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Original Article

Building an Efficient Portfolio Using Sharpe's Single Index Model (An Empirical Study with Reference to Nifty 50)

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Abstract

In recent years, construction of an optimal portfolio has become progressively more challenge, since investors expect maximum return with minimum risk from their respective investment. To achieve this, the investor needs to have appropriate knowledge about the security analysis and portfolio theory for making accurate investment decisions. Even though Harry Markowitz developed a comprehensive model which stated that investors can reduce their risk through diversification, this research paper uses Sharpe 's Single Index Model (SIM) to construct an optimal portfolio. Reason being SIM requires very few inputs and is easier to calculate. The results showed that, forty-two stocks were bullish during the study period and benefitted investor with positive returns consistently and eight stocks showed negative trend/returns. As per the results obtained from the model, Optimal Portfolio is built by selecting twelve stocks which are above the cut off rate. This paper throws light not only on the method of constructing the portfolio and its application, but also calculates intrinsic value for the above selected stocks. As the result only 10 stocks show progressive intrinsic value. This research paper found that though nifty 50 was down by 7500 points by last of march, Pharmaceutical field securities strived due to covid 19 crisis.

Key Words: *Return; Beta; Systematic Risk; Unsystematic Risk*

Introduction

The fund which we employ on assets with an aim to earn return and capital appreciation is called investment. There is always risk and return involved with every investment. For making correct investment decisions, an investor needs to have appropriate knowledge about security analysis and portfolio management. This can be achieved either through traditional or modern approach of portfolio construction. Being a rational investor, he always wants to maximize his return by minimizing his risk. Even though several models suggest that risk can be reduced by holding assets of different companies in a portfolio, analyst believes that at least 15 or more stocks are added to a portfolio to reduce the risk considerably. Studies have shown that systematic risk accounts for about one fourth of the total risk (Mandal, 2013). In the year 1950, Harry Markowitz proposed a new model which emphasized on the fact that diversification helps to minimize portfolio risk effectively. Markowitz Model is very information intensive but very complex. Since computation of co-variance is largely required as new securities are added to the portfolio. William sharpe developed a new and simple model of analyzing the portfolio to overcome the complexity of Markowitz Model. This research paper aims to construct an optimal portfolio using Sharpe's Single Index model by taking into consideration stocks of Nifty 50.

Review of Literature:

The literature consists of various studies to construct optimal portfolio using Sharpe's Single Index Model. Many studies reflect the association between risk and return which has been used for constructing optimal portfolio. Sharpe's Single Index Model has been chosen for its simplicity and practicality by many studies. Four studies are mentioned here for that purpose. Joshi (2015), in his study has built an optimal portfolio using few stocks from NSE nifty & its indices. This portfolio was constructed using Modern Portfolio theory (MPT). Varadharajan (2011) who in their study constructed an optimal portfolio consisting of five stocks. Five years data were taken into consideration which include 19 companies from information and banking sectors.

Saravanan and Natarajan (2012) has constructed an optimal portfolio comprising 4 stocks from Nifty 50. Proportion of investment in each stock were decided based on cutoff rate of return. Nalini (2014) in her study 15 stocks of various sectors from S&P index were considered, taking BSE Sensex as market index. Her study establishes that risk can be minimized by diversifying the portfolio. In the optimal portfolio only four stocks were selected. Since capital market in India is still in a developing stage, this model can be of great use. FIIs are investing vastly through stock exchanges.

Research Objectives

1. To examine the concept of SIM empirically.
2. To construct an optimal portfolio using stocks listed in NIFTY 50.
3. To calculate the risk and return of all stocks included in NIFTY 50 using SIM.
4. To calculate respective proportion for each selected stock to be invested in the portfolio.
5. To calculate intrinsic value of the individual stock selected for the optimal portfolio.

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, textbooks and websites of RBI and NSE1. Closing prices of NSE 50 stocks are collected from the website of National stock exchange.

Period: The period of study is 1st April 2020 to 30th September 2020.

1. **Return: Return** on Stock may be in the form of yield or capital appreciation. Yield means earnings produced and realized on an investment over a particular period of time. While capital appreciation means difference between the purchase price and the selling price of the stock. The daily return of individual stock is calculated by using the following formula

$$R_i = \frac{(\text{Current closing price of the day} - \text{Previous closing price of the day})}{\text{Previous closing price of the day}} \times 100$$

2. **Excess return to Beta ratio:** Excess return means the difference between the individual stock return and the risk-free rate of return offered by the government. In this study, we considered three different interest rate of term deposit greater than one-year, Public Provident fund and Employee Provident fund. The highest interest rate is EPF which is 8.5%. Hence, we took Risk-free rate as 8.5 %.

Excess return to beta ratio = $(R_i - R_f)/\beta_i$

Where R_i = expected rate of return

R_f = Risk free rate of return

β_i= Systematic risk of individual stock

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

$$\beta_i = \frac{Covariance\ (\text{Ri}, Rm)}{Variance\ (Rm)}$$

Where, R_i = Expected return of individual security

R_m = Return from market index

4. **Unsystematic risk:** Though unsystematic risk cannot be eliminated completely; it can be diversified by accumulating more shares in the portfolio. The difference between total risk and the systematic risk is known as unsystematic risk. It 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. **Market variance:** A tool which is used to measure the volatility of stock market is known as variance. Higher the variance, the volatility of the stock market will be higher and vice versa. Market variance is calculated as follows,

$$\sigma_m^2 = \frac{(Rm - \bar{Rm})2}{n-1}$$

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

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

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

Here,

$$\text{Cut-off Rate } C_i = \frac{\sigma m^2 \sum_{t=1}^{J} \frac{(Ri - Rf)\beta_i}{\sigma ei}}{1 + \sigma m^2 \sum_{t=1}^{J} \frac{\beta i^2}{\sigma ei^2}}$$

C_i = cut- off rate.

σ_m^2 = variance in the Market index. (Calculated with the help of Nifty 50 index return)

β_i = Beta of individual stock.

$R_i - R_f$= Excess Return of individual Security than risk-free rate.

σ_{ei}^2 = Variance in the Stock movement in Unsystematic Risk. (Unsystematic Risk is found out with the help of Systematic 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:

$$Xi^0 = \frac{Zi}{\sum_{j=1}^{N} Z_j}$$

Where,

$$Zi = \frac{\beta i}{\sigma ei^2}\left(\frac{Ri - Rf}{\beta i} - C^*\right)$$

C = Cut off point

σ_{ei}^2 = Unsystematic risk

Results and Discussion:

Calculation of annual returns, beta value and variance of 50 companies

Table 1: ***Display of 50 Company's Annual Mean, Beta & Variance***

Si. No.	Nifty 50 on 29th September 2020	Annual Mean Returns % (R_i)	Beta (β_i)	variance σ_i^2
1	Adani Ports and Special Economic Zone Ltd.	36.42	0.7029	5.2701
2	Asian Paints Ltd.	22.6167	0.6223	4.0956
3	Axis Bank Ltd.	27.7522	1.9930	17.2744
4	Bajaj Auto Ltd.	37.9782	1.0087	5.6111
5	Bajaj Finance Ltd.	48.7150	1.6181	14.8443
6	Bajaj Finserv Ltd.	32.8004	1.3778	10.0282
7	Bharat Petroleum Corporation Ltd.	29.5900	1.0420	8.6095
8	Bharti Airtel Ltd.	7.6644	0.6439	7.1733
9	Britannia Industries Ltd.	39.8566	0.5337	3.5938

10	Cipla Ltd.	65.6180	0.3922	7.3128
11	Coal India Ltd.	-14.1497	0.7398	4.6328
12	Divi's Laboratories Limited	52.4552	0.4688	5.6997
13	Dr. Reddy's Laboratories Ltd.	53.1194	0.4008	5.7185
14	Eicher Motors Ltd.	57.2724	1.0769	7.5614
15	GAIL (India) Ltd.	18.2818	0.8064	6.3109
16	Grasim Industries Ltd.	45.9243	1.0948	7.1462
17	HCL Technologies Ltd.	71.5549	0.7995	6.3587
18	HDFC bank limited	28.3478	1.2395	5.8649
19	HDFC life insurance company Ltd.	31.3290	0.7909	4.8587
20	Hero Moto Corp Ltd.	71.0479	1.0550	7.9390
21	Hindalco Industries Ltd.	73.9140	1.6435	13.6589
22	Hindustan Unilever Ltd.	27.6901	0.9566	5.6955
23	Housing Development Finance Corporation Ltd.	12.5545	1.2882	7.6219
24	I T C Ltd.	4.4625	0.3572	4.3871
25	ICICI Bank Ltd.	21.2078	1.8595	12.1215
26	Indian Oil Corporation Ltd.	-2.3877	0.8630	4.8052
27	IndusInd Bank Ltd.	58.3137	1.9032	22.1536
28	Infosys Ltd.	54.8966	0.7914	5.4272
29	JSW Steel Ltd.	74.2261	1.3835	8.8377
30	Kotak Mahindra Bank Ltd.	10.9306	1.1524	6.9685
31	Larsen & Toubro Ltd.	17.3882	0.7363	4.6741
32	Mahindra & Mahindra Ltd.	87.7462	1.3296	10.9587
33	Maruti India Ltd.	51.7395	1.4075	8.9707
34	Nestle India Limited	2.1015	0.5530	3.8725
35	NTPC Ltd.	8.4257	0.5938	5.6325
36	Oil & Natural Gas Corporation Ltd.	9.2213	0.7975	6.9135
37	Power Grid Corporation of India Ltd.	7.8420	0.5396	3.8709
38	Reliance Industries Ltd.	77.1346	0.9505	6.3050
39	State Bank of India	3.5192	1.2023	7.0215
40	SBI Life Insurance Company	27.6901	0.9566	5.6955
41	Shree cement limited	21.2505	0.8241	5.1029
42	Sun Pharmaceutical Industries Ltd.	42.2958	0.4447	5.7592
43	Tata Consultancy Services Ltd.	40.3592	0.7597	4.4552
44	Tata Motors Ltd.	75.1759	1.3981	14.7563
45	Tata Steel Ltd.	37.0449	1.1525	6.6959
46	Tech Mahindra Ltd.	43.7828	0.6141	4.8412
47	Titan Company Ltd.	26.5637	1.0840	7.3426
48	UPL Ltd.	53.5084	1.0375	9.3264
49	UltraTech Cement Ltd.	28.5841	0.8165	4.6194
50	Wipro Ltd.	53.4490	0.6146	6.1909

Sources: Data Taken from NSE Website and Compiled by the Author

Analysis: Table 1 shows that Mahindra & Mahindra Ltd. has the highest Return of 87. 7462 %, whereas Coal India Ltd. has the lowest Return of -14.1497%.

Beta value measures the volatility of a company. Axis Bank Ltd. has the highest Beta value of 1. 9930.That is, when there is the one percent change in the market there will be 1.9930% change in the Axis Bank Ltd. share which **highly volatile** than the market. I T C Ltd. has the lowest Beta Value of 0.3572. When there is the one percent change in the market there will be 0.3572% change in the I T C Ltd. share which **is less volatile** than the market.

IndusInd Bank Ltd. has the high variance of 22.1536 and Britannia Industries Ltd. has the low variance of 3.5938. Variance measures the variability of the returns of the particular company.

Calculation of excess return to beta ratio of nifty 50 companies for the six-month period for the year 2020.

Table 2: ***Depicts the Excess Return to Beta Ratio***

Si. No.	List of Companies	R_i	R_i-R_f	B_i	R_i-R_f/B_i	Rank
1	Adani Ports and Special Economic Zone Ltd.	36.42	27.92	0.70	39.72	19
2	Asian Paints Ltd.	22.62	14.12	0.62	22.68	28
3	Axis Bank Ltd.	27.75	19.25	1.99	9.66	38
4	Bajaj Auto Ltd.	37.98	29.48	1.01	29.22	22
5	Bajaj Finance Ltd.	48.72	40.22	1.62	24.85	25
6	Bajaj Finserv Ltd.	32.80	24.30	1.38	17.64	32
7	Bharat Petroleum Corporation Ltd.	29.59	21.09	1.04	20.24	29
8	Bharti Airtel Ltd.	7.66	-0.84	0.64	-1.30	45
9	Britannia Industries Ltd.	39.86	31.36	0.53	58.75	10
10	Cipla Ltd.	65.62	57.12	0.39	145.63	1
11	Coal India Ltd.	14.15	-22.65	0.74	-30.62	50
12	Divi's Laboratories Limited	52.46	43.96	0.47	93.76	3
13	Dr. Reddy's Laboratories Ltd.	53.12	44.62	0.40	111.33	2
14	Eicher Motors Ltd.	57.27	48.77	1.08	45.29	15
15	GAIL (India) Ltd.	18.28	9.78	0.81	12.13	36
16	Grasim Industries Ltd.	45.92	37.42	1.09	34.18	20
17	HCL Technologies Ltd.	71.55	63.05	0.80	78.87	4
18	HDFC bank limited	28.35	19.85	1.24	16.01	34
19	HDFC life insurance company Ltd.	31.33	22.83	0.79	28.86	23
20	Hero Moto Corp Ltd.	71.05	62.55	1.06	59.29	9
21	Hindalco Industries Ltd.	73.91	65.41	1.64	39.80	18
22	Hindustan Unilever Ltd.	27.69	19.19	0.96	20.06	30
23	Housing Development Finance Corporation Ltd.	12.55	4.05	1.29	3.15	40
24	I T C Ltd.	4.46	-4.04	0.36	-11.30	47
25	ICICI Bank Ltd.	21.21	12.71	1.86	6.83	39
26	Indian Oil Corporation Ltd.	-2.39	-10.89	0.86	-12.62	49
27	IndusInd Bank Ltd.	58.31	49.81	1.90	26.17	24
28	Infosys Ltd.	54.90	46.40	0.79	58.63	11
29	JSW Steel Ltd.	74.23	65.73	1.38	47.51	14
30	Kotak Mahindra Bank Ltd.	10.93	2.43	1.15	2.11	41
31	Larsen & Toubro Ltd.	17.39	8.89	0.74	12.07	37
32	Mahindra & Mahindra Ltd.	87.75	79.25	1.33	59.60	8

33	Maruti India Ltd.	51.74	43.24	1.41	30.72	21
34	Nestle India Limited	2.10	-6.40	0.55	-11.57	48
35	NTPC Ltd.	8.43	-0.07	0.59	-0.13	43
36	Oil & Natural Gas Corporation Ltd.	9.22	0.72	0.80	0.90	42
37	Power Grid Corporation of India Ltd.	7.84	-0.66	0.54	-1.22	44
38	Reliance Industries Ltd.	77.13	68.63	0.95	72.21	7
39	State Bank of India	3.52	-4.98	1.20	-4.14	46
40	SBI Life Insurance Company	27.69	19.19	0.96	20.06	30
41	Shree cement limited	21.25	12.75	0.82	15.47	35
42	Sun Pharmaceutical Industries Ltd.	42.30	33.80	0.44	76.00	5
43	Tata Consultancy Services Ltd.	40.36	31.86	0.76	41.94	17
44	Tata Motors Ltd.	75.18	66.68	1.40	47.69	13
45	Tata Steel Ltd.	37.04	28.54	1.15	24.77	26
46	Tech Mahindra Ltd.	43.78	35.28	0.61	57.45	12
47	Titan Company Ltd.	26.56	18.06	1.08	16.66	33
48	UPL Ltd.	53.51	45.01	1.04	43.38	16
49	UltraTech Cement Ltd.	28.58	20.08	0.82	24.60	27
50	Wipro Ltd.	53.45	44.95	0.61	73.14	6

Source: Compiled by Authors by Taking Values from Websites of NSE, *R_f = 8.5% p.a*

Analysis: Table 2 clearly depicts excess return to beta ratio and respective ranks for 50 companies of Nifty 50.

Table 3: *Rank of the Companies*

Si.No.	Ranked Companies	Si.No.	Ranked Companies
1	Cipla Ltd.	22	Bajaj Auto Ltd.
2	Dr. Reddy's Laboratories Ltd.	23	HDFC life insurance company Ltd.
3	Divi's Laboratories Limited	24	IndusInd Bank Ltd.
4	HCL Technologies Ltd.	25	Bajaj Finance Ltd.
5	Sun Pharmaceutical Industries Ltd.	26	Tata Steel Ltd.
6	Wipro Ltd.	27	UltraTech Cement Ltd.
7	Reliance Industries Ltd.	28	Asian Paints Ltd.
8	Mahindra & Mahindra Ltd.	29	Bharat Petroleum Corporation Ltd.
9	Hero Moto Corp Ltd.	30	Hindustan Unilever Ltd.
10	Britannia Industries Ltd.	31	SBI Life Insurance Company
11	Infosys Ltd.	32	Bajaj Finserv Ltd.
12	Tech Mahindra Ltd.	33	Titan Company Ltd.
13	Tata Motors Ltd.	34	HDFC bank limited
14	JSW Steel Ltd.	35	Shree cement limited
15	Eicher Motors Ltd.	36	GAIL (India) Ltd.
16	UPL Ltd.	37	Larsen & Toubro Ltd.
17	Tata Consultancy Services Ltd.	38	Axis Bank Ltd.
18	Hindalco Industries Ltd.	39	ICICI Bank Ltd.
19	Adani Ports and Special Economic Zone Ltd.	40	Housing Development Finance Corporation Ltd.
20	Grasim Industries Ltd.	41	Kotak Mahindra Bank Ltd.
21	Maruti India Ltd.	42	Oil & Natural Gas Corporation Ltd.

Sources: Data Compiled by the Author

Analysis: Table 3 shows the selected ranked companies for the clear version. And the next step is to eliminate all the negative excess return to Beta ratio as per Sharp's Model. Now among 50companies 42 top ranked companies are selected. Cipla Ltd. leads in top followed by Dr. Reddy's Laboratories Ltd., Divi's Laboratories Limited, etc.

Analysis: Table 4 below shows the calculation of Cutoff rate of the selected Forty-two companies using sharpe's single index model. Excess return, Beta, unsystematic risk and cut off rate are the various measures calculated by using the formula explained in the methodology part of the paper. It is observed that the cut off rate steadily increases from 8.03 to 53.44 and then decreases. Therefore, the value 53.44 is considered as the cut off rate. For construction of portfolio, the stocks which are below the cut off rate are not included. Hence, the portfolio is built using 12 stocks for the period under study.

Computation of cut off rate using sharpe's single index model

Table 4: *Cutoff Rate of 42 Companies*

S. No	**RANKED STOCK**	βi2	**R i- Rf / βi**	**R i- Rf) βi2 / βi = (R i- Rf) βi**	σei2	**(R i- Rf) βi / σei2 (I)**		**βi2 / σei2 (II)**		σm2*∑ (I) (A)	σm2 *∑ (II) (B)	1+(B) (C)	A+C Ci
							∑		∑				
1	Cipla Ltd.	0.15	145.63	22.40	6.91	3.24	3.24	0.02	0.02	8.49	0.06	1.06	8.03
2	Dr. Reddy's Laboratories Ltd.	0.16	111.33	17.88	5.30	3.38	6.62	0.03	0.05	17.34	0.14	1.14	15.24
3	Divi's Laboratories Limited	0.22	93.76	20.61	5.12	4.02	10.64	0.04	0.10	27.88	0.25	1.25	22.30
4	HCL Technologies Ltd.	0.64	78.87	50.41	4.68	10.76	21.40	0.14	0.23	56.07	0.61	1.61	34.88
5	Sun Pharmaceutical Industries Ltd.	0.20	76.00	15.03	5.24	2.87	24.27	0.04	0.27	63.59	0.71	1.71	37.26
6	Wipro Ltd.	0.38	73.14	27.63	5.20	5.31	29.58	0.07	0.34	77.50	0.90	1.90	40.86
7	Reliance Industries Ltd.	0.90	72.21	65.24	3.94	16.57	46.15	0.23	0.57	120.91	1.50	2.50	48.40
8	Mahindra & Mahindra Ltd.	1.77	59.60	105.37	6.33	16.65	62.80	0.28	0.85	164.54	2.23	3.23	50.94
9	Hero Moto Corp Ltd.	1.11	59.29	65.99	5.02	13.14	75.94	0.22	1.07	198.96	2.81	3.81	52.21
10	Britannia Industries Ltd.	0.28	58.75	16.74	2.85	5.88	81.82	0.10	1.17	214.36	3.07	4.07	52.63
11	Infosys Ltd.	0.63	58.63	36.72	3.79	9.70	91.51	0.17	1.34	239.76	3.51	4.51	53.21
12	Tech Mahindra Ltd.	0.38	57.45	21.67	3.85	5.62	97.14	0.10	1.44	254.50	3.76	4.76	**53.44**
13	Tata Motors Ltd.	1.95	47.69	93.22	9.64	9.68	106.81	0.20	1.64	279.85	4.29	5.29	52.86
14	JSW Steel Ltd.	1.91	47.51	90.93	3.82	23.79	130.60	0.50	2.14	342.17	5.61	6.61	51.80
15	Eicher Motors Ltd.	1.16	45.29	52.52	4.52	11.61	142.21	0.26	2.40	372.59	6.28	7.28	51.20
16	UPL Ltd.	1.08	43.38	46.70	6.51	7.18	149.39	0.17	2.56	391.40	6.71	7.71	50.76
17	Tata Consultancy Services Ltd.	0.58	41.94	24.20	2.94	8.22	157.61	0.20	2.76	412.94	7.22	8.22	50.21

18	Hindalco Industries Ltd.	2.70	39.80	107.51	6.58	16.33	173.94	0.41	3.17	455.74	8.30	9.30	49.00
19	Adani Ports and Special Economic Zone Ltd.	0.49	39.72	19.62	3.98	4.94	178.88	0.12	3.29	468.67	8.63	9.63	48.69
20	Grasim Industries Ltd.	1.20	34.18	40.97	4.01	10.23	189.11	0.30	3.59	495.47	9.41	10.41	47.60
21	Maruti India Ltd.	1.98	30.72	60.86	3.78	16.10	205.21	0.52	4.12	537.65	10.78	11.78	45.63
22	Bajaj Auto Ltd.	1.02	29.22	29.73	2.95	10.10	215.30	0.35	4.46	564.10	11.69	12.69	44.46
23	HDFC life insurance company Ltd.	0.63	28.86	18.06	3.22	5.61	220.91	0.19	4.66	578.79	12.20	13.20	43.86
24	IndusInd Bank Ltd.	3.62	26.17	94.81	12.66	7.49	228.40	0.29	4.94	598.40	12.95	13.95	42.91
25	Bajaj Finance Ltd.	2.62	24.85	65.07	7.98	8.15	236.55	0.33	5.27	619.75	13.81	14.81	41.86
26	Tata Steel Ltd.	1.33	24.77	32.90	3.22	10.23	246.78	0.41	5.68	646.56	14.89	15.89	40.70
27	UltraTech Cement Ltd.	0.67	24.60	16.40	2.87	5.71	252.49	0.23	5.91	661.51	15.50	16.50	40.10
28	Asian Paints Ltd.	0.39	22.68	8.78	3.08	2.85	255.34	0.13	6.04	668.98	15.82	16.82	39.76
29	Bharat Petroleum Corporation Ltd.	1.09	20.24	21.98	5.76	3.81	259.15	0.19	6.23	678.97	16.32	17.32	39.21
30	Hindustan Unilever Ltd.	0.92	20.06	18.36	3.30	5.57	264.72	0.28	6.51	693.55	17.05	18.05	38.43
31	SBI Life Insurance Company	0.92	20.06	18.36	3.30	5.57	270.28	0.28	6.78	708.14	17.77	18.77	37.72
32	Bajaj Finserv Ltd.	1.90	17.64	33.48	5.05	6.62	276.91	0.38	7.16	725.49	18.76	19.76	36.72
33	Titan Company Ltd.	1.18	16.66	19.58	4.26	4.59	281.50	0.28	7.43	737.52	19.48	20.48	36.02
34	HDFC bank limited	1.54	16.01	24.60	1.84	13.37	294.87	0.84	8.27	772.56	21.67	22.67	34.08
35	Shree cement limited	0.68	15.47	10.51	3.32	3.16	298.03	0.20	8.47	780.84	22.20	23.20	33.65
36	GAIL (India) Ltd.	0.65	12.13	7.89	4.61	1.71	299.74	0.14	8.61	785.33	22.57	23.57	33.32
37	Larsen & Toubro Ltd.	0.54	12.07	6.54	3.25	2.01	301.76	0.17	8.78	790.60	23.01	24.01	32.93
38	Axis Bank Ltd.	3.97	9.66	38.37	6.87	5.59	307.34	0.58	9.36	805.24	24.52	25.52	31.55
39	ICICI Bank Ltd.	3.46	6.83	23.63	3.06	7.72	315.06	1.13	10.49	825.46	27.48	28.48	28.98
40	Housing Development Finance Corporation Ltd.	1.66	3.15	5.22	3.27	1.60	316.65	0.51	11.00	829.64	28.81	29.81	27.83
41	Kotak Mahindra Bank Ltd.	1.33	2.11	2.80	3.49	0.80	317.46	0.38	11.38	831.74	29.81	30.81	27.00
42	Oil & Natural Gas Corporation Ltd.	0.64	0.90	0.58	5.25	0.11	317.57	0.12	11.50	832.03	30.12	31.12	26.73

Table 5: ***Construction of Portfolio and Proportion of Investment in Each Stock***

Si. No.	LIST OF COMPANIES	R_i-R_f/β_i	β_i/σ_{ei}^2	C*	[R_i-R_f/β_i]-C*	β_i/σ_{ei}^2 * [R_i-R_f/β_i]-C*	Investment (X_i)	Investment (%)
1	Cipla Ltd.	145.63	0.0568	53.4384	92.20	5.2331	0.1653	16.53
2	Dr. Reddy's Laboratories Ltd.	111.33	0.0757	53.4384	57.89	4.3796	0.1383	13.83
3	Divi's Laboratories Limited	93.76	0.0915	53.4384	40.32	3.6892	0.1165	11.65
4	HCL Technologies Ltd.	78.87	0.1707	53.4384	25.43	4.3405	0.1371	13.71
5	Sun Pharmaceutical Industries Ltd.	76.00	0.0848	53.4384	22.56	1.9141	0.0605	6.05
6	Wipro Ltd.	73.14	0.1182	53.4384	19.70	2.3275	0.0735	7.35
7	Reliance Industries Ltd.	72.21	0.2414	53.4384	18.77	4.5306	0.1431	14.31
8	Mahindra & Mahindra Ltd.	59.60	0.2101	53.4384	6.16	1.2952	0.0409	4.09
9	Hero Moto Corp Ltd.	59.29	0.2100	53.4384	5.85	1.2285	0.0388	3.88
10	Britannia Industries Ltd.	58.75	0.1874	53.4384	5.31	0.9961	0.0315	3.15
11	Infosys Ltd.	58.63	0.2090	53.4384	5.19	1.0843	0.0342	3.42
12	Tech Mahindra Ltd.	57.45	0.1594	53.4384	4.02	0.6401	0.0202	2.02
						31.6587		100

Sources: Author Compiled the Data by Taking Various Measures

Analysis: Table 5 clearly shows the computation of proportion of funds to be invested in the stocks selected to be included. The calculations shows that 16.53% of the funds must be invested in Cipla Ltd., 14.31% in Reliance industries Ltd., 13.83% in Dr. Reddy's Laboratories Ltd.,11.65% in Divi's Laboratories Ltd., 13.75% in HCL Tech Ltd., followed by sun pharma Ltd., Wipro Ltd., M&M Ltd., Hero Moto corp Ltd., Britannia Industries Ltd., Infosys and Tech Mahindra Ltd.

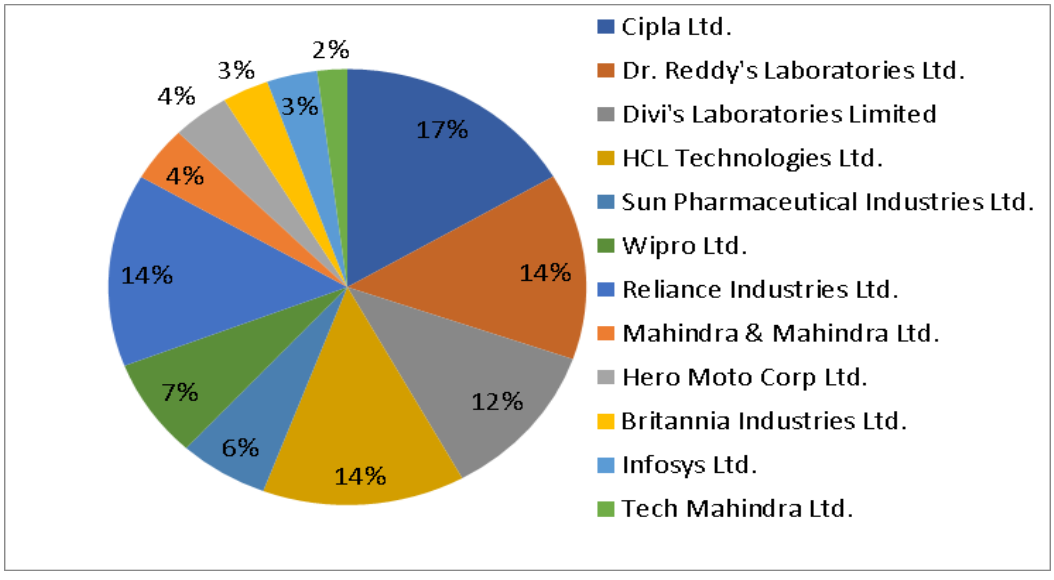

Figure 1: ***Proportion of Funds Invested in the Selected Stocks***

Computation of intrinsic value of securities included in portfolio

Table 6 – *Intrinsic Value of Securities Included in Portfolio*

S.no.	Name of the company	Expected dividend	Expected Return		Expected rate of return	Intrinsic value	
			6 months holding	one year holding period		6 months holding	one year holding period
1.	Cipla ltd.	3.2	582.70	1781.87	17.8054	539.2492	1515.004
2.	Dr. Reddy lab	21	2846.85	6376.25	18.06309	2639.395	5416.808
3.	Divi's Laboratories Limited	16.4	2740.94	9814.48	19.68557	2520.14	8212.931
4.	HCL Technology Ltd.	14.4	457.55	1030.34	27.57607	417.851	818.9132
5.	Sun Pharmaceutical Industries Ltd.	3.45	305.93	739.67	19.11054	623.8871	283.4799
6.	Wipro Ltd.	1.1	156.02	312.60	23.16436	141.5797	254.701
7.	Reliance Industries Ltd.	8.1	1124.55	2253.15	31.17893	988.922	1723.791
8.	Hero Moto Corp Ltd.	85.8	1636.02	3371.16	33.6723	1489.252	2586.147
9.	Britannia Industries	16.7	2856.80	8736.02	21.23408	2609.748	7219.683
10.	Tech Mahindra Ltd.	12.8	423.68	835.82	23.15243	393.3166	689.0793

Sources: Data Compiled by Author

Analysis: Table 6 displays the computation of intrinsic value of selected 10 stocks, since two companies Mahindra & Mahindra Ltd. & Infosys Ltd. shows negative dividend rate, we are ignoring these companies.

Findings

- It is found that out of 50 stocks considered for study, only 10 stocks are selected for inclusion in optimal portfolio.
- Axis Bank Ltd. has the highest Beta value of 1.9930 which means it is highly volatile.
- The cut-off point is 53.44.
- The stock with negative dividend rate implies that these stocks are to be short sold. These Stock areMahindra & Mahindra Ltd. & Infosys Ltd.
- It is found that top three place were occupied by pharmaceutical company due to covid 19 crisis during the data period.
-

Conclusion

The construction of optimal portfolio is hard and not easy. This paper attempts to build an optimal portfolio taking 50 stocks of Nifty 50 Index. As evident from the above study, only 10 stocks fulfil the Construction of Optimal Portfolio Using Sharpe's Single Index Model. Cutoff rate plays a vital role in building the optimal portfolio. Investment can be made on those stocks which produces high return, if the investors want to acquire utmost profit without taking the risk aspect into consideration. While making investment decision the risk involved in the stock return should be considered, even when the returns are high. The risk is reduced by diversifying the portfolio. The idea of diversity is to accomplish a given level of

expected return while accepting the least possible risk. Other factors which affect the securities movement and their selection are macro and general economic factor. In the field of investment finance, these factors should also be considered at the time of choosing securities for optimal study.

The investors should invest their funds on the securities which has good performance history and good net asset value. Net Asset Value (NAV) is a fund's market value per unit. It is obtained by dividing the total value of all the assets in a portfolio, minus all its liabilities. The outcome of the fund is calculated by studying the periodical movements of fund's net asset value and by comparing the fund's performance over their respective benchmarks for the specified period. It was traced that the funds, which embarked lower risk, did not always validate lower returns or vice versa. This states that the risks and return need not always be in a beeline or point-blank relationship. The optimal portfolio analysis and risk return trade-off are determined by the challenging attitudes of investors towards a variety of economic, monetary, political and psychological forces prevailing in the stock market. Thus, the portfolio construction table would help an investor in investment decisions. And the investor would select any company among the fifteen companies from the above portfolio table. I also hope this will help the investors as a guiding record in future and help them to make appropriate investment decisions. It is clear that the construction of optimal portfolio investment by using Sharpe"s Single Index Model is more comfortable.

Recommendation

Further studies can be made on other indices like NIFTY NEXT 50, NIFTY 500 and with the given details, the performances of the different funds can be evaluated by using, Treynor and Jensen performance evaluation techniques.

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Conflict of Interest

The authors declare that the research review was conducted in the absence of any commercial or economic associations that could be construed as a potential conflict of interest.

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