



Enhancing Financial Literacy and Inclusion through risk assessment

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Abstract

In today's era, the growing importance of financial literacy highlights the need for a comprehensive understanding of investment instruments. This study revolves around the assessment of derivatives, analyzing their risk and return dynamics to make informed decisions about future cash flows. Specifically, we investigate the impact of various confidence levels (levels of significance) in different scenarios to evaluate the probability of potential losses in the invested amount.

The research also highlights on various models used to calculate Value at Risk (VaR) values, employing descriptive statistics taking the example to a specific stock i.e., 'Tesla.' This will help us to gain insights into possible losses, contributing valuable information for financial decision-makers. It also provides the risk-return tradeoffs for any investment decisions made by investors studying the market risk and historical price fluctuations.

Thus, the research not only contributes to the understanding on financial literacy but also serves as a guide for individuals seeking to enhance their understanding of investment risks and returns. The insights gained from the study can empower investors, promoting financial inclusion through informed decision-making in the dynamic landscape of financial markets.

Keywords: VaR, Derivative contracts, Probability, Risk, Confidence level.

Introduction

Based on the today's scenario, the financial institutions and banks are going in for investment analysis to hedge the risk and extent of the profit or loss that can be incurred by the made choices. Thus, Value at risk (Var) and derivatives are two most important concepts in finance and risk management. They provide us the insights for assessing the role in managing the risk associated to the investment portfolios and trading activities. This paper will try to reveal the relation between the two and also how the derivatives help in reducing the Var for the portfolios.

Value at risk refers to the statistical measure of estimating the potential loss that can be made while forming the investment portfolio



over specific duration of time based on the normal market conditions. Typically, Var is followed as the chance of X% that our portfolio will not lose more than \$Y in ABC duration. There are several models that can be used to calculate Var including simulation models, parametric models and Monte Carlo simulations. The method to be considered depends upon the complexity of portfolio and the assets that are in combination as underlying. The three method that can be used to calculate Var include historical method, variance-covariance method and Monte Carlo method for simulation.

The Var is determined based on the combined effect of period / duration of investment, confidence level and the size of the possible loss that can be made. The calculation under various methods is as shown below:

Historical Method:

This method re-organizes the actual historical returns by putting them into the decreasing order of possibility of loss.

$$\text{Var} = V_m (V_i / V (I - 1))$$

Where, m refers to the no. of days from which historical data is taken for consideration and vi refers to no. of variables on the ith day.

The variance – covariance method:

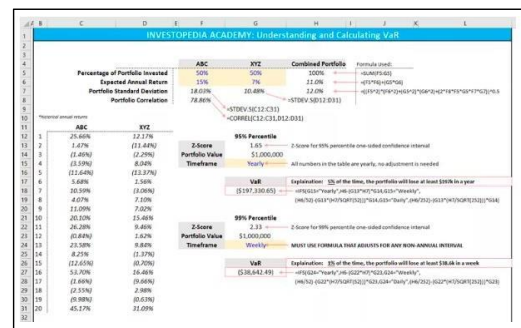
This method assumes that the stock returns are normally distributed and required the study of only two factors i.e., expected return and standard deviation. It takes into consideration only the confidence level of 95 % and 99 % thus the worst rate varies in range of 5% and 1% respectively.

Var = normal distribution value at the particular confidence level (Z- score) * deviation for the stock

Monte – Carlo Method:

This method generates random trials and probabilistic outcomes. The obtained probabilistic values are then used to analyze the description from random observations and the actual observations in comparison.

High value of risk indicates he good probability under confidence level for the possible losses that can be made



The above graph shows the calculation of the Var values based on the historical method.

Similarly, derivatives are the instruments that



are used to hedge the risk for underlying asset. This helps in protecting the value of underlying and also provide us with certain amount of profit in longer times considering all the risk factor and associated circumstances. There is various type of derivatives i.e., futures, forwards, options and swaps. These vary based on the conditions for the agreement and the settlement related details. Thus, derivatives help in analyzing the Value at risk for investment portfolios and help in speculation of future fluctuations based on the historical trends.

Thus, this paper tried to understand the concept and calculation of VaR for different derivatives in the investment portfolio

Literature review

Huang et. al. (2017)

This paper tried to find out the higher order risk associated and explore how it is independent of the underlying asset prices and behavioral implications. This paper showed the relationship between n th degree risk and m th degree risk when an unfair risk is present that affects the buyers to pay the higher cost. The study also helped us providing the insights for decision making processes of the people based on the varying degree of risk and how they tackle the risk by mitigating it. Thus, the

paper helped in understanding the higher order risk vulnerabilities and their practical implication in broader terms.

Rudiger Frey et. al. (2015)

The paper tried to represent the advancement in the domain of reduced form of credit-risk models under the scenario of incomplete information. The study included the mathematical approach to address the challenges faced during the state of incomplete information in credit-risk modelling. It provides the discussion on pricing strategy for options based on the underlying asset vales and getting onto various hedging strategies that refers to derivative asset pricing and risk-management. Finally, the paper tried to explore various simulation models for analyzing the pricing techniques to provide valuable insights to the researchers.

Mehak Thakral et. al. (2017)

Several studies were done to contribute the understanding of option and spot pricing in derivatives for various sectors in industry. And the studies revealed that future market price discovery plays a pivotal role in price discovery process for several commodities. The impact of future market for risk reduction and prediction of future spot prices is very



crucial to encourage firms in increasing their output by working on their operational costs. Few researchers also tried to find the relationship between inventory level based on spot market and efficient process of storage to cut down the costs. This helps the traders to make profits without the risk of operational costs or intermediary requirement for storage of stocks.

Muhle- Karbe et. al. (2018)

In this paper, the researchers tried to elaborate concept of derivative pricing in relation to the equilibrium framework for risk neutral traders regarding their underlying assets. The studies helped in understanding the psychology of traders even when they are involved in risk neutral strategies where almost negligible risk is associated and also lesser profits. Thus, price volatility type for speculation of prices to derive the fundamental value of derivatives in order to also evaluate the resale value of underlying was done



This was to ensure the equilibrium pricing Spencer Pierce (2020)

This paper explores the impact of derivatives and its accounting measures on earning volatility for traders. It included several accounting treatments for derivatives in varied sectors of industry and tried to explain the way derivatives are used in non-financial firms other than banks to hedge their risks. The results showed that there is no significant impact on the earnings if the method of accounting is changed and thus the fair market value will remain the same for derivatives underlying. Also, it highlights the concept of hedge accounting based on the correlation between gains and losses from derivatives and firm's total earnings excluding the portions earned from derivative trading strategy to construct the relationship between speculative behavior of buyers and sellers and derivative pricing

Glasserman (2018)

This paper named "Bounding wrong way risk in CVA Calculation" aims at finding the market correlation with that to associated credit risk during the financial transactions. The combined model tries to create the relationship between market risk and credit risk to estimate the risk of counterparty based on the probability of defaulting and market value of exposure. The researcher tried to focus on the constraints that limit the deviation of price from market prices by using the

practical models that helps in enhancing the CVA calculation of offering the methodology for risk evaluation and risk estimation to buyers and traders.

Leung et. al. (2018)

In this paper they have mentioned a method on dynamic index tracking and how they can use financial derivatives to expose the risk. It gives an ability to the investors to gain exposure on the market factors that affect the derivative instruments. One added advantage to the investors is that they can effectively manage on the amount of exposure they would want to have on the index or marketing factors in different financial models. Leung and Ward's have also integrated their strategies just to understand the performance when using various types of derivative

Titova et. al. (2016)

The study highlighted the usage of derivatives by non-financial firms that helped them in creating the strategies for risk management and also analyzing the potential return for the firm based on the performance that generate income apart from derivative trading. The studies showed that the banks with lower capital ratios and riskier portfolios are more prone to utilize credit derivatives. This study tried to investigate the connection between bank characteristics in terms



of risk evaluation and the risk of exposure the firm faced while trading with financial derivative contracts.

Tanupa Chakraborty (2012)

The paper tried to acknowledge the relationship between futures and underlying equity returns thus helping in price discovery. The study explains the model of normal distribution on the return distribution in relation to the underlying equity values. Thus, the paper tried to determine the price volatility and time to maturity for future contract. The paper also provides the model assumptions to calculate the price fluctuations based on the contract prices and also the futuristic values.

David Gopal (2017)

The author tried to construct a relationship between the different invested amount portfolios based on the external factors that measures the risk and the return amount. It also mentions on the concept of slippage which is used for having a clearer understanding and tracking of portfolio and its returns. This can be a beneficial tool to manage their risks well as protect their underlying prices in derivatives market. They have also come up with a path

wise approach which would help to building of a portfolio

Objective of the study

The objective of this study can be mentioned as follows:

1. The study tried to find the relationship between derivative prices based on the current and historical market fluctuations.
2. The impact of the confidence level on the return of the invested amount.

The risk-return ratio for the particular stock based on the market fluctuations

Research methodology

The methodology of this research starts by collecting the data, analyzing the data obtained based on the calculation of VaR value for the invested amount based on the defined confidence level and finally finding out the results to analyze the impact of VaR to predict the future value of cash flow for the invested amount.

Data Collection:

For data collection, we have taken the reference of the stock price for the company named “TESLA” for the past 5 years based on the weekly frequency. The data was obtained from the secondary sources like the



website “Yahoo Finance” from the date of 11 Sept 2023 till 17 Sept 2018. This data will be helpful in determine the invested amount VaR for the e.g., taken of \$1,000 and analyzing the value for several intervals

Analyzing the data

The method to analyze the data is based on the different confidence levels i.e., 99%, 95% and 90%. And the various method of calculation of VaR based on several methods like historical and Monte- Carlo simulation. The two methods taken for analysis are as follows:

Historical Analysis:

The data taken was used to calculate the rate of return for the stock price using the previous data into consideration. The formula used for the same was:

$$LN(\text{present stock price} / \text{previous stock price})$$

The obtained data was first sorted based on the inverse order from lowest rate of return to highest. Later on, the descriptive statistics is performed for the data to calculate the rate of returns on an average. Then we tried to analyze the probable rate of loss for the investment made in terms of multiplying it with standard deviation.

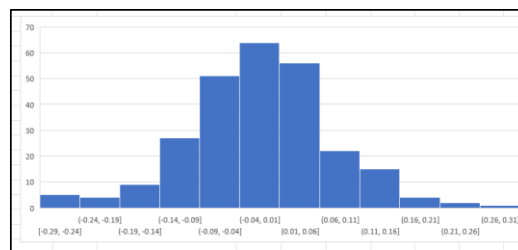
The table given below shows the calculation of investment risk based on the confidence level. Rate of return = total count * alpha value (level of significance)

total no. of returns	260		
confidence level	95%	99%	90%
alpha (level of confidence)	5%	1%	10%
Historical Var at position	13%	3%	26%
Value of my asset	1000		
VAR Dollar Amount	-177	-250	-130

Table 1: Amount of risk for investment portfolio based on different confidence levels

Interpretation: Thus, we can infer that as the level of confidence increases the probable loss (risk) start decreasing thus having an inverse relation on the investment portfolio. For the solved cases, being highest for 1% i.e., (250) and highest for 10% i.e., (130).

The histogram representation for various ate of return based on the holding period is given below based on the frequency for particular interval on y-axis and interval of return on x-axis



Graph 1: Frequency distribution for rate of return interval

Monte-Carlo Simulation method:



Based on this method we tried to find the fluctuation of return on investment based on the random probabilistic measures of the given data.

Here we tried to get the probability range of 100 observation based on the actual weekly observations for the stock price.

The results obtained for the descriptive analysis of the random data is as follows:

Historical Method	
Mean	157.905249
Std. deviation	111.6750073
Min	12.34
Max	407.36
percentile	
10%	17.25
5%	15.54
1%	13.894

Monte- Carlo	
Mean	158.5122896
Std. deviation	113.1628619
Min	-216.2128811
Max	517.2488444
percentile	
10%	15.3415089
5%	-28.67065458
1%	-111.0547998

Table 2: The tables provided above gives a comparative study about the descriptive statistics for the two methods i.e., historical and Monte-

Carlo and thus tried to evaluate the results.

The formula used for finding the random probable values was

= Percentile.inc (rand (), mean, standard deviation)

And this series is continued over to obtain count of 1000 observations

Results and findings

Based on the above study, we can make certain inferences that the fluctuation based on the risk on investments varies for different level of confidence and have an **inverse relationship for the amount of loss to the level of significance**. If the amount of investment is kept constant and the level of significance is low the amount of loss will be high and vice versa. And the studies also helped in providing the insights regarding various potentials for the risk associated in investment projects such as time duration, confidence level and the interest rate for the derivative contracts. The results also helped in highlighting the importance of historical fluctuation methods and the Monte-Carlo simulation methods as from Monte- Carlo, we can analyze that the risk involved will vary based



on the no. of analysis done by the trader.

Future scope for study

The study done will have several gaps that can be improved by further studies. They can be as follows:

Evaluation of risk-free rates in order to analyze the impact of other factors for investment portfolio.

Analyzing the various risk-free rate measures individually and considering the combined effect of significance level and beta in calculating the probable losses.

We can also consider the different types of derivatives that have varied terms and policies for settlement and price discovery to provide holistic approach about the derivative trading markets

Conclusion

The paper helped us in highlighting the various scenarios of risk factors at various significance level (1 – confidence level) and thus analyzing the probability of losses incurred on the invested amount. The paper also helped in evaluating the different models for predicting prices of derivatives in trading for buyers in order to incur

minimum losses. The results for the models differed based on the probability of the consideration as in Monte-Carlo Method random probabilistic values for observations. The paper also tried to evaluate several scenarios of risk- return assessment based on the rate of holding period of returns. The analysis made from the study can help in creating several assumptions that need to be considered while buying the trades in derivative markets. Thus, one must analyze the implications of all the associated risks in order to hedge their risk to an extent that they doesn't affect the underlying value by considering all the internal and external factors

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