DOI: 10.21276/sjebm.2016.3.7.4

Scholars Journal of Economics, Business and Management e-ISSN 2348-5302
Monica Verma *et al.*; Sch J Econ Bus Manag, 2016; 3(7):382-390 p-ISSN 2348-8875

(An International Publisher for Academic and Scientific Resources)

Performance Evaluation of Portfolio using the Sharpe, Jensen, and Treynor Methods

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Abstract: This paper attempts to get an insight and to construct an optimal portfolio empirically using Sharpe's single index model, Further, we evaluate portfolio and market returns using Sharpe, Jensen and Treynor Ratio. The study is based on secondary data collected from www.nseindia.com and www.riskcontrol.com. Taking Nifty- 50 as the Market Performance Index (MPI) and considering weekly closing share prices of all the stocks for the period between 1st January 2015 to 31st December 2015, the cut- off rate has been computed and those securities are selects to construct an optimal portfolio whose excess return to beta ratio is greater than the cut-off rate. Our study shows that the composition of the optimal portfolio would be 0.80 % of fund invested in Infosys 0.20 % of fund invested in Bank of Baroda. Evaluation of Portfolio and market return by Sharpe, Jensen and Treynor Ratio show market returns is lower than that of the securities. And Treynor measure has a positive return on portfolio, however other ratios consistently giving negative return in 2015.
Keywords: Sharpe Ratio, Portfolio Optimization, Jensen's Alpha, Treynor Ratio, systematic risk, unsystematic risk, diversified portfolios, Beta, Cut-off Rate, Expected Return on security, Risk free rate

INTRODUCTION

The rational investors never ignore the risk factor while taking investment decisions. The investors prefer to invest in a group of securities which is known as a portfolio in order to diversify the risk. There are different investment avenues for investors to invest. While some investment avenues involve huge risk others may be either less risky or risk less avenues. Therefore, it is essential to educate the investor about the investment alternatives and the risk and return from those investments. Modern portfolio theory provides a well developed paradigm to form a portfolio with the highest expected return for a given level of risk tolrance.

The Theoretical Insight

The portfolio performance evaluation determines how a particular investment portfolio has performed relative to some comparison benchmark. The performance evaluation methods generally fall into two categories, namely conventional (Benchmark Comparison and Style Comparison) and risk-adjusted methods (While there are many such methods, the most notables are the Sharpe ratio, Treynor Ratio, Jensen's alpha, and Treynor Squared).

Harry Markowitz, in early 1950's developed a comprehensive model in which he made a simple assertion that almost all investors invest in multiple securities for obtaining benefits from the investment in portfolio consisting of different stocks. In this model he formulated the fundamental theorem of mean- variance portfolio framework which explains trade- off between mean and variance each representing expected returns and risk of portfolio, respectively. Although Markowitz's theory uses only mean variance to describe the characteristics of return, his theory about the structure of portfolio became a cornerstone of modern portfolio theory [1]. While Markowitz's model is viewed as a classic attempt to develop a comprehensive technique to incorporate first the concept of diversification of investments in a portfolio as a risk reduction mechanism, it has many limitations. One of the most noteworthy limitation being complexity in computation as the number of securities in the portfolio increase. To this direction, in 1966 William F. Sharpe has developed simplified Single Index Model (SIM) by taking cue from Markowitz's concept of index for generating covariance terms. This model gives estimate of a security's return as well as of the value of index. Sharpe further extended the model and introduced the capital Asset Pricing Model (CAPM) to solve the problem behind the determination of correct, arbitrage- free fair equilibrium price of an asset. The CAPM specifies the expected return in terms of the risk-free rate, systematic risk, and the market risk premium. The main problems with this ratio is that, firstly, it relies on the notions that risk equals volatility (volatility is bad) and it treats all volatility the same. Secondly, if applied to a single fund in isolation, the

Sharpe ratio ignores the correlation of the fund with the other investments in the portfolio, and so it may not correspond in any meaningful way to the desirability of the fund as an investment. If the Sharpe ratio of a fund is higher than that of the investor's total investment portfolio, we may still be able to conclude that the investor should be interested in the fund. However, if it is lower, we cannot draw any conclusions without knowing about the correlations. Thirdly, it may also be inappropriate when returns are highly non- normal. Furthermore, if the returns distributions are highly skewed, such as when options may be traded, the Sharpe ratio can be misleading. Despite these limitations, the Sharpe ratio is used in practice as a measure of portfolio performance as its principal advantage is that it is directly computable from any observed series of returns without need for additional information surrounding the source of profitability and observes both systematic and idiosyncratic risk.

Treynor [2] provides an alternative reward- to – risk ratio. **The Treynor ratio** named after Jack L. Treynor computes the risk premium per unit of systematic risk. The risk premium is same as defined in the Sharpe measure. The difference in this method is that it uses the systematic risk of the portfolio as the risk parameter and it cannot be eliminated through diversification. It is measured by the parameter known as 'beta'

While the Sharpe ratio measures the risk premium of the portfolio over the portfolio risk, or its standard deviation, Treynor's ratio, compares the portfolio risk premium to the systematic risk of the portfolio as measured by its beta. It is a measure of the return per unit risk.

Like the Sharpe ratio, the Treynor ratio does not quantify the value added. It is a ranking criterion only. A ranking of portfolios based on the Treynor Ratio is only useful if the portfolios under consideration are sub-portfolios of a broader, fully diversified portfolio. If this is not the case, portfolios with identical systematic risk, but different total risk, will be rated the same. But the portfolio with a higher total risk is less diversified and therefore has a higher unsystematic risk which is not priced in the market.

An alternative method of ranking portfolio management is Jensen's alpha. Developed by Michael C. Jensen (1968), **Jensen's alpha** is based on the Capital Asset Pricing Model (CAPM) of Sharpe [3], Lintner [4], and Mossin [5]. It quantifies the added return as the excess return above the security market line in the capital asset pricing model. The alpha represents the amount by which the average return of the portfolio deviates from the expected return given by the CAPM. Hence, alpha is determined by the fundamental values of the companies in the portfolio in contrast to beta, which measures the portfolio's return due to its volatility. The alpha can be greater than, less than, or equal to zero. An alpha greater than zero suggests that the portfolio earned a rate of return in excess of the expected return of the portfolio. Despite being the most popular performance measures in academic studies it too has some disadvantages.

When the portfolio is well diversified all three methods - Sharpe, Treynor, and Jensen – will give the same ranking of performance. When the portfolio is not well diversified or when it represents the total wealth of the investor, the appropriate measure of risk is the standard deviation of returns of the portfolio, and hence the Sharpe ratio is the most suitable. When the portfolio is well diversified, however, a part of the total risk has been diversified away and the systematic risk is the most appropriate risk metric. Both Treynor ratio and Jensen's alpha can be used to assess the performance of well-diversified portfolios of securities. These two ratios are also appropriate when the portfolio represents a sub-portfolio or only a part of the client's portfolio.

REVIEW OF LITERATURE

Sharpe's Single Index Model gives an easy mechanism for constructing an optimal portfolio of stocks (as number of inputs required in SIM is less than in Markowitz's model when arriving at risk and returns) for a rational investor by analyzing the reason behind the inclusion of securities in the portfolio with their respective weights Mandal [6]. Goetzmann *et al.* [7] show that by selling put options at fair market prices one can generate very high Sharpe ratios without investment skill. Average return is more closely related to the beta measured with respect to a stock market index than to the beta measured with respect to consumption growth [8]. Multiple Index Model would give more robust results if we use country level data to evaluate the risk return trade off faced in agriculture enterprise selection. The greater the Sharpe's ratio of portfolio, the better will be the performance of it. Returns on either individual securities or on portfolio comprising of securities of different companies listed in Nifty 50 stocks under various sector are asymmetrical and heterogeneous [9]. Both Sharpe and Treynor ratio can be based on either ex ante or ex post excess return and standard deviation [10] expost ratios are most useful for evaluating past investments performance and for making decisions about future portfolio allocation. However, for decision making purpose ex ante ratios are preferred. Chen & Lee [11] examined the statistical distribution of Sharpe, Treynor, and Jensen measures and shows that the empirical relationship between these measures and their risk proxies is dependent on the

sample size, the investment horizon and market conditions. Cumby and Glen [12], Grinblatt and Titman [13] have provided evidence of the application of performance evaluation techniques. Dileep & Rao [14] suggest that Indian investors can apply Sharpe's Single Index Model and can construct a portfolio for improving the expected returns on their investment, it is applicable and sustainable to get better returns in secondary market

Need For Study

Every investor not only is confused but also in dilemma while deciding about the proportion of investment to be made in each security. To help investors get out of such chaotic situations the Sharpe's Single Index model may be used to construct an optimal portfolio. This helps the investor to find a portfolio that best suits his needs. The present study is undertaken to prove that by applying this model an individual can construct a portfolio with maximum return for a given level of risk.

OBJECTIVES OF THE STUDY

- To Construction Portfolio by Sharpe's Single Index Model and analyse its return.
- To Evaluate Portfolio by Sharpe, Jensen and Treynor Ratio.
- To Optimize Performance of Portfolio.
- To compute investment Proportion of security included in Portfolio.

METHODOLOGY

The study is based on secondary data procured by surfing www.nseindia.com www.riskcontrol.com. For the purpose of the study, Nifty-50 is taken as the Market Performance Index (MPI). With weekly closing share prices of all the stocks for the period between 1st January 2015 to 31st December 2015 (1 Year) are taken into account for the purpose of computing daily return of each security as well as calculating the daily market return. Taking the computed mean daily return of each security and that of the market, the proposed method formulates a unique cut off rate and selects those securities whose "excess-return to beta" ratio is greater than or equals to the cut off rate. Further the portfolio was kept on hold for three months i.e. January to March and thereafter we constructed a revised portfolio by including the new securities added to Nifty-50 on 1 April 2016 with a view to know the impact of new securities on the portfolio. To arrive at the optimal portfolio, the proportion of investment in each of the selected securities in the optimal portfolio is computed on the basis of its beta value, unsystematic risk, risk free rate of return, excess-return to beta ratio and the cut off rate. Different journals, periodicals, conference proceedings, books and other relevant documents have been consulted to supplement the theory as well as the data. All calculations have been done using MS Excel The available data have been analyzed and interpreted by using different statistical and financial tools and techniques, charts, diagrams etc. statistical tools

ANALYSIS AND INTERPRETATION

To arrive at optimal portfolio by applying Single index model (which security and in what proportion it is included) we at first, calculate excess return to beta ratio [(Ri – Rf) / β] for each security under consideration and then ranked all the security based on excess return to beta, from highest to lowest. Thereafter, calculated cutoff rate Ci

$$Ci = \frac{\sigma_m^2 \Sigma_i^i=1 (Ri-Rf)\beta i/\sigma^2_{ei}}{1+ \sigma_m^2 \Sigma_i^i=1 \beta_i^2/\sigma^2_{ei}}$$

all the securities having [(Ri – Rf) / β] ≥ Ci will be part of portfolio and securities having [(Ri – Rf) / β] < Ci will not be part of portfolio.

Table 1 and Table 2 show Excess Return to Beta and Cut-off rate respectively. Securities are ranked based on excess return to beta ratio from Highest to lowest, this ranking represent the desirability of including that security in portfolio (Table 1).

Table 2 represents the Ci of Nifty-50. The cumulative of (Ri- Rf) β/σ^2_{ei} and $\beta i^2/\sigma^2_{ei}$are necessary for the calculation of Ci. The Ci value goes on increasing from 0.000876935 to 0.002531264 and thereafter, starts declining. Therefore, the value of 0.002531264 is considered as the Cut-off Point. The securities which come after the cut-off point will not be considered for the Optimal Portfolio Construction. In other words, Securities having [(Ri – Rf) / β] ≥ Ci will be part of portfolio and securities having [(Ri – Rf) / β] < Ci will not be part of portfolio. Hence, we have considered two securities in portfolio i.e. Bank of Baroda and Infosys.

Consideration of New Securities

From April, National Stock Exchange (NSE) included Aurobindo Pharma Ltd, Bharti Infratel Ltd, Eicher Motor Ltd, and Tata Motors DVRs. To make room for the new inclusions, Cairn India Ltd, Punjab National Bank, and Vedanta Ltd were removed from the index. (All changes effective April 1, 2016.). With this the benchmark NSE index has 51 members. Table3, shows the Revised Excess Returns to Beta and Table 4 shows the revised Optimal Portfolio Construction.

Table 1: Calculation of Excess Return to Beta

Sr. No.	Company Name	Mean Return	Unsystematic Risk	Excess Return	Beta	Excess Return to Beta	Rank
		Ri	σ^2_{ei}	Ri-Rf	β	(Ri-Rf)/β	
1	ACC	-0.000601172	0.000548005	-0.076925892	0.911558078	-0.084389458	33
2	ADANIPORTS	-0.001881672	0.001660281	-0.078206392	1.29777536	-0.060261887	11
3	AMBUJACEM	-0.002024603	0.000675429	-0.078349323	1.190531034	-0.0658104	18
4	ASIANPAINT	0.003678352	0.000621267	-0.072646368	1.153551609	-0.062976262	16
5	AXISBANK	-0.001815103	0.001182901	-0.078139823	1.329190774	-0.058787515	8
6	BAJAJAUTO	0.000386202	0.000671997	-0.075938518	1.019827639	-0.07446211	29
7	BANKBARODA	-0.036221061	0.047437363	-0.112545781	-1.654720333	0.068014987	2
8	BHARTIARTL	-0.000755144	0.00146885	-0.077079864	0.805721733	-0.095665613	41
9	BHEL	-0.007487847	0.001249334	-0.083812567	1.254068629	-0.06683252	19
10	BOSCHLTD	0.000111627	0.001414914	-0.076213093	1.562212081	-0.048785369	3
11	BPCL	0.006103158	0.001165098	-0.070221562	0.501003731	-0.140161754	50
12	CAIRN	-0.010572446	0.001805568	-0.086897166	0.796532426	-0.109094323	46
13	CIPLA	0.000799287	0.000769426	-0.075525433	1.111165519	-0.067969561	22
14	COALINDIA	-0.002591194	0.001386516	-0.078915914	0.762796694	-0.103456025	44
15	DRREDDY	-0.000154143	0.001447535	-0.076478863	1.034133198	-0.073954558	28
16	GAIL	-0.002909941	0.001557931	-0.079234661	1.076855921	-0.07357963	27
17	GRASIM	0.001971833	0.000275559	-0.074352887	0.916537958	-0.081123631	31
18	HCLTECH	-0.011399981	0.010697202	-0.087724701	0.942161098	-0.093110087	39
19	HDFC	0.002343363	0.00055854	-0.073981357	1.430131598	-0.051730454	5
20	HDFCBANK	0.002484248	0.000150667	-0.073840472	0.839198531	-0.087989277	35
21	HEROMOTOCO	-0.002625961	0.000754024	-0.078950681	0.86195864	-0.091594512	36
22	HINDALCO	-0.011022166	0.002333455	-0.087346886	1.286046898	-0.067918896	21
23	HINDUNILVR	0.002633683	0.001121827	-0.073691037	0.795466816	-0.092638732	37
24	ICICIBANK	-0.005561948	0.000791941	-0.081886668	1.302097619	-0.062888271	15
25	IDEA	-0.000828716	0.002414944	-0.077153436	0.883686272	-0.087308628	34
26	INDUSINDBK	0.003985475	0.000456845	-0.072339245	1.16974839	-0.061841714	14
27	INFY	-0.010731609	0.009750775	-0.087056329	-0.224412026	0.387930767	1
28	ITC	-0.002180064	0.000992167	-0.078504784	0.725522526	-0.108204475	45
29	KOTAKBANK	-0.010453117	0.009312243	-0.086777837	1.452520967	-0.059742915	10
30	LT	-0.002936062	0.00066405	-0.079260782	1.113238366	-0.071198392	26
31	LUPIN	0.005034824	0.001616841	-0.071289896	0.745711624	-0.095599819	40
32	M&M	0.000254547	0.001064432	-0.076070173	1.260615456	-0.060343678	12
33	MARUTI	0.006168187	0.000963344	-0.070156533	0.588771748	-0.119157438	48
34	NTPC	0.000918634	0.000922395	-0.075406086	0.765881522	-0.098456594	43
35	ONGC	-0.006680091	0.000950333	-0.083004811	1.169695883	-0.070962728	24
36	PNB	-0.012317023	0.001598115	-0.088641743	1.245983143	-0.071142009	25
37	POWERGRID	0.000549294	0.000584197	-0.075775426	0.919671345	-0.082394028	32
38	RELIANCE	0.002496627	0.000715201	-0.073828093	1.051286883	-0.0702264	23
39	SBIN	-0.005949242	0.000725576	-0.082273962	1.377446961	-0.059729314	9
40	SUNPHARMA	0.000208194	0.001752066	-0.076116526	1.464652621	-0.051968996	6
41	TATAMOTORS	-0.004056294	0.001659264	-0.080381014	1.300470299	-0.061809189	13
42	TATAPOWER	-0.003363458	0.000686516	-0.079688178	1.473019018	-0.05409854	7
43	TATASTEEL	-0.008059771	0.002022932	-0.084384491	0.907682988	-0.092966919	38
44	TCS	-0.000520425	0.00063736	-0.076845145	0.615442316	-0.124861653	49
45	TECHM	-0.030063763	0.038803873	-0.106388483	0.966846789	-0.110036548	47
46	ULTRACEMCO	0.001245346	0.000634893	-0.075079374	1.1723464	-0.064041971	17
47	VEDL	-0.015677115	0.003686441	-0.092001835	1.184483632	-0.077672525	30
48	WIPRO	0.000426008	0.000704209	-0.075898712	0.783640234	-0.096854027	42
49	YESBANK	-0.000391059	0.001035744	-0.076715779	1.535315198	-0.049967446	4
50	ZEEL	0.002802363	0.000938154	-0.073522357	1.093685247	-0.067224421	20
Source: Computed			*Risk Free Rate: 0.07632472				

Table 2: Calculation of Cut-off

Company Name	(Ri-Rf)/β	(Ri-Rf) β /σ^2_{ei}	Cumulative	$\beta i^2/\sigma^2_{ei}$	Cumulative	Ci
INFY	0.387930767	2.003582975	2.003582975	5.164795236	5.164795236	0.000876935
BANKBARODA	0.068014987	3.925846268	5.929429243	57.72031228	62.88510751	0.002531264
BOSCHLTD	-0.048785369	-84.14720209	-78.21777284	1724.845046	1787.730154	-0.019230775
YESBANK	-0.049967446	-113.7181929	-191.9359657	2275.845621	4063.575775	-0.030258689
HDFC	-0.051730454	-189.4279086	-381.3638743	3661.825733	7725.401507	-0.03811735
SUNPHARMA	-0.051968996	-63.63019403	-444.9940684	1224.387591	8949.789098	-0.039627654
TATAPOWER	-0.05409854	-170.982457	-615.9765254	3160.574356	12110.36345	-0.042806004
AXISBANK	-0.058787515	-87.8033726	-703.779898	1493.57176	13603.93521	-0.044308789
SBIN	-0.059729314	-156.1904779	-859.9703759	2614.971916	16218.90713	-0.046488655
KOTAKBANK	-0.059742915	-13.53558189	-873.5059578	226.5637997	16445.47093	-0.046649024
ADANIPORTS	-0.060261887	-61.13080241	-934.6367602	1014.418983	17459.88991	-0.047348594
M&M	-0.060343678	-90.09055712	-1024.727317	1492.957679	18952.84759	-0.048262343
TATAMOTORS	-0.061809189	-62.9997051	-1087.727022	1019.261155	19972.10875	-0.048882869
INDUSINDBK	-0.061841714	-185.2242045	-1272.951227	2995.133762	22967.24251	-0.050420229
ICICIBANK	-0.062888271	-134.6368466	-1407.588074	2140.889611	25108.13212	-0.051394852
ASIANPAINT	-0.062976262	-134.8878674	-1542.475941	2141.884306	27250.01642	-0.052234892
ULTRACEMCO	-0.064041971	-138.6360452	-1681.111986	2164.768558	29414.78498	-0.053041331
AMBUJACEM	-0.0658104	-138.1009048	-1819.212891	2098.466288	31513.25127	-0.053834264
BHEL	-0.06683252	-84.13016032	-1903.343051	1258.820709	32772.07198	-0.054301074
ZEEL	-0.067224421	-85.7112549	-1989.054306	1275.001757	34047.07374	-0.054754661
HINDALCO	-0.067918896	-48.1398579	-2037.194164	708.784458	34755.85819	-0.055006598
CIPLA	-0.067969561	-109.0699858	-2146.26415	1604.688688	36360.54688	-0.055544938
RELIANCE	-0.0702264	-108.5212957	-2254.785445	1545.306266	37905.85315	-0.056109504
ONGC	-0.070962728	-102.1645607	-2356.950006	1439.693255	39345.5464	-0.056623234
PNB	-0.071142009	-69.11024048	-2426.060247	971.4406704	40316.98707	-0.056954344
LT	-0.071198392	-132.8756544	-2558.935901	1866.273241	42183.26032	-0.05755222
GAIL	-0.07357963	-54.76771107	-2613.703612	744.3325127	42927.59283	-0.05781611
DRREDDY	-0.073954558	-54.63725146	-2668.340864	738.7949201	43666.38775	-0.05807561
BAJAJAUTO	-0.07446211	-115.2447997	-2783.585663	1547.697212	45214.08496	-0.058609604
VEDL	-0.077672525	-29.56093993	-2813.146603	380.5842531	45594.66921	-0.058761148
GRASIM	-0.081123631	-247.3050788	-3060.451682	3048.496194	48643.16541	-0.06009988
POWERGRID	-0.082394028	-119.289295	-3179.740977	1447.790554	50090.95596	-0.060716205
ACC	-0.084389458	-127.9593827	-3307.70036	1516.295819	51607.25178	-0.061382335
IDEA	-0.087308628	-28.23230845	-3335.932668	323.3621815	51930.61396	-0.061536985
HDFCBANK	-0.087989277	-411.2818985	-3747.214567	4674.227521	56604.84148	-0.063636759
HEROMOTOCO	-0.091594512	-90.25200388	-3837.466571	985.3429161	57590.1844	-0.064096891
HINDUNILVR	-0.092638732	-52.25295836	-3889.719529	564.050882	58154.23528	-0.064363282
TATASTEEL	-0.092966919	-37.8630467	-3927.582576	407.2744068	58561.50969	-0.064554757
HCLTECH	-0.093110087	-7.72639401	-3935.30897	82.98127834	58644.49097	-0.06459365
LUPIN	-0.095599819	-32.87997801	-3968.188948	343.9334746	58988.42444	-0.064767706
BHARTIARTL	-0.095665613	-42.28131476	-4010.470263	441.9698295	59430.39427	-0.064988999
WIPRO	-0.096854027	-84.45968905	-4094.929952	872.0307418	60302.42501	-0.065433012
NTPC	-0.098456594	-62.61106844	-4157.54102	635.9255993	60938.35061	-0.065765205
COALINDIA	-0.103456025	-43.41586353	-4200.956884	419.6552441	61358.00585	-0.066013756
ITC	-0.108204475	-57.40664165	-4258.363525	530.538517	61888.54437	-0.066362586
CAIRN	-0.109094323	-38.33497907	-4296.698504	351.3929774	62239.93735	-0.066595316
TECHM	-0.110036548	-2.650801482	-4299.349306	24.09019123	62264.02754	-0.06661153
MARUTI	-0.119157438	-42.87789583	-4342.227202	359.8423766	62623.86992	-0.066902859
TCS	-0.124861653	-74.20260334	-4416.429805	594.2785614	63218.14848	-0.067428734
BPCL	-0.140161754	-30.19597849	-4446.625783	215.4366489	63433.58513	-0.067667185
Source: Computed	*Risk Free Rate: 0.07632472			*Market Variance 0.000438675		

Table 3: Revise Calculation of Access Return to Beta (as on or after 1st April)

Sr. No.	Company Name	Mean Return	Unsystematic Risk	Excess Return	Beta	Excess Return to Beta	Rank
1	ACC	-0.000601172	0.000548005	-0.076925892	0.911558078	-0.084389458	34
2	ADANIPORTS	-0.001881672	0.001660281	-0.078206392	1.29777536	-0.060261887	12
3	AMBUJACEM	-0.002024603	0.000675429	-0.078349323	1.190531034	-0.0658104	20
4	ASIANPAINT	0.003678352	0.000621267	-0.072646368	1.153551609	-0.062976262	18
5	AUROPHARMA	-0.004177702	0.010924473	-0.080502422	0.969494386	-0.08303547	33
6	AXISBANK	-0.001815103	0.001182901	-0.078139823	1.329190774	-0.058787515	8
7	BAJAJAUTO	0.000386202	0.000671997	-0.075938518	1.019827639	-0.07446211	30
8	BANKBARODA	-0.036221061	0.047437363	-0.112545781	-1.654720333	0.068014987	2
9	BHARTIARTL	-0.000755144	0.00146885	-0.077079864	0.805721733	-0.095665613	42
10	BHEL	-0.007487847	0.001249334	-0.083812567	1.254068629	-0.06683252	21
11	BOSCHLTD	0.000111627	0.001414914	-0.076213093	1.562212081	-0.048785369	3
12	BPCL	0.006103158	0.001165098	-0.070221562	0.501003731	-0.140161754	50
13	CIPLA	0.000799287	0.000769426	-0.075525433	1.111165519	-0.067969561	24
14	COALINDIA	-0.002591194	0.001386516	-0.078915914	0.762796694	-0.103456025	45
15	DRREDDY	-0.000154143	0.001447535	-0.076478863	1.034133198	-0.073954558	29
16	EICHERMOT	0.002044854	0.001520202	-0.074279866	1.191780397	-0.062326806	16
17	GAIL	-0.002909941	0.001557931	-0.079234661	1.076855921	-0.07357963	28
18	GRASIM	0.001971833	0.000275559	-0.074352887	0.916537958	-0.081123631	31
19	HCLTECH	-0.011399981	0.010697202	-0.087724701	0.942161098	-0.093110087	40
20	HDFC	0.002343363	0.00055854	-0.073981357	1.430131598	-0.051730454	5
21	HDFCBANK	0.002484248	0.000150667	-0.073840472	0.839198531	-0.087989277	36
22	HEROMOTOCO	-0.002625961	0.000754024	-0.078950681	0.86195864	-0.091594512	37
23	HINDALCO	-0.011022166	0.002333455	-0.087346886	1.286046898	-0.067918896	23
24	HINDUNILVR	0.002633683	0.001121827	-0.073691037	0.795466816	-0.092638732	38
25	ICICIBANK	-0.005561948	0.000791941	-0.081886668	1.302097619	-0.062888271	17
26	IDEA	-0.000828716	0.002414944	-0.077153436	0.883686272	-0.087308628	35
27	INDUSINDBK	0.003985475	0.000456845	-0.072339245	1.16974839	-0.061841714	15
28	INFRATEL	0.004748394	0.001880036	-0.071576326	0.480744929	-0.148886284	51
29	INFY	-0.010731609	0.009750775	-0.087056329	-0.224412026	0.387930767	1
30	ITC	-0.002180064	0.000992167	-0.078504784	0.725522526	-0.108204475	46
31	KOTAKBANK	-0.010453117	0.009312243	-0.086777837	1.452520967	-0.059742915	11
32	LT	-0.002936062	0.00066405	-0.079260782	1.113238366	-0.071198392	27
33	LUPIN	0.005034824	0.001616841	-0.071289896	0.745711624	-0.095599819	41
34	M&M	0.000254547	0.001064432	-0.076070173	1.260615456	-0.060343678	13
35	MARUTI	0.006168187	0.000963344	-0.070156533	0.588771748	-0.119157438	48
36	NTPC	0.000918634	0.000922395	-0.075406086	0.765881522	-0.098456594	44
37	ONGC	-0.006680091	0.000950333	-0.083004811	1.169695883	-0.070962728	26
38	POWERGRID	0.000549294	0.000584197	-0.075775426	0.919671345	-0.082394028	32
39	RELIANCE	0.002496627	0.000715201	-0.073828093	1.051286883	-0.0702264	25
40	SBIN	-0.005949242	0.000725576	-0.082273962	1.377446961	-0.059729314	10
41	SUNPHARMA	0.000208194	0.001752066	-0.076116526	1.464652621	-0.051968996	6
42	TATAMOTORS	-0.004056294	0.001659264	-0.080381014	1.300470299	-0.061809189	14
43	TATAMTRDVR	-0.002377097	0.001836704	-0.078701817	1.323407231	-0.059469085	9
44	TATAPOWER	-0.003363458	0.000686516	-0.079688178	1.473019018	-0.05409854	7
45	TATASTEEL	-0.008059771	0.002022932	-0.084384491	0.907682988	-0.092966919	39
46	TCS	-0.000520425	0.00063736	-0.076845145	0.615442316	-0.124861653	49
47	TECHM	-0.030063763	0.038803873	-0.106388483	0.966846789	-0.110036548	47
48	ULTRACEMCO	0.001245346	0.000634893	-0.075079374	1.1723464	-0.064041971	19
49	WIPRO	0.000426008	0.000704209	-0.075898712	0.783640234	-0.096854027	43
50	YESBANK	-0.000391059	0.001035744	-0.076715779	1.535315198	-0.049967446	4
51	ZEEL	0.002802363	0.000938154	-0.073522357	1.093685247	-0.067224421	22
Source: Computed			*Risk Free Rate: 0.07632472				

Table 4: Revise Calculation of Cut-off Rate

Company Name	(Ri-Rf)/β	(Ri-Rf) β/σ^2_{ei}	Cumulative	$\beta i^2/\sigma^2_{ei}$	Cumulative	Ci
INFY	0.387930767	2.003582975	2.003582975	5.164795236	5.164795236	0.000876935
BANKBARODA	0.068014987	3.925846268	5.929429243	57.72031228	62.88510751	0.002531264
BOSCHLTD	-0.048785369	-84.14720209	-78.21777284	1724.845046	1787.730154	-0.019230775
YESBANK	-0.049967446	-113.7181929	-191.9359657	2275.845621	4063.575775	-0.030258689
HDFC	-0.051730454	-189.4279086	-381.3638743	3661.825733	7725.401507	-0.03811735
SUNPHARMA	-0.051968996	-63.63019403	-444.9940684	1224.387591	8949.789098	-0.039627654
TATAPOWER	-0.05409854	-170.982457	-615.9765254	3160.574356	12110.36345	-0.042806004
AXISBANK	-0.058787515	-87.8033726	-703.779898	1493.57176	13603.93521	-0.044308789
TATAMTRDVR	-0.059469085	-56.70733104	-760.487229	953.5598369	14557.49505	-0.045167385
SBIN	-0.059729314	-156.1904779	-916.677707	2614.971916	17172.46697	-0.047124969
KOTAKBANK	-0.059742915	-13.53558189	-930.2132889	226.5637997	17399.03077	-0.047270241
ADANIPORTS	-0.060261887	-61.13080241	-991.3440913	1014.418983	18413.44975	-0.047907121
M&M	-0.060343678	-90.09055712	-1081.434648	1492.957679	19906.40743	-0.048744011
TATAMOTORS	-0.061809189	-62.9997051	-1144.434353	1019.261155	20925.66858	-0.049317882
INDUSINDBK	-0.061841714	-185.2242045	-1329.658558	2995.133762	23920.80234	-0.050749561
EICHERMOT	-0.062326806	-58.23259353	-1387.891152	934.3105617	24855.11291	-0.051148192
ICICIBANK	-0.062888271	-134.6368466	-1522.527998	2140.889611	26996.00252	-0.05200673
ASIANPAINT	-0.062976262	-134.8878674	-1657.415865	2141.884306	29137.88682	-0.052754577
ULTRACEMCO	-0.064041971	-138.6360452	-1796.051911	2164.768558	31302.65538	-0.053482182
AMBUJACEM	-0.0658104	-138.1009048	-1934.152815	2098.466288	33401.12167	-0.054207233
BHEL	-0.06683252	-84.13016032	-2018.282976	1258.820709	34659.94238	-0.054637476
ZEEL	-0.067224421	-85.7112549	-2103.994231	1275.001757	35934.94413	-0.055057431
HINDALCO	-0.067918896	-48.1398579	-2152.134089	708.784458	36643.72859	-0.055291635
CIPLA	-0.067969561	-109.0699858	-2261.204074	1604.688688	38248.41728	-0.055793612
RELIANCE	-0.0702264	-108.5212957	-2369.72537	1545.306266	39793.72355	-0.056323712
ONGC	-0.070962728	-102.1645607	-2471.889931	1439.693255	41233.4168	-0.056808066
LT	-0.071198392	-132.8756544	-2604.765585	1866.273241	43099.69004	-0.057399884
GAIL	-0.07357963	-54.76771107	-2659.533296	744.3325127	43844.02256	-0.057660989
DRREDDY	-0.073954558	-54.63725146	-2714.170548	738.7949201	44582.81748	-0.057917861
BAJAJAUTO	-0.07446211	-115.2447997	-2829.415347	1547.697212	46130.51469	-0.058446789
GRASIM	-0.081123631	-247.3050788	-3076.720426	3048.496194	49179.01088	-0.059790204
POWERGRID	-0.082394028	-119.289295	-3196.009721	1447.790554	50626.80144	-0.060408761
AUROPHARMA	-0.08303547	-7.14420226	-3203.153924	86.03795745	50712.83939	-0.060445497
ACC	-0.084389458	-127.9593827	-3331.113306	1516.295819	52229.13521	-0.061111558
IDEA	-0.087308628	-28.23230845	-3359.345615	323.3621815	52552.49739	-0.061266051
HDFCBANK	-0.087989277	-411.2818985	-3770.627513	4674.227521	57226.72491	-0.063365163
HEROMOTOCO	-0.091594512	-90.25200388	-3860.879517	985.3429161	58212.06783	-0.063824988
HINDUNILVR	-0.092638732	-52.25295836	-3913.132476	564.050882	58776.11871	-0.064091178
TATASTEEL	-0.092966919	-37.8630467	-3950.995522	407.2744068	59183.39312	-0.064282518
HCLTECH	-0.093110087	-7.72639401	-3958.721916	82.98127834	59266.3744	-0.064321386
LUPIN	-0.095599819	-32.87997801	-3991.601894	343.9334746	59610.30787	-0.064495206
BHARTIARTL	-0.095665613	-42.28131476	-4033.883209	441.9698295	60052.2777	-0.064716223
WIPRO	-0.096854027	-84.45968905	-4118.342898	872.0307418	60924.30844	-0.065159631
NTPC	-0.098456594	-62.61106844	-4180.953966	635.9255993	61560.23404	-0.065491311
COALINDIA	-0.103456025	-43.41586353	-4224.36983	419.6552441	61979.88929	-0.065739245
ITC	-0.108204475	-57.40664165	-4281.776472	530.538517	62510.4278	-0.066086975
TECHM	-0.110036548	-2.650801482	-4284.427273	24.09019123	62534.518	-0.06610331
MARUTI	-0.119157438	-42.87789583	-4327.305169	359.8423766	62894.36037	-0.066396236
TCS	-0.124861653	-74.20260334	-4401.507772	594.2785614	63488.63893	-0.066924527
BPCL	-0.140161754	-30.19597849	-4431.703751	215.4366489	63704.07558	-0.067163646
INFRATEL	-0.148886284	-18.30281504	-4450.006566	122.9315054	63827.00709	-0.067315617
Source: Computed	*Risk Free Rate: 0.07632472			*Market Variance 0.000438675		

Formulating the Optimal Portfolio by Calculating the Percentage Invested in each Security:

As per this revise model, first 2 securities should be there in Optimal Portfolio. Proportion for these securities can be found out with the help of below mention formula

$$Xi = \frac{Zi}{\sum_{j=}^{n} Zj}$$

where, $Zi = \frac{\beta i}{\sigma_{ei}^2} * (\frac{Ri - Rf}{\beta i} - C*)$

Table 5 represents the proportion of investment to be made in each company. The two Company ranking 1 and 2 are selected for the optimal portfolio & shows that 80% of investment may be made in the Infosys stock (which means majority of the funds is to be invested on this company's stock), remaining 20% in Bank of Baroda..

Table 6 represents the proportion of investment, individual security returns and the returns on portfolio. The returns on portfolio are calculated based on the proportion of investment in each security. The highest return on portfolio is from the Bank of Baroda i.e. -0.007244212 and the lowest is Infosys i.e. -0.008585287. Total return from the optimal portfolio is -0.0158295.

Table 5: Proportion of Investments

Stock	Ci	Zi	Xi	Proportion
INFY	0.000876935	-8.869887909	0.795212855	0.8
BANKBARODA	0.002531264	-2.284217379	0.204787145	0.2

*Computed

Table 6: Return on Portfolio and Individual Security

Company	Proportion	Average Return	Return on Portfolio
INFY	0.8	-0.010731609	-0.008585287
BANKBARODA	0.2	-0.036221061	-0.007244212
Total Return on Portfolio			-0.0158295

*Computed

In Table 7, we have calculated Portfolio Return, Portfolio Standard Deviations, and Portfolio Beta by using Proportion of Investments. We found that an Optimal Portfolio gives negative return i.e. -0.0158295. Standard deviation of Portfolio is 0.123194525, and Beta of Optimal Portfolio is -0.510473687.

Table 7: Calculation of Average Return, S.D., and Beta of Portfolio

Security	Proportion	Average Return	σ	β
Nifty50	-	-0.000594468	0.020944566	1
INFY	0.80	-0.010731609	0.098857813	-0.224412026
BANKBARODA	0.20	-0.036221061	0.220541374	-1.654720333
Portfolio	-	-0.0158295	0.123194525	-0.510473687

*Computed

Table 8 shows an Optimal Portfolio by using Sharpe, Jensen, and Treynor Methods. On measuring portfolio and market return by Sharpe Ratio, we find that optimal portfolio had a negative return of -0.0748, and market return is also negative i.e. -3.673. As portfolio returns are higher than the market return it suggests that Investor cannot earn positive return from this Portfolio.

Using Jensen ratio, we find that the portfolio had negative return of -0.131 and Market has no return (by definition). This Portfolio is risky and the investors should not invest for the same.

The Treynor measure, shows that Portfolio has positive yield of 0.181, whereas market has negative return of -0.077, and it has the best results.

On comparing it can be concluded that, Treynor measure had a positive return on portfolio, however other ratios consistently giving negative return in 2015.

Table 8: Comparison of Sharpe, Jensen, and Treynor measures

Fund	Mean return	Standard deviation	Beta	Sharpe Measure	Jensen Measure	Treynor Measure
Portfolio	-0.0158295	0.123194525	-0.510473687	-0.748	-0.131	0.181
Market Index	-0.000594468	0.020944566	1	-3.673	0.000	-0.077
Risk-free return		0.07632472				

CONCLUSION

It can be concluded that the composition of the optimal portfolio would be:0.80 % of fund invested in Infosys and 0.20 % of fund invested in Bank of Baroda. When comparing individually, weekly average return of Nifty-50 is -0.000594 but weekly average return of selected security in portfolio is -0.010731609 and -0.036221061for Infosys and Bank of Baroda respectively. It indicates Market is giving higher return than security. Although, returns on hypothetic portfolio of two securities is-0.01582 which is comparatively lower than return of Nifty-50.

If we compare portfolio and market returns by all methods, the portfolio return as well as the market returns are lowest as per the Sharpe measure however, Portfolio had a highest and positive return by Treynor measures i.e. 0.181. But in market, Treynor measure give lowest and negative return. This clearly indicates that market investment was riskier than investment in Portfolio. People should avoid to go for investment in market.

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