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CONSTRUCTION OF PORTFOLIO & EVALUATING ITS RISK USING VALUE AT RISK (VaR)

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ABSTRACT

The evaluation of E-commerce and internet in the trading floor has bought a revolution in the investment strategies. Making investments must be carefully analyzed and evaluated in this era. Controlling financial risk is an important issue for the business. VaR is one of the methods that can be used to analyze the risk. The BSE sensex is volatile and an investor needs to take decision on various portfolios to invest therefore value at risk is an approach to help the investor, trader and stock brokers to take decision on the construction and finding of the optimum portfolio, and the probable loss he would suffer. The tools used under the current study for assisting the investors at the time of decision making regarding number of days of holding the portfolio are Historical Simulation, One Asset and Two Asset Models; whereas portfolio can be constructed using Sharpe Optimal Portfolio Construction Method. Value at risk provides a decision making and choosing the right stocks at the right time and assessing the loss suffered by an investor.

Key words: ***value at risk, portfolio construction, historical simulation, one asset model, two asset model, BSE, E-commerce.***

1. INTRODUCTION:

Value at risk (VaR) is a statistical technique used to measure and quantify the level of financial risk within a firm or investment portfolio over a specific time frame.

VaR modeling determines the potential loss in the entity being assessed, as well as the probability of occurrence for the defined loss. Vary is measured by assessing the amount of potential loss, the probability of occurrence for the amount of loss and the time frame. Value at risk is used by investment banks and brokers to assess the market risk of the portfolio.

The Bombay Stock Exchange (BSE) the first and largest securities market in India. In 1995 the BSE switched from an open-floor to an electronic trading system. The BSE's overall performance is measured by the Sensex. For the current study BSE 30 is considered it is an index of 30 of the BSE's largest stocks covering 12 sectors. BSE Ltd has facilitated the growth of the Indian corporate sector by providing it with an efficient platform for raising capital. The investor would like to invest in a stock exchange like BSE but would like to take decision on what are the stocks to invest in and what will be the risk in selecting a particular stock or a portfolio. The value at risk is an appropriate measure to understand this approach. The main approaches are historical simulation, one asset model and two asset model.

Parameters of Value at Risk:

Two parameters are considered in this regards, they are:

- Holding period
- Confidence level

This paper considers holding period for one day/10 days/5 days and with a confidence level of 97.50 % / 99% / 95% which means for the 3.5% / 1% / 5% time the investor or firm would lose more than the number given by the VAR.

2. LITERATURE REVIEW

2.1. An Introduction to Value at Risk, by North star Risk Corp, March 28, 2013

A Research Paper by North Star Risk Corporation published on March 28, 2013. This paper provides an introduction to value at risk. It describe three basic models i.e. Delta-Normal VaR , Historical VaR, Monte Carlo Simulation , and explain how to assess the effectiveness of value at risk models through back-testing. Provides a graphical representation of VaR and also established criteria for assessing the effectiveness of VaR models through back testing,

2.2. Portfolio Performance Evaluation Using Value at Risk, by Prof. Gordon J. Alexander and Prof. Alexander M Baptista, June 2003

This article shows a value at risk-based measure of portfolio performance called the reward-to-VaR ratio. It demonstrates under normality, that the reward-to-VaR ratio gives the same ranking for portfolio performance as the frequently used Sharpe ratio. Under non-normality, the reward-to-VaR ratio at one confidence level may give a ranking for portfolio performance different from the ranking obtained at a different confidence level.

2.3. Transformation-Based Approach to Estimate Value at Risk- Simulation and Empirical Results, by G. P. Samanta, February 2015

This paper examines the performance of the indirect transformation-based approach for the measurement of value at risk (VaR). The simulation exercise carried out in this paper shows that the transformation to normality providing a sensible alternative to the measurement of VaR, the empirical assessment of the accuracy of the VaR estimates with respect to selected exchange rates reveals that the transformation-based approach outperforms the method based on the normality assumption for return distribution

2.4. VaR Models in the Indian Stock Market, by Varma, Jayanth R. and Jayanth Rama Varma, January 1999

This paper describes various tests of different risk management models in the GARCH-GED (Generalized Auto-Regressive Conditional Heteroskedasticity with Generalized Error Distribution residual) and EWAM model (Exponentially Weighted Moving Average). Under this paper, the researcher constructed the VaR using 1 day with a normal distribution of 99%. It also provides evidence suggesting that it is possible to improve the performance of the VaR model by considering the price movement in foreign stock markets. The GARCH-GED and EWAM-GED model is measured by examining distribution of standardized residual to goodness of fit and the result shows a reasonable good fit to the data in terms of broad parameters. The tests results are consistent with an accurate model and the probability of accepting an inaccurate model is low.

2.5. Comparison of value at risk approaches on a stock portfolio, Sime corkalo

The author uses Variance-Covariance method, Historical Simulation, Monte-Carlo Simulation and Boot Strapping to calculate VAR of selected stocks based on their liquidity and finds that VAR methods differ in the ability to capture risks of options. The best choice will be determined by which dimension the risk manager finds most

important distribution of returns not completely normal. So Historical Simulation and Bootstrapping should give better estimate.

2.6. Risk and opportunities in an increasingly digital world, EY.

Several directors of EY discuss about digital transformation and its scope as it is hard to define digitalization as it is has many things to focus on. It is changing the consumer behavior. Digitalization increases capability technology, consumer behavior. The more information and greater transparence in markets increase volatility going forward, these forces are changing the way people buy and sell, rent as well all of these associated risk and benefits.

3. RESEARCH METHODOLOGY

3.1 Objectives

- To construct the portfolio for investment in BSE
- Estimate the future value of portfolio using Historical Simulation Method
- To analyze and compare the estimated loss realized by the investor from holding the portfolio at different time intervals using One Asset Model, Two Asset Model and Historical Estimation.

3.2 Type of Research – Analytical Research

3.3 Type of data – the study is completely based on secondary data. Data used for the current study is closing and opening prices of BSE 30 Index along with its listed companies, Treasury bill rates (considered as risk free rates and BSE S&P 500 Index closing and opening prices). All these information's have been collected from BSE website and Money Control.com

4. DATA ANALYSIS AND INTERPRETATION

4.1 Sharpe Optimal Portfolio

In order to assess the risk on portfolio, portfolio needs to be constructed by calculating the excess returns on portfolio with the market return using Sharpe optimal portfolio for all the 30 stocks listed in BSE. The returns calculated for all the stocks are required to be ranked based on the excess return to beta from highest to lowest for all the 30 stocks.

The formula for calculating excess return is $\frac{R_i - R_f}{\beta_i}$

Where,

R_i = expected return on stock i

R_f = return on a riskless asset

β_i = expected change in the rate of return on stock i associated with one unit change in the market return.

The next step is to calculate **C_i** is i.e. cut off ratio for all the 30 stocks according to the ranked order using the 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

σ_m^2 = variance of the market index

σ_{ei}^2 = stock's unsystematic risk

Table below shows the stocks providing the high excess return on stock and the market and cutoff ratio C_i.

SLNO	Companies	Mean Return	Stadard Deviation	Risk free rate	Excess Return	Beta	Excess return to beta	Ci
21	Reliance commu	-5.091781039	8.442292907	-0.614205667	-4.47758	-0.00144	3100.309292	107.8113
14	Jai prakash	3.516843829	2.890672191	-0.614205667	4.131049	0.002337	1767.649939	833.407
3	Bharat Airtel	0.335910934	24.46911805	-0.614205667	0.950117	0.000982	967.1646878	833.5511
27	Tata Power	2.982001408	8.397590357	-0.614205667	3.596207	0.00404	890.1908739	841.1356

The **C_i** value is the cutoff point therefore after ranking all the stocks and cut off for all the stocks among the 30 stocks is taken where the returns for all the stocks are in an increasing trend.

Since portfolio is constructed VAR is calculated using two models

4.2 Historical Simulation

VaR can be calculated using historical simulation that is the use of percentage price changes and apply these to today's portfolio, as follows:

- Firstly obtain the price change of the optimal portfolio of all the four stocks

- Apply price changes to the portfolio to generate a "historical" series of portfolio values changes
- Sort the series of portfolio value changes into percentiles
- The Vary of the portfolio is the value change corresponding to the required level of confidence

Table showing the future value of the portfolio Using Simulation Technique

Month	Future portfolio value
1	475.2017721
2	517.8386172
3	493.0899149
4	471.616361
5	463.5844004
6	502.0636426
7	482.9237663
8	470.3902759
9	552.1456224
10	524.2710149
11	483.7267544

The following table represents the tentative loss realized by the investor from his/her selected portfolio if they hold the portfolio for a day.

Current value of portfolio	492.5
10% of the sample	463.5844
loss per portfolio on holding one share of each company	28.9156
Per day loss on Portfolio	161.92736

Current Value of portfolio: It is the closing price of the portfolio

10% of the sample: It is the confidence level of 90% and out of 11 months 10% of the 11 is 1.1 therefore eliminate one stock having least predicted value.

Loss per Portfolio: The difference between the current value and eliminated value

Per day loss on portfolio: If 5000 is invested among the four stocks equally the loss per day on portfolio is 161.92.

Thus the historical simulation provides the risk on a particular day after constructing portfolio which is 161.92 on a particular day.

4.3 Variance Covariance method

Under variance co variance method the historical data is used to calculate main parameters: mean, standard deviation, correlation. This method calculates Vary by assuming some theoretical distribution of asset returns. Usually normal distribution it allows volatility to be described in terms of standard deviations (SD). Another advantage of normal distribution is that it can be described by its first two moments mean, and standard deviation. The volatility on a daily basis is taken by calculating year volatility divided by square root of 252.

The VAR is calculated as: (One Asset Model)

= **Size of investment *volatility *N(x) * √N**

Size of investment: assumed to be 20,000 and 5,000 invested equally in each of the four stock

N(x): Confidence level in a normal distribution 97.5 % i.e. is 1.96

√N: loss on a single day on the portfolio

The table below showing the loss suffered by the investor

Company	Reliance communication	Jai prakash	Bharat Airtel	Tata Power
Size of investment	5000	5000	5000	5000
Confidence level0.975	1.96	1.96	1.96	1.96
Volatility	0.531814465	0.182095232	1.541409551	0.528998469
Var 1 day on each stock	52.11781756	17.84533272	151.058136	51.84184996
Total loss				272.8631363

The below table shows the loss of holding individual company and total loss realized by the investor from the portfolio construction using one asset model at various confidence level at different time intervals

	Loss from Reliance communication	Loss from Jai Prakash	Loss from Bharat Airtel	Loss from Tata Power	Total Loss (One Asset Model)
97.50%					
VaR 10 days	164.8110102	56.42694207	477.6458261	163.9239	862.8077
VaR 5 days	116.5389829	39.90337705	337.7762607	115.9219	610.1405
VaR 1 day	52.11781756	17.84533272	151.058136	51.84185	272.8631
99%					
VaR 10 days	195.9232927	67.08485716	567.8635213	194.8859	1025.758
VaR 5 days	138.5386889	47.43615741	401.5401467	137.8051	725.3201
VaR 1 day	61.95638516	21.21409451	179.5742127	61.62832	324.373
95%					
VaR 10 days	138.7439626	47.50644391	402.1351116	138.0093	726.3948
VaR 5 days	98.10679684	33.59212864	284.3524644	97.58731	513.6387
VaR 1 day	43.87469336	15.02285663	127.166288	43.64237	229.7062

The following table represents advantage investor gains from diversification. From this table it is clearly observed that maximum loss investor realizes under one asset model compared to two asset model.

	Total Loss Using One Asset Model	Total Loss Using Multiple Asset Model	Profit Gained by Investor using Diversification
97.50%			
VaR (10 days)	862.807708	561.18941	301.618298
VaR (5 days)	610.1405213	396.8208392	213.3196821
VaR (1 day)	272.8631363	177.4636742	95.39946203
99%			
VaR (10 days)	1025.757536	667.1282302	358.6293056
VaR (5 days)	725.3201095	471.7308955	253.589214
VaR (1 day)	324.3730141	210.9644699	113.4085442
95%			
VaR (10 days)	726.3948216	472.4298626	253.9649589
VaR (5 days)	513.6387041	334.0583595	179.5803446
VaR (1 day)	229.7062117	149.3954401	80.31077161

Applying the above formula the loss suffered by the investor on a single day is 272.86 based on the volatility and assumed confidence level and size of the investment. The greater the investment the greater the loss may increase.

5. FINDINGS

- The BSE 30 has wide range of shares Sharpe's portfolio model helps in finding the stocks in excess return to market and the four optimal stocks are found which provides increasing returns. The cut off rate is 841 below which the stocks provide decreasing return.
- The stocks which provide greater return are Reliance communication, Jai Prakash, Bharti Airtel and Tata Power.
- The investor can invest in the four stocks but still assess the risk suffered by him/her in order to be cautious.
- The investor can use historical simulation and one asset/two asset model to assess the risk and found that under historical simulation the loss is 161.92 and one asset/two asset method the loss is 272.86/177.46 when investor holds the portfolio for a day.
- The loss can be asses in both the methods but the historical simulation is an appropriate method as it simulates the actual market.
- The investor can avail the data easily and construct the optimal portfolio with the help of technology where data is available at any time.

6. CONCLUSION

The VAR is an useful technique for the investor in estimating the loss from the holding portfolio at different time frames. From the current study it is revealed that the loss is directly proportional to number of days of holding the portfolio, larger the time period higher the loss and vice versa. The VaR can be applied to other stock exchanges and wide combination of stocks can be used to estimate the risk on a particular day/week/month/year. It is advisable to the investors consider historical simulation method while estimating the loss from the portfolio. While selecting VaR approach the investor should make sure that there is no unusual volatility in the stock exchange, as these volatilities do not repeat. It is recommending to the investors that construct the VaR using 95% confidence limit compared to other most common levels that is 99% or 97.5% because this level is leading to minimum loss in both one asset model and two asset model.

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