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A study on risk and return in building optimal portfolio using Markowitz model and its relevance in current scenario

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Abstract
The entire report explains the study of risk and return using Markowitz Model and its relevance in current scenario. The main purpose of doing this project is to construct a portfolio, to guide the investors with an investment opportunity that reap them maximum returns and to find the relevance of Markowitz Model in present scenario. The intention of the study is to generate an optimal portfolio that will yield higher returns with minimum volatility. For this purpose the monthly closing prices regarding 25 companies listed in the National Stock Exchange (NSE) and Nifty50 indices from April 2016 to March 2017 is being considered. All the stocks have been selected from Nifty50 index which serves as a benchmark, too. The core area of the project is the sectorial analysis of five sectors i.e. Banking, Pharmaceuticals, Oil &Gas, Information Technology and Automotive sector and selected five companies in each sector listed on NSE which tells an advisory about the performance level of each company in each sector. This project contains some equations which are used in calculation, and which help in drawing suggestions. In this study, portfolios are being compared based on their risk and return profiles. The outcomes using this function will provide standard recommendations on the suitable approach to choose stocks in building the portfolio.

Keywords: risk and return, portfolio, Markowitz model, investment, correlation

1. Introduction
Investment is an activity or an asset that is purchased with a hope of generating returns or expecting it to appreciate in the future. In economic sense, investment means purchasing goods not for immediate consumption, but to create wealth for the future. In finance terms, investment is an asset of monetary value which is purchased with an idea that it will generate profit on the sale of asset in the future.
Investments can only be done by savings and savings can be referred to having more income after deducting all the expenditures.
Every investment or any security will involve risk and there is no asset or security that does not involve risk. However, risk can be minimised or mitigated to a certain extent and cannot be completely avoided.
Portfolio refers to mixture of various classes of assets or investments such as stocks, bonds etc. which is held by investors in order to gain returns. An investment portfolio may be referred to a pizza which is divided into different parts and sizes which represents different classes of assets or investments in order to achieve risk-return allocation of the portfolio.
Different kinds of assets or investments are required to build up a portfolio, such as stocks, mutual funds, money market instruments, bonds etc. Investing in a diversified portfolio will also give room to diversify risk of assets classes and help to achieve higher returns.
In order to manage the portfolio effectively, the investor need to select, analyse, revise and evaluate his investments. The reason for portfolio management is to create a portfolio that will yield the expected returns for a given amount of risk, such kind of portfolio is observed to be investor friendly and most of the investor seek to have this type of a portfolio.

2. Review of literature
Myles E. Mangram (2013) [16], has discussed in his study about the problems of MPT and the objective of his study was to find if there is a relevance of MPT in the market and also to find the relevance of the underlying objectives. The study was carried out through conceptual analysis and was an explanatory paper. The findings of his study showed that, the market is difficult to beat and those who are successful are risk takers who diversify their portfolio and take above average investment risk.
Sujan Adhikari, Pawan Kumar Jha, have stated in their study, the applicability of MPT in the stock exchange of Nepal. The main objective of the study was to find if MPT has impact on the optimum portfolio selection of the stocks in NEPSE. The data collected for the study was from secondary sources and stratified sampling was done in the study. The findings of the study showed that the mean-variance model of Markowitz is helpful in creation of optimum portfolio in the NEPSE. The model has proved to get good percentage of returns expected by the investors, and can be increased if more factors are taken into consideration.
Martin Sirucek and Lukas Kren (2015), their study focuses on building investment portfolios by using MPT. The objective of their study was to examine if the stocks that have higher beta values can bring higher returns. CAPM method was carried to calculate the weights of individual securities in the portfolio

and the data was collected from secondary sources. The findings showed that the beta value or coefficients are alone not enough to determine the returns, or higher betas do not account for higher returns. The relationship between expected return and beta is not prominent as expected.

Iyiola Omisore *et al*. (2012) [10], have carried out this study to show how MPT can aid the investor to classify, control and estimate the returns and risk in order to maximize returns on portfolio. The main objective is to predict the probability of price evolution by valuation of company stock. To evaluate the business management on its performance and also to evaluate its credit risk. The findings of the study shows that the MPT is relevant in investment decision making even though there are many flaws and limitations, it is widely accepted. Investors are able to maximize their returns and create an optimum portfolio with the help of MPT which aids them.

3. Methodology

Primary Objective

- To investigate the performance of equity shares of 5 sectors consisting of 25 companies. The selected sectors are Banking, Automobile, Oil & Gas, Information Technology, and Pharmaceuticals.
- To ascertain the risk and return of each company and of market as a whole and to find the relevance of Markowitz model.

For this study, the target population taken into consideration are all the companies listed in the NSE, and sample population is the companies that are listed in the Nifty50 for the period April 2016 to March 2017. The sample size of the study are 5 different sectors i.e. IT sector, banking sector, automotive sector, oil & gas and pharmaceutical sector. From each selected sector, 5 best performing companies are taken into consideration in order to create a portfolio that would yield higher returns with least volatility.

The monthly returns of all 25 stocks and the NSE index is calculated, being NSE index prices the independent variable and the stock prices the dependent variable. Further the volatility of each stock is calculated, this shows probability of the stock's performance in relation to its returns. The study gives a picture of the stocks that an investor must invest in so as to gain maximum returns by diversifying his portfolio. Further portfolio returns is ascertained for each sector consisting of 5 stocks and similarly, Markowitz model has been used to ascertain the portfolio risk of stocks of each sector. The correlation between each stock in a sector is also calculated which shows the relation between each stock.

Few equations have been used to analyse the data provided for the study.

Expected return of portfolio

$$\mathbf{R_p} = \sum_{\mathbf{i=1}}^{\mathbf{N}} \mathbf{W_i}(\mathbf{R_i})$$

Portfolio risk

$$\boldsymbol{\sigma_p^2} = (\mathbf{W_A})^2\boldsymbol{\sigma_A^2} + (\mathbf{W_B})^2\boldsymbol{\sigma_B^2} + 2\mathbf{W_A}\mathbf{W_B}\mathbf{Cov_{A,B}}$$

Covariance

$$\mathbf{Cov} = \sum(\mathbf{R_i A} - \overline{\mathbf{RA}}) * (\mathbf{R_i B} - \overline{\mathbf{RB}})$$

Coefficient of correlation

$$\mathbf{R} = \frac{\mathbf{n}\sum\mathbf{xy} - (\sum\mathbf{x})(\sum\mathbf{y})}{\sqrt{\mathbf{n}\sum\mathbf{x^2} - (\sum\mathbf{x})^2}\ \sqrt{\mathbf{n}\sum\mathbf{y^2} - (\sum\mathbf{y})^2}}$$

4. Empirical findings

Taking into consideration the correlation co-efficient the finding are as follows:

In IT sector TCS is highly correlated (0.4227) with the market index return, followed by Wipro (0.3151), Infosys (0.1905), HCL (0.1046), and Tech Mahindra (-0.1046). In case of Banking sector, HDFC (0.835) and Axis (0.8113) is highly correlated with the market index return, followed by Kotak (0.6649), SBI (0.5196), and ICICI (0.4953).

In case of automotive sector, Mahindra & Mahindra (0.8985) is highly correlated with the market index return, followed by Hero Moto Corp (0.787), Maruti (0.6579), Tata Motors (0.5867) and Eicher motors (0.5704). In case of Oil & Gas sector, Indian Oil Corporation (0.8206) is highly correlated with the market index return, followed by Reliance (0.4069), Powergrid (0.3452) and ONGC (-0.0636), BPCL (-0.0811) are having a negative correlation. In case of Pharmaceutical sector, Sunpharma (0.6223) is comparatively highly correlated with the market index return, followed by Aurobindo (0.4622), Cipla (0.3095) Lupin (0.1467) and Dr. Reddy's (0.0668)

Taking into consideration all the companies of all the 5 sectors M&M (0.898), HDFC (0.835), IOC (0.821), Axis (0.811), and Hero Moto Corp (0.787)are comparatively highly correlated with market index return, whereas Tech Mahindra, BPCL, ONGC and Dr. Reddy' are very less correlated with market index return.

Table 1: Table showing coefficient of correlation for all 5 sectors

Companies	Correlation coefficient
Wipro	0.315
Tech mahindra	-0.105
TCS	0.423
Infosys	0.190
HCL	0.105
SBI	0.520
HDFC	0.835
AXIS	0.811

ICICI	0.495
Kotak	0.665
Tata motors	0.587
Maruti	0.658
M&M	0.898
Eicher	0.570
Hero Moto Corp	0.787
Reliance	0.407
ONGC	-0.064
IOC	0.821
BPCL	-0.081
Powergrid	0.345
Sunpharma	0.622
LUPIN	0.147
CIPLA	0.309
Dr. Reddys	0.067
Aurobindo	0.462

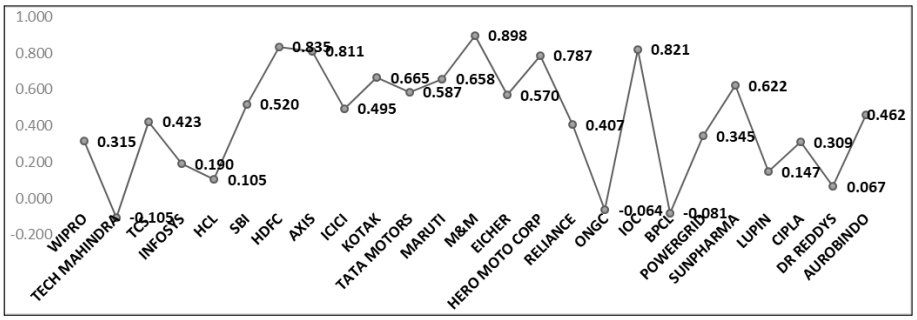

Fig 1: Graphical representation of co-efficient of correlation for all 5 sectors

Findings in terms of expected return and standard deviation (risk) following are the findings

In IT sector HCL is giving highest return (0.416%) with the highest volatility (5.047%), followed by Tech Mahindra (Average Return 0.327%), (Risk 4.990%), TCS (Average Return 0.103%), (Risk 4.276%), Wipro (Average Return -0.992%), (Risk 4.233%), Infosys (Average Return -1.404%), (Risk 3.941%).

In Banking sector SBI is giving highest return (3.520%) with a volatility (5.317%), followed by HDFC (Average Return 2.501%), (Risk 3.634%), Kotak (Average Return 2.023%), (Risk 4.128%), ICICI (Average Return 1.524%), (Risk 4.836%), Axis Bank (Average Return 1.237%), (Risk 6.306%).

In Automotive sector Maruti is giving highest return (4.733%) followed by Eicher (2.074%), Tata Motors (1.804%), Hero Moto Corp (1.047%), M&M (0.203%). In case of volatility Tata motors has the highest volatility (8.001%), followed by Eicher (6.296%), Maruti (5.769%), M&M (4.588%), and Hero Moto Corp (4.208%).

In Oil & Gas sector, Powergrid is giving highest return (2.885%) with the least volatility (3.737%), followed by Reliance (Average Return 2.119%), (Risk 6.102%), IOC (Average Return 0.254%), (Highest Risk 14.835%), ONGC (Average Return -0.571%), (Risk 8.009%), BPCL (Average Return -2.651%), (Risk 11.354%).

In Pharmaceuticals sector all the stocks are giving negative returns and have higher volatility. Lupin is giving a negative return (-0.349%) with a volatility of (4.972%), followed by Dr. Reddy's (Average Return -0.936%), (Risk 5.762%), Aurobindo (Average Return -0.997%), (Risk 4.765%), Cipla (Average Return -1.321%), (Risk 4.579%), Sunpharma (Average Return -1.383%), (Risk 4.263%).

Table 2: Table showing average returns and standard deviation of all 5 sectors

Companies	Avg. return	Std. dev
Wipro	-0.992%	4.233%
Tech Mahindra	0.327%	4.990%
TCS	0.103%	4.276%
Infosys	-1.404%	3.941%
HCL	0.416%	5.047%
SBI	3.520%	5.317%
HDFC	2.501%	3.634%
AXIS	1.237%	6.306%
ICICI	1.524%	4.836%
Kotak	2.023%	4.128%
Tata Motors	1.804%	8.001%
Maruti	4.733%	5.769%
M&M	0.203%	4.588%
Eicher	2.074%	6.296%
Hero Moto Corp	1.047%	4.208%
Reliance	2.119%	6.102%
ONGC	-0.571%	8.009%
IOC	0.254%	14.835%
BPCL	-2.651%	11.354%
Powergrid	2.885%	3.737%
Sunpharma	-1.383%	4.263%
Lupin	-0.349%	4.972%
CIPLA	1.321%	4.579%
DR REDDYS	-0.936%	5.762%
AUROBINDO	-0.997%	4.765%

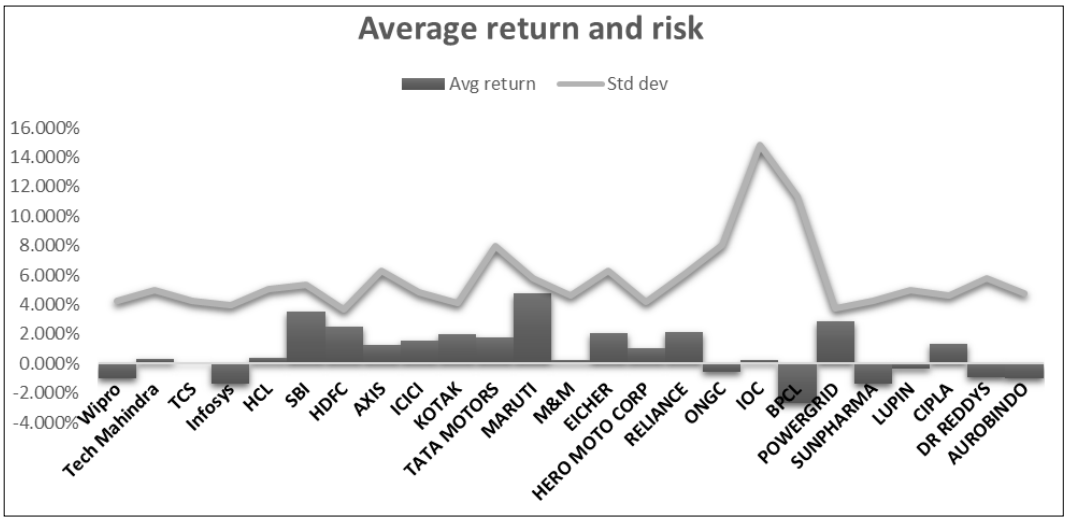

Fig 2: Graphical representation of Average return and Risk of all 5 sectors

In case an investor want invest in a single sector then the Portfolio Risk and Return of each sector using Markowitz Model is as follows:

Automotive sector is giving portfolio return of 21.696 % with the portfolio risk of 130.233 % in a particular time period. IT sector is giving negative portfolio return of -3.410 % with the portfolio risk of 64.7% in a particular time period. Pharmaceuticals sector is giving negative portfolio return of -5.155% with the portfolio risk of 87.786 % in a particular time period.

Banking sector is giving portfolio return of 23.767 % with the portfolio risk of 94.38 % in a particular time period. Oil & Gas sector is giving portfolio return of 4.48 % with the portfolio risk of 79.64 % in a particular time period.

Table 3: table showing portfolio risk and return of each sector

Industries	Portfolio return	Portfolio risk
IT	-3.409669691	64.7002
Banking	23.76704908	94.38
Automotive	21.6965027	130.233
OIL & GAS	4.479963118	79.64
Pharmaceutical	-5.154967914	87.786

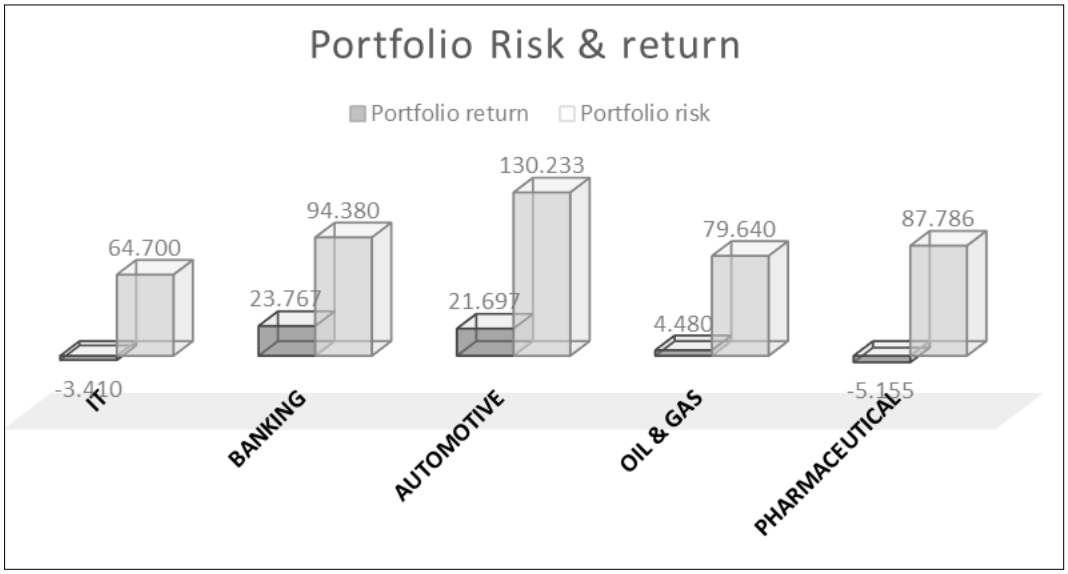

Fig 3: Graphical representation of Portfolio risk and return of each sector if an investor invests his funds in the companies falling under same sector

Table 4: Exhibits portfolio risk and return of the diversified portfolio

	Portfolio return	Portfolio risk
Diversified portfolio	31.20%	83.07%

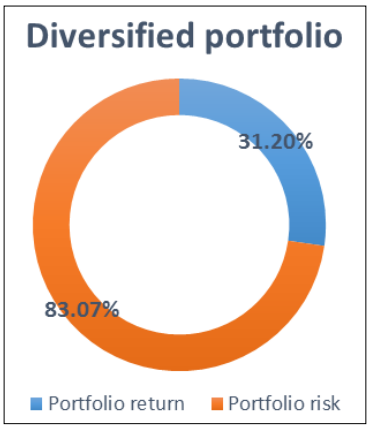

Fig 4: Graphical representation of portfolio risk and return of the diversified portfolio

5. Conclusions and Discussions

The main purpose of this study was to create a portfolio to the investors which would aid them in investment decision making, with the help of Markowitz portfolio theory. It is evident from the study that Markowitz model helps in building a portfolio with higher returns for a given level of volatility and also in diversifying the investments. However if suggestions is to be given to investors in building their portfolio, the stocks that would be a good investment and which would yield higher returns when compared to other stocks are Maruti (Automotive sector), SBI (Banking sector), Powergrid (Oil & Gas sector), HDFC (Banking sector), Reliance (Oil & Gas sector), Eicher Motors (Automotive sector), Kotak bank (Banking sector).

However, these 7 companies are having high volatility. It is advised to the investors that only if they are risk takers, they can move forward in taking these investments as the other stocks are giving less returns and high risk in comparison to the selected 7 stocks in the portfolio. Also, when the portfolio risk and return of this selected diversified portfolio is calculated, it shows that it has a portfolio return of 31.2% and portfolio volatility of 83.07%, which means that it is yielding higher returns than other portfolios (sector wise) and have less volatility than other portfolios (sector wise).

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