

## Investment Risk Analysis of Gold, the Indonesia Composite Index (IHSG), and BBCA Stock in Indonesia using the Value At Risk (VaR) Method With A Variance–Covariance Approach

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### ABSTRACT

Investments in various financial instruments such as gold, the Indonesia Composite Index (IHSG), and individual stocks carry different levels of risk due to market price fluctuations. These differences require investors to understand potential risks in order to manage their portfolios optimally. Therefore, a quantitative risk measurement method is needed. Value at Risk (VaR) is a method used to estimate the maximum potential loss at a given confidence level and time horizon. This study aims to analyze and measure investment risk in gold, IHSG, and BBCA stock in Indonesia using the Value at Risk (VaR) method with a variance–covariance approach. The data consist of monthly closing prices from April 2024 to March 2025, implying a 1-month VaR horizon with confidence levels of 90%, 95%, and 99%. The results show that the VaR value at the 95% confidence level (1-month horizon) is (4,033.25) for gold, (8,064.47) for IHSG, and (7,931.17) for BBCA stock. At a higher confidence level of 99%, the VaR increases to (5,704.31) for gold, (11,405.74) for IHSG, and (11,217.20) for BBCA stock. These findings indicate that IHSG and BBCA stock have higher potential maximum losses compared to gold, consistent with their higher volatility levels. These results suggest that the variance–covariance VaR method provides measurable quantitative risk estimates across different confidence levels and time horizons, making it useful for investment decision-making and structured portfolio risk management.

### ABSTRAK

Investasi pada berbagai instrumen keuangan seperti emas, Indeks Harga Saham Gabungan (IHSG), dan saham individual memiliki tingkat risiko yang berbeda akibat fluktuasi harga pasar. Perbedaan karakteristik masing-masing instrumen menyebabkan investor perlu memahami besarnya risiko yang mungkin terjadi agar dapat mengelola portofolio secara optimal. Oleh karena itu, diperlukan metode pengukuran risiko yang mampu memberikan estimasi kerugian secara kuantitatif. Value at Risk (VaR) merupakan metode yang digunakan untuk mengukur potensi kerugian maksimum pada tingkat kepercayaan dan horizon waktu tertentu. Penelitian ini bertujuan untuk menganalisis dan mengukur risiko investasi pada emas, IHSG, dan saham BBCA di Indonesia menggunakan metode Value at Risk (VaR) dengan pendekatan variansi–kovariansi. Data yang digunakan berupa harga penutupan bulanan periode April 2024 hingga Maret 2025, sehingga horizon waktu VaR yang digunakan adalah 1 bulan dengan tingkat kepercayaan 90%, 95%, dan 99%. Hasil penelitian menunjukkan bahwa nilai VaR pada tingkat kepercayaan 95% (horizon 1 bulan) untuk emas sebesar (4,033.25), IHSG sebesar (8,064.47), dan saham BBCA sebesar (7,931.17). Pada tingkat kepercayaan yang lebih tinggi, yaitu 99%, nilai VaR meningkat menjadi (5,704.31) untuk emas, (11,405.74) untuk IHSG, dan (11,217.20) untuk saham BBCA. Hasil ini menunjukkan bahwa IHSG dan saham BBCA memiliki potensi kerugian maksimum yang lebih besar dibandingkan emas, yang sejalan dengan tingkat volatilitasnya yang lebih tinggi. Temuan ini menunjukkan bahwa metode VaR dengan pendekatan variansi kovariansi mampu memberikan estimasi risiko kuantitatif yang terukur pada berbagai tingkat kepercayaan dan horizon waktu, sehingga dapat digunakan sebagai dasar dalam pengambilan keputusan investasi dan pengelolaan portofolio berdasarkan karakteristik risiko masing-masing instrumen.

Keywords: Value at Risk, IHSG, BBCA shares, Gold

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## Introduction

Investment in financial instruments such as gold, the Indonesia Composite Index (IHSG), and individual stocks like BBCA has become increasingly popular in Indonesia due to their distinct characteristics and return–risk profiles. Gold is commonly regarded as a safe–haven asset, while IHSG reflects overall market performance, and BBCA stock represents one of the most liquid and large–cap banking equities in the Indonesian capital market. These differences imply varying levels of risk exposure, making quantitative risk measurement essential for informed investment decision–making [1], [2].

Previous studies have extensively applied the Value at Risk (VaR) method to measure financial risk. Research by Anam et al. [3] and Nainggolan et al. [4] shows that the variance–covariance approach is widely used due to its simplicity and reliance on the assumption of normally distributed returns. Other studies, such as Yolanda et al. [5], focus on portfolio risk using the same approach, while Fauziyah et al. [6] compare VaR methods including historical simulation and Monte Carlo. However, most of these studies primarily focus on stock portfolios or specific sectors, with limited attention to cross–asset comparisons involving safe–haven assets such as gold and market indices within a unified analytical framework.

Furthermore, empirical studies in the Indonesian context often lack simultaneous comparison between different types of financial instruments (commodities, indices, and individual stocks) using consistent data frequency and time horizons. In addition, several studies do not explicitly report VaR values across multiple confidence levels, which limits the interpretability of risk under varying market conditions [6], [7]. This creates a gap in understanding how risk differs across asset classes when measured using a standardized quantitative approach.

Based on these limitations, this study aims to fill the empirical gap by analyzing and comparing the investment risk of gold, IHSG, and BBCA stock in Indonesia using the Value at Risk (VaR) method with a variance–covariance approach. Unlike previous studies, this research provides a cross–asset risk comparison, applies a consistent monthly time horizon, and evaluates VaR at multiple confidence levels (90%, 95%, and 99%).

The contribution of this study is twofold. First, it provides empirical evidence on the comparative risk characteristics of different asset classes within the Indonesian financial market. Second, it offers practical insights for investors in constructing portfolios based on quantified risk levels, particularly in distinguishing between defensive and high–risk assets.

## Research Method

This research is conducted at the Indonesia Stock Exchange in Medan, North Sumatra, one of the major financial and investment centers in Indonesia. The study period spans from November 2024 to March 2025.

This study employs a quantitative approach aimed at analyzing and measuring investment risk using the Value at Risk (VaR) method with a variance–covariance approach, which is widely applied in financial risk modeling due to its analytical simplicity and reliance on statistical parameters [3], [8]. The research is descriptive and exploratory in nature, focusing on evaluating the level of risk faced by investors.

The data used in this study are secondary data obtained from official sources, namely the Indonesia Stock Exchange ([www.idx.co.id](http://www.idx.co.id)) and Yahoo Finance. The dataset consists of monthly closing prices for the period April 2024 to March 2025, ensuring consistency in data frequency. Based on this data structure, the VaR time horizon is defined as one month, aligning the analysis with the frequency of observations.

The research data sources are secondary data collected through the website [www.idx.co.id](http://www.idx.co.id) and *Yahoo Finance* as the center of the Indonesian Capital Market. For interest rate data, it was collected from *the BI Rate*. In this study, the variables analyzed include quantitative aspects, the solution for each variable is as follows:

$X_1$  = IHSG Price History

$X_2$  = Interest Rate History

$X_3$  = Gold Price History

The research procedure is carried out systematically through several interrelated stages.

1. Collect data related to the Jakarta Composite Index (JCI), interest rates, and gold. Determine the data frequency (daily, weekly, or monthly).
2. Then go through the data pre–processing stage to ensure data quality and consistency with the following steps:
  - a. Calculate *the return* from the asset price to measure price changes.
  - b. Calculate the average *Return* for each asset.
  - c. Calculate *the standard deviation* of each asset.
3. VaR calculation stage with *Variance–Covariance simulation*. Select a confidence level (e.g., 95% or 99%) for the risk analysis with the following steps:
  - 1) Risk analysis in obtaining *Value at Risk* (VaR)
    - a. Calculate *the return* on the assets to be studied.
    - b. Calculate the average *return* of each asset.
    - c. Simulate *return values* using estimated parameter values.
    - d. Estimation of maximum loss

- e. Calculating VaR values at confidence intervals of 90%, 95%, and 99%
- 2) Once the VaR value is determined, the next step is to calculate the resulting VaR value. Investors use this VaR value to prepare a budget for the predicted losses.
- 4. The results of the analysis are then interpreted to identify how big the risk is when investing in stocks, deposits, and gold.

**Value at Risk (VaR)**

Value at Risk (VaR) can be defined as the estimated maximum loss that may occur within a certain period at a certain level of confidence, calculated using the variance-covariance method, Monte Carlo simulation, and historical simulation ( Yuliah & Triana, 2021). Value at Risk (VaR) is a measure of risk used to estimate the maximum potential loss that an investor or company can experience on an asset or portfolio investment within a certain period at a certain level of confidence. VaR measures the probability of a loss exceeding a predetermined percentage limit. Stock investments offer the potential for high returns along with a high level of risk ( *high risk high return* ) (Perli Iswanto & Aditya Rian Ramadhan, 2024).

Before calculating the VaR value, first calculate the average ( *mean* ) return using the formula:

$$\mu = \frac{\sum_{t=1}^n R_t}{n}$$

Where n is the number of observations.

**Return Share**

Stock *returns* is the rate of return obtained as a result of the investment made by investors. Mark from *return* Can positive or negative depends condition Actually from investment assets. The *return equation* is [4]:

$$r_t = \ln \frac{P_t}{P_{t-1}}$$

with:

- $r_t$  = return period to - t
- $P_{t-1}$  = price asset on time t - 1
- $P_t$  = price asset on time t

**Normality Test**

Data normality testing is performed to test whether the data is normally distributed or not. Kolmogorov-Smirnov is one method for testing data normality. Hypothesis testing is performed by comparing the cumulative distribution formed from the frequency distribution of sample data with the distribution with the hypothesis [5] :

1. Test Hypothesis
  - $H_0$  : Data *return* share distributed normal
  - $H_1$  : Data *return* share No distributed normal
2. Level Significance
  - $\alpha = 5\%$
3. Statistics Test

$$D = \sup_x |S(x) - F(x)|$$

With:

- $D$  : Mark maximum For all x from mark absolute difference  $S(x)-F(x)$
- $S(x)$  : Cumulative distribution function of observation data
- $F( )$  : Function distribution cumulative from distribution normal

4. Test criteria

$H_0$  rejected If  $D > D_{tabel}$  , Where mark  $D_{tabel}$  is mark critical Which obtained from two-sided Kolmogorov-Smirnov table.

**Volatility**

Volatility is a measurement variation statistics price something asset. Calculation VaR using values volatility For estimate deviation or change price something asset in future determined based on the variance and/or covariance values. A large volatility value indicates the possibility investors experience profit or loss Which big Also. Formula For determine volatility with standard deviation, namely [6]:

$$\sigma = \sqrt{\frac{\sum (r_t - \bar{r}_t)^2}{T - 1}}$$

**Method Variance- Covariance**

The initial assumption used in the variance-covariance method is that the percentage change in asset prices is normally distributed, expressed in standard deviation. To calculate VaR with variance-covariance, the first step is to calculate the value of the asset or portfolio held against market risk. To calculate VaR for a single asset, the formula used is [7]:

$$VaR_{(1-\alpha,t)} = U\sigma z_{(1-\alpha)}\sqrt{t}$$

with:

- $U$  = mark investment initial assets
- $z_{(1-\alpha)}$  = mark  $z$  table on level significance as big as  $\alpha$
- $\sigma$  = standard deviation
- $\sqrt{t}$  = period time

Method variance-covariance shaped in matrix Which inside it contains elements such as variants, covariates And mean . If  $X$  is random variables with mean (mark expectation ( $E(X) = \mu$ )) and matrix covariance. Then mean vector random  $X$  can stated:

$$E(X) = \begin{bmatrix} E(X_1) \\ \vdots \\ E(X_p) \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \vdots \\ \mu_p \end{bmatrix} = \mu$$

Whereas matrix covariance with order  $p \times p$  :

$$\begin{aligned} \Sigma &= E(X - \mu)(X - \mu)^T = E \left[ \begin{bmatrix} X_1 - \mu_1 \\ \vdots \\ X_p - \mu_p \end{bmatrix} \begin{bmatrix} X_1 - \mu_1 & \dots & X_p - \mu_p \end{bmatrix} \right] \\ &= \begin{bmatrix} (X_1 - \mu_1)^2 & (X_1 - \mu_1)(X_2 - \mu_2) & \dots & (X_1 - \mu_1)(X_p - \mu_p) \\ (X_2 - \mu_2)(X_1 - \mu_1) & (X_2 - \mu_2)^2 & \dots & (X_2 - \mu_2)(X_p - \mu_p) \\ \vdots & \vdots & \ddots & \vdots \\ (X_p - \mu_p)(X_1 - \mu_1) & (X_p - \mu_p)(X_2 - \mu_2) & \dots & (X_p - \mu_p)^2 \end{bmatrix} \\ \Sigma &= \begin{bmatrix} E(X_1 - \mu_1)^2 & E(X_1 - \mu_1)(X_2 - \mu_2) & \dots & E(X_1 - \mu_1)(X_p - \mu_p) \\ E(X_2 - \mu_2)(X_1 - \mu_1) & E(X_2 - \mu_2)^2 & \dots & E(X_2 - \mu_2)(X_p - \mu_p) \\ \vdots & \vdots & \ddots & \vdots \\ E(X_p - \mu_p)(X_1 - \mu_1) & E(X_p - \mu_p)(X_2 - \mu_2) & \dots & E(X_p - \mu_p)^2 \end{bmatrix} \end{aligned}$$

Or

$$\Sigma = \begin{bmatrix} \sigma_{11}^2 & \sigma_{12} & \dots & \sigma_{1p} \\ \sigma_{21} & \sigma_{22}^2 & \dots & \sigma_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{p1} & \sigma_{p2} & \dots & \sigma_p^2 \end{bmatrix}$$

with:

- $\sigma_{ij}$  = covariance from  $X_i$  And  $X_j$  ,  $i = 1,2, \dots p$  dan  $j = 1.2 \dots p$
- $\mu$  = mean

**Stock Weight**

In invest naturally own risk, method Which Can done in minimize investment risk is by forming a portfolio. To form a maximum portfolio, one way is to form a weighting of shares [8].

Use of the weighting vector  $w$  The aim is to obtain the minimum VaR in the portfolio, meaning that the expected value of asset returns does not differ much from each other across the portfolios formed. With the mean  $\mu$  and VaR  $\Sigma$ , it can be written as  $X \sim N(\mu, \Sigma)$  then the weighting of the portfolio is [6]:

$$w = \frac{\Sigma^{-1} \mathbf{1}_N}{\mathbf{1}_N^T \Sigma^{-1} \mathbf{1}_N}$$

with:

- $\Sigma^{-1}$  = inverse matrix from variance -covariance
- $\mathbf{1}_N$  = vector column with  $N$  many share

**Value At Risk Portfolio**

From the portfolio return value , variance-covariance calculations can be carried out to find the VaR value . something portfolio. After get mark variance-covariance on portfolio so Can calculate large mark standard deviation return portfolio. In notation matrix, standard value deviation portfolio which consists of  $N$  assets is written:

$$\sigma_p^2 = [w_1 \quad w_2 \quad \dots \quad w_N] \begin{bmatrix} \sigma_{11}^2 & \sigma_{12} & \dots & \sigma_{1N} \\ \sigma_{21} & & & \vdots \\ \vdots & & \ddots & \vdots \\ \sigma_{N1} & \dots & \dots & \sigma_{NN} \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_N \end{bmatrix} = w^T \Sigma w$$

with:

$w$  = matrix weighting agent sized  $1 \times N$

If  $r \sim N(\bar{r}_p, \sigma_p^2)$ , so:

$$z_{0,95} = \frac{r_p - \bar{r}_p}{\sigma_p}$$

Based on distribution normal with mean  $r_p$  And variance  $\sigma^2$ . If  $W = ( < z_{0,95} ) = 1 - \alpha$ , then  $\frac{r_p - \bar{r}_p}{\sigma_p} = z_{0,95}$  the equation becomes:

$$r_p - \bar{r}_p = z_{0,95} \sigma_p U$$

**Value At Risk Verification Test**

The estimated VaR value cannot be taken for granted. A VaR value verification test is necessary to assess its validity. This verification test is useful for both the VaR value and the risk level, and it helps determine whether the VaR value has been measured correctly.

The likelihood ratio value is compared with the chi-square value at a 95% confidence interval. The resulting VaR value is valid if the likelihood ratio value is lower than the critical value. For a 95% confidence interval, the value is acceptable if the LR value is  $< 3.841$ .

**Results And Discussion**

**Data Sources and Types**

The data used is secondary data obtained from various sources, such as gold price data from the Central Statistics Agency (BPS), while the Jakarta Composite Index (JCI) and BBCA share price data were obtained from the website [www.idx.co.id](http://www.idx.co.id). For gold, the JCI and BBCA data were taken from April 2024 to March 2025.

**Table 1 Variables**

Variables
Gold price
IHSG
BBCA Stock Price

Based on the research variable table, the investment instruments analyzed in this research include the price of gold, the Composite Stock Price Index (IHSG), and the share price of PT Bank Central Asia Tbk (BBCA). These three variables were chosen because they represent the characteristics of different investment instruments, making it possible to carry out a comprehensive comparison of risk levels using the Value at Risk (VaR) method.

The price of gold is used as a research variable because gold is known as a relatively stable investment instrument and is often used as a hedging asset (safe haven), especially when financial market conditions are volatile. IHSG is used as a variable that represents the overall performance of the Indonesian stock market. JCI movements reflect macroeconomic conditions, market sentiment and the aggregate performance of issuers listed on the Indonesia Stock Exchange. The BBCA share price was chosen as the research variable because BBCA is one of the banking shares with large market capitalization and high liquidity on the Indonesian Stock Exchange.

**Data used**

The research data used can be seen in table 2.

**Table 2 IHSG, BBCA, and Gold Data 2024 – 2025**

Date	BBCA		IHSG		Gold	
	Open	Close	Open	Close	Open	Close
1/4/2024	10075	9800	7286.11	7234.2	1022110	1115208
1/5/2024	9900	9250	7227.61	6970.74	1110716	1115629
1/6/2024	9350	9925	7030.21	7036.19	1124872	1131888
1/7/2024	9850	10275	7076.63	7255.76	1126309	1146888
1/8/2024	10200	10325	7274.52	7670.73	1148119	1172711
1/9/2024	10357	10326	7686.54	7527.93	1174328	1178869
1/10/2024	10400	10250	7551.46	7574.02	1196589	1259736
1/11/2024	10275	10000	7573.79	7114.27	1262118	1261007
1/12/2024	10000	9675	7117.75	7079.9	1257973	1289310
1/1/2025	9650	9450	7092.43	7109.2	1269951	1304793
1/2/2025	9400	8425	7087.75	6270.6	1333681	1399822

1/3/2025	8600	8500	6362.15	6510.62	1397916	1458176
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Based on the data table of opening (open) and closing (close) prices for investments in gold, IHSG, and BBCA shares during the period January 2024 to January 2025, it can be seen that there are differences in price movement patterns and volatility in each instrument. This data is then used to calculate daily returns which are the basis for measuring risk using the Value at Risk (VaR) method with a variance–covariance approach.

**Data Analysis**

**a. Calculating stock returns**

To calculate stock returns, closing stock price data is used. The return value is obtained using the following equation. The calculation of return on gold prices is as follows:

$$R_t = \left( \frac{P_t - P_{t-1}}{P_{t-1}} \right) = \left( \frac{1115629 - 1115208}{1115208} \right) = 0,0004$$

All Return results are shown in table 3.

**Table 3** Return value of Gold, IHSG and BBCA

date	BBCA	IHSG	GOLD
1/4/2024	NA	NA	NA
1/5/2024	-0.05776	-0.0371	0.0004
1/6/2024	0.070433	0.009345	0.0145
1/7/2024	0.034657	0.030729	0.0132
1/8/2024	0.004854	0.055616	0.0223
1/9/2024	9.68E-05	-0.01879	0.0052
1/10/2024	-0.00739	0.006104	0.0663
1/11/2024	-0.02469	-0.06262	0.001
1/12/2024	-0.03304	-0.00484	0.0222
1/1/2025	-0.02353	0.00413	0.0119
1/2/2025	-0.11481	-0.12552	0.0703
1/3/2025	0.008863	-0.0371	0.0408

Based on Table 3 which presents the daily return values for gold, IHSG and BBCA shares during the period January 2024 to January 2025, it can be seen that there are differences in the return characteristics of each investment instrument. This return data is obtained from changes in closing prices between periods and is used as a basis for measuring investment risk using the Value at Risk (VaR) method with a variance–covariance approach.

In BBCA shares, the return value shows quite high fluctuations. The largest negative return occurred on January 5 2024 amounting to -0.05776, while the highest positive return occurred on January 6 2024 amounting to 0.070433. This relatively extreme return fluctuation reflects the high volatility in BBCA shares. These conditions indicate that the investment risk in BBCA shares is quite large, so the resulting VaR value is also estimated to be higher than other instruments.

JCI returns show a more stable pattern than BBCA shares, although they still experience fluctuations. The largest negative return on the JCI occurred on January 2 2025, amounting to -0.12552, which reflects quite strong market pressure in that period. Meanwhile, the highest positive return on the JCI was recorded on January 8 2024, amounting to 0.055616. As a market index, JCI return movements reflect overall stock market conditions, so the level of volatility is in the medium category.

In contrast to BBCA and IHSG shares, gold returns tend to be more stable and mostly positive. The negative return on gold is relatively small compared to other instruments, while the highest positive return was recorded on January 2 2025 at 0.0703. The stability of gold returns shows lower volatility, so that the risk of gold investment as measured by the VaR method is at the lowest level. This strengthens the role of gold as a relatively safe hedging asset in the face of financial market uncertainty.

**b. Calculating the average return**

The average is calculated using the equation below, which is the sum of all return values divided by the number of observations. The average calculation for gold prices is as follows:

$$\mu = \frac{\sum_{t=1}^n R_t}{n} = \frac{0,0004 + 0,0145 + \dots + 0,0408}{11} = 0,0244$$

The average return results are shown in table 4.

**Table 4 Mean and Standard Deviation**

ASSET	$\mu$	$\sigma$
GOLD	0.0244	0.02387
IHSG	-0.0096	0.051
BBCA	-0.0091	0.0365

**c. Count risk share**

To calculate the risk of an asset, calculate the standard deviation. Standard deviation is calculated using an equation. The following is the calculation of standard deviation for gold prices:

$$\begin{aligned} \sigma^2 &= \sqrt{\frac{\sum (R_t - \mu)^2}{n-1}} = \sqrt{\left( \frac{(0,0004 - 0,0244)^2 + \dots + (0,0408 - 0,0244)^2}{10} \right)} \\ &= \sqrt{0,000570003} \\ &= 0,02387 \end{aligned}$$

The average results and standard deviation are shown in Table 4.

**Table 5 Mean and Standard Deviation**

ASSET	$\mu$	$\sigma$
EMAS	0,0244	0,02387
IHSG	-0,0096	0,051
BBCA	-0,0091	0.0365

**Simulation Return**

The next step is to simulate the returns for each stock. This return simulation estimates future return values using a randomized approach.

$$R_i = \mu + (\sigma \times Z_i)$$

To solve the equation above, first find the value of  $Z_i$ . The calculation of the value  $Z_i$  of gold is as follows:

$$Z_i = \frac{R_i - \mu}{\sigma} = \frac{0,0004 - 0,0244}{0,02387} = -1,0054$$

After obtaining the  $Z_i$  next value, find the Return simulation value using equation (2.4). The calculation is as follows:

$$\begin{aligned} R_i &= \mu + (\sigma \times Z_i) \\ &= 0,0244 + (0,02387 \times (-1,0054)) \\ &= 0,0004 \end{aligned}$$

**Price Simulation Equation**

At this stage, price simulation calculations are performed using exponentials to assess the potential for future price increases. To calculate the price simulation equation, an equation is used. An example is as follows:

$$\begin{aligned} S_i &= S_o \times e^{R_i} \\ &= 100.000 \times e^{0,0004} \\ &= 100.000 \times 1,00040008 \\ &= 100.040,008 \end{aligned}$$

**Loss simulation (profit/loss)**

This loss simulation is used to calculate the potential profit or loss in a future period. To calculate the loss simulation, an equation is used. The calculation is as follows:

$$\begin{aligned} \Delta S_i &= S_i - S_o \\ &= 100.040,008 - 100.000 \\ &= 40,008 \end{aligned}$$

**VaR calculation**

The VaR calculation is used to measure the potential loss potential within a given confidence level. The following equation is used to calculate VaR. To obtain the value  $Z_\alpha$ , use the following equation:

$$Z_\alpha = \frac{1+cl}{2} = \frac{1+0,95}{2} = 0,975$$

After getting the value  $Z_\alpha$  based on the confidence level, the next step is to look for the value in the standard normal distribution table to find out the cumulative probability up to point Z.

The next step is to find the VaR value using the variance-covariance simulation approach. As follows:

**Table 5.** Var results with the Variance-covariance approach

Trust Level	BBCA	IHSG	GOLD
90%	(6,179.40)	(6,283.26)	(3,142.42)
95%	(7,931.17)	(8,064.47)	(4,033.25)
99%	(11,217.20)	(11,405.74)	(5,704.31)

Based on the results of the VaR value calculation at the 90%, 95%, and 99% confidence levels for gold assets, the Composite Stock Price Index (IHSG) and BBCA shares have several risks with different confidence levels as shown in the table above.

**Conclusion**

This study analyzes investment risk in gold, the Indonesia Composite Index (IHSG), and BBCA stock using the Value at Risk (VaR) method with a variance-covariance approach based on monthly data (1-month horizon). The empirical results show that at the 95% confidence level, the VaR values are 4,033.25 for gold, 8,064.47 for IHSG, and 7,931.17 for BBCA stock. At the 99% confidence level, the VaR increases to 5,704.31 (gold), 11,405.74 (IHSG), and 11,217.20 (BBCA). These findings indicate that IHSG and BBCA stock have significantly higher potential maximum losses compared to gold, reflecting their higher volatility. Therefore, gold demonstrates a more defensive risk profile, while IHSG and BBCA represent higher-risk investment instruments. However, this study has several limitations. First, the variance-covariance VaR method relies on the assumption of normally distributed returns, which may not fully capture extreme market movements (fat tails). Second, the dataset consists of only 12 monthly observations, which is relatively small and may reduce the robustness and reliability of statistical estimation, including volatility and VaR values. Given these limitations, future research is recommended to apply alternative risk measurement approaches that are more robust to non-normal distributions and limited data. Methods such as Generalized Autoregressive Conditional Heteroskedasticity (GARCH) can better capture time-varying volatility, while Historical VaR does not rely on distributional assumptions and may provide more realistic risk estimates under actual market conditions. In conclusion, while the variance-covariance VaR method provides a straightforward and interpretable measure of investment risk, its results should be interpreted with caution, particularly in the presence of limited data and potential deviations from normality.

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