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EXAMINES DIFFERENT COMPUTATIONAL APPROACHES OF VALUE-AT-RISK (VAR) FOR BSE INDEX STOCKS OF SENSEX

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Abstract

This paper applies the concept of Value-at-Risk (VaR) to Indian Capital Markets and examines the different computational approaches to VaR and their relative differences in measuring the downside of the risk involved in the investment of equities by applying the concept of VaR on a portfolio comprising of the stocks listed on the Indian Capital Market Index - the BSE SENSEX; by testing the model on time series data i.e. historical daily returns of the Index over a two month horizon and back testing the results of the Monte-Carlo Simulation against historically obtained VaR estimates.

Keywords: **Markets; Investment; Nifty Index; Profitability**

INTRODUCTION

The concept of Value-at-Risk is popular among finance managers as a useful tool to express the downside of risk across various risk categories such as Market risk and Credit risk. Value-at-Risk (VaR) is a tool to predict the maximum loss over a given time horizon with a specific level of confidence. It estimates the losses without looking at the root causes of the risks. Thus, while it is a generally applicable tool, it has to be used carefully by managers to avert model risk.

VaR can be computationally found using various approaches such as:
1. The Parametric Approach
2. Delta-Normal or Variance-Covariance Approach
3. Historical Simulation
4. Monte Carlo Simulation
5. Hybrid approaches

RESEARCH OBJECTIVES

1. To study the four basic approaches to computing VaR i.e. the Parametric Approach, the Delta-Normal or Variance-Covariance Approach, Historical Simulation and Monte Carlo Simulation.
2. To apply the concept of VaR through the various approaches stated above to a portfolio consisting BSE SENSEX stocks and compare the VaR values to derive logical conclusions regarding the four approaches.
3. Backtest the result of Monte-Carlo Simulation using historical data for the same period.

In this paper, we are applying the parametric approach to the two month daily returns of each of the 30 SENSEX stocks and computing their individual VaR estimates (each stock valued MTM as an individual security in a portfolio comprising of 30 SENSEX Stocks). We also find out the portfolio VaR estimate using the Delta-Normal or Variance-Covariance Approach. We apply historical simulation on the time series data and compute VaR. In addition, we apply Monte-Carlo Simulation for a time horizon two month ahead and compute VaR using a simple average of thousand such iterations. The VaR obtained using the Monte-Carlo Simulation can be back tested using two month historical returns for the same period.

LITERATURE REVIEW

In this paper the author has tested all three methods of calculation of Value at Risk i.e. Historical Method, Variance-Covariance and Monte-Carlo Simulation. This study is done on Equity assets probably first time as VaR is a basic BASEL norm where underlying asset is relatively stable. There is comparison study between benchmark indices like S and P 500 and the select 10 mutual funds [1].

This paper examines techniques for gauging quality of select Indian Bank. CAMELS rating system is popularly used for evaluating banking stocks. The author has applied CAMELS rating on 8 listed Indian Banks SBI, Union Bank, IDBI Bank, HDFC Bank, BOB, AXIS Bank, IndusInd Bank, PNB which is a mixture of public sector and private banks. The abbreviation CAMELS stands for Capital adequacy, Asset quality, Management, Earnings, Liquidity and Sensitivity. The study reveals that this method is critical in not only assessing stability of bank but could also be used for making initial investment decision [2].

This research paper studies performance of top twelve Indian mutual funds by Asset Under Management (AUM). The study discloses which mutual funds are best performer based on all these parameters and the benchmark taken for this is NIFTY index. This study is primarily done to assess performance of the select mutual funds over a period of five years [3].

In this paper we validate use of Piotroski F-Score analysis for identifying value stocks. This method proved effective in understanding the strengths and weaknesses a company possesses and the opportunities available for the company to develop upon and the threats it faces in doing so. This is a ranking method invented by Dr. Joseph Piotroski a Chicago Booth School Professor. This research was applied to all the companies of Banking and Automobile sector that are a part of the Nifty Index for validating this model [4].

In this paper we assess performance of Indian Mutual Funds in ELSS (Equity Linked Savings Scheme) category. We compare traditional methods like Sharpe Ratio, Treynor Ratio and other with Fama-French Model. The beauty of Fama French Model is it helps assess reasons for return rather than doing simple comparative study. This is because majority of return is due to Compensation for Diversification and Net Selectivity. This is a benchmark study as it not only gives reason for good return using Fama and French Model but also measures portfolio performance using Jensen's Alpha and Sharpe Ratio [5].

In this paper we authenticate Kisor-Whitebeck Model which uses the most fundamental parameter for valuing a company which is price earning multiple. This is a first of its kind application of Kisor-Whitebeck Model on Indian Capital Market. We have taken 30 index stocks for this study from SENSEX. We can categorize these stocks as undervalued stocks, overvalued stocks and suitably valued stocks. This model has certain limitation like lack peer comparison, global liquidity scenario etc. which is discussed in our paper [6].

The purpose of this research is to have a better understanding of the CANSLIM philosophy of investment and also to identify stocks using this theory and to use it as a tool for investment. The abbreviation CANSLIM stands for Current quarter earnings per share, Annual earnings increase, new product- management or event, Small supply and large demand, Laggards, Institution sponsorship and Market averages.

The interpretation of the data, the values required for the seven abbreviations of the CANSLIM approach. The returns of the above selected stocks are then compared with the returns of the index nifty 50 [7].

In this paper, we have calculated Graham Harvey Measures for top ten ELSS funds in India according to their Asset under Management. Graham Harvey measure is most popularly used for bond market and has fewer applications in equity assets. Our finding suggests that Graham and Harvey Measures are superior to Sharpe ratio for performance grading [8].

Data Collection

The time series data was chosen from BSE (Bombay Stock Exchange) and other finance portals. The stock selection was based on the market index SENSEX and daily returns for over two months for each of the 30 SENSEX stocks were gathered.

RESEARCH METHODOLOGY

The primary data collected from BSE (Bombay Stock Exchange) and other finance portals was used to find daily percentage returns, the mean and the standard deviation for each of the 30 stocks as well as for the SENSEX. The confidence level Alpha was assumed to be set at 95% so that the confidence interval was set at 1.645 times the standard deviation. Percentage VaR was computed using the formula VaR=-Mean+1.645*Standard Deviation. Every individual stock investment was assumed to be INR 10 Lacs with the total portfolio investment of 30*10 Lacs=INR 3 Crores. Thus, VaR was computed using the formula-based approach. For the Delta-Normal or Variance-Covariance approach, we require to first create 3 matrices – the weight matrix (of the order 1 x 30), the covariance matrix (of the order 30 x 30) and the transpose of the weight matrix (of the order 30 x 1). We find the variance of the portfolio by taking the linear product of the three matrices in a serial order as stated and find the standard deviation by taking the square-root of the variance of the portfolio. To simplify intermediate computations, a 30 x 30 correlation matrix was built using the correlation coefficients of all 30 stocks instead of the covariance matrix.

In Monte Carlo Simulation, we have to use random numbers to simulate the stock prices over the future horizon of two months.

We assume that:
No of Hypothetical Future Scenarios, i.e. No of Samples or Draws, N=1000;
No of Market Factors, K=1 i.e. Sensex returns;
No of Instruments in the Portfolio, M=30;
No of days to simulate prices, D=60.

We compute a drift from the last closing price of stock as,

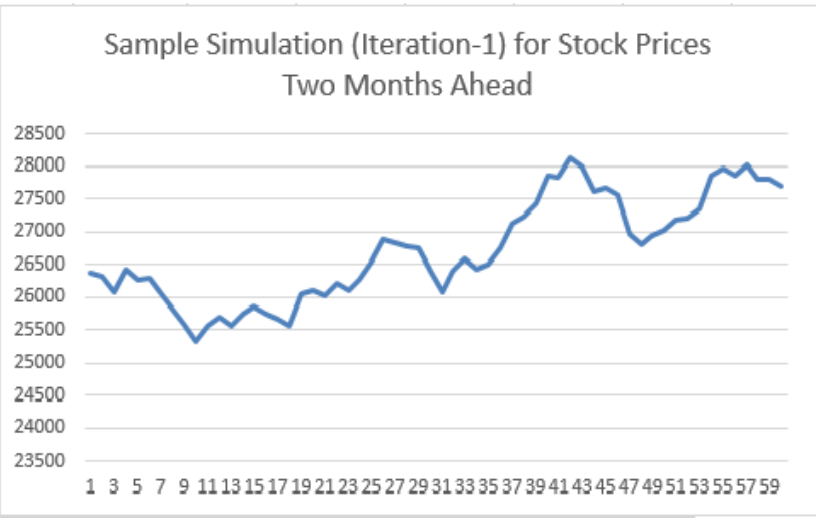
Drift=Mean - (Variance/2)

And

Tomorrow's Closing Price=Today's Closing Price*e ^ r
Where r=Drift+Standard Deviation*Random Confidence Interval

Figure 1: Trial of a Monte Carlo simulation.

Simulated Prices	Simulated Pct Returns
26382.87748	0%
26326.34071	-1%
26074.37849	1%
26417.96197	-1%
26266.52054	0%
26301.59061	-1%
26063.32441	-1%
25837.68759	-1%
25595.34923	-1%
25313.06236	1%
25566.29593	1%
25704.12435	-1%
25565.72877	1%
25734.28412	0%



The above is a snapshot of a sample trial of a Monte Carlo Simulation. The trial is repeated 1000 to 10000+ times to get a fair estimate of VaR which is as accurate as possible (Figure 1).

Backtesting is done by applying Monte Carlo Simulation on the stock price of the 1st day of an n-day historical horizon to get VaR estimate for the next (n-1) days and compare it with the actual VaR derived from Historical Simulation (Table 1).

Table 1: For a portfolio of INR 3 Crores.

VaR Computation Method	**Value (INR)**
Formula-based Portfolio VaR	369,033
Variance-Covariance (VCV)-Portfolio	62,677
Historical Simulation-SENSEX	408,979
Historical Simulation-Portfolio	329,442
Monte Carlo Simulation-Portfolio	366,360
Backtesting-Portfolio	367,264

Although the VCV approach is easier to compute, the estimate is rather low considering a portfolio of INR 3 Crores. The formula-based and Monte Carlo

estimates (with 1000 trials) are very close to each other on a percentage scale. The Historical Simulation VaR for SENSEX is higher than the historical Portfolio VaR as the weights are different for SENSEX returns as against the portfolio weights of 0.033. Backtesting yielded a higher VaR estimate than the historical estimate for the portfolio.

CONCLUSION

The Formula-based approach and the Monte Carlo approaches are better indicators of VaR as compared to other approaches. The Formula-based approach is the easiest to compute. Monte Carlo Simulation is computationally intensive. Historical Simulation is also a good resort when it comes to near-zero assumptions depending on past data for predicting future estimates. The Variance-Covariance approach can be avoided in real life computations due to a dependency on correlation of stocks within the portfolio.

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