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USE OF GLUE VALUE AT RISK FOR OPTIMAL PORTFOLIO RISK MEASUREMENT WITH THE SINGLE INDEX MODEL METHOD

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ABSTRACT

Creating an optimal portfolio and measuring risk are ways that can be used to reduce losses and maximize returns in an investment. In this study, the optimal portfolio is formed using the Single Index Model method, which assumes stock returns are influenced only by market returns. The stocks used are stocks that are consistently included in the IDX30 index during the period October 24, 2022-October 25, 2024 and provide positive expected returns, so that based on the Single Index Model method, 5 stocks are included in the optimal portfolio with the proportion of each stock as follows, PT Indofood Sukses Makmur Tbk (INDF) 30%, PT Barito Pacific Tbk (BRPT) 8%, PT Bank Mandiri Tbk (BMRI) 35%, PT Bank Central Asia Tbk (BBCA)17%, and PT Bank Negara Indonesia Tbk (BBNI) 10%. The risk of the optimal portfolio can be calculated using the Glue Value at Risk method, which provides a more accurate and coherent measure of risk. In this study with a confidence level of $1-\alpha_1 = 95\%$ and $1-\alpha_2 = 98\%$ and used a high distortion function $h_1 = 0.3 \leq \frac{\alpha_2}{\alpha_1}$ and $h_2 = 0.4 \geq h_1$, the Glue Value at Risk amount for the optimal portfolio was obtained at Rp1,996,926. The backtesting results show that Glue Value at Risk provides valid and accurate results for measuring risk at this level of confidence.

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1. INTRODUCTION

The Indonesia Stock Exchange (BEI) noted that throughout 2024, there has been an increase of more than 863 thousand new single investor identification (SID), and the number of Indonesian stock investors has touched 5.7 million SID [1]. Stocks are one kind of investment that many people are interested in because they can provide benefits, one of which is capital gains [2]. Stock is a sign of capital participation or ownership by a person or entity in a company [3]. One type of stock index on the BEI is the IDX30, which measures the price performance of 30 stocks that have high liquidity and large market capitalization and are supported by good company fundamentals [4].

In investing, an investor certainly expects a return on the capital invested, but investors must realize that in investment, there must be risks that will occur [5]. Risk is the possibility of loss caused by deviations from expected returns [6]. According [7], one of the factors causing investment losses is that investors often pay more attention to returns but less attention to the level of risk that will be faced if they choose to invest in certain stocks. Therefore, investors have to minimize investment risk; one way is to quantify risk, so that risk can be measured. By measuring the risk, investors can determine the estimated loss and the amount of capital that must be prepared for investment.

Although it has become a widely used risk measure, Value at Risk (VaR) still has limitations, namely, not paying attention to any losses that exceed the VaR level [8], and VaR does not always fulfill the subadditivity property. Subadditivity is one of the axioms that must be met to say that a risk measure is coherent. A coherent risk measure indicates that the risk measure is good and effective to use [9]. This limitation can be overcome using another risk measure called Tail Value at Risk (TVaR), but in practice, TVaR has not been widely accepted in the financial and insurance industry because TVaR has a higher capital requirement than VaR [10]. In 2013, a new risk measure called Glue Value at Risk (GlueVaR) which is a form of linear combination between VaR and TVaR. The purpose of GlueVaR is to produce a more accurate risk assessment. GlueVaR has four parameters that make risk measurement more flexible. Parameters $1-\alpha_1, 1-\alpha_2$ are used as confidence levels to describe bad scenarios and very bad scenarios, thus producing a combination of scenarios that reflect specific risk attitudes, and then, as a risk measure, GlueVaR also fulfills all the properties of a coherent risk measure [11].

The use of GlueVaR in measuring risk will be applied to the optimal portfolio that will be formed using the Single Index Model (SIM) method, which assumes that the returns between two or more stocks will be correlated or move together and have the same reaction to a single factor or index included in the model [12]. Thus, the main objective of this paper is to use GluVaR in measuring the risk in the optimal portfolio to be formed using the Single Index Model (SIM) on stock data that is consistently incorporated in the IDX30 index in the period October 24, 2022, to October 25, 2024.

2. RESEARCH METHODS

2.1 Data Type and Source

The type of data used in this study is in the form of closing price data from the IDX30 stock index in the period October 24, 2022, to October 25, 2024, and is influenced by the Composite Stock Price Index (IHSG) in the period October 24, 2022, to October 25, 2024, and the Bank Indonesia interest rate in the same daily period. Stock closing price data is obtained from http://finance.yahoo.com.

2.2 Actual Return and Expected Return

Return is the result of the investor's courage to take risks on the chosen investment [13]. In general, the higher the risk of an investment, the higher the return that will be received. In other words, the more volatile the returns, the higher the risk of an investment. If two investments have the same return, investment decisions are based on the lower risk [14]. Return can be measured as the sum of the change in the market price of a security plus any income received during the period, divided by the price of the security at the beginning of the holding period [15]. Actual return can be expressed in Eq. (1) [16]:

$$R_{it} = \frac{P_{it} - P_{it-1}}{P_{it-1}}. \tag{1}$$

Meanwhile, the expected return can be calculated using Eq. (2).

$$E(R_i) = \frac{1}{n}\sum_{t=i}^{n}(R_{it}), \tag{2}$$

with:

R_{it} : actual return of stock-i in period t;
$E(R_i)$: expected return of stock-i;
P_{it} : closing price of stock-i in period t;
P_{it-1} : closing price of stock-i in period $t-1$;
n : the number of historical data observations.

2.3 Single Index Model

Previously, there was a Markowitz portfolio model with complex variance and covariance calculations that were considered quite complicated to calculate portfolio risk. Therefore, this model was further developed by William Sharpe by creating a Single Index Model (SIM) [17], where the purpose of SIM is to simplify the Markowitz model, which is considered quite complex, with the basic idea that stock returns should only be influenced by a market index return [12].

2.3.1 Actual Return and Expected Return of Shares on SIM

Actual return on the SIM Method is expressed in Eq. (3) [12].

$$R_i = \alpha_i + \beta_i R_M + e_i. \tag{3}$$

Based on Eq. (3), the expected return form for SIM is expressed in Eq. (4) below [12].

$$E(R_i) = \alpha_i + \beta_i \ E(R_M), \tag{4}$$

with:

R_i : return stock-i;
R_M : actual return of IHSG;
α_i : expected value of stock return independent of IHSG return;
β_i : a coefficient that regulates the change in R_i as a result of changes in R_M;
e_i : residual error, which is a random variable with value $E(e_i) = 0$.

2.3.2 Assumptions on SIM

There are 2 assumptions for the SIM method, according to [12]:

1. The residual error of the stock-i (e_i) is uncorrelated with the residual error of the stock-j (e_j) for all values of i and j.

$$E(e_i, e_j) = 0. \tag{5}$$

2. e_i is uncorrelated with the return IHSG (R_M).

$$E(e_i.[R_M - E(R_M)]) = 0. \tag{6}$$

2.3.3 Optimal Portfolio Based on SIM

To determine the optimal portfolio, a cut-off point is required, which is used to determine the limit of ERB values that can be included in the portfolio. The value of the cut-off point can be determined in the following way [12]:

1. Sort the stocks based on the largest ERB value to the smallest ERB value.

$$ERB_i = \frac{E(R_i) - R_{BR}}{\beta_i}, \tag{7}$$

where:

$$\beta_i = \frac{\sum_{t=i}^{n}(R_{it} - E(R_i)\,(R_{Mt} - E(R_M))}{n\,\sigma_M^2}, \tag{8}$$

with:

ERB_i : excess return to beta stock-i;
$E(R_i)$: expected return from stock-i;
R_{BR} : risk-free stock return;
β_i : beta stock-i;
σ_M^2 : variance of return IHSG.

2. Calculate the value of A_i and B_i values of each stock$-i$, with

$$A_i = \frac{[E(R_i) - R_{BR}]\,\beta_i}{\sigma_{ei}^2}, \tag{9}$$

$$B_i = \frac{\beta_i^2}{\sigma_{ei}^2}, \tag{10}$$

with:

σ_{ei}^2 : variance of residual error stock-i.

3. Calculate the C_i value

$$C_i = \frac{\sigma_M^2\,\sum_{j=1}^{i} A_j}{1 + \sigma_M^2\,\sum_{j=1}^{i} B_j}. \tag{11}$$

4. Find the cut-off point value where the cut-off point (C*) is the C_i where ERB value last time is still greater than the C_i.
5. Determine the weight (w_i) for each stock included in the optimal portfolio.

$$w_i = \frac{Z_i}{\sum_{j=1}^{k} Z_j}, \tag{12}$$

with the value of Z_i obtained from:

$$Z_i = \frac{\beta_i}{\sigma_{ei}^2}(ERB_i - C^*). \tag{13}$$

2.4 Percentile

The percentile VaR method attempts to explain the expected investment loss that an investor might incur at a level of α [18].

$$P_\alpha = \alpha \times n, \tag{14}$$

with:

α : Significance level;
n : the number of historical data observations.

2.5 Value at Risk (VaR)

VaR portfolios can provide a summary of the maximum expected loss (or worst loss) over a certain period of time within a certain confidence interval [19].

2.5.1 Historical Simulation Method

One of the most widely used nonparametric methods to calculate VaR is the historical simulation method [14]. The historical simulation method overrides the assumption of normally distributed returns as well as the linear nature between the return portfolio and single asset returns [18].

$$VaR_{1-\alpha} = -V_0\,P_\alpha\,\sqrt{t}, \tag{15}$$

with:

V_0 : amount of initial fund value;
P_α : αth percentile;
$\sqrt{t}$: set time period.

2.6 Tail Value at Risk (TVaR)

The TVaR value is always greater than VaR, so TVaR is more appropriate for measuring the value of loss reserves [20]. TVaR is defined as the amount of loss that will be borne if there is a loss that exceeds VaR [21].

$$TVaR_{1-\alpha}(X) = E[X|X > VaR_{1-\alpha}(X)]. \tag{16}$$

2.7 Glue Value at Risk (GlueVaR)

Belles-Sampera introduced a new risk measure called Glue Value at Risk (GlueVaR). GlueVaR is a response to the limitations of other risk measures, such as VaR and TVaR. GlueVaR was developed as a risk measure that sits between VaR and TVaR, to provide a more accurate assessment of risk, and is a risk measure that fulfills all coherent properties. GlueVaR has four parameters, h_1 and h_2 as the height of the distortion function and $1-\alpha_1, 1-\alpha_2$ as a confidence level. These four parameters make the GlueVaR risk measure more flexible, with $1-\alpha_1, 1-\alpha_2$ values used to describe bad and very bad scenarios [11].

Distortion function for GlueVaR at confidence level $1-\alpha_1$ and $1-\alpha_2$

$$\kappa_{1-\alpha_2,1-\alpha_1}^{h_1,h_2} = \begin{cases} \dfrac{h_1}{\alpha_2} S_X(x); & \text{if } 0 \leq \mathrm{S_X}(x) < \alpha_2, \\ h_1 + \dfrac{h_2-h_1}{\alpha_1-\alpha_2}[S_X(x) - (\alpha_2)]; & \text{if } \alpha_2 \leq \mathrm{S_X}(x) < \alpha_1, \\ 1; & \text{if } \alpha_1 \leq \mathrm{S_X}(x) < 1. \end{cases} \tag{17}$$

For each $\mathrm{S_X}(x) \in [0,1]$, where $1-\alpha_1, 1-\alpha_2 \in [0,1]$ with $1-\alpha_1 < 1-\alpha_2, h_1 \in [0,1]$ and $h_2 \in [h_1, 1]$.

GlueVaR calculation can be done by showing the linear combination between VaR and TvaR [11].

$$GlueVaR_{1-\alpha_2,1-\alpha_1}^{h_1,h_2}(X) = \omega_1 TVaR_{(1-\alpha_2)}(X) + \omega_2 TVaR_{(1-\alpha_1)}(X) + \omega_3 VaR_{(1-\alpha_1)}(X). \tag{18}$$

It can be concluded that GlueVaR is a linear combination of $TVaR_{(1-\alpha_2)}(X)$, $TVaR_{(1-\alpha_1)}(X)$, and $VaR_{(1-\alpha_1)}(X)$ with [11],

$$\omega_1 = h_1 - \frac{h_2-h_1}{\alpha_1-\alpha_2}(\alpha_2), \tag{19}$$

$$\omega_2 = \frac{h_2-h_1}{\alpha_1-\alpha_2}(\alpha_1), \tag{20}$$

$$\omega_3 = 1 - \omega_1 - \omega_2. \tag{21}$$

The four parameters in GlueVaR can be expressed as an interpretation of decision-making behavior in risk management, if the desired value of $GlueVaR_{(1-\alpha_2),(1-\alpha_1)}^{h_1,h_2}(X)$ whose value is equal to $VaR_{(1-\alpha_1)}(X)$ can be taken $h_1 = 0$ and $h_2 = 0$. If the desired value of $GlueVaR_{(1-\alpha_2),(1-\alpha_1)}^{h_1,h_2}(X)$ whose value is equal to $TVaR_{(1-\alpha_1)}(X)$ can be taken $h_1 = \frac{\alpha_2}{\alpha_1}$ and $h_2 = 1$, and if the desired value of $GlueVaR_{(1-\alpha_2),(1-\alpha_1)}^{h_1,h_2}(X)$ is equal to $TVaR_{(1-\alpha_2)}(X)$ can be taken $h_1 = 1$ and $h_2 = 1$. So it can be concluded that for $h_1 \leq \frac{\alpha_2}{\alpha_1}$ and $h_2 \geq h_1$ then $VaR_{(1-\alpha_1)}(X) \leq GlueVaR_{(1-\alpha_2),(1-\alpha_1)}^{h_1,h_2}(X) \leq TVaR_{(1-\alpha_1)}(X)$, if $h_1 \geq \frac{\alpha_2}{\alpha_1}$ and $h_2 = 1$ then $TVaR_{(1-\alpha_1)}(X) \leq GlueVaR_{(1-\alpha_2),(1-\alpha_1)}^{h_1,h_2}(X) \leq TVaR_{(1-\alpha_2)}(X)$ **[11]**.

2.8 Backtesting

Backtesting is a statistical procedure that ensures that actual losses match predicted losses. The POF (proportion of failure) test examines whether the number of exceptions corresponds to a certain confidence level [22]. The hypothesis for POF is expressed as:

$$H_0: \alpha = \hat{p} = \frac{T}{N}$$
$$H_1: \alpha \neq \hat{p} \tag{22}$$

with:

α : significance level;
$\hat{p}$: estimated failure rate;
T : number of exceptions;
N : number of observations.

$$LR_{POF} = -2\ln\left[(1-\alpha)^{N-T}\,\alpha^{T}\right] + 2\ln\left[\left(1-\frac{T}{N}\right)^{N-T}\left(\frac{T}{N}\right)^{T}\right]. \tag{23}$$

The LR_{POF} value is then compared with the chi-square (χ^2) at the 95% confidence level with a degree of freedom of 1, if $LR < 3.841$ it means accept H_0, or, in other words, the GlueVaR calculation is accepted (accurate) [19].

2.9 Data Analysis Technique

The stages of analysis used in achieving the research objectives are as follows:

1. Take daily closing price data on stocks that are consistently included in the IDX30 stock index and the JCI daily closing price for the period October 24, 2022, to October 25, 2024.
2. Calculate the return using the formula in Eq. (1) and the expected return using the formula in Eq. (2) from the closing price of each consistent stock in the IDX30 index and IHSG.
3. Estimate the parameters β_i using the formula Eq. (8) and α_i based on Eq. (4)
4. Form an optimal portfolio with the SIM method.
5. Estimate the VaR value at a confidence level of $1-\alpha_1$ using the formula in Eq. (15).
6. Estimate the TVaR value at the $1-\alpha_1$ and $1-\alpha_2$ confidence levels using the formula in Eq. (16).
7. Estimate the GlueVaR value at distortion height h_1, h_2 with $h_1 \in [0,1]$ and $h_2 \in [h_1, 1]$.
8. Calculate the GlueVaR value using the formula in Eq. (18).
9. Test the accuracy of the risk measure results obtained by the backtesting method.

3. RESULTS AND DISCUSSION

3.1 Description of Data

In this study, the data used is historical daily closing price data from stocks that are consistently part of the IDX30 in the period October 24, 2022, to October 25, 2024, and stocks that provide positive expected returns. Through these criteria, 8 stocks were selected whose data will be used in this study, which are listed in Table 1.

Table 1. Stocks that Fit the Research Criteria

No.	Stock Code	Name of the Company
1.	ADRO	PT Alamtri Resources Indonesia Tbk
2.	BBCA	PT Bank Central Asia Tbk
3.	BBNI	PT Bank Negara Indonesia (Persero) Tbk
4.	BBRI	PT Bank Rakyat Indonesia (Persero) Tbk
5.	BMRI	PT Bank Mandiri (Persero) Tbk
6.	BRPT	PT Barito Pacific Tbk
7.	CPIN	PT Charoen Pokphand Indonesia Tbk
8.	INDF	PT Indofood Sukses Makmur Tbk

The amount of data from each stock is 483 daily closing price data during the period October 24, 2022, to October 25, 2024.

3.2 Descriptive Analysis of Stock Return

The following Table 1 summarizes the return data of the 8 stocks shown in Table 2.

Table 2. Stock Return Data Summary

No.	Stock	Minimum	Maximum	Mean	Variance	Sharpe Ratio
1.	ADRO	-0.07752	0.09375	0.00010	0.00048	-0.09656
2.	BBCA	-0.03788	0.04323	0.00047	0.00015	0.02614
3.	BBNI	-0.08000	0.05600	0.00051	0.00024	0.02375
4.	BBRI	-0.06214	0.04717	0.00024	0.00025	0.00634
5.	BMRI	-0.08333	0.05469	0.00080	0.00028	0.03946
6.	BRPT	-0.18182	0.24762	0.00121	0.00150	0.02750
7.	CPIN	-0.07328	0.08149	0.00004	0.00035	-0.00573
8.	INDF	-0.05385	0.04105	0.00044	0.00015	0.02397

Based on Table 2, it can be seen It can be seen that the stock with the highest minimum return is BCA at -0.03788, while the stock with the lowest minimum return is BRPT at -0.18182. The stock with the lowest maximum return is INDF at 0.04105, and the stock with the highest maximum return is BRPT at 0.24762. The mean also shows the expected return for each stock, while the variance shows the risk for each stock. Based on the table, it can be seen that BRTP stock has the highest mean at 0.00121, but upon closer inspection, it also has the highest variance at 0.00150. Then, in the Sharpe ratio column, it is used to show the risk-adjusted performance assessment of the stock. The stock that provides the largest Sharpe ratio is BMRI at 0.03946, so this stock is good to use, but in this study, the stock will be further eliminated in the portfolio formation process that will be carried out with SIM.

3.3 Optimal Portfolio Using the SIM Method

3.3.1 Determine the Stocks Included in the Optimal Portfolio

First, the ERB value is calculated in order to facilitate the determination of stocks that can be included in the optimal portfolio. ERB values are then sorted from largest to smallest. Stocks that will be included in the portfolio are determined by comparing the ERB_i with C_i. Stocks whose ERB_i value is greater than or equal to the C^* value are candidates for the optimal portfolio. The C^* value is obtained from the comparison results, where the last ERB_i value is still greater than C_i.

Table 3. Comparison of ERB Value with C_i

No.	Stock	ERB_i	C_i	*Cut-off point*
1	INDF	0.00090	0.00003	
2	BRPT	0.00048	0.00010	
3	BMRI	0.00046	0.00021	
4	BBCA	0.00034	0.00024	
5	BBNI	0.00033	0.00025	C^*
6	BBRI	0.00007	0.00022	
7	ADRO	-0.00005	0.00021	
8	CPIN	-0.00015	0.00020	

Based on Table 3, the cut-off point value is 0.00025, which is because the BBRI stock C_i value is greater than the ERB value; therefore, the last stock where C_i is still greater than ERB is BBNI stock. It is concluded that the stocks included in the optimal portfolio with the SIM method are INDF, BRPT, BMRI, BBCA, and BBNI stocks.

3.3.2 Determine the Weight for Each Stock

Table 4 interprets that the largest weight is given to BMRI shares, which is 0.34778 or 35%, which means that in the optimal portfolio, investors provide 35% of investment funds to be invested in BMRI stocks.

Table 4. Comparison of ERB Value with C_i

No.	Stock	Z_i	Weight (w_i)
1.	INDF	1.48064	0.30336
2.	BRPT	0.40394	0.08276
3.	BMRI	1.69748	0.34778
4.	BBCA	0.81141	0.16624
5.	BBNI	0.48737	0.09985

3.3.3 Calculate the Return Portfolio

Based on the weights for each stock in Table 4, a return portfolio is formed, which will be used for the calculation of risk measures. Table 5 is the result of the return portfolio calculation.

Table 5. Return Portfolio

Period	Return Portfolio (R_P)
25/10/2022	-0.00757
26/10/2022	-0.00073
27/10/2022	0.00718
⋮	⋮
23/10/2024	0.00548
24/10/2024	-0.00560
25/10/2024	0.00314

*(*note: for complete data on the return portfolio, it can be accessed through the following link https://bit.ly/40LTYYf)*

3.4 Calculate the Estimated GlueVaR Value

In this study, a confidence level of $1-\alpha_1 = 95\%$ will be used to represent a bad scenario and $1-\alpha_2 = 98\%$ to represent a very bad scenario.

3.4.1 Estimate VaR Value

VaR at a confidence level of $1-\alpha_1 = 95\%$ in the daily period is calculated using the historical simulation method. The results of the VaR calculation are shown in Table 6.

Table 6. VaR Value Estimation Results

	Percentile $_{0.05}$	$VaR_{0.95}$
Portfolio	-0.01538	Rp. 1,537,950

Based on Table 6, it shows that when investors invest in the portfolio, there is 95% confidence that with an initial capital of Rp. 100,000,000, the loss that will be experienced will not exceed Rp. 1,541,520 within a period of one day after October 25, 2024, or in other words, there is a 5% possibility that the loss that will occur is Rp. 1,537,950 or more.

3.4.2 Estimate TVaR Value

Table 7 shows the calculation results for TVaR values at the $1-\alpha_1 = 95\%$ and $1-\alpha_2 = 98\%$.

Table 7. TVaR Value Estimation Results

	$TVaR_{0.95}$	$TVaR_{0.98}$
Portfolio	Rp. 2,325,319	Rp. 2,942,583

Based on Table 7, the loss that investors will bear at a 95% confidence level if the loss exceeds the TVaR value is Rp. 2,325,319, and it can be seen that TVaR at a smaller significance level has a higher TVaR value, or the greater the level of confidence used by investors, the greater the TVaR value.

3.4.3 Estimate GlueVaR Value

Based on the paper by Belles-Sampera, if it is desired to have the value of $GlueVaR^{h_1,h_2}_{(1-\alpha_2),(1-\alpha_1)}(X)$ that lies between $VaR_{(1-\alpha_1)}(X) \leq GlueVaR^{h_1,h_2}_{(1-\alpha_2),(1-\alpha_1)}(X) \leq TVaR_{(1-\alpha_1)}(X)$, then a high distortion function h can be selected with $h_1 \leq \frac{\alpha_2}{\alpha_1}$ and $h_2 \geq h_1$, Therefore, $h_1 = 0.3 \leq \frac{0.02}{0.005} = 0.4$ and $h_2 = 0.4 \geq h_1$ will be used. The calculation of the GlueVaR value based on these parameters results in Rp. 1,996,926.

Next, it will be examined further how the effect of taking a high distortion value h affects the resulting GlueVaR risk measure, whether it approaches VaR or TVaR. At the confidence level $1 - \alpha_1 = 95\%$ and $1 - \alpha_2 = 98\%$, the parameter selection scenarios for h are listed in Table 8 below.

Table 8. Scenario for Parameter h

	s_1	s_2	s_3
h_1	0.3	0.4	0.4
h_2	0.4	0.4	0.5

Used the h_1 and h_2 parameter selection scenarios as specified in Table 8, the $GlueVaR^{h_1,h_2}_{1-\alpha_2,1-\alpha_1}$ risk measure for each scenario is obtained as in Table 9 below.

Table 9. GlueVaR Value Estimation Results

Scenario	s_1	s_2	s_3
GlueVaR	Rp. 1,996,926	Rp. 2,099,803	Rp. 2,137,389

Based on Table 9, it can be explained that at the confidence level $1 - \alpha_1 = 95\%$ and $1 - \alpha_2 = 98\%$ and the selection of parameter h with value $h_1 \leq \frac{\alpha_2}{\alpha_1}$ and $h_2 \geq h_1$, When compared with the $VaR_{0.95}$ and $TVaR_{0.95}$ values that have been generated, it can be seen that when the h_2 value remains constant, and the h_1 value decreases, the glue value generated will approach the $VaR_{0.95}$ value, whereas when the h_1 value remains constant and h_2 is greater, the glue value generated will approach the $TVaR_{0.95}$ value. Therefore, the results show that the magnitude of parameters h_1 and h_2 will affect the value of the $GlueVaR^{h_1,h_2}_{1-\alpha_2,1-\alpha_1}$ risk measure obtained.

3.5 Backtesting

The results of the GlueVaR risk measure accuracy test at a confidence level of $1 - \alpha_1 = 95\%$ and $1 - \alpha_2 = 98\%$ and the selection of the h value between $h_1 = 0.3 \leq \frac{\alpha_2}{\alpha_1}$ and $h_2 = 0.4 \geq h_1$, are described in Table 10 as follows.

Table 10. GlueVaR Backtesting Calculation Results

	LR_{POF} 95%	LR_{POF} 98%	Chi-Square ($\chi^2_{1,(0.05)}$)
Backtesting	3.235	3.579	3.841

Based on Table 10, it is found that the test result is $LR_{POF} < \chi^2_{1,(0,05)}$, so it can be concluded that the risk value generated by the GlueVaR method in scenario 4, with a confidence level of $1 - \alpha_1 = 95\%$ and $1 - \alpha_2 = 98\%$ and the selection of h values $h_1 = 0.3 \leq \frac{\alpha_2}{\alpha_1}$ and $h_2 = 0.4 \geq h_1$ is accurate.

4. CONCLUSIONS

From the 8 stocks that qualify for the research criteria, which provide positive expected returns and are consistently part of the IDX30 index during the period October 24, 2022-25 October 2024, after being analyzed, the following conclusions can be drawn: Using the SIM method, an optimal portfolio is formed consisting of 5 stocks, namely, PT Indofood Sukses Makmur Tbk (INDF) with an investment weight of 30%, PT Barito Pacific Tbk (BRPT) with an investment weight of 8%, PT Bank Mandiri Tbk (BMRI) with an investment weight of 35%, PT Bank Central Asia Tbk (BBCA) with an investment weight of 17%, PT Bank Negara Indonesia Tbk (BBNI) with an investment weight of 10%.

At a confidence level of $1-\alpha_1 = 95\%$ and $1-\alpha_2 = 98\%$ and the selection of the value of h between $h_1 = 0.3 \leq \frac{\alpha_2}{\alpha_1}$ and $h_2 = 0.4 \geq h_1$, produces a GlueVaR risk measure value that is between the value of $\text{VaR}_{0.95}$ and $\text{TVaR}_{0.95}$ which is Rp. 1,996,926. The choice of distortion height affects the risk measure result; a small distortion function value makes the risk measure closer to $\text{VaR}_{0,95}$ while the larger the distortion function chosen, the risk measure is closer to $\text{TvaR}_{0.95}$. And the backtesting test results of $GlueVaR^{(0.3),(0.4)}_{(0.98),(0.95)}$ which is between $\text{VaR}_{0.95}$ and $\text{TVaR}_{0.95}$ is accurate.

Author Contributions

Turnika Afdatul Rafni: Conceptualization, Methodology, Data Curation, Writing-Original Draft, Software, Validation. Dina Agustina: Validation, Writing-Review and Editing. All authors discussed the results and contributed to the final manuscript.

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Declarations

The authors declare no competing interests.

Declaration of Generative AI and AI-assisted Technologies

Generative AI tools (e.g., ChatGPT) were used solely for language refinement, including grammar, spelling, and clarity. The scientific content, analysis, interpretation, and conclusions were developed entirely by the authors. All final text was reviewed and approved by the authors.

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