VAR как ключевой инструмент оценки рисков

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Аннотация

Сегодня очень важно выбрать наиболее точный способ оценки рыночных рисков, чтобы лучше контролировать и управлять ими. VAR - один из самых популярных инструментов, используемых многими финансовыми аналитиками. Эта статья связана с проблемой точного измерения риска и обзором различных методов VAR. Более того, практические примеры помогут детально разобраться в концепции VAR.

Ключевые слова: var, управление рисками, оценка рисков, функция распределения доходности.

VAR as a key instrument in risk assessment

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Abstract

Today, it is vital to choose the most accurate way of risk assessment in order to control and manage market risks. VAR – one of the most popular tools, used by lots of financial analytics. This article is connected with problem of accurate risk measurement and overview of different VAR methods. Moreover, practical examples will help to understand in details the concept of VAR.

Keywords: var, risk management, risk assessment, returns distribution function.

In modern world, especially in crisis realities, the problem of understanding and measuring risk becomes more and more relevant. Financial institutions, professional investors and beginners are concerning about how risk can affect their income, consequently, the effective risk management strategy preventing parties from losses has to be developed and successfully applied. Nowadays, there exists plethora of instruments that can measure risk but the most common one is VAR (value at risk) which is the subject of this article. Investor's portfolio is considered to be the object of research provided. This paper is dedicated to the main methods of determining value at risk. The purpose of the article is to conduct deep analysis of historical, analytical and Monte-Carlo methods in order to verify the best option for the portfolio consisting of shares of a particular company. Methodological base of this study is analysis, deduction, synthesis, statistical, computational and constructive methods. The goal of this investigation is: to compare 3 main methods of calculation value at risk, identify its peculiarities, give basic recommendations in order to optimize the VAR understanding for investors that only started to study investment process and on the real example show for ordinary investors that has an opportunity and will to invest money in financial assets how VAR works.

The main aim of value at risk calculation is to find the numerical value that can be expressed in currency or percentage that reflects information concerning the risk of portfolio. Risk is connected with share price dynamics uncertainty on the market during the particular period of time. VAR has 2 main paraments: the time frame (N=1,2,3) expressed in days and the confidence interval which varies from 95 to 99%. [3, p. 7]. It is essential to add that in practice, financial institutions such as banks often prefer to use 1 or 10 days value at risk since the lack of data that would reflect the market variables changes incorrectly. Moreover, it is necessary to know portfolio structure, decide how much money the potential investor will invest in securities.

When VAR parameters are chosen it is required to determine the distribution function of portfolio value changes. Overall, there exists 3 methods: historical, variance-covariance method and simulation method.

Before the conduction of comparative analysis of these methods, the advantages and disadvantages of VAR calculation has to be considered.

The pitfalls of VAR applications are the following. In all models of VAR, the historical data is used as a primer source of information and if the market conditions change, especially when the volatility faces sudden hikes, or the correlation between financial assets in the portfolio declines, then VAR will take this factor into consideration only after some time after the occurrence of such event. Moreover, the liquidity of instruments in the portfolio is not reflected at all. In this case, the change of portfolio structure in order to decrease risk will be under the question since it is required to proof that liquidity is not correlated with VAR. In the end, VAR is only one of the instruments that can be used in risk management but not the universal tool for risk assessment.

The first pros of using VAR is that it gives an opportunity for managers of banks or investors the statistical number, so the uncertainty turns into a certain number that expresses the loss that with the given probability will not be exceeded over the next timeframe [1, p. 7]. Var is the instrument that measures the market risk and has advantage over sample variance as the former does not reflect the possible asymmetry in portfolio returns distribution, while there are methods of VAR determination that can be applied for derivatives. Furthermore, the user of VAR may choose the method that suits him in the most optimal way. Finally, VAR has certain modification such as conditional value at risk that gives an opportunity for financial managers to compare and adjust the obtained results.

That is why VAR is important when making any financial decisions that can reflect the financial institutions' policy or the investors' understanding of portfolio structure and risk evaluation.

Comparative analysis of basic methods when computing VAR

As it was mention before, 3 basic methods are applicable for VAR determination.

Historical method analyzes portfolio value change based on historical data, so the returns distribution will be the same as historical ones.

Analytical method is connected with normal distribution of returns. Here, it is essential to calculate volatility of portfolio which take into consideration the correlation between financial assets in investor's portfolio. Variance-covariance technique concentrates on search of market factors that influence the value of portfolio and gives approximate results.

Monte- Carlo is a method based on stochastic process, where random value dictates the returns distribution. The result of each individual test is random. After a series of tests, a sample is obtained [4, p. 7].

It is observed that all these methods are different and the return distribution are determined in different ways. How financial institution or investor shall understand what method to use in order to find the most accurate result? To answer this question, the following table was constructed.

From the perspective of large financial organizations such as banks, the accuracy plays the vital role in planning and funds management. Banks have to decide what portion of capital will be dedicated as reserves against any unexpected losses. Following this logic, the most suitable method to deal with is Monte-Carol since it includes sudden market environment changes and "problem of fat tails" is solved due to different returns distribution. Despite the fact that this method requires large investment in technological devices, banks can afford it, otherwise consequences may be unpredictable.

For investors, it is essential to pay attention at what kind of securities they would like to operate with. Variance-covariance way to calculate VAR is unsuitable for options and other instruments with nonlinear returns structure. But this method is much easier to calculate and provides a good approximate result. This method can be applied to diversified portfolio and can be easily interpreted as a lot of processes has normal distribution.

For beginners, we would like to recommend historical method if market is stable and strong. Future may copy past events and historical data analysis and collection takes not so much amount of time. This is a rough a fast method of VAR calculation but is acceptable in order to understand the concept. However, there are several tips how to improve this method. For, instance conditional VAR can be applied or exponential weighting of returns distribution and adjusting the distribution for volatility may also correct and improve the accuracy of VAR result [3, p. 7].

VAR calculus based on Spanish exchange market

For the practical example, Spanish stocks and Index (IBEX 35) was chosen. Spanish market in 2019 was pretty stable and faced positive growth up to COVID-19 crisis.

For the historical method Ferrovial's shares were chosen. It is a Spanish company specializing in the design, construction and management of infrastructure facilities. Confidence interval = 95% and we are going to calculate 1 day VAR.

The data was chosen from 11.03.2019 to 9.03.2020. After shares' returns calculation and sorting them in acceding order, the k coefficient was calculated. It is the residual number of the following multiplication

$$k = (\alpha * \text{number of trading days}) - \text{integer} = 0{,}05 * 255 = 12{,}75 - 12 = 0{,}75$$

Count 12 (b) and 13(a) number of returns respectively and using the following formula we will get VAR.

$$VAR = a + (a - b) * k = -2{,}1754\%$$

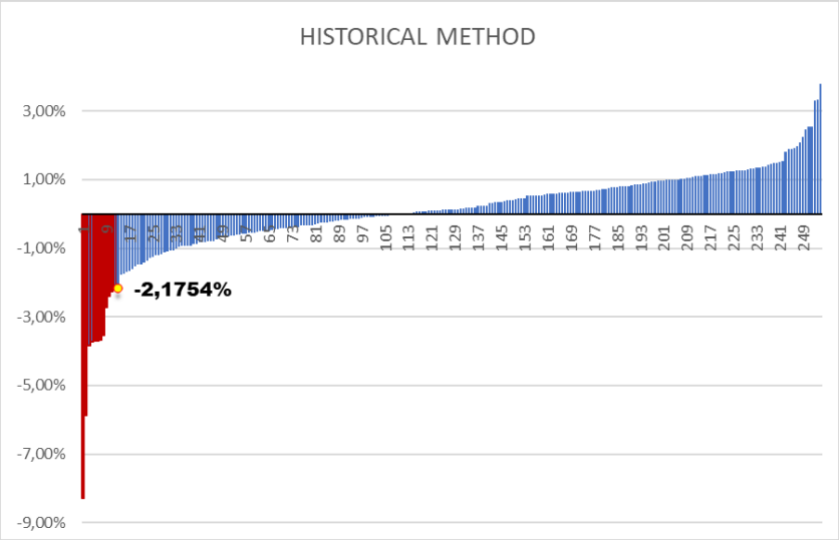

Fig. 1. VAR using historical method[1]

According to the graph, it is seen that with 95% probability, the potential investor will lose no more than 2,1754% of the portfolio value. If a person invests 1000 euros, the maximum amount of a daily loss with 95% probability = 21,754 euros.

For analytical method, the portfolio was enlarged up to 5 different companies. The weights for each type of shares = 0,2 for simplicity.

Table 2. Portfolio analysis[2]

	FER	ACX	ANA	AENA	ITX
cov	0,00009130	0,000125716	0,000084074	0,0000910	0,00010512
variance	0,000113349	0,000113349	0,000113349	0,000113349	0,000113349
beta	0,805511873	1,109107874	0,741726028	0,802834855	0,927367511
rf	0,000009682	0,000009682	0,000009682	0,000009682	0,000009682
rm	-0,000751551	-0,000751551	-0,000751551	-0,000751551	-0,000751551
mu(day)	-0,000603501	-0,000834608	-0,000554945	-0,000601463	-0,000696261
av(ln)	0,000583565	-0,00082506	0,000421715	-0,00100423	-0,000315877
sum	0,000178315	0,000334594	0,000266095	0,000157809	0,000208033
sigma	0,0134	0,0183	0,0163	0,0126	0,0144
sigma(year)	0,213237786	0,292098189	0,260488546	0,200602375	0,230322485
w	0,2	0,2	0,2	0,2	0,2

According to the table, the daily returns for each stock was calculated using CAPM model. Afterwards, it is essential to determine the expected return of portfolio, which was obtained via multiplication of daily return by each weight.

Speaking about risk of portfolio, it is essential to take into consideration the fact that inside the portfolio, each share correlates with each other, that is why the logarithmic covariance matrix was created.

[1] Complied by authors
[2] Complied by authors

Table 3. Covariance matrix for portfolio of assets[3]

covariance matrix					
	FER	ACX	ANA	AENA	ITX
FER	0,000177616	8,29735E-05	9,22167E-05	9,73852E-05	7,71236E-05
ACX	8,29735E-05	0,000333281	6,24492E-05	7,93634E-05	0,000100148
ANA	9,22167E-05	6,24492E-05	0,000265052	9,01276E-05	7,69113E-05
AENA	9,73852E-05	7,93634E-05	9,01276E-05	0,00015719	8,72829E-05
ITX	7,71236E-05	0,000100148	7,69113E-05	8,72829E-05	0,000207217

Using the formula for σ determination, the risk of portfolio was calculated.

Overall, the expected return = -0,000658155 and $\sigma_p = 0{,}010643909$

Now, it is possible to calculate VAR, using the normal distribution returns function.

The formula in this case will be

$$(\sigma_p * Z - r_p) * \text{portfolio value}$$

In our case, the value of portfolio = 1000 euros.

Overall, the table of VAR was constructed according to different confidence level and timeframe.

Table 4. VAR for portfolio using analytical method

1-a	z value	1 day VAR	10 days VAR
90%	-1,28155157	-€ 12,9826	-€ 41,0545
95%	-1,64485363	-€ 16,8495	-€ 53,2829
99%	-2,32634787	-€ 24,1033	-€ 76,2213
99,90%	-3,09023231	-€ 32,2340	-€ 101,9328

[4]

According to the results, the following conclusion can be made. The higher the probability, the higher will be the potential loss, as more accuracy adds more euros in portfolio that can be burnt.

In conclusion, it is necessary to say that wise risk management is a key to success for each corporation, institution or investor. Risk is always connected with uncertain events that can damage the level of income. VAR is one of the most famous instruments that gives an opportunity to measure the market risk. Using various methods, financial analytic is able to make assumptions concerning the strategy how to deal with risks. For banks, it is a tool that gives a clue what part of its capital has to be preserved in case of sudden market changes. Professional investor or beginner may calculate VAR using excel and understand in monetary terms the loss of portfolio within 24 hours or several days. Every method is different, however the most expensive and accurate one is Monte-Carlo which is used by large organizations. Nevertheless, even the less accurate methods may be improved and actively applied when considering investor's portfolio.

[3] Complied by authors
[4] Complied by authors

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