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PORTFOLIO MANAGEMENT

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Abstract:

Portfolio management is a critical issue which should be skilled by position sizing and resource allocation. Traditional and generic portfolio strategies require to forecast the future stocks prices as the model inputs, which is not a trivial task in the real-world applications. To solve the above limitations and provide a better solution for the portfolio management to the inventors, we then develop a portfolio management system (PMS) with equity market neutral strategy in reinforcement learning. A novel reward function involving Sharpe ratio is also designed to evaluate the performance of the developed systems. Experimental results indicate that the PMS with Sharpe ratio reward function has the outstanding performance, and increase the return 39.0% and decrease the drawdown of 13.7% on average than that with reward function of trading return. In addition, the developed PMS_CNN model is more suitable and profitable to construct RL portfolio, but has 1.98 times more drawdown risk than the PMS_RNN. Overall, the proposed PMS outperforms the benchmark strategies in the measurements of total return and Sharpe ratio. The PMS is profitable and effective with lower investment risk, and the novel reward function by involving Sharpe ratio really enhances the performance, and well support the resource-allocation in the empirical stock trading.

INTRODUCTION

Traditional trading strategies are based on predetermined and subjective indicators to generate trading signals through the movements of indicators, such as moving averages, relative strength index, and opening range breakout [1], [2]. However, most indicators can only provide long (buy) and short (sell) signals, regardless of position size and risk management. Considering the position and investment risk, portfolio managreement is an important and useful subject for investors to well-manage investments. Common portfolio strategies such as modern portfolio theory (MPT) [3] and Kelly criterion [4] require the predicted future price of stocks as the input to provide the appropriate and suitable solutions for portfolio managreement.

However, small deviations of those two strategies greatly affect the weights of portfolio. Among the variants of portfolio strategies, Equity Market Neutral (EMN) is a hedging strategy to provide better strength for risk management [5]. EMN can provide a balance between buying the relatively strong stocks and selling the relatively weak stocks, thus the risk for investment can be greatly deducted and reduced, but it is not a trivial task to quantify and classify the relatively strong and weak stocks in real situations. In order to solve the above limitations for investment, an efficient portfolio management system (PMS) is then build based on the reinforcement learning (RL) architecture, which is used to support human decision-making in practical trading situations. With the attempts by the agent and the reward by environment, RL models can achieve better and effective performance for decision-making with enormous trial-andtest progresses. In addition, two NN-based models called CNN and RNN are then integrated with the designed RL system to handle the spatial and temporal information for better obtaining the portfolio strategies. Thus, the developed PMS_CNN and PMS_RNN systems can assign the appropriate weights to the stocks. Previous works [6], [7] use the trading return as a reward function in the RL-based approach, which can optimize profitability, but neglect the stability and risk.

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Sharpe ratio [8] is a well-known performance indicator for trading, that can optimize the trade-off between profitability and risk. Thus, we consider the Sharpe ratio in the developed reward function to obtain the trade-off between profitability and stableness of the trading. Experimental results indicate that the developed PMS with Sharpe ratio in the developed reward function can obtain better performance than that of the reward function with trading return. Especially the increasing return is about 39% on average and decreasing drawdown is about 13.7% on average (novel and effective reward function). Furthermore, the designed PMS_CNN outperforms the PMS_RNN in terms of return and Sharpe ratio. Moreover, the PMS_CNN has 1.98 times more drawdown risk than the PMS_RNN (CNN is more suitable to construct EMN portfolio). Compared to the existing benchmark strategies (UCRP [9], Winner [10], Loser [11]), the developed PMS can thus obtain better performance in the measurements of total return and Sharpe ratio. In conclusion, the designed PMS is profitable and effective with lower investmint risk, and the novel reward function by involving Sharpe ratio and return factors really enhances the performance.

PORTFOLIO MANAGEMENT

Portfolio management in common parlance refers to the selection securities and them continues shifting in the portfolio to optimize returns to suit the objectives of an investor. This, however, requires financial expertise in selecting the right mix of securities in change market conditions to get the best out of the stock market. In India, as well as in number western countries, portfolio management has assumed the role of a specialized service now-a-days and a number of professional merchant bankers compete aggressively to provide the best to high-net-worth clients, who have little time to manage their investment. The idea is catching on with the boom in the capital market and an increasing number of people are inclined to make profits out of their hard-earned savings. Portfolio management is one of the merchant banking activities recognized by Securities Exchange Board of India (SEBI). The Portfolio management service can be rendered either by the SEBI authorized categories I&II Merchant Bankers or portfolio managers or discretionary portfolio manager as defined in clauses (e) and (f) of rule 2 of Securities and Exchange Board of India RULES, 2093. Portfolio is the collection of financial or real assets such as equity shares, debentures, bonds, treasury bills, and property etc.

Portfolio Management guides the investor in a method of selecting the best available securities that will provide the expected rate of return for any given degree of risk and also to mitigate (reduce) the risks. It is a strategic decision which is addressed by the top-level managers. Portfolio management is concerned with efficient management of portfolio investment in financial assets, including shares and debentures of companies. Portfolio is the combination of assets (or) it can also be called as the combination of securities The art and science of making decisions about investment mix and policy, matching investments to objectives, asset allocation for individuals and institutions, and balancing risk against performance. Portfolio management is all about strengths, weaknesses, opportunities and threats in the choice of debt vs. equity, domestic vs. international, growth vs. safety, and many other tradeoffs encountered in the attempt to maximize return at a given appetite for risk. There are many types of portfolios including the market portfolio and the zero-investment portfolio.[4] A portfolio's asset allocation may be managed utilizing any of the following investment approaches and

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principles: equal weighting, capitalization-weighting, price-weighting, risk parity, the capital asset pricing model, arbitrage pricing theory, the Jensen Index, the Treynor Index, the Sharpe diagonal (or index) model, the value at risk model, modern portfolio theory and others. There are several methods for calculating portfolio returns and performance. One traditional method is using quarterly or monthly money-weighted returns; however the true time-weighted method is a method preferred by many investors in financial markets. There are also several models for measuring the performance attribution of a portfolio's returns when compared to an index or benchmark, partly viewed as investment strategy. Portfolios are the securities held by individuals and it may be recalled that the expected return from individual's securities carries some degree of risk. Risk can be defined as the standard deviation around the expected return. The simple fact that securities carried different degrees of expect risk leads most investors to the notion of holding more than one security at a time in an attempt to spared risk by "not putting all their eggs into one basket" In the case of mutual and exchange-traded funds (ETFs), there are two forms of portfolio management: passive and active. Passive management simply tracks a market index, commonly referred to as indexing or index investing. Active management involves a single manager, co-managers, or a team of managers who attempt to beat the market return by actively managing a fund's portfolio through investment decisions based on research and decisions on individual holdings. Closed-end funds are generally actively managed. Modern portfolio theory (MPT) refers to the theory of investment that seeks to maximize the expected return of portfolio at a given level of risk. Similarly it also attempts to diminish risk for a given level of return expected. To achieve this, portfolio manager chooses the proportions of different assets in a portfolio carefully. The modern portfolio theory is extensively used for practice in the financial industry, however basic assumptions of this theory has faced certain challenges in fields like behavioral economics. Modern Portfolio theory (MPT) presents the concept of diversification in investing by using mathematical formulation. It aims to select a collection of investment assets which has lower risk than any individual asset. It can be observed spontaneously as dynamic market conditions cause changes in value of different types of assets in conflicting ways. The prices in the bond market may fall independently from prices in the stocks market, thus there is overall lower risk in a collection of both bond and stocks assets as compared to individual asset. Moreover, the diversification reduces the risk even if cases where assets' returns are positively correlated.

INDUSTRY PROFILE

India has a diversified financial sector undergoing rapid expansion, both in terms of strong growth of existing financial services firms and new entities entering the market. The sector comprises commercial banks, insurance companies, non-banking financial companies, co-operatives, pension funds, mutual funds and other smaller financial entities. The banking regulator has allowed new entities such as payments banks to be created recently thereby adding to the types of entities operating in the sector. However, the financial sector in India is predominantly a banking sector with commercial banks accounting for more than 64 per cent of the total assets held by the financial system.

The Government of India has introduced several reforms to liberalize, regulate and enhance this industry. The Government and Reserve Bank of India (RBI) have taken various measures to

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facilitate easy access to finance for Micro, Small and Medium Enterprises (MSMEs). These measures include launching Credit Guarantee Fund Scheme for Micro and Small Enterprises, issuing guideline to banks regarding collateral requirements and setting up a Micro Units Development and Refinance Agency (MUDRA). With a combined push by both government and private sector, India is undoubtedly one of the world's most vibrant capital markets. The securities market achieves one of the most important functions of channeling idle resources to productive resources or from less productive resources to more productive resources. Hence in the broader context the people who save and investors who invest focus more towards the economy's abilities to invest and save respectively. This enhances savings and investments in the economy, the two pillars for economic growth. The Indian Capital Market has come a long way in this process and with a strong regulator it has been able to usher an era of a modern capital market regime. The past decade in many ways has been remarkable for securities market in India. It has grown exponentially as measured in terms of amount raised from the market, the number of listed stocks, market capitalization, trading volumes and turnover on stock exchanges, and investor population. The market has witnessed fundamental institutional changes resulting in drastic reduction in transaction costs and significant improvements in efficiency, transparency and safety.

STOCK MARKET:

When investors think of the stock market, they may imagine a specific place - such as a stock exchange. In fact, the stock market is the abstract idea of stock trading and stock exchange. All selling of stocks - at stock exchanges and in other ways - affects the market overall. Following stock market information in the news can help you make the right decisions about stock market investing

COMPANY PROFILE

JM Financial is an integrated financial services group, offering a wide range of services to a significant clientele that includes corporations, financial institutions, high net-worth individuals and retail investors.The Group has interests in investment banking, institutional equity sales, trading, research and broking, private and corporate wealth management, equity broking, portfolio management, asset management, Non-Banking Finance Company activities, private equity and asset reconstruction. JM Financial Services Ltd. is the dedicated financial services arm of the JM Financial Group . We are one of the largest brokerage firms in India, offering comprehensive investment advisory and investment management services to institutions, banks, corporates, ultra high net-worth individuals and Family offices.With more than three decades of experience & expertise in managing wealth,we our offer clients guidance to grow, protect & transfer their wealth. An exclusive level of personal attention, research capabilities and in-depth capital market expertise enables us to design and execute customised investment solutions for our clients. We provide comprehensive financial planning, research-based investment consulting services and execution capabilities We service our investors through three distinct businesses, which draws on the full spectrum of the Group's resources; research base and expertise to generate investment ideas for our clients. These solutions incorporate a wide range of financial products to meet individual client needs, both short-term and long-term. We are among the largest distributors of third party products (Mutual funds/IPO). We have a strong network of more than 25,000 IFAs spread across india. We facilitate client transactions with a diverse group of financial institutions, investment funds, governments and

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individuals, trading of and investing in fixed income and equity products and derivatives on these products. JM Financial Ltd. operates as an investment holding company. The company through its subsidiaries provides investment banking, institutional equity sales, trading, research and broking, private and corporate wealth management, equity broking, portfolio management, asset management, commodity broking, NBFC activities, private equity and asset reconstruction. It operates through four segments: Investment Banking & Securities Business, Fund Based Activities, Alternative Asset Management and Asset Management. The Investment Banking & Securities Business segment offers advisory and execution services to corporate, institutions, governments and government owned corporations. The Fund Based Activities segment provides finance against securities and commercial real estate to a diverse range of corporate and non-corporate clients. The Alternative Asset Management segment manages funds of institutional and large non-institutional investors. The Asset Management segment manages mutual fund assets. JM Financial was founded by Nimesh Nagindas Kampani in 2073 and is headquartered in Mumbai, India.

PORTFOLIO ANALYSIS:

A Portfolio is a group of securities held together as investment. Investors invest their funds in a Portfolio of securities rather than in a single security because they are risk averse. By constructing a Portfolio, investor's attempt to spread risk by not putting all their eggs into one basket Portfolio phase Portfolio management consists of denitrifying the range of possible Portfolio that can be constituted from a given set of securities and calculating their return and risk for further analysis.

PORTFOLIO SELECTION:

Portfolio analysis provides the input for the nest phase in portfolio management, which is Portfolio selection. The proper goal of Portfolio construction is to get high returns at a given level of risk. The inputs from Portfolio analysis can be used to identify the set of efficient Portfolio. From this set of Portfolio the optimal Portfolio has to be selected for investment.

PORTFOLIO REVISIONS:

Having constructed the optimal Portfolio the investor has to constantly monitor the Portfolio to ensure that it continues to be optimal. As the economy and financial markets are dynamic, the changes take place almost daily. The investor now has to revise his Portfolio. The revision leads to purchase of new securities and sale of some of the existing securities from the Portfolio.

PORTFOLIO EVALUATION:

The objective of constructing a portfolio and revising it periodically is to earn maximum returns with minimum risk Portfolio evaluation is the process which is concerned with assessing the performance of a Portfolio over a selected period of time in terms of return and risk Portfolio evaluation is useful in yet another way. It provides a mechanism for identifying weakens in the investment process and for improving these deficient areas.

RETURN ON PORTFOLIO:

Each security in a portfolio contributes returns in the proportion of this investment in a security. Thus the Portfolio expected return is the weighted average of the expected return of the securities, with weights representing the proportionate share of the security

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in the total investment. Why an investor does have so many securities in his Portfolio. If the security ABC gives the maximum return why not he invests in that security all his funds and thus maximize the returns. The answer to this question lies in the investors perception of risk attached to investments his objectives of income safety, appreciation, liquidity and hedge against loss of value of money etc. this pattern of investment in different asset categories, security categories types of instruments etc. Would all be described under the caption of diversification which aims at the reduction or even elimination of nonsystematic or company related risk and achieve the specific objectives of investors.

PORTFOLIO RISK:

Risk on Portfolio is different from on individual securities. The risk is reflected in the variability of the returns from zero to infinity. The expected return depends on the probability of returns and their weighted contribution to the risk of the Portfolio. There are two measures of risk in this context, one is the absolute deviation and the other is standard deviation. Most investors invest in a Portfolio of assets as they do not want to put all their eggs in one basket. Hence, what really matters to them is not the risk and return of the stocks in isolation but the risk and a whole

DATA ANALYSIS & INTERPRETATION

The following portfolio combinations are selected. Calculated correlation

1. HCL Technologies & Reliance Industries.
2. Wipro & Jindal Steel Co...
3. Infosys Technologies & BHEL.
4. GAIL & Titan.

From the correlation table the above given portfolio combinations are selected , as the correlation coefficient between securities is -1.0, then a perfect correlation exists (r_{ay} cannot be less than -1.0). If the coefficient of correlation is zero , then returns are said to be independent of one another . If the returns on two securities are perfectly correlated , the coefficient of correlation will be 1.0, and perfect positive correlation is said to exist (r_{ay} cannot exceed 1.0).

Analysis and Interpretation of Each Set of Portfolio

1. HCL Technologies & Reliance Industries

Table: 1

Calculation of Standard Deviation of HCL **Technologies Ltd**

DATE	RETURN	MEAN RETURN	DEVIATION	SQUARE DEVIATION
	R	R'	(R - R')	$(R-R')^2$
Apr-20	-9.743895	4.859205	-19.60309	213.2502375
May-20	8.323529	4.859205	3.464374	12.00208721
Jun-20	5.27027	4.859205	0.411120	0.209020543
Jul-20	2.436548	4.859205	-2.422607	5.869024676
Aug-20	19.125	4.859205	9.265845	85.85588556
Sep-20	-0.708833	4.859205	-5.567988	31.00249057
Oct-20	-7.868132	4.859205	-12.727287	201.9838344
Nov-20	20.236406	4.859205	20.577251	236.4598483
Dec-20	4.679612	4.859205	-0.209543	0.032235689
Jan-21	20	4.859205	11.190845	124.1204273
Feb-21	-2.563898	4.859205	-7.423053	55.10202084
Mar-21	8.1232956	4.859205	3.2641906	10.65461386
$\sum R$ =	58.3098626			936.4992193

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$$\text{Average } R' = \frac{\sum R}{N}$$

$$= \frac{58.30986}{12}$$

$$= 4.85920$$

$$\text{Standard Deviation } \sigma = \frac{\sqrt{(R-R')^2}}{T}$$

$$= \frac{\sqrt{936.49921}}{12}$$

$$= 8.83412$$

$$\text{Average } R' = \frac{\sum R}{N}$$

$$= \frac{38.75829}{12}$$

$$= 3.229858$$

$$\text{Standard Deviation } \sigma = \frac{\sqrt{(R-R')}}{T}$$

$$= \frac{\sqrt{1127.8620}}{12}$$

$$= 9.6947$$

Table: 2

Standard Deviation of Reliance Industries

DATE	RETURN	MEAN RETURN	DEVIATION	SQUARE DEVIATION
	R	R'	(R-R')	$(R-R')^2$
Apr-20	-5.20748654	3.229858282	-8.43734482	71.02019967
May-20	1.03872077	3.229858282	-2.20113251	4.801105511
Jun-20	20.4350855	3.229858282	20.26522722	282.5445725
Jul-20	9.385662068	3.229858282	6.205803786	37.8942886
Aug-20	2.332859205	3.229858282	-0.89699911	0.804907398
Sep-20	10.36856745	3.229858282	7.138709205	50.96120865
Oct-20	-2.88624204	3.229858282	-6.09610032	37.18243912
Nov-20	7.288587209	3.229858282	3.958728886	20.51366402
Dec-20	5.620377207	3.229858282	2.387720920	5.701203820
Jan-21	-20.05599	3.229858282	-23.2858495	542.2307787
Feb-21	-8.00464596	3.229858282	-4.05450424	20.27722445
Mar-21	12.33737062	3.229858282	9.107712359	82.99042405
∑R =	38.75829959			1127.862020

PORTFOLIO RISK

HCL Technologies & Reliance Industries

$$\Sigma p = \sqrt{\sigma_A^2 W_A^2 + \sigma_B^2 W_B^2 + 2 r_{ab} a_b W_B}$$

$$= \sqrt{(8.8341)^2(0.5462)^2 + (9.6947)^2(0.4538)^2 + 2(-0.00278)(8.8341)(9.6947)(0.5462)(0.4538)}$$

$$= \sqrt{23.2824 + 20.3552 - 0.12030}$$

$$= 6.5207$$

HCL Technologies & Reliance Industries

As per the calculations and the study, HCL Technologies bears a proportion of 0.5462 and Reliance Industries bears a proportion of 0.4538. The risk of HCL Technologies is less than that of Reliance Industries i.e. 8.3341<9.6947, which means an investor can invest 54% of his/her funds in HCL technologies and the remaining funds in

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Reliance Industries. Even the portfolio risk of 6.5207% is less when compared to the individual risk of both the companies.

$$\text{Average } R' = \frac{\sum R}{N} = \frac{2.71135}{12} = 0.22595$$

$$\text{Standard Deviation } \sigma = \frac{\sqrt{(R-R')^2}}{T}$$

$$= \frac{\sqrt{3323.3046}}{12}$$

$$= 20.6420$$

DATE	RETURN	MEAN RETURN	DEVIATION	SQUARE DEVIATION
	R	R'	(R-R')	
Apr-20	-2.792090764	5.980234702	-8.7720255	76.944922
May-20	-6.020408203	5.980234702	-12.000643	144.0204292
Jun-20	-7.497297297	5.980234702	-13.477532	201.6438688
Jul-20	20.09883721	5.980234702	12.1206025	196.8605267
Aug-20	20.26600985	5.980234702	9.28577520	86.22562019
Sep-20	22.25208428	5.980234702	20.2720496	264.7635257
Oct-20	-20.09855132	5.980234702	-25.078786	532.6303641
Nov-20	13.64746387	5.980234702	7.66722920	58.78640511
Dec-20	11.8892059	5.980234702	5.90894120	34.92058603
Jan-21	-0.390775194	5.980234702	-6.3710098	40.58976646
Feb-21	0.499671269	5.980234702	-5.4805634	30.03657555
Mar-21	23.90849673	5.980234702	20.928262	321.4225784
∑R =	71.76282043			2020.834967

$$\text{Average } R' = \frac{\sum R}{N} = \frac{71.76282}{12} = 5.98023$$

$$\text{Standard Deviation } \sigma = \frac{\sqrt{(R-R')^2}}{T}$$

$$= \frac{\sqrt{2020.8349}}{12}$$

$$= 12.6453$$

PORTFOLIO RISK

Wipro & Jindal Steel Ltd

$$\Sigma p = \sqrt{\sigma_A^2 W_A^2 + \sigma_B^2 W_B^2 + 2 r_{ab} a_b W_B}$$

$$= \sqrt{(20.6420)^2 (0.3827)^2 + (12.6453)^2 (0.6203)^2 + 2(-0.1972)(20.6420)(12.6453)(0.3827)(0.6203)}$$

$$= \sqrt{40.5608 + 60.9328 - 19.6358}$$

$$= 9.3207$$

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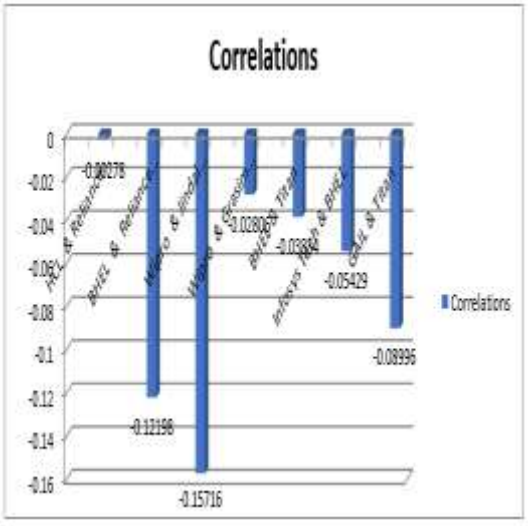
Wipro & Jindal Steel Ltd

As per the study ,**Wipro** bears a proportion of 0.0.3827 and **Jindal Steel** bears a proportion of 0.6203. The risk of **Jindal Steel** is less than that of **Wipro** i.e.12.6453<20.6420, which means an investor can invest 62% of his/her funds in **Jindal Steel** and the remaining funds in **Wipro**. Even the portfolio risk of 9.3207% is less when compared to the individual risk of both the companies.

Correlations & Portfolio Risk of Portfolio Combinations

Portfolio	C
HCL & Reliance Industries	-(
BHEL & Reliance Industries	-(
Wipro & Jindal Steel Co.	-(
Wipro & Grasim Industries	-(
BHEL & Titan	-(
Infosys Tech & BHEL	-(
GAIL & Titan	-(

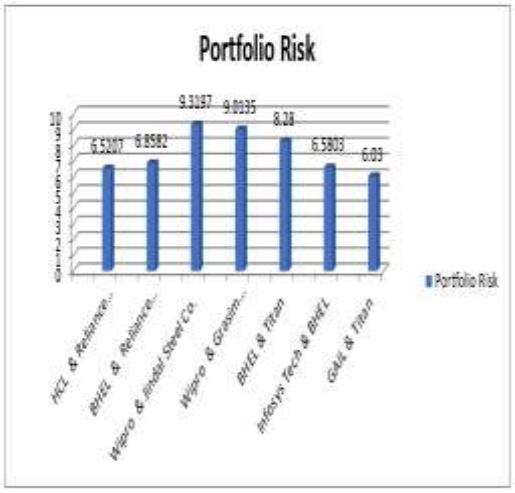
Chart: 3



Interpretation

The chart represents the calculated correlation coefficient of selected portfolio combinations. The Portfolios selected are perfect negatively correlated securities which minimizes the risk level of individual securities. The Portfolios **BHEL & Reliance Industries**, **Wipro & Jindal Steel**, GAIL**& Titan** are highly correlated securities where (r<-1) selected. **ICICI Bank & ACC** are less correlated and remaining are medium correlated securities.

Chart: 4



Interpretation

The above chart represents the portfolio risk of the selected portfolio combinations. As per the chart, the portfolio risk of Wipro**& Grasim Industries**, **BHEL & Titan** and **Wipro & Jindal Steel** are high. The investor has minimum portfolio risk with portfolio **GAIL &Titan** .All other portfolios are moderately risky.

CONCLUSION

Portfolio is a combination of securities such as stocks, bonds, and money market instruments. The

process of blending together the broad asset classes so as to obtain optimum return with minimum risk is called portfolio construction. The investor always likes to purchase a combination of stocks that provides the highest return and has lowest risk. He wants to satisfactory reward to risk ratio. Traditionally analysts paid more attention to return aspect of the stock. Now a day's risk has received increased attention and analysts are providing estimates of risk as well as return. Casual observation of the stock price over a period of time reveals that most if the stock price moves with the market index. When the market increases, the stock price also tends to increase and vice-versa. This indicates that some under lying factor affect the market index as well as the stock prices. Stock prices are related to the market index and this relationship could be used to estimate the return on stock.

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