopal (2017) documented that the Banking and Automobile sector were considered to create a portfolio by using the Sharpe's single index model for the period of October 2016 to September 2017 from Bombay stock exchange. In total 10 companies were selected and ranked according to excess return to beta ratio. The other such measures were used such as market variance, Standard deviation, Unsystematic risk, cut off rate and the weightage are calculated by applying Sharpe Index model. Finally, portfolio constructed by three companies were selected, one company was selected from banking sector and two from the automobile sector.

Tanuj Nandan and Nivedita Srivastava (2017) endeavors to create a portfolio by using Sharpe's single index model of Nifty 50 stocks during 1st August 2010 to 31st July 2015. The statistical tools were used such as Mean stock return, mean index return, Standard deviation, and variance, systematic and unsystematic risk to determine the values of all nifty stocks and the weekly data of MIBOR has been averaged for the last five years as considered as risk free rate of return. Finally, 24 companies were chosen to construct a portfolio based on the cut off rate by using Sharpe's single index model.

Suresh A S (2015) applied Sharpe's single index model to build an optimal portfolio on selected mutual fund schemes during 2007-08 to 2011-12 in Indian capital market. In total eight schemes were selected such as Birla sun

life India gennext, SBI Magnum Midcap, Kotak Classic Equity, SBI Emerging Businesses, Kotak 50, Axis Equity, TATA Equity Management and UTI India Lifestyle. Birla sun life India gennext and UTI India Lifestyle formed a portfolio based on the cut off rate calculated by using Sharpe's single index model.

Chintan A. Shah (2015) examined the comparison study of Sharpe Index and CAPM model in constructing a portfolio of BSE top 15 companies based on market capitalization from January 2010 to March 2015 in Indian capital market. The statistical tools were used such as expected return, Standard deviation, Residual variance, Sharpe and CAPM model. According to Sharpe Index model based on cut off rate, five companies are chosen to form a portfolio, whereas the CAPM model suggested 11 stocks are underpriced designates to buy a stock. Researcher highlighted that the CAPM model emphasis on individual security, whereas Sharpe index model emphasis on portfolio of securities which simplifies to build a portfolio and also to determine the proportion of investment in each stocks.

Niranjan Mandal (2013) empirically constructed an optimal portfolio by using Sharpe single index model by considering BSE Sensex as market performance index during April 2001 to March 2011. The portfolio is formed by considering ten stocks based on the cut off rate using single index model and also portfolio risk and return were calculated. Further, it is highlighted that the portfolio return is higher than the individual stock return except in two stocks and portfolio standard deviation is less than the individual stocks except in four securities. Finally, he concluded that the Sharpe's Single index model is simple and easier to construct a portfolio than the Markowitz's Mean Variance model.

William F Sharpe (1963) explicated the process of selecting stocks to form a portfolio by applying the Markowitz model by using various techniques such as critical line method, Diagonal model and the analogue of considering 2000 securities. Further says that the diagonal model performed well in representing the relationship among securities can be used for the initial application of Markowitz technique.

Elton et al(1978) used simple technique to find out the efficient portfolio in two cases such as single index model and a model of constant correlation coefficient to construct an optimal portfolio.

III. RESEARCH OBJECTIVES

1. To analyse the stocks listed on BSE Sensex by computing systematic risk and Return
2. To examine the cut off rate by applying Sharpe Index Model
3. To construct an optimal portfolio and to calculate the proportion of investment in each security.
4. To calculate Portfolio risk and return of an optimal portfolio.

IV. RESEARCH METHODOLOGY

Data: The data used for the study is mainly secondary in nature. It is collected from various sources such as published journals, magazines, text books and websites of RBI and BSE. Closing prices of BSE 30 stocks are collected from the website of Bombay stock exchange.

Period: The period of study is 1st January 2019 to 31st December 2019.

Methodology:

1. **Return:** The return on stock is either in the form of yield or capital appreciation. Yield refers to earnings generated and realized on an investment over a particular period of time. Whereas, capital appreciation refers to the difference between the purchase price and the selling price of stock. The daily return of individual stock is calculated by using the following formula.

$$R_i = \frac{(P_t - P_0)}{P_0} \times 100$$

Where,
R_i = Return in individual security
P_t = Current Closing price of the day
P_o = Previous Closing price of the day

2. **Excess Return to Beta ratio:** The excess return is the difference between the individual security return and the risk free rate of return offered on the government security such as Treasury bill. The study takes into account one year or 364 day Treasury bill rate, which is 6.41% as the risk free rate of interest/return. Excess return to beta measures the additional return earned for bearing risk per unit.

$$\text{Excess return to beta ratio} = \frac{(R_i - R_f)}{\beta_i}$$

Where,
R_i = Expected return on individual stock
R_f = Risk free rate of return
β_i = Systematic risk of individual stock

3. **Systematic risk (βi):** Beta refers to the statistical tool used to measure the volatility of the stock market. Greater the value of Beta, higher is the volatility and vice versa. Beta is calculated by using the following formula.

$$\beta_i = \frac{\text{Covariance } (R_i, R_m)}{\text{Variance } (R_m)}$$

Where,

R_i = Expected return of individual security
R_m = Return from market index

4. **Unsystematic risk:** Unsystematic risk cannot be eliminated completely, but it can be diversified by adding more securities into the portfolio. It is the difference between the total risk and the systematic risk. The unsystematic risk is calculated as follows

$$\sigma_{ei}^2 = \sigma_i^2 - \beta^2 \sigma_m^2$$

Where
σ_{ei}^2 = Unsystematic risk of the portfolio
σ_i^2 = Variance of the individual stock
β = Systematic risk
σ_m^2 = Variance of the market index

5. **Standard Deviation:** Standard deviation measures the total risk of a security. The square root of the variance is referred to as standard deviation.

$$\sigma_i = \text{SQRT} \quad \frac{(R_i - \bar{R_i})^2}{n-1}$$

Where,
σ_i = Standard deviation of individual security
R_i = Expected return of individual security
$\bar{R_i}$ = Mean return of individual security
n = Number of observations

6. **Market Variance:** Variance is a tool used to measure the volatility of stock market. Higher the variance, higher is the volatility of the stock market and vice versa. The market variance is calculated from the following formula.

$$\sigma_m^2 = \frac{(R_m - \bar{R}_m)^2}{n-1}$$

Where,
σ_m^2 = Variance of Market index return
R_m = Expected return of Market index
$\bar{R}_m$ = Mean return of Market index.
n = Number of observations

7. **A) Cut off rate by using Sharpe Index Model:** Cut off rate is calculated by using the following formula.

$$C_i = \frac{\sigma_m^2 \sum_{i=1}^{N} \frac{(R_i - R_f)}{\sigma_{ei}^2} \times \beta_i}{1 + \sigma_m^2 \sum_{i=1}^{N} \frac{\beta_i^2}{\sigma_{ei}^2}}$$

Where,
R_i = Expected return of individual stock
R_f = Risk free rate of return
β_i = Systematic risk of individual stock
σ_m^2 = Variance of the market index
σ_{ei}^2 = Unsystematic risk

B) Proportion of Investments in each individual security is calculated as follows: The proportion of investment in each security that is a part of portfolio is calculated using the following formula:

$$Z_i = \frac{\beta_i}{\sigma_{ei}^2}\left[\left(\frac{R_i - R_f}{\beta_i}\right) - C^*\right] \qquad X_i = \frac{Z_i}{\sum_{i=1}^{N} Z_i}$$

Where,
X_i = Proportion of investment in individual security
R_i = Expected return of individual security
R_f = Risk free rate of return
β_i = Systematic risk
C = Cut off point
σ_{ei}^2 = Unsystematic risk

8. **Portfolio Return and Risk :** Portfolio return and risk is calculated by using the following formula

(A) Portfolio Return

$$\mathbf{R_p = \alpha_p + \beta_p R_m}$$
$$\alpha_p = \sum x_i \alpha_i$$
$$\beta_p = \sum x_i \beta_i$$

Where,
R_p = Portfolio Return
α_i = Specific return of an individual security
β_i = Beta coefficient of an individual security
R_m = Return of Market Index

(B) Portfolio Risk

$$\sigma_p^2 = \beta^2 \sigma_m^2 + \sum x_i^2 \sigma^2_{ei}$$

Where,
σ_p^2 = Portfolio Variance
β = Beta coefficient
σ_m^2 = Market variance
x_i = Proportion of investment in individual security
σ^2_{ei} = Unsystematic risk

V. DATA ANALYSIS AND INTERPRETATION

I. Classification of BSE 30 Stocks on the basis on industry

Table 1.1: Industry classification of BSE 30 stocks

SL.NO	NAME OF THE COMPANY	INDUSTRY
1	BAJAJ-AUTO	AUTOMOTIVE
2	HEROMOTOCO	
3	M&M	
4	MARUTI	
5	ULTRACEMCO	CEMENT & CEMENT PRODUCTS
6	L&T	CONSTRUCTION & ENGINEERING
7	NTPC	ELECTRIC UTILITIES
8	POWERGRID	
9	AXISBANK	FINANCE
10	HDFCBANK	
11	ICICIBANK	
12	INDUSINDBK	
13	KOTAKBANK	
14	SBIN	
15	HDFC	
16	BAJFINANCE	
17	ITC	FMCG
18	HINDUNILVR	
19	ASIANPAINT	FURNITURE, FURNISHING & PAINTS
20	ONGC	INTEGRATED OIL & GAS
21	RELIANCE IND.	
22	TATASTEEL	IRON & STEEL/INTERM. PROD
23	HCLTECH	IT CONSULTING & SOFTWARE
24	INFYOSYS	
25	TCS	
26	TECHM	
27	TITAN	OTHER APPARELS &

		ACCESSORIES
28	NESTLEIND	PACKAGED FOODS
29	SUNPHARMA	PHARMACEUTICALS
30	BHARTIARTL	TELECOM SERVICES

Source: BSE Website

Analysis: Table 1.1 indicates the classification of stocks industry wise. It is evident from the table that the stocks are diversified into various sectors. Majority of them being into financial services sector, followed by IT and automobile sectors.

Table 1.2: Return and Beta values of BSE 30 Stocks

Sl. No	Name of the Company	Beta (β)	Returns (%)
1	ASIANPAINT	0.92	0.12
2	AXISBANK	1.32	0.09
3	BAJAJ-AUTO	0.78	0.07
4	BAJFINANCE	1.51	0.21
5	BHARTIARTL	0.95	0.17
6	HCLTECH	0.37	-0.13
7	HDFC	1.17	0.09
8	HDFCBANK	1.43	-0.13
9	HEROMOTOCO	1.22	-0.08
10	HINDUNILVR	0.68	0.03
11	ICICIBANK	1.42	0.18
12	INDUSINDBK	1.79	0.01
13	INFYOSYS	0.34	0.06
14	ITC	0.74	-0.06
15	KOTAKBANK	0.97	0.13
16	L&T	-0.01	0.11
17	M&M	1.41	-0.14
18	MARUTI	1.44	0.01
19	NESTLEIND	0.61	0.13
20	NTPC	0.45	-0.07
21	ONGC	1.01	-0.04
22	POWERGRID	0.31	-0.01
23	RELIANCE IND.	0.98	0.14
24	SBIN	1.73	0.07
25	SUNPHARMA	0.55	0.02
26	TATASTEEL	1.54	-0.01
27	TCS	0.31	0.06
28	TECHM	0.33	0.03
29	TITAN	0.89	0.12
30	ULTRACEMCO	1.31	0.02

Source: Compiled by authors

Analysis: From the above table 1.2, it is clear that the returns of stocks ranges from -0.14 and 0.21, Whereas, the values of Beta lie in the range of -0.01 to 1.79. It is important to note that, if the value of Beta is greater than one, it indicates the stock is highly volatile and is more sensitive towards the market return, any small change in market return influences more than proportionate change in the stock prices. It is evident from the table that 13 stocks have beta value more than 1.

Table 1.3: Positive Return of BSE stocks

Sl.No	Name of the Company	Beta (β)	Returns (%)
1	BAJFINANCE	1.51	0.21
2	ICICIBANK	1.42	0.18
3	BHARTIARTL	0.95	0.17
4	RELIANCE IND.	0.98	0.14
5	KOTAKBANK	0.97	0.13
6	NESTLEIND	0.61	0.13
7	ASIANPAINT	0.92	0.12
8	TITAN	0.89	0.12
9	L&T	-0.01	0.11
10	AXISBANK	1.32	0.09
11	HDFC	1.17	0.09
12	BAJAJ-AUTO	0.78	0.07
13	SBIN	1.73	0.07
14	INFYOSYS	0.34	0.06
15	TCS	0.31	0.06
16	HINDUNILVR	0.68	0.03
17	TECHM	0.33	0.03
18	SUNPHARMA	0.55	0.02
19	ULTRACEMCO	1.31	0.02
20	INDUSINDBK	1.79	0.01
21	MARUTI	1.44	0.01

Analysis: Table 1.3 shows up only stocks with positive returns during the study period. It is clear from the table that of the 30 stocks, 21 stocks have positive returns. These 21 stocks form the sample size on which Sharpe model is applied to find out the cut off rate and its inclusion in the portfolio.

II. Computation of Cut off rate, Excess return to Beta ratio, Standard deviation, Variance and Unsystematic risk

Table 2.1: Excess Return to Beta ratio

Sl. No	Name of the Company	Returns (R_i) %	Excess Return (R_i-R_f)%	Beta	Excess Return to Beta	Rank
1	BAJFINANCE	0.21	0.192	1.51	0.127	4
2	ICICIBANK	0.18	0.162	1.42	0.114	9
3	BHARTIARTL	0.17	0.152	0.95	0.160	2
4	RELIANCE IND.	0.14	0.122	0.98	0.125	5
5	KOTAKBANK	0.13	0.112	0.97	0.116	7
6	NESTLEIND	0.13	0.112	0.61	0.184	1

7	ASIANPAINT	0.12	0.102	0.92	0.111	10
8	TITAN	0.12	0.102	0.89	0.115	8
9	L&T	0.11	0.092	-0.01	-9.244	21
10	AXISBANK	0.09	0.072	1.32	0.055	13
11	HDFC	0.09	0.072	1.17	0.062	12
12	BAJAJ-AUTO	0.07	0.052	0.78	0.067	11
13	SBIN	0.07	0.052	1.73	0.030	15
14	INFYOSYS	0.06	0.042	0.34	0.125	6
15	TCS	0.06	0.042	0.31	0.137	3
16	HINDUNILVR	0.03	0.012	0.68	0.018	16
17	TECHM	0.03	0.012	0.33	0.038	14
18	SUNPHARMA	0.02	0.002	0.55	0.004	17
19	ULTRACEMCO	0.02	0.002	1.31	0.002	18
20	INDUSINDBK	0.01	-0.008	1.79	-0.004	19
21	MARUTI	0.01	-0.008	1.44	-0.005	20

Source: Compiled by authors by taking values from websites of BSE and RBI, R_f = 6.41% p.a. For calculation purpose the risk free rate is taken as 0.018% per day.

Analysis: Table 2.1 indicates the excess return or additional return earned per unit of systematic risk. The excess return to beta ratio shows the desirability of stock that can be included in constructing a portfolio (Fischer & Jordan, 1995). It is calculated using the formula as discussed in methodology part of the paper. They are further ranked from highest to lowest based on return. It is clear from the table that excess return per unit of risk taken is maximum in Bharti Airtel stock followed by stocks of Nestle, Bajaj Finance and so on. It is also pertinent to note that 3 of the stocks have negative values of excess return to beta ratio.

Table 2.2: Computation of Cut off rate using Sharpe's Single Index Model

Sl. No	Name of the Company	Excess Return ($R_i - R_f$)	Beta	SD	Un systematic Risk (σ_{ei}^2)	$((R_i - R_f)*\beta/\sigma_{ei}^2$	β^2/σ_{ei}^2	$\Sigma(R_i - R_f)*\beta/\sigma_{ei}^2$	$\Sigma\beta^2/\sigma_{ei}^2$	Cut off rate
1	NESTLEIND	0.112	0.61	1.38	1.62450638	0.042220454	0.229054	0.042220454	0.229054	0.027090653
2	BHARTIARTL	0.152	0.95	2.31	4.6572395	0.031094909	0.193784	0.073315363	0.422839	0.041840169
3	TCS	0.042	0.31	1.43	1.97261358	0.006669269	0.048717	0.079984632	0.471556	0.044411498
4	BAJFINANCE	0.192	1.51	2.01	2.32500878	0.124980998	0.980684	0.20496563	1.45224	0.073684281
5	RELIANCE	0.122	0.98	1.69	2.13368712	0.056235794	0.450113	0.261201424	1.902353	0.080822609
6	INFYOSYS	0.042	0.34	1.75	2.97554568	0.004849208	0.03885	0.266050632	1.941203	0.081345213
7	KOTAKBANK	0.112	0.97	1.36	1.14185502	0.095515809	0.82401	0.361566441	2.765213	0.088302233
8	TITAN	0.102	0.89	1.81	2.68028238	0.034015124	0.295529	0.395581565	3.060742	0.0901061
9	ICICIBANK	0.162	1.42	1.78	1.65166392	0.139654601	1.220829	0.535236166	4.281571	0.095390433
10	ASIANPAINT	0.102	0.92	1.38	1.26773792	0.074339724	0.667646	0.60957589	4.949217	**0.097087086**
11	BAJAJ-AUTO	0.052	0.78	1.4	1.50236152	0.027225083	0.404962	0.636800974	5.354179	0.095277954
12	HDFC	0.072	1.17	1.47	1.13121342	0.074922093	1.210116	0.711723066	6.564296	0.090163093
13	AXISBANK	0.072	1.32	1.68	1.51176672	0.063249593	1.152559	0.77497266	7.716855	0.085667473
14	TECHM	0.012	0.33	1.44	1.99168542	0.002060897	0.054677	0.777033556	7.771532	0.085379243

15	SBIN	0.052	1.73	2.16	2.41434062	0.037574796	1.239635	0.814608352	9.011166	0.078777667
16	HINDUNILVR	0.012	0.68	1.14	0.95178272	0.008886568	0.485825	0.823494921	9.496992	0.076063419
17	SUNPHARMA	0.002	0.55	2.05	3.9749595	0.000337386	0.076101	0.823832307	9.573093	0.075563429
18	ULTRACEMCO	0.002	1.31	1.82	2.02154958	0.001580098	0.848903	0.825412405	10.422	0.070239316
19	INDUSINDBK	-0.008	1.79	2.51	3.88997598	-0.003479544	0.823681	0.821932861	11.24568	0.065361877
20	MARUTI	-0.008	1.44	1.95	2.24273808	-0.004855122	0.924584	0.817077739	12.17026	0.060525643
21	L&T	0.092	-0.01	0.87	0.75682478	-0.001221397	0.000132	0.815856342	12.17039	0.060434576

Source: Compiled by authors by taking various values

Analysis: Table 2.2 shows the computation of cut off rate using Sharpe's Single Index Model. Various measures such as Excess return, Beta, Standard deviation, unsystematic risk and cut off rate is calculated by using the formula explained in the methodology part of the paper. It is observed that the cut off rate steadily increases from 0.02709 to 0.09708 and then decreases. Therefore, the value 0.09708 is considered as the cut off rate. The stocks which are below the cut off rate are not included in the portfolio. Thus, the portfolio is constructed using 10 stocks for the period under study.

Table 2.3: Construction of Portfolio and Proportion of Investment in each Stock

Sl. No	Name of the Company	$(R_i - R_f)/ \beta$	Unsystematic Risk (σ_{ei}^2)	β_i/ σ_{ei}^2	Cut off rate	Z value	X Proportion of Investment	
1	NESTLEIND	0.184325174	1.62450638	0.375498679	0.027090653	0.059041355	27.28878903	27%
2	BHARTIARTL	0.160461428	4.6572395	0.203983497	0.041840169	0.024196779	11.18370006	11%
3	TCS	0.136897923	1.97261358	0.157151914	0.044411498	0.014534419	6.717777497	7%
4	BAJFINANCE	0.12744262	2.32500878	0.649459913	0.073684281	0.034913886	16.13712408	16%
5	RELIANCE	0.124937098	2.13368712	0.459298831	0.080822609	0.020261733	9.364930182	9%
6	INFYOSYS	0.124818695	2.97554568	0.114264756	0.081345213	0.004967487	2.295961834	2%
7	KOTAKBANK	0.115915831	1.14185502	0.849494886	0.088302233	0.023457611	10.84205793	11%
8	TITAN	0.115099277	2.68028238	0.332054565	0.0901061	0.008299099	3.835825747	4%
9	ICICIBANK	0.114393209	1.65166392	0.859739068	0.095390433	0.016337429	7.551124929	8%
10	ASIANPAINT	0.111346039	1.26773792	0.725702044	0.097087086	0.010347751	4.782708711	5%

Source: Compiled by authors by taking various values

Analysis: Table 2.3 displays the computation of proportion of funds to be invested in the securities selected to be included in the portfolio. The computations show that 27% of the funds must be invested in Nestle, 16% in Bajaj Finance, 11% in Bharti Airtel and Kotak Bank, followed by Reliance Industries, ICICI Bank, TCS, Asian Paint, Titan and Infosys.

III. Calculation of Portfolio Risk and Return

Table 3 : Calculation of Portfolio Risk and Return

Sl.No	Name of the Company	X	R_i	SD	α_i	β_i	Unsystematic Risk	Alpha Portfolio(α_p)	Beta Portfolio(β_p)	Portfolio residual variance
1	NESTLEIND	0.27	0.13	1.38	0.088588	0.61	1.62450638	0.02391876	0.1647	0.118426515
2	BHARTIARTL	0.11	0.17	2.31	0.11526	0.95	4.6572395	0.0126786	0.1045	0.056352598
3	TCS	0.07	0.06	1.43	0.030348	0.31	1.97261358	0.00212436	0.0217	0.009665807
4	BAJFINANCE	0.16	0.21	2.01	0.133308	1.51	2.32500878	0.02132928	0.2416	0.059520225

5	RELIANCE	0.09	0.14	1.69	0.084084	0.98	2.13368712	0.00756756	0.0882	0.017282866
6	INFYOSYS	0.02	0.06	1.75	0.029172	0.34	2.97554568	0.00058344	0.0068	0.001190218
7	KOTAKBANK	0.11	0.13	1.36	0.074476	0.97	1.14185502	0.00819236	0.1067	0.013816446
8	TITAN	0.04	0.12	1.81	0.067612	0.89	2.68028238	0.00270448	0.0356	0.004288452
9	ICICIBANK	0.08	0.18	1.78	0.106836	1.42	1.65166392	0.00854688	0.1136	0.010570649
10	ASIANPAINT	0.05	0.12	1.38	0.066436	0.92	1.26773792	0.0033218	0.046	0.003169345

Portfolio Daily Return	0.1436645
Portfolio Annual Return	52.4375425
Portfolio Variance	0.944021715
Portfolio SD	0.971607799
Beta of Portfolio	0.9

Analysis: Table 3 illustrates the computation of return and risk of an optimal portfolio. The annualized return of the constructed optimal portfolio is 52%. Whereas, the standard deviation of the optimal portfolio is 0.97% which is less than the standard deviation of individual stocks. Similarly, the beta of the constructed portfolio is 0.9 (<1) which indicates less volatility.

VI.CONCLUSION

Investment in individual security is always riskier and therefore investors tend to invest in a group of securities termed as portfolio. Portfolio helps in diversifying the risk and maximizes the returns. It is not as easy task to construct a portfolio which is optimal. It requires analysis of return and risk. Apart from it, the investors has to compute the excess return earned for per unit risk, market return, cut off rate and proportion of funds to be invested in individual securities. Thus, this paper attempts to discuss the methodology and computations involved in selecting the stocks for building the portfolio and the proportion of funds to be invested. The study employed Sharpe's Single Index Model for selecting the stocks from BSE Sensex. During the study period, the study revealed that ten securities form the optimal portfolio. The results obtained are limited for the period under study and can differ with varying time periods; differing indices, and models chosen for the study. This information helps investors to take right investment decisions. This information serves to be beneficial for investors and other market participants in selecting stocks to form a portfolio and maximize their return.

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