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An empirical study on construction portfolio with reference to BSE

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Abstract

The main thrust of this study is to construct optimal portfolio using Sharpe single index model with reference to BSE Sensex. Portfolio construction is an important process for the investors/ portfolio managers in the capital markets. In this paper we made an attempt to apply Sharpe single index model to BSE Sensex 30 stocks. In order to construct the portfolio of BSE Sensex 30 stocks with 5 years data i.e from June 2016 to July 2021 have be considered. The proposed method formulates a unique cut-off rate and selects those securities to construct optimal portfolio and whose excess return to beta ratio is higher than the cut-off rate. Study found that nine stocks included in optimal portfolio and highest weightage of funds allocated in Drreddys Labs. It is concluded that the pre and post Covid-19 period Pharmaceutical and Financial services companies posted reasonable returns and highest risk in the study period.

Keywords: Optimal portfolio, BSE Sensex, cut-off rate, securities, beta

Introduction

It is difficult task of selecting appropriate stocks for portfolio construction (Poornima, S., & Remesh, A. P. 2019)^[13]. A rational investor always seeks to maximize the returns with limited risk levels (Rout, B., & Panda, J. 2019)^[16]. Investing the entire money with single stock is very risky and exposed to higher level of losses. Construction optimal portfolio always minimizes the risk of the investment (Naveen 2014)^[12]. This is done through the construction optimal portfolio with wide range of assets in the capital markets. Present study significance arises from the fact that the application of the fundamental models develops an offer to investors for making decision in the choice of optimal portfolios in the BSE Sensex 30 blue chip stocks (Raja M. *et al.* 2018)^[15]. Many economist proposed various theories to create portfolio and the popular theories among them are Markowitz and Sharpe models (Nandan, T., & Srivastava, N. 2017)^[11].

The rational of the study is to apply theoretical framework of portfolio management on practical scenario and form a well-diversified optimal portfolio with BSE Sensex 30 stocks (Subashree, M. S., & Bhoopa, D. M. (2017) ^[19]. Markowitz model is created optimal portfolio using efficient frontier by rational investors (Markowitz 1952). According to (Sharpe 1964) single index model, all stocks are affected by movements in the capital markets and the securities which give excess return to beta values are eligible to form a portfolio with lower level of risk (Hertina, D., Hidayat, M. B. H., & Saudi, M. H. 2021) ^[8]. Finally, calculate the unique cut-off rate of the stocks and which need to be including in optimal portfolio. In this paper we made an attempt to construct optimal portfolio using Sharpe single index model with BSE Sensex 30 stocks.

Review of Literature

Gulliksson, M., & Mazur, S. (2020)^[7] studied portfolio construction with a single covariance matrix. Study explored convergence properties gives a solution as better than the solutions that are based on constrained least norm Moore–Penrose, Lasso, and naive equal-weighted approaches. It confirms that the optimal portfolio weights that are obtained by DFPM and Moore–Penrose inverse methods can be modelled by white noise process.

Basha, S. M., & Ramaratnam, M. S. (2017)^[3] analyzed nifty midcap 150 stocks for optimal portfolio construction from 2011 to 2016. Sharpe single index model applied to find out

excess return to beta and calculation of cut-off point. Study confirms that the 150 stocks of midcap only 25 scripts covered in final portfolio. It's found that pharma stocks weightage will be more than the other sectors stocks.

Basanna, P., & Konnur, N. P. (2019)^[2] Study undertaken to construct optimal portfolio using Sharpe single index with Nifty 50 index. For construction portfolio daily closing prices took from the period of four year i.e., 2014 to 2019. It is found that stocks selected for optimal portfolio is consumer non-durables (3 stocks), consumer durables (1 stock), and finance (3 stocks) and agree based sectors (1 stock).

Angelidis, T., & Tessaromatis, N. (2017)^[1] studied global factor allocation strategy using capital market index and portfolio construction methods to meet the robust estimation of error. It is found that exchange-traded funds or index futures, a portfolio based on country indexes with favorable outperforms, factor exposures significantly both statistically, the economically and world market portfolio. The capitalization outperformance remains significant after taking into account transaction costs, alternative portfolio construction methods and tracking error mistakes.

Senthilkumar, A., Namboothiri, A., & Rajeev (2021) analyzed Sharpe single index model with Elton's portfolio optimization framework and Markowitz portfolio theory framework for optimal portfolio intra and inter-sectorial stocks. Studied 11 sector-specific stocks and one intersector optimal portfolio using the NSE sectorial indices and it includes automobiles, banking, financial services, FMCG, IT, media, metals, pharmaceuticals, private banks, PSU banks, realty, and broad-market inter-sector index Nifty50. It is found that inter-sector portfolio performs better than some of the intra-sector portfolios and also the intra-sector portfolios like realty, metals, information technology, and media generated higher returns with relatively moderate or less risk than their sectorial peers and benchmark indices. Study concluded that Sharpe's single index model is better than Markowitz model.

Need For the Study

Every investor gets confusion about selection of right stocks in stock market. Construction of portfolio investor get confusion like where to invest, how much to invest and proportion of investment. Financial literacy and lack of awareness is a gap for investing in capital markets. In order to meet the investor requirement Sharpe single index model is useful strategy to meet these requirements.

Objectives of the study

- To find the risk and returns of individual securities in BSE Sensex 30
- To find the optimal portfolio using single index model
- To determine proportion of investment in optimal portfolio

Research Methodology

The study on portfolio construction is empirical in nature and secondary data collected from BSE website. The data is collected from June 2016 to July 2021. The sample size is limited to 30 stocks of BSE and Risk free rate considered 7.1% (Treasury bill).

Theoretical Framework

Sharpe has provided a model for the selection of appropriate securities in optimal portfolio. Instead of co-relating each security with an index of all securities included in the analysis, Co-relate each security with the efficient market value weighted portfolio of all risky assets in the universe. Following steps involved in the process of construction of portfolio.

The steps for finding out the stocks to be included in the optimal portfolio are given below.

(i) Find out the "Excess return to beta" ratio for each stock under consideration

Excess Return to Beta Ratio =
$$\frac{R_i - R_f}{\beta_i}$$

(ii) Rank them from highest to the lowest Proceed to calculate Ci for all stocks/portfolios according to the ranked order using the following formula.

$$C_{i} = \frac{\sigma_{m}^{2} \sum_{i=1}^{N} \frac{(R_{i} - R_{f})\beta_{i}}{\sigma_{ei}^{2}}}{1 + \sigma_{m}^{2} \sum_{i=1}^{N} \frac{\beta_{i}^{2}}{\sigma_{ei}^{2}}}$$

Where,

 $\sigma m2 = Variance$ of the return of market index.

 σ 2ei =Variance of the stock's movement that is not associated with the movement of market index i.e. stocks unsystematic risk.

- (iii) Compute the cut-off point, which the highest value, of Ci and is taken C*. The stock whose excess return to risk ratio is above the cut-off ratio are selected and all whose ratios are below are rejected. The main reason for this selection is that since securities are ranked from highest excess return to beta to lowest, and if particular security belongs to optimal portfolio all highest ranked securities belongs to optimal portfolio.
- (iv) Once we came to know which securities are to be included in the optimal portfolio, we shall calculate the percent to be invested in each security by using the following formula.

$$X_i = \frac{Z_i}{\sum_{i=1}^{N} Z_i}$$

Where,

$$Z_{i} = \frac{\beta_{i}}{\sigma_{ei}^{2}} \left(\frac{\mathbf{R}_{i} - \mathbf{R}_{f}}{\beta_{i}} - \mathbf{C}^{*} \right)$$

The first portion determines the weight each stock and total comes to 1 to ensure that all funds are invested and second portion determines the relative investment in each security.

Data Analysis and Interpretation Step: 1 Mean return, Beta and Standard deviation

| S. No | Company | Ri | βi | SD (σ) |
|-------|----------------|----|------|--------|
| 1 | Asian Paint | 39 | 1.34 | 1.46 |
| 2 | Axis Bank | 31 | 1.48 | 1.99 |
| 3 | Bajaj Auto | 51 | 1.83 | 1.71 |
| 4 | Bajaj Finsv | 32 | 1.84 | 1.37 |
| 5 | Bajaj Finance | 36 | 1.86 | 1.59 |
| 6 | Bharati Airtel | 25 | 1.91 | 1.48 |
| 7 | Drreddy | 54 | 1.47 | 2.35 |
| 8 | HCLTECH | 35 | 2.78 | 1.47 |
| 9 | HDFC | 33 | 1.67 | 2.47 |
| 10 | HDFC Bank | 41 | 1.71 | 2.03 |
| 11 | Hindunilvr | 36 | 1.01 | 1.54 |
| 12 | ICICI Bank | 31 | 1.85 | 2.08 |
| 13 | Indusind Bank | 67 | 1.95 | 1.65 |
| 14 | Infosys | 33 | 1.46 | 1.91 |
| 15 | ITC | 19 | 1.03 | 1.12 |
| 16 | Kotak Bank | 22 | 1.65 | 2.11 |
| 17 | L&T | 12 | 2.08 | 2.08 |
| 18 | M&M | 29 | 1.99 | 1.37 |
| 19 | Maruti | 34 | 2.11 | 2.43 |
| 20 | NestleInd | 54 | 1.14 | 1.71 |
| 21 | NTPC | 33 | 1.15 | 1.49 |
| 22 | Powergrid | 19 | 1.11 | 1.47 |
| 23 | Reliance | 18 | 1.75 | 1.91 |
| 24 | SBIN | 37 | 1.79 | 2.23 |
| 25 | Sunpharma | 42 | 1.91 | 2.01 |
| 26 | Tata Steel | 12 | 1.52 | 1.13 |
| 27 | TCS | 34 | 2.36 | 1.41 |
| 28 | Techmahendra | 22 | 1.15 | 2.51 |
| 29 | Titan | 39 | 1.65 | 1.21 |
| 30 | Ultracement | 21 | 1.48 | 1.19 |

| Table 1: Mean return, Beta and Standard deviation | able 1: Mean r | turn, Beta | and Standard | deviation |
|----------------------------------------------------------|----------------|------------|--------------|-----------|
|----------------------------------------------------------|----------------|------------|--------------|-----------|

Source: Computed data

Table 1 shows calculation of mean, beta and standard deviation. Indusind Bank posted highest returns followed by Drreddys labs and Bajaj auto. HCL Technology posted beta with highest (2.67%) followed by TCS and Maruti auto. These stocks are more volatile than the other selected

stocks. Techmahedra posted highest standard deviation (2.51%) followed by Drreddys lab and State Bank of India.

Step 2: Calculation of Excess Return to Beta Ratio and Raking the Scripts

Table 2: Calculation of Excess Return to Beta Ratio and Raking the Scripts

| S. No | Company | Ri | βi | σei2 | Ri-Rf | Ri-Rf/βi | Rank |
|-------|----------------|----|------|---------|-------|----------|------|
| 1 | Asian Paint | 39 | 1.34 | 0.00148 | 38.99 | 29.1003 | 7 |
| 2 | Axis Bank | 31 | 1.48 | 0.00229 | 30.99 | 20.9421 | 13 |
| 3 | Bajaj Auto | 53 | 1.83 | 0.00273 | 53.99 | 29.5051 | 6 |
| 4 | Bajaj Finsv | 32 | 1.84 | 0.00288 | 31.99 | 17.3882 | 18 |
| 5 | Bajaj Finance | 36 | 1.86 | 0.00306 | 35.99 | 19.3518 | 15 |
| 6 | Bharati Airtel | 25 | 1.91 | 0.00314 | 24.99 | 13.0860 | 26 |
| 7 | Drreddy | 54 | 1.47 | 0.00316 | 97.99 | 66.6628 | 1 |
| 8 | HCLTECH | 35 | 2.78 | 0.00353 | 34.99 | 12.5879 | 27 |
| 9 | HDFC | 83 | 1.67 | 0.00359 | 82.99 | 49.6972 | 2 |
| 10 | HDFC Bank | 41 | 1.71 | 0.00372 | 40.99 | 23.9733 | 9 |
| 11 | Hindunilvr | 36 | 1.01 | 0.00437 | 35.99 | 35.6380 | 4 |
| 12 | ICICI Bank | 31 | 1.85 | 0.00442 | 30.99 | 16.7537 | 20 |
| 13 | Indusind Bank | 67 | 1.95 | 0.00445 | 66.99 | 34.3561 | 5 |
| 14 | Infosys | 33 | 1.46 | 0.00461 | 32.99 | 22.5989 | 11 |
| 15 | ITC | 19 | 1.03 | 0.00462 | 18.99 | 18.4411 | 17 |
| 16 | Kotak Bank | 22 | 1.65 | 0.00471 | 21.99 | 13.3299 | 25 |
| 17 | L&T | 12 | 2.08 | 0.00482 | 11.99 | 5.7665 | 30 |
| 18 | M&M | 29 | 1.99 | 0.00489 | 28.99 | 14.5700 | 22 |
| 19 | Maruti | 34 | 2.11 | 0.00495 | 33.99 | 16.1111 | 21 |
| 20 | NestleInd | 54 | 1.14 | 0.00497 | 53.99 | 47.3635 | 3 |
| 21 | NTPC | 33 | 1.15 | 0.00506 | 32.99 | 28.6907 | 8 |

| 22 | Powergrid | 19 | 1.11 | 0.00513 | 18.99 | 17.1120 | 19 |
|----|--------------|----|------|---------|-------|---------|----|
| 23 | Reliance | 18 | 1.75 | 0.00513 | 17.99 | 10.2825 | 28 |
| 24 | SBIN | 37 | 1.79 | 0.00521 | 36.99 | 20.6672 | 14 |
| 25 | Sunpharma | 42 | 1.91 | 0.00525 | 41.99 | 21.9866 | 12 |
| 26 | Tata Steel | 12 | 1.52 | 0.00526 | 11.99 | 7.8910 | 29 |
| 27 | TCS | 34 | 2.36 | 0.00539 | 33.99 | 14.4044 | 23 |
| 28 | Techmahendra | 22 | 1.15 | 0.00544 | 21.99 | 19.1255 | 16 |
| 29 | Titan | 39 | 1.65 | 0.00571 | 38.99 | 23.6329 | 10 |
| 30 | Ultracement | 21 | 1.48 | 0.00593 | 20.99 | 14.1854 | 24 |

Source: Computed data

Table 2 depicts, Calculation of excess return to beta ratio and rakings. Excess return is difference between risk free asset return and mean return. Drreddy laboraties (66.66) has posted highest excess return to beta ratio, followed by HDFC Ltd.(49.69) and Nestle Ltd. (47.36). Since scripts are ranked from highest to lowest excess return to beta ratio, we know that all high ranked scripts belong to optimal portfolio. Investor can reduce the risk through diversification. Ultracement, posted highest (0.00593) as unsystematic risk.

Step 3: Calculation of Cut of rate

| Table 5: Calculation of Cut of rate |
|--------------------------------------------|
|--------------------------------------------|

| S. No | Company | (Ri-Rf)*βi/σei2 | Σ(Ri-Rf)*βi/σei2 | Σβi2/σei2 | Ci | Status |
|-------|----------------|-----------------|------------------|-----------|--------|--------|
| 1 | Asian Paint | 2.5898 | 2.5898 | 1.5453 | 0.0060 | In |
| 2 | Axis Bank | 9.5860 | 12.1758 | 7.4374 | 0.0276 | In |
| 3 | Bajaj Auto | 15.0500 | 27.2257 | 17.1426 | 0.0604 | In |
| 4 | SBIN | 21.4370 | 48.6627 | 34.1282 | 0.1041 | In |
| 5 | Reliance | 29.2110 | 77.8738 | 57.3138 | 0.1587 | In |
| 6 | Bharati Airtel | 18.0122 | 95.8860 | 71.7457 | 0.1899 | In |
| 7 | Drreddy | 1.8426 | 97.7286 | 73.2545 | 0.1929 | In |
| 8 | Techmahendra | 27.6449 | 125.3735 | 101.1715 | 0.2346 | In |
| 9 | HDFC | 8.8482 | 134.2216 | 110.3385 | 0.2469 | In |
| 10 | HDFC Bank | 5.2391 | 139.4607 | 115.7981 | 0.2540 | Out |
| 11 | Hindunilvr | 15.5913 | 155.0520 | 132.5857 | 0.2740 | Out |
| 12 | ICICI Bank | 14.6155 | 169.6675 | 148.9134 | 0.2914 | Out |
| 13 | Indusind Bank | 80.2734 | 249.9408 | 240.3995 | 0.3710 | Out |
| 14 | Infosys | 27.0982 | 277.0391 | 272.6644 | 0.3924 | Out |
| 15 | ITC | 68.8917 | 345.9308 | 361.7781 | 0.4351 | Out |
| 16 | Kotak Bank | 103.4890 | 449.4198 | 517.9125 | 0.4725 | Out |
| 17 | L&T | 43.0172 | 492.4370 | 584.7311 | 0.4837 | Out |
| 18 | M&M | 49.3725 | 541.8095 | 668.2291 | 0.4919 | Out |
| 19 | Maruti | 48.8614 | 590.6709 | 751.6091 | 0.4985 | Out |
| 20 | NestleInd | 90.3916 | 681.0625 | 907.3157 | 0.5080 | Out |
| 21 | NTPC | 40.1035 | 721.1660 | 977.7929 | 0.5111 | Out |
| 22 | Powergrid | 42.3348 | 763.5008 | 1055.7705 | 0.5127 | Out |
| 23 | Bajaj Finsv | 11.5553 | 775.0560 | 1077.2586 | 0.5131 | Out |
| 24 | Bajaj Finsv | 30.8592 | 805.9153 | 1135.1788 | 0.5138 | Out |
| 25 | Sunpharma | 79.9376 | 885.8529 | 1289.0406 | 0.5143 | Out |
| 26 | Tata Steel | 19.0399 | 904.8928 | 1326.4432 | 0.5142 | Out |
| 27 | TCS | 37.0522 | 941.9450 | 1399.5231 | 0.5139 | Out |
| 28 | HCLTECH | 26.9121 | 968.8571 | 1453.4857 | 0.5135 | Out |
| 29 | Titan | 74.4945 | 1043.3515 | 1604.4002 | 0.5120 | Out |
| 30 | Ultracement | 12.5065 | 1055.8581 | 1630.1196 | 0.5117 | Out |

Source: Computed data

Table 3 shows Calculation of Cut of rate C*, All scripts whose excess return to beta ratio is above the cut off rate are selected and whose excess return to beta ratio are below are rejected. Cut off rate will decide which scripts are kept "In" the optimal portfolio and which scripts are "Out", illustrated in the "Status". Used Market variance (0.002308024) for calculation of C*. Inference from table 3, highest value Ci has taken as the cut off rate C*. Cut off rate is C* = 0.2469.

HDFC Ltd. Recorded the C*, there are 9 scripts are recorded with more excess return to beta ratio than the cut off rate. These nine stocks are eligible to construction optimal portfolio according to their excess return to beta ratio.

Step 4: Construction of Optimal Portfolio

| Table 4: Construction of Optimal Portfol | lio |
|-------------------------------------------------|-----|
|-------------------------------------------------|-----|

| Company | βi | σei2 | Ri-Rf/βi | βi2/σei2 | Zi | Xi=Zi/ΣZi |
|-------------|------|---------|----------|----------|---------|-----------|
| Asian Paint | 1.34 | 0.99383 | 0.1104 | 2.8062 | 19.9000 | 13.9000 |
| Axis Bank | 1.48 | 0.01631 | 0.2949 | 179.2826 | 6.1935 | 11.3400 |
| Bajaj Auto | 1.83 | 0.02374 | 0.7370 | 42.9697 | 20.4786 | 11.5600 |

| SBIN | 1.79 | 0.00763 | 0.2456 | 448.5583 | 13.4300 | 9.0200 |
|----------------|------|---------|--------|----------|---------|---------|
| Reliance | 1.75 | 0.00835 | 0.2843 | 455.3892 | 10.8779 | 8.1300 |
| Bharati Airtel | 1.91 | 0.00801 | 0.2906 | 266.1174 | 8.0514 | 11.4000 |
| Drreddy | 1.47 | 0.00802 | 0.1304 | 132.2818 | 12.3400 | 29.2100 |
| Techmahendra | 1.15 | 0.01205 | 0.3481 | 225.9336 | 19.8134 | 3.4500 |
| HDFC | 1.67 | 0.02209 | 0.2088 | 195.8533 | 23.4500 | 1.9900 |

Source: Computed Data

Table 4 shows the proportion of funds investment in each script. The maximum fund investment should be done in Drreddys Lab. (29.21%) followed by Asian Paint Ltd. (13.90%) and Bajaj Auto Ltd. (11.56%). However, HDFC Ltd. (1.99%) got least allocation funds in optimal portfolio. Considering Drreddys Lab. got highest fund allocation, which is holding beta reasonable beta value and higher mean return generated stock in this optimal portfolio. After having this results Investor, Portfolio manager and financial institution make a note on before investing.

Conclusion

Risk and return two parameters plays very important role in investment decision. This study aims at analyzing the opportunity that are available for investors as per as returns and risk are concerned while investing in selected stocks of firms listed in the BSE Sensex 30. Out of 30 stocks of BSE only nine stocks included optimal portfolio. The present results are similar to (Nandan, T., & Srivastava, N. 2017^[11] and Basanna, P., & Konnur, N. P. 2019) [2]. Construction optimal portfolio is a road map for portfolio manager, financial institutions and corporate bodies and investor for taking right investment decisions. Study believes a fundamental analysis of individual securities included in the portfolio would to a great extent to improve the higher performance of well-diversified portfolio. Investors should take appropriate advices and suggestions from experts from the capital markets to evaluate the stocks periodically. Study found that nine stocks included in optimal portfolio and highest weightage of funds allocated in Drreddys Labs and concluded that the pre and post covid-19 period Pharmaceutical and financial services companies posted reasonable returns and highest risk in the study period.

References

- 1. Angelidis T, Tessaromatis N. Global equity country allocation: An application of factor investing. Financial Analysts Journal. 2017;73(4):55-73.
- Basanna P, Konnur NP. Construction of an Optimal Portfolio Using the Single Index Model: An Empirical Study of Nifty50 Stocks. Indian Journal of Research in Capital Markets. 2019;6(4):20-35.
- Basha SM, Ramaratnam MS. Construction of an Optimal Portfolio Using Sharpe's Single Index Model: A Study on Nifty Midcap 150 Scrips. Indian Journal of Research in Capital Markets. 2017;4(4):25-41.
- 4. Basha M, Singh AP, Rafi M, Rani MI, Sharma NM. Cointegration and Causal relationship between Pharmaceutical sector and Nifty–An empirical Study. PalArch's Journal of Archaeology of Egypt/Egyptology. 2020;17(6):8835-8842.
- Debasish S, Swaroop Khan SJ. Optimal portfolio construction in stock market An empirical study on selected stocks in manufacturing in India. International Journal of Business Management. 2012;2(2):37-44.
- 6. Francis J, Mary Rathika G. The single index model and

the construction of optimal portfolio with CNX pharma script. International Journal of Management. 2015;6(1):87-96.

- 7. Gulliksson M, Mazur S. An iterative approach to illconditioned optimal portfolio selection. Computational Economics. 2020;56(4):773-794.
- 8. Hertina D, Hidayat MBH, Saudi MH. Share Portfolio Performance Analysis Using Sharpe, Trey nor and Jensen Methods with the Geographical Perspective of Indonesia Stock Exchange. Review of International Geographical Education Online. 2021;11(3):55-61.
- Muthu MG. Optimal portfolio selection using Sharpe's single index model. Indian Journal of Applied Research. 2014;4(1):286-288. DOI: 10.15373/2249555X.
- Nalini R. Optimal portfolio construction using Sharpe's single index model A study of selected stocks from BSE. International Journal of Advanced Research in Management and Social Sciences. 2014;3(12):72-93.
- Nandan T, Srivastava N. Construction of optimal portfolio using Sharpe's single index model: an empirical study on nifty 50 stocks. Journal of Management Research and Analysis. 2017;4(2):74-83.
- Naveen CH. Application of Sharpe index model to BSE. An International Journal of Management Studies. 2014;4(2):1-5.
- Poornima S, Remesh AP. Optimal portfolio construction of selected stocks from nse using sharpe's single index model. International Journal of Management, IT and Engineering. 2019;7(12):283-298.
- 14. Pornima S, Ramesh AP. Construction of optimal portfolio using Sharpe's single index model A Study with reference to banking & IT sector. International Journal of Applied Research. 2015;1(13):21-24.
- Raja M, Venkatamuni RR, Muthu MG, Anand P. A study on optimal portfolio construction with special reference to NSE CNX Nifty pharma index. International Journal of Civil Engineering and Technology. 2018;9(13):1355-1363.
- Rout B, Panda J. Construction of Optimal Portfolio on Selected Stocks of BSE Using Sharpe's Single Index Model. Srusti Management Review. 2019;12(1):27-41.
- 17. Senthilkumar A, Namboothiri A, Rajeev S. Does portfolio optimization favor sector or broad market investments? Journal of Public Affairs, e02752.
- Shah CA. Construction of optimal portfolio using Sharpe index model & CAPM for BSE top 15 securities. International Journal of Research and Analytical Reviews. 2015;2(2):168-178.
- 19. Subashree MS, Bhoopa DM. Construction of Optimal Portfolio Using Sharpe's Single Index Model-A Study With Reference To Banking and Automobile Sectors. ISSN (Print), 2017, 2320-5504.