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Performance Evaluation of Stock Using Markowitz and Sharpe Single Index Model

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Abstract--- *Stock Selection since the ages has been a tedious task to perform because that entail lot of analysis. An investor always found a problem in selecting a good stock among various stock available in the market. They always tried to have risk return trade off by investing in different stocks. But they can reduce the unsystematic risk through diversification but what about the systematic risk. Systematic risk is the risk that can be measure but can't reduce through diversification. For an individual investor it is not possible to calculate the risk of each security. This study helps an investor in constructing an optimal portfolio. For constructing the optimal portfolio two studies has been taken into consideration i.e. Markowitz Model and Sharpe- Single Index Model. After construction of portfolio with the respective models, the performance of the model is compared.*

Keywords: Risk Return Trade off, Diversification, Systematic Risk, Unsystematic Risk, Sharpe- Single Index Model, Markowitz Model.

A. Introduction:

Investment is an amount that an investor wants to invest in those securities which gives a better return in less risk and accumulate day by day and helps to accomplish an investor objective at each step of life. But an investor is always get confused in selection of security. And most of the time an investor gets irritate, whatever security he buys that get fall and what he sells that start rising. To overcome with these problems of investor we have a Several models i.e. Sharpe's Single Index model and Markowitz. In the present study the daily adjusted closing stock prices of Nifty Fifty has been taken from 2011-2019. The relevance of the present study is that the two model Sharpe and Markowitz compared simultaneously. The two model provides the portfolio which is evaluated based on risk return analysis.

B. **Literature Review:**

[1]Performance of portfolio is to be evaluated by using [8,9]Markowitz, Sharpe-Single index model and ratio analysis and setting few parameters, namely, beta, market return, stock return, systematic risk, unsystematic risk, and downside risk. [2]To evaluate this a study has been conducted on Banking & Finance, Cement &Cement Products, Automobiles and Metal Products and Mining for constructing portfolio Sharpe Single Index model applied.[3] Now, Comparison between Sharpe and constant Correlation model has been done in which researcher found that [5,6]Sharpe model gives better results.[4] Sharpe, Jensen and Treynor Ratio has also been used in ranking the portfolio.

In the present Study, performance of Markowitz and Sharpe Single Index Model is compared which is the research gap and time period also.

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C. Research Methodology:

The study has been conducted for which secondary data of daily adjusted closing price collected from 1 April 2011 to 31 March 2019 for NSE nifty-fifty. From the selected fifty stocks forty-seven has been selected as three stocks are excluded due to unavailability of data from 2011. For analysis Convenient Sampling and Time Series data has been used.
The **objectives of the study** are:

- To construct the portfolio based on Markowitz and Sharpe Single Index Model.
- Evaluate the performance of the portfolio constructed through Sharpe and Markowitz Model.

The empirical research has been done on which convenient sampling used. The steps in constructing the portfolio by using [12]Sharpe Model:

1. Expected return has been calculated by using the equation (Price at the end - Price at the beginning)/Price at the beginning
2. Expected return to beta ratio has been calculated by using the formula: (Expected return – Risk free rate of return)/ Beta
3. Cut-off ratio has been calculated:

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

Where,
C_i= Cut-off ratio
R_i= Expected Return of stock i,
R_f=Risk Free Rate of Return,
β_i=Systematic Risk of stock i
σ_m^2=Variance of the Market Index,
σ_{ei}^2=Unsystematic Risk.

4. Then finally weights are calculated.

$$Z_i = \left(\frac{\beta_i}{\sigma_{ei}^2}\right)\left[\{(R_i - R_f)\beta_i\} - C_i\right] \quad (2)$$

$$W_i = \frac{Z_i}{\sum_{i=1}^{N} Z_i} \quad (3)$$

For constructing the portfolio through Markowitz-Efficient frontier in which stocks are selected through Risk Return Analysis. In constructing the efficient frontier, the stock which is having same risk then the stock having high return has been chosen and the stock having same return then stock with low level risk is selected. Now, all the selected stocks are plotted on the graph. Risk level is plotted on X -Axis and Return is plotted on Y -Axis.

D. Data analysis and Interpretation:

The data collected from NSE and the stocks that included are Nifty-Fifty. For selecting stocks firstly, expected return is calculated then excess return to beta after calculating this ranking has been done after doing the ranking C (cut-off value) is computed. Then weights of selected stock are calculated.

Section I: Sharpe Single Index Model

The ***Table I*** showing the ranks of security based on Excess Return to Beta and then by using the cut off value 0.137 i.e. showing by ZEE Entertainment Enterprises Ltd. The security till ZEE Entertainment Enterprises Ltd is selected for constructing the portfolio.

Table I showing the Ranking of Stock through Sharpe Index Model

Security No.	Company Name	Expected Return	Excess return	Beta	Unsystematic Risk	Excess return to Beta	Cut off Value	Rank
8	Britannia Industries Ltd.	0.17	0.148	0.514	2.368	0.288	1	0.045
4	Bajaj Finance Ltd.	0.25	0.228	0.945	4.094	0.241	2	0.055
12	Eicher Motors Ltd.	0.17	0.148	0.765	3.402	0.194	3	0.066
19	Hindustan Unilever Ltd.	0.11	0.088	0.517	1.929	0.170	4	0.097
5	Bajaj Finserv Ltd.	0.155	0.133	0.823	3.347	0.161	5	0.103
2	Asian Paints Ltd.	0.12	0.098	0.713	2.073	0.138	6	0.116
40	Tech Mahindra Ltd.	0.1	0.078	0.621	3.051	0.126	7	0.122
15	HCL Technologies Ltd.	0.1	0.078	0.658	2.738	0.119	8	0.128
6	Bharat Petroleum Corporation Ltd.	0.13	0.108	0.926	3.843	0.117	9	0.128
42	UPL Ltd.	0.13	0.108	0.945	4.176	0.114	10	0.128
37	Tata Consultancy Services Ltd.	0.09	0.068	0.619	2.111	0.110	11	0.136
41	Titan Company Ltd.	0.11	0.088	0.881	3.906	0.100	12	0.135
25	Infosys Ltd.	0.09	0.068	0.698	2.619	0.098	13	0.138
30	Maruti Suzuki India Ltd.	0.11	0.088	0.904	2.089	0.097	14	0.136
23	Indian Oil Corporation Ltd.	0.1	0.078	0.813	3.587	0.096	15	0.136
47	Zee Entertainment Enterprises Ltd.	0.09	0.068	0.758	3.664	0.090	16	0.137
16	HDFC Bank Ltd.	0.1	0.078	0.945	0.857	0.083	17	0.121
27	Kotak Mahindra Bank Ltd.	0.1	0.078	1.06	1.661	0.074	18	0.115
26	JSW Steel Ltd.	0.12	0.098	1.341	4.044	0.073	19	0.113
24	IndusInd Bank Ltd.	0.11	0.088	1.209	2.058	0.073	20	0.108
46	Yes Bank Ltd.	0.13	0.108	1.563	5.025	0.069	21	0.106
22	ITC Ltd.	0.07	0.048	0.728	1.818	0.066	22	0.107
43	UltraTech Cement Ltd.	0.08	0.058	0.896	1.991	0.065	23	0.106
36	Sun Pharmaceutical Industries Ltd.	0.06	0.038	0.643	3.117	0.059	24	0.106
14	Grasim Industries Ltd.	0.07	0.048	0.898	1.891	0.054	25	0.104
1	Adani Ports and Special Economic Zone Ltd.	0.082	0.060	1.162	4.578	0.051	26	0.103
3	Axis Bank Ltd.	0.09	0.068	1.448	2.614	0.047	27	0.099
13	GAIL (India) Ltd.	0.06	0.038	0.817	2.722	0.047	28	0.098

33	Power Grid Corporation of India Ltd.	0.05	0.028	0.652	1.549	0.043	29	0.098
34	Reliance Industries Ltd.	0.07	0.048	1.135	1.566	0.042	30	0.093
20	Housing Development Finance Corporation Ltd.	0.07	0.048	1.137	1.485	0.042	31	0.088
29	Mahindra & Mahindra Ltd.	0.06	0.038	0.954	2.023	0.040	32	0.086
21	ICICI Bank Ltd.	0.08	0.058	1.523	2.105	0.038	33	0.081
17	Hero MotoCorp Ltd.	0.05	0.028	0.754	2.143	0.037	34	0.081
11	Dr. Reddy's Laboratories Ltd.	0.04	0.018	0.507	2.516	0.036	35	0.081
35	State Bank of India	0.07	0.048	1.415	3.251	0.034	36	0.080
45	Wipro Ltd.	0.04	0.018	0.56	2.122	0.032	37	0.080
28	Larsen & Toubro Ltd.	0.06	0.038	1.318	1.707	0.029	38	0.076
9	Cipla Ltd.	0.04	0.018	0.634	2.081	0.029	39	0.076
39	Tata Steel Ltd.	0.03	0.008	1.443	3.056	0.006	40	0.074
18	Hindalco Industries Ltd.	0.03	0.008	1.538	4.134	0.005	41	0.073
44	Vedanta Ltd.	0.02	-0.002	1.542	5.257	-0.001	42	0.072
38	Tata Motors Ltd.	0.02	-0.002	1.444	3.555	-0.001	43	0.071
32	Oil & Natural Gas Corporation Ltd.	0.02	-0.002	0.953	2.653	-0.002	44	0.070
7	Bharti Airtel Ltd.	0.02	-0.002	0.867	3.165	-0.002	45	0.069
31	NTPC Ltd.	0.02	-0.002	0.793	1.97	-0.002	46	0.068
10	Coal India Ltd.	0.02	-0.002	0.707	2.514	-0.003	47	0.067

Sources: *Authors Calculation*

After identifying the securities which form part of the portfolio based on cut off value, Z_i calculated to find the weights of securities which symbolizes how much investment an investor can have in a security.

Table II Showing the Weights Provided to Stock through Sharpe Index Model

Security No.	Company Name	C	Zi	Wi
8	Britannia Industries Ltd.	0.0449	3.443	0.103
4	Bajaj Finance Ltd.	0.0549	4.545	0.136
12	Eicher Motors Ltd.	0.0660	3.205	0.096
19	Hindustan Unilever Ltd.	0.0971	1.510	0.045
5	Bajaj Finserv Ltd.	0.1033	2.512	0.075
2	Asian Paints Ltd.	0.1165	0.991	0.030
40	Tech Mahindra Ltd.	0.1221	2.346	0.070
15	HCL Technologies Ltd.	0.1276	1.677	0.050
6	Bharat Petroleum Corporation Ltd.	0.1279	2.160	0.065
42	UPL Ltd.	0.1279	2.441	0.073
37	Tata Consultancy Services Ltd.	0.1355	1.014	0.030
41	Titan Company Ltd.	0.1353	2.046	0.061
25	Infosys Ltd.	0.1377	1.194	0.036
30	Maruti Suzuki India Ltd.	0.1361	0.554	0.017
23	Indian Oil Corporation Ltd.	0.1363	1.826	0.055
47	Zee Entertainment Enterprises Ltd.	0.1367	1.941	0.058

Sources: *Authors Calculation*

Section II: Markowitz Model

[8]Harry Markowitz known for his pioneering work in the field of Modern Portfolio Theory (MPT). By using [9,10]Markowitz theory of diversification an investment framework can be developed based on the principle of selecting securities having maximum expected return and simultaneously having minimum Risk. For calculated expected Return natural log of adjusted daily closing price has been used and then average is taken. The average value of security is considered as Expected Return and for risk standard deviation is calculated.

Table III showing the risk return relation of the securities. The security is selected on the basis maximum expected return and minimum risk. In the calculated table Security 8,12 having the same expected return so the security with low risk is selected for portfolio construction likewise other securities also selected.

Table III showing Risk Return Relationship

Security No.	**Name of the Company**	**Risk**	**Return**
4	Bajaj Finance Ltd.	2.22	25%
8	Britannia Industries Ltd.	1.62	17%
12	Eicher Motors Ltd.	1.98	17%
5	Bajaj Finserv Ltd.	1.99	15%
6	Bharat Petroleum Corporation Ltd.	2.15	13%
42	UPL Ltd.	2.23	13%
46	Yes Bank Ltd.	2.69	13%
2	Asian Paints Ltd.	1.59	12%
26	JSW Steel Ltd.	2.38	12%
19	Hindustan Unilever Ltd.	1.47	11%
24	IndusInd Bank Ltd.	1.84	11%
30	Maruti Suzuki India Ltd.	1.68	11%
41	Titan Company Ltd.	2.15	11%
15	HCL Technologies Ltd.	1.77	10%
16	HDFC Bank Ltd.	1.29	10%
23	Indian Oil Corporation Ltd.	2.05	10%
27	Kotak Mahindra Bank Ltd.	1.64	10%
40	Tech Mahindra Ltd.	1.85	10%
3	Axis Bank Ltd.	2.13	9%
25	Infosys Ltd.	1.75	9%
37	Tata Consultancy Services Ltd.	1.57	9%
47	Zee Entertainment Enterprises Ltd.	2.05	9%
1	Adani Ports and Special Economic Zone Ltd.	2.41	8%
21	ICICI Bank Ltd.	2.05	8%
43	UltraTech Cement Ltd.	1.65	8%
14	Grasim Industries Ltd.	1.62	7%
20	Housing Development Finance Corporation Ltd.	1.63	7%
22	ITC Ltd.	1.52	7%
34	Reliance Industries Ltd.	1.66	7%
35	State Bank of India	2.25	7%
13	GAIL (India) Ltd.	1.83	6%
28	Larsen & Toubro Ltd.	1.81	6%

29	Mahindra & Mahindra Ltd.	1.69	6%
36	Sun Pharmaceutical Industries Ltd.	1.87	6%
17	Hero MotoCorp Ltd.	1.63	5%
33	Power Grid Corporation of India Ltd.	1.39	5%
9	Cipla Ltd.	1.56	4%
11	Dr. Reddy's Laboratories Ltd.	1.66	4%
45	Wipro Ltd.	1.55	4%
18	Hindalco Industries Ltd.	2.51	3%
39	Tata Steel Ltd.	2.23	3%
7	Bharti Airtel Ltd.	1.96	2%
10	Coal India Ltd.	1.72	2%
31	NTPC Ltd.	1.60	2%
32	Oil & Natural Gas Corporation Ltd.	1.87	2%
38	Tata Motors Ltd.	2.34	2%
44	Vedanta Ltd.	2.72	2%

Sources: *Authors Calculation*

Table IV Showing the finally selected securities which is plotted on the Graph I. Total fourteen securities are selected based on Risk Return analysis.

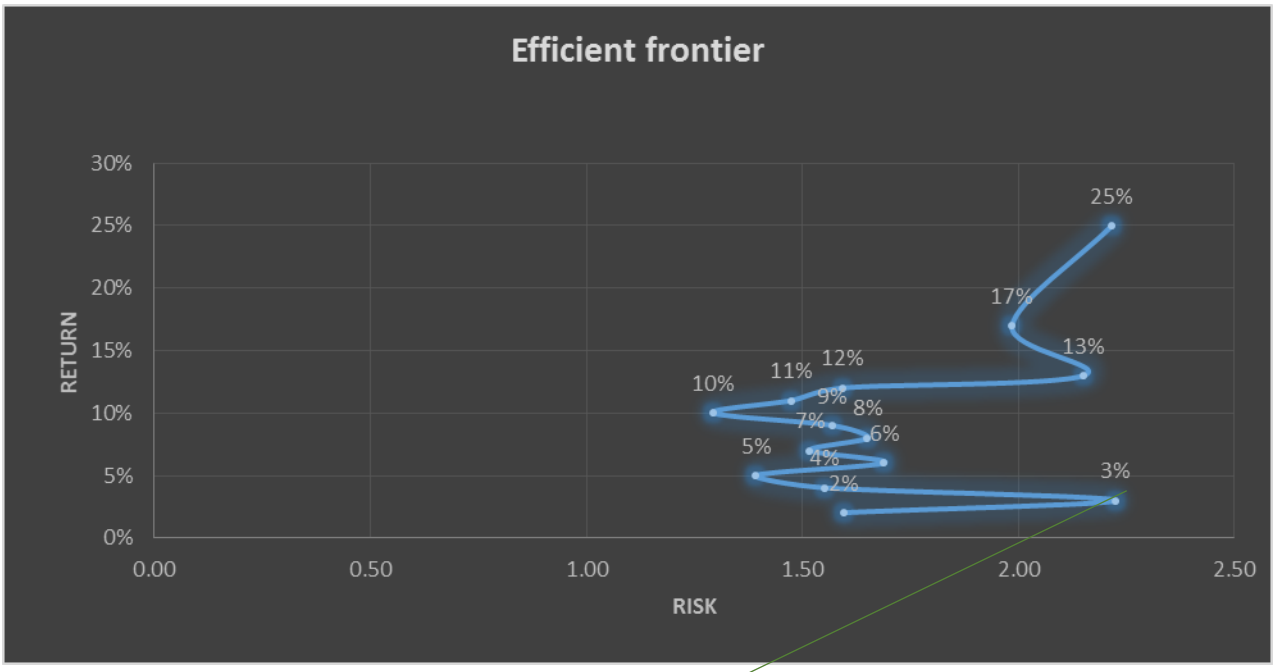
Table IV Stock Selected to Plot on Efficient Frontier

Security No.	**Name of the Company**	**Risk**	**Return**
4	Bajaj Finance Ltd.	2.22	25%
12	Eicher Motors Ltd.	1.98	17%
6	Bharat Petroleum Corporation Ltd.	2.15	13%
2	Asian Paints Ltd.	1.59	12%
19	Hindustan Unilever Ltd.	1.47	11%
16	HDFC Bank Ltd.	1.29	10%
37	Tata Consultancy Services Ltd.	1.57	9%
43	UltraTech Cement Ltd.	1.65	8%
22	ITC Ltd.	1.52	7%
29	Mahindra & Mahindra Ltd.	1.69	6%
33	Power Grid Corporation of India Ltd.	1.39	5%
45	Wipro Ltd.	1.55	4%
39	Tata Steel Ltd.	2.23	3%
31	NTPC Ltd.	1.60	2%

Sources: *Authors Calculation*

Graph I Showing the [11]efficient frontier on which risk is plotted on x-axis and expected return are plotted on y-axis. By joining the expected return 25% and 10% we can have a curve shape efficient frontier. In above the efficient frontier no portfolio is lying but the portfolio inside the efficient frontier is not optimal.

Graph I: Efficient Frontier according to Markowitz Model



Sources: *Authors Calculation*

E. **Conclusion:**

In the study two model shows the security which is considered for portfolio construction. Fr doing analysis Nifty Fifty is considered and adjusted daily closing price has been taken from 2011-2019. The two model when compared namely Markowitz and Sharpe Single Index Model, few securities are common. The common securities are Eicher Motors Ltd., Hindustan Unilever limited, Asian Paints Ltd., Bharat Petroleum Corporation Limited, Tata Consultancy Services Ltd.

There are few limitations of the study as the Markowitz Model and Sharpe Single Index Model based on some assumptions which are far from practical life. The data used in the study is time series whose applications are for certain period only. In future a study may be done in which these models can be used as one the criteria to select the stock and then modern computational techniques applied.

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