

## **STUDY OF MOVEMENT OF SECTORAL INDICES IN NSE BY USING PORTFOLIO THEORY**

*Dr. Gitanjali Jindal & Dr. Anand Kumar*

*Kedarnath Aggarwal Institute of Management, Charkhi Dadri (Hr.), Haryana, India*

### **ABSTRACT**

*The two key components of an equity percentage funding are danger and return. Every investor seeks the best feasible return on his funding with the lowest possible chance. In 1952, Harry Markowitz created a version to assist the investors. By reading more than one ability portfolios of the furnished securities, the model makes suggestions for the selection of an green portfolio. Additionally, it's far operating on an efficient frontier based on a set diploma of danger and the very best go back. The goal of the studies is to use Markowitz portfolio principle to create the portfolio primarily based at the most advantageous portfolio and the least quantity of threat. After that, it creates a portfolio by comparing the performance to the Nifty. 50 shares from [www.Yahoo.Finance.Com](http://www.Yahoo.Finance.Com) which might be used to calculate from April 2011 to October 2022 had been considered. The hazard-unfastened price of go back is calculated the use of Treasury bill facts for the equal time period. The securities are analyzed the usage of Microsoft Excel. There is a wealth of facts to be had to buyers regarding whilst, how, and why to put money into a given portfolio.*

**KEYWORDS:** *Efficient Portfolios, Portfolio Optimization, Variance, Covariance, Risk and Return, Markowitz Version, Portfolio.*

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### **INTRODUCTION**

Investing is a vital idea for all of us. It encompasses a whole lot of belongings together with shares, bonds, real property, mutual finances, and authorities securities. Portfolio selection entails identifying the green portfolio after which deciding on the nice one from the set. Every investor aims to put money into securities that provide the most return with minimal risk. The selection of the top-quality portfolio, referred to as efficient portfolios, depends at the investor's risk aversion or, conversely, on their hazard tolerance. The concept of portfolio optimization is crucial in investing, and Dr. Harry Markowitz's Markowitz model (1952), additionally called the current portfolio idea or portfolio choice, is used to select the most finest portfolio. The fundamental standards of the modern portfolio theory are derived from a chain of propositions about rational investor behavior recommend via Dr. Markowitz. He hired mathematical programming and statistical analysis to achieve the gold standard allocation of assets inside a portfolio based on a danger-reward framework. The best portfolio for an investor might be placed on the point where the green frontier and the investor's chance-return application curve tangentially intersect. He took under consideration the variance in expected returns and the relationships among investments while constructing portfolios. Designing an surest portfolio is important. This is because the overall performance of a portfolio is impacted by means of the returns when an investor invests in a unmarried safety. Investing in

multiple securities can lessen the version inside the overall portfolio returns. The goal of this paper is to assemble a varied funding portfolio the usage of Modern Portfolio Theory after which check its overall performance in opposition to the overall performance of the well-known Nifty (NSE index) portfolio.

## REVIEW OF LITERATURE

In 1998, Michael J. Hartley and Gurdip S. Bakshi performed an analysis in which they evolved an econometric technique associated with solving the portfolio choice trouble in opposite. Specifically, while supplied with a time series showing the actual located portfolio of risky assets for a group of investors, a set of socio-economic trends for each investor, and a time series of past prices of returns for the risky property, the technique calculates the parameter values in every investor's software function and the corresponding parameters in the returns era method.

In 2004, Michael J. Hartley and Gurdip S. Bakshi said that their research centered on a positive type of dynamic Markowitz mean-variance portfolio selection problems. Considering the marketplace trend and different factors, a discrete-time model managed by a Markowitz chain turned into carried out. To simplify complexity, we appoint nearly absolutely decomposable transition matrices and vulnerable convergence techniques to address the limit mean-variance portfolio selection hassle the use of probability vectors and transition chance matrices in the weak topology..Obtaining the restriction structures and vulnerable convergence remains viable. Regarding the restriction mean-variance problem, we are able to create ultimate portfolios and determine the green frontier for the eventualities mentioned through utilising the framework of LQ control with indefinite control weights. Next, we utilized the most excellent portfolios from the limit hassle to create portfolios for the initial discrete-time version, demonstrating that those portfolios are near being green. In 2005, Heinz H Moller from the University of Zurich referred to that the Markowitz version, known as current portfolio theory, has advanced into a complex location of have a look at..

It is an increasing number of clean that reading actuarial and monetary dangers separately isn't appropriate for a considerable quantity of insurance issues. Modern portfolio concept is usually used for studying commonplace shares. Yet, the rising importance of latest economic gear and the accessibility of pc electricity also can be attributed to the surge in actuaries' interest in contemporary portfolio idea. Investors don't forget both Risk and Reward as important aspects of funding, in step with Markowitz. The anticipated final results could fluctuate based totally on the assumptions made. If the investor goals a more go back, he have to be inclined to accept greater hazard. Modern portfolio theory, developed through Harry Markowitz, helps buyers recognize how to spread out risk thru diversification. In simple phrases, MPT is an funding strategy that pursuits to maximise expected returns at the same time as decreasing funding chance by means of selecting and constructing investment portfolios (Fabozzi, Gupta,& Markowitz, 2002).

Markowitz H. (1952 and 1959) said that the middle assumption of the Markowitz's portfolio evaluation approach is that buyers generally tend to keep away from chance. This suggests that with the intention to tackle more threat, buyers ought to get hold of greater returns. Markowitz ultimately created a portfolio analysis model. Markowitz (1952) and Tobin (1958) validated that determining the make-up of a super portfolio of unstable securities is feasible whilst supplied with projections of future returns and a suitable covariance matrix of inventory returns.

In 1964, William Sharpe brought the Sharpe Single Index Model (SIM) which outlines the essential steps for developing most fulfilling portfolios. Konno and Yamazaki (1991) advised an extraordinary version using implied absolute deviation (MAD) as a danger measure to address the constraints of Markowitz's implied-variance model. One essential difficulty is the difficult computational mission of fixing a huge quadratic problem linked to a dense covariance matrix.

## **DATA AND METHODOLOGY**

### **Data Source and Time Period**

The foremost intention of this study is to determine the optimal funding allocation amongst securities which can provide the very best hazard-adjusted return. To take a look at the effectiveness of the Markowitz model in minimizing investor hazard, examine the factors that impact investor selection-making in the stock market, and propose strategies for maximizing investment returns. Selecting the right investment ratio includes acting mean variance analysis, which requires understanding three vital additives: anticipated returns, trendy deviation, and correlation.

A loss of correlation among asset lessons reduces portfolio threat and advantages common portfolio returns. Therefore, the mean variance is a crucial tool in asset allocation that could reveal significant possibilities for danger reduction via diversification. The modern studies continue the exam via which include 50 stocks (Table A1) which can be utilized in the computation of NSE Index, known as NIFTY. In order to perform the analysis, the studies accumulated the changed monthly closing costs of 50 shares over an 11-yr duration (April 2011 to Oct 2022) from yahoo.Finance.Com. When thinking about threat-unfastened returns, the 364-day Treasury Bill return of five.39% (Rf) is taken into account and the statistics is acquired from the RBI internet site.

### **Markowitz Portfolio Theory**

As per Harry Markowitz, merging stocks in portfolios can lower standard deviation. According to Modern Portfolio Theory, when selecting a portfolio, expected returns, variance, and covariance of the securities within the portfolio must be taken into account. An efficient portfolio is one that is predicted to generate the greatest return for the smallest amount of risk, or a specified level of risk. By combining different securities, one can create a group of effective portfolios that have the lowest combined risk for a specific level of return and investment amount the investor is able to make.

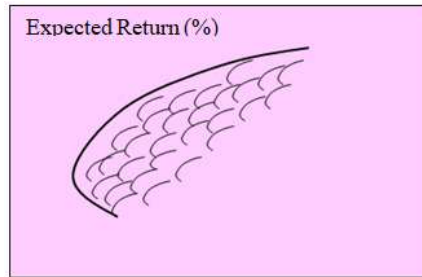
### **Markowitz's Modern Portfolio Theory is Founded on These Assumptions**

- Investors act in a way that maximizes their satisfaction or usefulness with a certain amount of money.
- Investors can obtain unbiased and accurate information on the returns and risk without any cost.
- The markets are effective and rapidly incorporate information accurately.
- Investors are cautious and aim to reduce risk while increasing potential returns.

## **EFFICIENT FRONTIER**

### **Expected Return of a Portfolio**

The Expected Return on a Portfolio is without a doubt the weighted common of the returns of the person assets that make up the portfolio:



**Figure 1**

### **Covariance**

Covariance is a measure of how returns of securities circulate collectively. It is the statistical measure that suggests the interactive chance of a safety relative to others in a portfolio of securities. The covariance between securities x and y can be calculated the usage of the subsequent method:

### **Return**

The go back of a portfolio is just the weighted average of the securities inside the portfolio. The percentage of the portfolio invested in each security determines the burden given to every go back. The method for determining the predicted return of a portfolio may be articulated as validated beneath

### **RETURN OF THE PORTFOLIO**

#### **Portfolio Risk**

Portfolio risk refers to the possibility of the assortment of assets or units in your investment not meeting your financial goals. Every investment in a portfolio comes with its own level of risk, where greater potential profit usually indicates greater risk. To find the portfolio variance of securities in a portfolio, first square the weight of each security, then multiply by its variance, and finally add two multiplied by the weighted average of the securities multiplied by the covariance between them.

#### **Sharpe Ratio**

Nobel laureate William F. Sharpe created the Sharpe ratio to assist investors in evaluating investment returns relative to risk. The ratio measures the average excess return earned per unit of total risk or volatility above the risk-free rate. Volatility measures the price fluctuations of an asset or portfolio. Typically, investors view a Sharpe ratio higher than 1.0 as satisfactory to strong. A ratio above 2.0 is considered excellent. An excellent rating is given to a ratio of 3.0 or above. A ratio lower than 1.0 is seen as less than ideal.

$$\text{Sharpe Ratio} = \frac{R_p - R_f}{\sigma_p}$$

#### **Where:**

$R_p$  = return of portfolio

$R_f$  = risk-free rate

$\sigma_p$  = standard deviation of the portfolio's excess return

## RESULT AND DISCUSSION

### Descriptive Statistics

Nobel Prize winner William F. Sharpe developed the Sharpe ratio to help investors assess investment returns in relation to risk. The ratio calculates the mean extra profit gained per each measure of total risk or volatility beyond the risk-free rate. Volatility assesses the price changes of a specific asset or portfolio. Normally, investors consider a Sharpe ratio above 1.0 to be satisfactory to strong. An excellent rating is given to a ratio that is higher than 2.0. A ratio of 3.0 or higher receives a superior rating. A ratio below 1.0 is considered not ideal

**Table 1: Descriptive Statistics**

| COMPANY    | Average Return | Std     | Skewess | Kurtosis | Jacquer-bera | P    | Sharpe Ratio |
|------------|----------------|---------|---------|----------|--------------|------|--------------|
| ACC        | 16.10          | 31.42   | 1.84    | 3.77     | 23.16        | 0.00 | 0.50         |
| ADANIENT   | 69.34          | 100.47  | 0.92    | 0.90     | 9.51         | 0.00 | 0.68         |
| ADANIGREEN | 289.37         | 305.51  | 1.66    | 0.00     | 13.81        | 0.00 | 0.95         |
| ADANITRANS | 113.25         | 110.42  | 1.01    | -0.78    | 6.77         | 0.00 | 1.02         |
| AMBUJACEM  | 18.83          | 32.90   | 1.62    | 2.78     | 19.29        | 0.00 | 0.56         |
| BAJAJHLDNG | 29.93          | 35.00   | 1.21    | 1.76     | 13.73        | 0.00 | 0.84         |
| BANDHANBNK | 10.72          | 55.16   | 1.58    | 2.97     | 19.39        | 0.00 | 0.18         |
| BANKBARODA | 9.60           | 47.61   | 1.35    | 1.31     | 13.95        | 0.00 | 0.19         |
| BERGEPAIN  | 40.60          | 20.05   | 0.63    | 0.17     | 5.59         | 0.00 | 2.00         |
| BIOCON     | -17.07         | 0.00    | 0.00    | 0.00     | 0.00         | 0.00 | 0.00         |
| BOSCHLTD   | 19.02          | 39.31   | 1.30    | 0.76     | 12.39        | 0.00 | 0.47         |
| CHOLAFIN   | 43.82          | 37.50   | 0.55    | -1.11    | 2.28         | 0.00 | 1.15         |
| COLPAL     | 11.38          | 10.06   | 0.51    | -0.23    | 3.75         | 0.00 | 1.08         |
| DABUR      | 16.95          | 12.40   | 0.24    | -0.55    | 0.81         | 0.00 | 1.32         |
| DLF        | 8.75           | 31.58   | 1.20    | 1.71     | 13.57        | 0.00 | 0.26         |
| DMART      | 1018.04        | 2462.47 | 2.23    | 4.99     | 29.02        | 0.00 | 0.41         |
| GAIL       | 4.30           | 23.51   | 0.23    | -1.64    | -1.46        | 0.00 | 0.16         |
| GLAND      | 7.38           | 57.61   | 0.00    | 0.00     | 0.00         | 0.00 | 0.12         |
| GODREJCP   | 19.23          | 20.12   | 0.04    | 0.81     | 1.98         | 0.00 | 0.93         |
| HAVELLS    | 29.70          | 23.45   | 0.84    | 0.34     | 7.68         | 0.00 | 1.24         |
| HDFCAMC    | 17.38          | 61.37   | 1.97    | 3.90     | 24.52        | 0.00 | 0.27         |
| ICICIGI    | 11.59          | 21.39   | 0.91    | 0.89     | 9.45         | 0.00 | 0.52         |
| ICICIPRUL  | 10.40          | 22.87   | 0.49    | -0.11    | 3.85         | 0.00 | 0.43         |
| INDIGO     | -6.93          | 0.00    | 0.00    | 0.00     | 0.00         | 0.00 | 0.00         |
| INDUSTOWER | 6.96           | 32.87   | 1.51    | 2.07     | 16.91        | 0.00 | 0.20         |
| IOC        | 7.61           | 29.40   | 0.18    | -1.44    | -1.48        | 0.00 | 0.24         |
| JUBLFOOD   | 23.07          | 31.64   | -0.28   | -0.93    | -4.28        | 0.00 | 0.71         |
| LIC        | 0.00           | 0.00    | 0.00    | 0.00     | 0.00         | 0.00 | 0.00         |
| LTI        | 46.64          | 47.54   | -0.41   | -2.98    | -9.65        | 0.00 | 0.97         |
| LUPIN      | 8.39           | 31.40   | 0.28    | -1.21    | -0.19        | 0.00 | 0.25         |
| MARIC      | 20.00          | 16.92   | 0.25    | -1.70    | -1.41        | 0.00 | 1.15         |
| MCDOWELL-N | 19.77          | 32.24   | 0.90    | 0.71     | 8.97         | 0.00 | 0.60         |
| MINDTREE   | 39.92          | 58.30   | 1.10    | 1.26     | 11.79        | 0.00 | 0.68         |
| MUTHOOTFIN | 26.98          | 36.61   | -0.26   | -1.61    | -5.49        | 0.00 | 0.72         |
| NAUKRI     | 29.78          | 30.90   | 0.50    | -0.15    | 3.86         | 0.00 | 0.95         |
| NYKAA      | -11.47         | 0.00    | 0.00    | 0.00     | 0.00         | 0.00 | 0.00         |
| PAYTM      | -20.01         | 0.00    | 0.00    | 0.00     | 0.00         | 0.00 | 0.00         |
| PGHH       | 21.58          | 23.65   | 2.26    | 6.30     | 31.97        | 0.00 | 0.89         |
| PIDILITIND | 29.10          | 14.69   | 0.84    | 0.75     | 8.55         | 0.00 | 1.94         |
| PIIND      | 30.43          | 58.09   | -0.64   | 2.54     | -0.08        | 0.00 | 0.51         |
| PNB        | -8.80          | 33.65   | 0.82    | 0.24     | 7.33         | 0.00 | -0.28        |
| SAIL       | 6.64           | 52.07   | 1.91    | 4.24     | 24.76        | 0.00 | 0.12         |
| SBICARD    | 5.96           | 22.17   | 0.00    | 0.00     | 0.00         | 0.00 | 0.24         |

**Table 1: Contd.,**

|            |        |       |      |       |       |      |      |
|------------|--------|-------|------|-------|-------|------|------|
| SIEMENS    | 14.10  | 29.42 | 0.62 | -0.75 | 3.65  | 0.00 | 0.46 |
| SRF        | 56.62  | 89.66 | 2.27 | 5.90  | 31.21 | 0.00 | 0.63 |
| TATAPOWER  | 15.53  | 58.35 | 2.81 | 8.58  | 41.27 | 0.00 | 0.26 |
| TORNTPHARM | 26.18  | 30.60 | 1.29 | 1.77  | 14.42 | 0.00 | 0.84 |
| VEDL       | 13.24  | 53.29 | 1.04 | 0.87  | 10.52 | 0.00 | 0.24 |
| ZOMATO     | -47.84 | 0.00  | 0.00 | 0.00  | 0.00  | 0.00 | 0.00 |
| ZYDUSLIFE  | 12.73  | 32.83 | 0.42 | -0.75 | 1.97  | 0.00 | 0.37 |
| Nifty      | 11.75  | 12.37 | 1.42 | 0.79  | 13.48 | 0.00 | 0.91 |

**Short Listing Securities: Comparison with T-Bills Returns**

The current study has selected 50 scripts utilized in the formation of the NSE Index, known as Nifty, as previously mentioned. Next, evaluate the yearly return of single stocks against the return of 364-day treasury bills (figure1). Securities with returns higher than risk-free securities are considered when creating an optimal portfolio. Table 2 makes it clear that four stocks have returns lower than T-bills and will not be considered for portfolio building.

**Table 2: Comparison between Individual Securities Return and T Bills Return**

| COMPANY             | Average yearly return (%) | 364 days T-bills (%) | Decision      |
|---------------------|---------------------------|----------------------|---------------|
| ASIAN PAINTS        | 24.08                     | 5.6390               |               |
| AXIS BANK           | 12.71                     | 5.6390               |               |
| BAJAJ FINANCE       | 37.87                     | 5.6390               |               |
| BAJAJ FINSERV       | 60.06                     | 5.6390               |               |
| BHARTI AIRTEL       | 5.96                      | 5.6390               |               |
| DR. REDDYS LAB      | 14.77                     | 5.6390               |               |
| HCL TECHNOLOGIES    | 26.45                     | 5.6390               |               |
| HDFC                | 14.00                     | 5.6390               |               |
| HDFC BANK           | 20.49                     | 5.6390               |               |
| HUL                 | 23.00                     | 5.6390               |               |
| ICICI BANK          | 12.83                     | 5.6390               |               |
| INDUSIND BANK       | 16.32                     | 5.6390               |               |
| INFOSYS             | 13.87                     | 5.6390               |               |
| ITC                 | <b>5.36</b>               | <b>5.6390</b>        | <b>Reject</b> |
| KOTAK MAHINDRA BANK | 23.94                     | 5.6390               |               |
| L&T                 | 8.05                      | 5.6390               |               |
| M&M                 | 7.86                      | 5.6390               |               |
| MARUTI SUZUKI       | 24.98                     | 5.6390               |               |
| NESTLE              | 17.36                     | 5.6390               |               |
| NTPC                | <b>-3.93</b>              | <b>5.6390</b>        | <b>Reject</b> |
| POWER GRID          | 7.41                      | 5.6390               |               |
| RELIANCE IND.       | 20.11                     | 5.6390               |               |
| SBI                 | <b>3.26</b>               | <b>5.6390</b>        | <b>Reject</b> |
| SUN PHARMA          | 12.26                     | 5.6390               |               |
| TATA STEEL          | <b>5.57</b>               | <b>5.6390</b>        | <b>Reject</b> |
| TCS                 | 19.31                     | 5.6390               |               |
| TECH MAHINDRA       | 22.69                     | 5.6390               |               |
| TITAN               | 24.07                     | 5.6390               |               |
| ULTRATECH CEMENT    | 18.06                     | 5.6390               |               |
| Sensex              | 18.77                     |                      |               |

## PORTFOLIO CONSTRUCTION

### Minimum Risk Portfolio

After selecting 42 stocks (Table 3) that produce a return higher than risk-free securities, the next step is to build a portfolio that offers minimal risk. It is worth noting that the current study created the model focusing solely on the long position. Table 4 displays that Markowitz model needs 945 bits of data to create this type of portfolio.

**Table 3: Return and Standard Deviation Of Shortlisted Securities**

| COMPANY    | Average Return | Std         |
|------------|----------------|-------------|
| ACC        | 16.10216255    | 31.41843587 |
| ADANIANT   | 69.33839674    | 100.4723019 |
| ADANIGREEN | 289.3729155    | 305.514769  |
| ADANITRANS | 113.2521857    | 110.4195057 |
| AMBUJACEM  | 18.83049623    | 32.90235435 |
| BAJAJHLDNG | 29.93201186    | 35.00049362 |
| BANDHANBNK | 10.71672092    | 55.16443414 |
| BANKBARODA | 9.596063079    | 47.61009985 |
| BERGEPAIN  | 40.59932941    | 20.04656492 |
| BOSCHLTD   | 19.02376467    | 39.30796721 |
| CHOLAFIN   | 43.81643285    | 37.50246242 |
| COLPAL     | 11.3753451     | 10.06458245 |
| DABUR      | 16.94811051    | 12.39666584 |
| DLF        | 8.745696961    | 31.58288538 |
| DMART      | 1018.036653    | 2462.474732 |
| GLAND      | 7.381638859    | 57.61375175 |
| GODREJCP   | 19.22603844    | 20.11919466 |
| HAVELLS    | 29.70355738    | 23.45044363 |
| HDFCAMC    | 17.38096205    | 61.36901775 |
| ICICIGI    | 11.59315926    | 21.39221275 |
| ICICIPRUL  | 10.39592394    | 22.8652705  |
| INDUSTOWER | 6.956542494    | 32.87104862 |
| IOC        | 7.60808819     | 29.40397639 |
| JUBLFOOD   | 23.06621751    | 31.63706747 |
| LTI        | 46.63948289    | 47.53897897 |
| LUPIN      | 8.388512086    | 31.39557636 |
| MARIC      | 19.99791013    | 16.91660523 |
| MCDOWELL-N | 19.77039637    | 32.23843338 |
| MINDTREE   | 39.92186313    | 58.3011372  |
| MUTHOOTFIN | 26.98377378    | 36.60808772 |
| NAUKRI     | 29.77747313    | 30.89855259 |
| PGHH       | 21.5818602     | 23.6501009  |
| PIDILITIND | 29.10251701    | 14.68969456 |
| PIIND      | 30.4294174     | 58.08611654 |
| SAIL       | 6.641345446    | 52.07152481 |
| SBICARD    | 5.962478909    | 22.16591487 |
| SIEMENS    | 14.09974111    | 29.42262728 |
| SRF        | 56.61906986    | 89.6556593  |
| TATAPOWER  | 15.52571941    | 58.34948427 |
| TORNTPHARM | 26.1787905     | 30.60287564 |
| VEDL       | 13.23926609    | 53.28646214 |
| ZYDUSLIFE  | 12.73181036    | 32.82959686 |
| Nifty      | 11.74557483    | 12.36912116 |

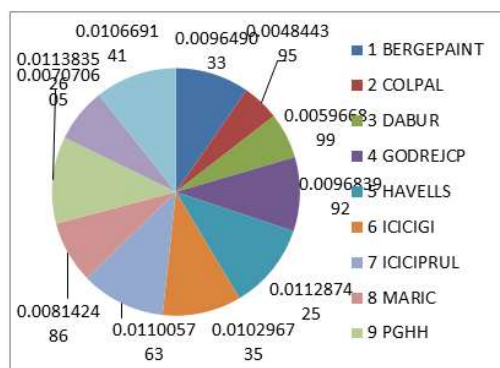
**Table 4: Bits of Information Required**

| Bits of Information Required |                     |                       |                                     |
|------------------------------|---------------------|-----------------------|-------------------------------------|
| Expected Returns(N)          | Variance of Returns | Covariances(N(N-1)/2) | Total Bits of Information(N(N+3)/2) |
| 42                           | 42                  | 861                   | 945                                 |

The construction of the minimum risk portfolio utilized both the covariance matrix and Microsoft Excel. At first, each individual security was given an equal weight of 0.0238 (1/42), and the solver was then utilized with three constraints. Table 5 shows the findings produced. The software has chosen 11 stocks from a pool of 42 options (see figure 2) to create a portfolio with the least amount of risk possible. In Table 6, the minimum risk portfolio shows a portfolio standard deviation of 0.0067% along with a portfolio return of 0.158% and a risk-return trade of 1.09.

**Table 5: Proportion of Investment Minimum Risk Portfolio**

| Proportion of Investment Minimum Risk Portfolio |         |
|-------------------------------------------------|---------|
| COMPANY                                         | weight  |
| BERGEPAIN                                       | 0.00965 |
| COLPAL                                          | 0.00484 |
| DABUR                                           | 0.00597 |
| GODREJCP                                        | 0.00968 |
| HAVELLS                                         | 0.01129 |
| ICICIGI                                         | 0.0103  |
| ICICIPRUL                                       | 0.01101 |
| MARIC                                           | 0.00814 |
| PGHH                                            | 0.01138 |
| PIDILITIND                                      | 0.00707 |
| SBICARD                                         | 0.01067 |
|                                                 | 0.1     |

**Figure 2: Minimum Risk Portfolio****Table 6: Descriptive Statistics of Minimum Risk Portfolio**

| Descriptive Statistics of Minimum Risk Portfolio |         |
|--------------------------------------------------|---------|
| Portfolio std                                    | 0.0067  |
| Portfolio variance                               | 0.00134 |
| Portfolio mean                                   | 0.158   |
| sharpe ratio                                     | 1.09    |
| Risk free rate of return                         | 0.0539  |

### Optimum Portfolio

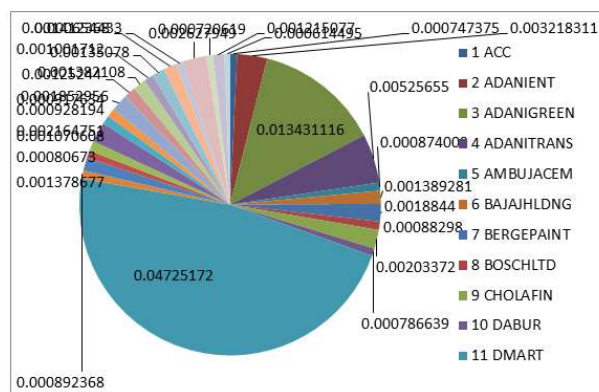
An optimal portfolio is described as a mix of assets that gives investors the highest level of satisfaction. As previously mentioned, at first each individual security was assigned equal weight of (1/42=0.0238), and subsequently, a solver was utilized with three constraints inputted. The outcomes produced by the solver are shown in Table 7. Solver has crafted a



prime portfolio with the selection of just 9 stocks. Based on the Markowitz model, investors should consider these 9 stocks as the most suitable investment options. In simpler terms, spreading your investment across all 9 of these stocks can provide investors with the best balance between risk and return. Statistics describing the best portfolio show a standard deviation of 0.02% per year, a return of 0.0242%, and a risk-return trade-off of 1.34.

**Table 7: Proportion of Investment of Optimum Portfolio**

| Proportion of Investment of Optimum Portfolio |                |
|-----------------------------------------------|----------------|
| COMPANY                                       | Average return |
| BAJAJ AUTO                                    | 0.038          |
| ASIAN PAINTS                                  | 0.110          |
| HUL                                           | 0.105          |
| KOTAK MAHINDRA BANK                           | 0.110          |
| RELIANCE IND.                                 | 0.092          |
| L&T                                           | 0.037          |
| TITAN                                         | 0.110          |
| HCL TECHNOLOGIES                              | 0.121          |
| BAJAJ FINSERV                                 | 0.275          |
|                                               | 1.000          |



**Figure 3: Optimum Portfolio.**

**Table 8: Descriptive Statistics of Optimum Portfolio**

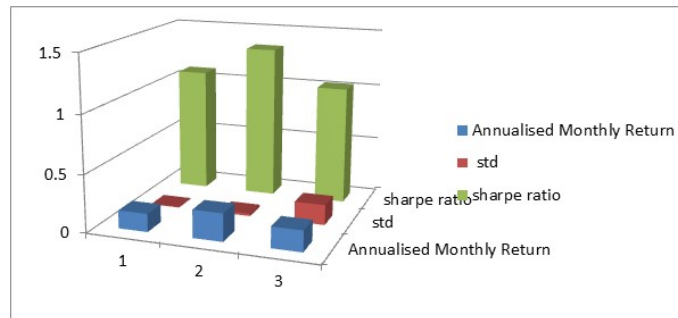
| Descriptive Statistics of Optimum Portfolio |               |
|---------------------------------------------|---------------|
| Portfolio std                               | <b>0.02</b>   |
| Portfolio Variance                          | <b>0.039</b>  |
| Portfolio Mean                              | <b>0.242</b>  |
| Sharpe Ratio                                | <b>1.34</b>   |
| Risk Free Rate of Return                    | <b>0.0539</b> |

**COMPARATIVE STATEMENT OF PORTFOLIO PERFORMANCE**

As mentioned at the outset, the main goal of the paper is to analyze the performance of Sensex in comparison with the MPT-designed portfolio. Table 9 clearly indicates that MPT successfully met its goal by displaying a Sharpe ratio of 1.34, surpassing both the minimum risk portfolio and the Sensex, which did not even reach 1.10. When it comes to portfolio risk, MPT demonstrated strong performance by revealing a standard deviation of 0.0067%, the smallest of the three portfolios.

**Table 9: Comparative Statement of Portfolio Performance**

| Comparative Statement of Portfolio Performance |                        |                   |        |
|------------------------------------------------|------------------------|-------------------|--------|
| Descriptive statistics                         | minimum risk Portfolio | Optimum Portfolio | Sensex |
| Annualized Monthly Return                      | 0.158                  | 0.242             | 0.1175 |
| std                                            | 0.0067                 | 0.02              | 0.1256 |
| Sharpe ratio                                   | 1.09                   | 1.34              | 1.03   |



**Figure 4: Portfolio Performance.**

**CONCLUSION**

Different instruments commonly consist of stocks, bonds, real estate, mutual funds, and government securities. Portfolio selection involves identifying the efficient portfolio and choosing the optimal portfolio from the available options. All investors will choose to invest in securities that offer the highest possible return with the lowest amount of risk. Efficient portfolios, which is the selection of the best portfolio, are based on the investor's level of risk aversion or, conversely, on their risk tolerance. The study's goal is to create a portfolio with minimal risk and optimal returns using the Markowitz portfolio theory. Next, it evaluates the performance against Sensex when constructing a portfolio. 50 stocks were analyzed for calculations from April 2011 to Oct 2022 on yahoo.Finance.com. Data on tuberculosis for the same time frame is utilized as a rate of return with no risk. MS excel is utilized for analyzing securities. 42 out of the 50 stocks have been chosen because they outperformed risk-free assets like T-bills. After selecting 42 stocks, two portfolios were created - one aimed at minimizing risk and the other focused on achieving the highest Sharpe ratio, which represents the best risk-return trade off.

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