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Prediction Of Loss Risk Investment on The Idx Indonesia: Quantitative Approach with Var and Adj-Es

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Abstract

Loss is the primary risk associated with any investment. In stock investments, the risk of loss can occur at any time and its magnitude cannot be precisely determined. Improper risk management can negatively impact the investment activities carried out by investors. This study aims to predict the risk of loss using the quantitative Value-at-Risk (VaR) model, particularly for stocks listed on IDX Indonesia. VaR has the main advantage of being a simple model that can be applied to various types of financial assets. However, VaR also has a drawback it does not satisfy the subadditivity principle. Therefore, this study also employs the Adjusted-Expected-Shortfall (Adj-ES) model as an improvement to VaR. The VaR and Adj-ES models will be implemented on the stocks AMRT.JK and BBCA.JK. These two stocks are part of the IDX Indonesia 2024 blue chip stocks, with a significant increase in market capitalization. The results show that VaR provides prediction results for the risk of loss in the range of 1.2% - 3.4 for AMRT.JK data, and 1.1 - 3.2% for BBCA.JK data. Referring to the Violation Ratio value, it is known that both VaR and Adj-ES have VR values <1 so it is concluded that the prediction accuracy is very good. The research results can be a reference for investors to properly assess and manage the risk of loss on the stock assets they own so that they can still provide optimal profits with the smallest possible loss risk.

Keywords: Stock Investment; Loss Risk; Blue Chip; VaR; Adj-ES

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INTRODUCTION

The economic sector is an important element in the sustainability of a country. 9 the country, economic activity can be a means of obtaining income that can be developed for national development (Hidayu et al., 2024). From the community's perspective, economic activity is the main medium for improving welfare, gaining profit, and preparing for a better life in the future (Aliyah, 2021).

Adiningtyas and Hakim (2022) states that in addition to improving welfare, the main motivation of each individual in carrying out economic activities is to obtain maximum profit with minimal risk. In Indonesia, there are five sectors that are the mainstays of the Indonesian economy, namely trade and services, manufacturing, construction, mining, and agriculture (Utama, 2018). The

tangible impact of these sectors can be observed from the contribution they make to Indonesia's Gross Domestic Product (GDP) (Sari & Sutrisno, 2023). From 2010 to 2023, the total contribution of these five sectors has consistently accounted for more than 50% of the GDP each year (Sultan et al., 2023).

In the trade and services sector, technological advancements and the development of science have led to the emergence of various new business activities carried out by society (Mamonto et al., 2024). Trade is no longer conducted conventionally through the buying and selling of physical products. Nowadays, many people are becoming increasingly interested in allocating their funds for investment and purchasing financial assets.

According to Basyiran (2023), the main attraction offered by financial assets is their potential to provide significant profits in a short period. Financial assets generally also have high liquidity, which assures investors that they will be able to find potential buyers when they decide to sell their assets (Kundurthy & Nozari, 2024). Furthermore, financial assets do not require maintenance costs, unlike real assets. Lastly, the return on investment can be measured and predicted accurately using various appropriate mathematical models.

IDX Indonesia is the official market where financial assets are bought and sold (IDX Indonesia, 2022). Since its establishment in 2007, there have been at least seven types of financial assets traded, including stocks, bonds, mutual funds, Exchange Traded Fund (ETF), Structured Warrants, Real Estate Investment Funds, and Derivative assets. According to Rozi, Susyanti, and Saraswati (2022) the number of investors involved in trading on the capital market has consistently increased each year. A significant increase occurred between 2017 and 2022. In 2017, the number of registered investors on the Indonesia Stock Exchange (IDX) was 1.025.414. By 2022, this number had risen by 740.73% to 8.620.911 investors.

Stocks have become the most popular asset among investors compared to other types of financial assets traded. In 2022, out of the 8.620.911 investors registered on the IDX, 5.023.442 were stock investors. According to Masridha, (2023) in addition to the motivation of maximizing profits, investors' consideration in choosing stocks as their investment asset is based on the company's performance.

Every year, the IDX releases a list of stocks that are classified as Blue-Chip. This release aims to provide information about stocks that have a good national reputation in terms of quality, capability, and reliability to operate profitably in both favorable and unfavorable economic conditions. Stocks in the Blue-Chip category also tend to have stable movements throughout the year, making them suitable and safe to be used as investment assets

The information about Blue-Chip stocks is very helpful for investors in making decisions about buying or selling stocks.

According to Melina et al. (2023), every stock investment always involves the risk of loss. This risk is uncertain, meaning it can occur at any time, and the exact amount of the loss cannot be determined in advance. Therefore, an appropriate risk management strategy is needed to effectively address the risk of loss and prevent bankruptcy in investing (Hartono et al., 2024). Samimi et al. (2022) and Dai, Kang, and Wen (2021) state that to determine an appropriate risk management strategy, investors must have an accurate estimate of the potential loss that may occur in the future period.

Risk measures are quantitative models that can be used to predict potential losses based on historical returns. Risk measures can be applied effectively to both individual assets and portfolios (Dai et al., 2021). One of the most widely known and commonly used risk measures is Value at Risk (VaR). According to Maruddani & Abdurakhman (2021), VaR is defined as the prediction of the

maximum loss for a specific time period at a predetermined confidence level. Typically, the confidence level is chosen as (1-α)%, where α represents the expected error margin. A good risk measure must satisfy the property of coherence, which consists of four components: Monotonicity, Translation Invariance, Positive Homogeneity, and Subadditivity (Frohlich & Williamson, 2024).

In practice, VaR fails to meet the subadditivity condition. This means that for a portfolio consisting of multiple assets, the predicted VaR value is not always smaller than or equal to the sum of the VaR of the individual assets. This occurs because the VaR calculation focuses on the quantile of the distribution (e.g., the 5th percentile) and does not capture the overall tail behavior of the distribution. When assets are highly correlated, the combined portfolio tail can be much larger than the sum of the individual asset tails, leading to a higher portfolio VaR (Prihatiningsih et al., 2020).

To address this limitation, investors can use the Expected Shortfall (ES) model. Theoretically, ES has been proven to satisfy the subadditivity property. However, the ES value is highly sensitive and easily influenced by outliers, which implies that predictions become inaccurate when there are outliers in the stock return data (Lazar & Zhang, 2019).

As a solution to the shortcomings of the VaR and ES models, this study will utilize the Adjusted Expected Shortfall (Adj-ES) model to predict losses on Blue-Chip stocks in IDX Indonesia. In its application to financial asset risk prediction, particularly stocks, Adj-ES was first introduced by (Trimono et al., 2019). Adj-ES works by calculating the average loss that exceeds VaR, but with a shorter calculation horizon than ES (Burzoni et al., 2022).

This study aims to predict the risk of loss for Blue-Chip stocks on IDX Indonesia in 2024 using the VaR and Adj-ES models, and to select the best model through backtesting accuracy tests. Specifically, two stocks will be chosen: AMRT.JK (trade sector) and BBCA.JK (financial services sector). In addition to being part of the Blue-Chip stocks, this selection is based on several other conditions, namely, both stocks have shown significant market capitalization growth compared to the previous year.

At the end of 2023, the market capitalization of AMRT.JK was 84.29 trillion IDR, which then increased to 118.34 trillion IDR, representing a 40,4% rise and the highest increase in the Primary Consumer Goods and Retail Goods Trading sector stocks. Furthermore, BBCA.JK is one of the private banking stocks that has a very strong reputation in the market. This reputation is reflected in its market capitalization of 1.140 trillion IDR in 2023, which increased by 2,87% to 1.180 trillion IDR.

According to Nisa & Fadil, (2024) investors tend to choose stocks from companies that have a good reputation, significant business growth, and stable stock movements. Therefore, analyzing the risk of loss on such stocks becomes an important study, as, no matter how good the stock's performance is, there is always an element of risk involved.

The best model is expected to serve as a relevant reference for investors in formulating the appropriate risk management strategy.

The data for this study is sourced from the Historical Stock Prices of Blue-Chip companies in 2022, specifically XL Axiata (EXCL.JK) and Indofood CBP Sukses Makmur (ICBK.JK). These companies operate in the telecommunications and food sectors and were able to continue recording profits during the COVID-19 pandemic from 2020 to 2021. Therefore, we are interested in analyzing the risk of loss prediction for the year 2022. A novel aspect of this research is the numerical comparison between VaR and Adj-ES, followed by measuring their accuracy using a Backtesting accuracy test.

LITERATURE REVIEW AND HYPOTHESES

Literatur Review

In previous studies, there have been many investigations into the risk of loss in stock investments on IDX Indonesia. Some of these studies include Tarno et al. (2020) who applied the ARIMA-GARCH stochastic model and Ensemble ARIMA-GARCH to predict the risk of loss using VaR on IDX Indonesia stock portfolios. This study focused on the issue of portfolio return volatility that is not constant. The volatility modeling of returns was conducted using ARIMA-GARCH, and the predicted volatility results were then used to forecast the VaR value. The final results showed that the VaR loss prediction had high accuracy with a violation ratio of less than 1.

Hersugondo et al. (2022) implemented the Geometric Brownian Motion model and VaR with the Monte Carlo Simulation approach to predict the price of the JKII (Jakarta Islamic Index) along with its risk of loss. This study did not test whether VaR provides an accurate prediction. Accuracy testing was limited to the price prediction model only. Based on the MAPE value obtained (2.03%), the price prediction was concluded to be highly accurate.

Maruddani & Trimono (2021) applied the Multidimensional-GBM model to predict stock prices on IDX Indonesia, which have interdependent structures and are formed into stock portfolios. The prediction results showed that Multidimensional-GBM was able to provide a MAPE value of < 10% with a loss risk below 5%. Furthermore, Andrianto et al. (2020) implemented the Glue-VaR model for stock prediction on IDX Indonesia. This model is claimed to be an improvement over VaR. Glue-VaR also considers the loss value in the tail of the distribution, allowing it to provide more comprehensive predictions, especially during extreme loss conditions.

Based on previous studies, this research will examine the use of the VaR model as a simple risk measure with the Standard Deviation Premium Principle (SDPP) approach, and then compare it with Adj-ES, which is an improvement over the VaR model. The comparison and numerical analysis of these two methods are the main innovations offered. This is because, in previous studies, there has been no comparison between VaR using the HS approach and Adj-ES in the IDX Indonesia stock market.

Hypothesis

Hypothesis for the VaR model for risk prediction:

H0: VaR with the HS approach provides accurate predictions

H1: VaR with the HS approach does not provide accurate predictions

Hypothesis for the Adj-ES model for risk prediction:

H0: The Adj-ES model provides accurate predictions

H1: The Adj-ES model does not provide accurate predictions

METHODS

VaR-SDPP Risk Measure

VaR-SDPP is a risk measure model that predicts risk values based on the mean and standard deviation of historical random risk. It is a relatively simple risk measure and can be applied to any

return data. The standard-deviation principle premium risk measure is defined by: (Gómez-Fernández-Aguado et al., 2014):

$$\text{VaR-SDPP} = \mu_X + \alpha\, \sigma_X \quad (1)$$

Where $\alpha \geq 0$ is the error rate. In the SDPP model, the distribution of losses with large variance values will have higher risks.

Adj-ES Risk Measure

Let X represent the stock return value. Then, constants a and c are given, where their values lie in the interval (0,1). Adj-ES for a confidence level α is defined as the average loss within the range of VaRα(X) to $\text{VaR}_{\alpha+(1-\alpha)^{1+c}}(X)$. The equation for Adj-ES is as follows (Trimono & Maruddani, 2023):

$$\text{Adj-ES(X)} = -\text{E}\left[X \middle| -\text{VaR}_{\alpha+(1-\alpha^c)}(X) \geq -X \geq -\text{VaR}_{\alpha}(X)\right] \quad (2)$$

If calculated using a historical simulation approach, the following model equation is needed:

$$\text{Adj} - \text{ES} \quad (X) = -\frac{1}{[u]+2}\sum_{i=0}^{[u]+1} X_{(k)i} \quad (3)$$

c : a real number between 0 and 0.1

Backtesting Test

A backtesting test is a guideline used to measure the accuracy of risk loss predictions. Backtesting works by comparing actual stock returns with predicted risk losses. This test allows us to evaluate whether the frequency of losses that occur is higher than the expected frequency of losses (Halilbegovic & Vehabovic, 2016).

The principle of analysis in backtesting is to calculate the violation ratio (VR). A risk loss prediction is considered accurate if the violation ratio obtained is ≤ 1. If VR > 1 it is said that the risk prediction is inaccurate. In the *t* period, a violation is said to occur if the actual loss exceeds the predicted loss. The following is the equation to calculate VR (Shaik & Padmakumari, 2022):

$$VR = \frac{v_1}{m_0 \times N_U} \quad (4)$$

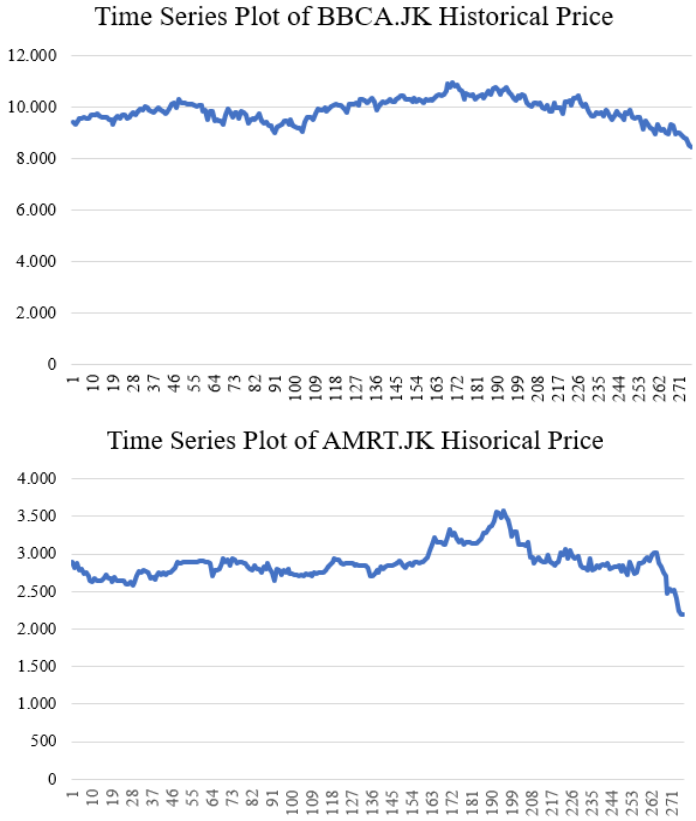
V_1 is the number of violations that occur during the backtesting period. m_0 is the expected violation probability (usually set to 0.05). Nu represents the length of the testing period.

Data Analysis Procedure

In this study, the data used are secondary data obtained from the website finance.yahoo.com, specifically the closing price data of AMRT.JK and BBCA.JK stocks for the period from January 1, 2024, to February 28, 2025, with a total of 276 observations for each stock. The following are the data analysis procedures carried out:

a. Determine the risk calculation period and collect stock price data
b. Split the data into two parts: in-sample and out-of-sample
c. Calculate return values based on stock price data
d. Test data normality using the Jarque-Bera test

Figure 1. Time series plot of AMRT.JK and BBCA.JK



Source: Data Processing

e. Calculate risk values using the VaR-SDPP and Adj-ES methods
f. Calculate prediction accuracy through back testing
g. Interpret the model

RESULT AND DISCUSSION

The risk analysis of losses for AMRT.JK and BBCA.JK stocks begins with descriptive analysis. This analysis helps to understand the initial characteristics of the stock price data and returns during the observation period.

Based on the time series plot, it can be observed that during the observation period, the stock prices of AMRT.JK and BBCA.JK experienced fluctuations and dynamic price changes. These fluctuations were generally caused by factors related to the instability of economic conditions in Indonesia, which impacted the daily stock prices. Overall, the stock prices of AMRT.JK and BBCA.JK remained relatively stable, with no significant price drops (jump prices). Further characteristics of the stock prices are presented in the following descriptive statistics table:

Table 1. Analysis Descriptive AMRT.JK and BBCA.JK Historical Price

	AMRT.JK	BBCA.JK
Min	2.190	8.425
Max	3.570	10.950
Mean	2.876,63	9.888
St.Dev	206,91	458,18
Skew	0,68	-0,25
Kurtosis	2,06	-0,12

Source: Data Processing

Table 2. Illustration of Estimation Data and Test Data

Est period	Start Date	End Date	Test Period	Date
1	2/1/24	20/1/25	1	21/1/25
2	3/1/24	21/1/25	2	22/1/25
3	4/1/24	22/1/25	3	23/1/25
…	…	…	…	…
26	6/2/25	27/2/25	26	28/2/25

Source: Data Processing

The results of the descriptive analysis of AMRT.JK stock price data show that during the observation period, the average daily stock price was IDR 3.570, representing an increase of 273 points from the previous year, which was recorded at IDR 3.297. The lowest stock price was IDR 2.190, recorded on September 18, 2024. Meanwhile, the highest stock price was recorded on February 20, 2025, with a value of IDR 3,570. For BBCA.JK stock, the lowest price was IDR 8.425, observed on May 7, 2024. The highest price was recorded on December 21, 2024, at IDR 10.950. The average stock price was IDR 9.888, which is the highest average ever reached by this stock compared to previous periods.

Stock price fluctuations can be observed by referring to the standard deviation values. The higher the standard deviation, the greater the price movement fluctuations during the period. BBCA.JK has a standard deviation of 458,18, which is higher than AMRT.JK's standard deviation of 206,91. When compared to the stock prices of each company, the recorded standard deviation values are considered relatively low. In other words, the stock price movements are still considered stable (stationary).

In predicting risk of loss, which will also be measured for prediction accuracy, the first step is to divide the data into two parts: the estimation data and the test data. The estimation data is used to form the parameters for risk prediction, while the test data is used as a comparison value in the accuracy test. In this study, the length of the estimation data is 250, and the length of the test data is 26.

Thus, the predicted loss risk for the period from January 21, 2025 to February 28, 2025 will be used as a reference to measure prediction accuracy. If the testing indicates high accuracy, then the risk measure can be used for predictions in future periods.

Normality Test of Return Data

Stock return is the primary data used as a reference in risk prediction. Since this study employs the VaR-SDPP method, which requires the stock returns to follow a normal distribution, the results of the normality test using the Kolmogorov-Smirnov test are presented in Table 3.

By setting $\alpha = 5\%$, the test results in Table 3 indicate that the stock return data follow a normal distribution, as the obtained significance values are greater than or equal to α. Thus, the VaR-SDPP model can be applied to both stocks.

Table 3. The result of normality test

Variable	KS-value	Sig
AMRT.JK Return	1.42	0.078
BBCA.JK Return	2.32	0.092

Source: Data Processing

Table 4. VaR-SDPP Model Parameters for AMRT.JK

Est period	Start date	End date	μ	σ
1	2/1/2024	20/1/25	0.0175	0.0297
2	3/1/2024	21/1/25	-0.0281	0.0254
3	4/1/2024	22/1/25	0.0035	0.0221
…	…	…	…	…
26	6/2/2025	27/2/25	-0.0151	0.0157

Source: Data Processing

Determining the Parameters of the VaR-SDPP Model

Based on Equation (1), risk calculation using the VaR-SDPP model requires the parameters μ and σ^2 of the historical return. The values of these two parameters for each estimation period are presented in table 4. Next, table 5 shows the parameter values μ and σ for BBCA.JK returns. Then, in risk prediction using the Adj-ES model with the historical simulation approach, the required parameter is *c*, and in this study, the value of *c* is set at 0,01.

Loss Risk Prediction

The risk loss prediction conducted includes both VaR-SDPP and Adj-ES models. One of the main elements in loss prediction is determining the confidence level; we selected a 95% confidence level (α = 5%). The results of the risk prediction for AMRT.JK on 1/21/25 to 2/28/25 are presented in the Table 6.

Table 5. VaR-SDPP Model Parameters for BBCA.JK

Est period	Start date	End date	μ	σ
1	2/1/2024	20/1/25	-0.0080	0.0142
2	3/1/2024	21/1/25	0.0133	0.0142
3	4/1/2024	22/1/25	0.0105	0.0141
…	…	…	…	…
26	6/2/2025	27/2/25	0.0130	0.0141

Source: Data Processing

Table 6. Loss Prediction of AMRT.JK using VaR-SDPP

No	Periods	VaR-SDPP	No	Periods	VaR-SDPP
1	1/21/25	-0,0312	14	2/12/25	-0,0251
2	1/22/25	-0,0239	15	2/13/25	-0,0325
3	1/23/25	-0,0354	16	2/14/25	-0,0301
4	1/24/25	-0,0224	17	2/17/25	-0,0377
5	1/30/25	-0,0312	18	2/18/25	-0,0326
6	1/31/25	-0,0164	19	2/19/25	-0,0300
7	2/3/25	-0,0406	20	2/20/25	-0,0225
8	2/4/25	-0,0284	21	2/21/25	-0,0315
9	2/5/25	-0,0221	22	2/24/25	-0,0235
10	2/6/25	-0,0230	23	2/25/25	-0,0298
11	2/7/25	-0,0305	24	2/26/25	-0,0345
12	2/10/25	-0,0260	25	2/27/25	-0,0308
13	2/11/25	-0,0378	26	2/28/25	-0,0152

Source: Data Processing

Based on Table 6, the VaR-SDPP loss predictions range from -0.01 to -0.03. The largest predicted loss occurred on February 26, 2025, with a loss value of 3.45%. Meanwhile, the smallest predicted loss occurred on January 31, 2025, with a loss value of 1.64% of the total investment capital. The results of the Adj-ES loss prediction are presented as follows:

Table 7. Loss Prediction of AMRT.JK using Adj-ES

No	Periods	VaR-SDPP	No	Periods	VaR-SDPP
1	1/21/25	-0,0271	14	2/12/25	-0,0312
2	1/22/25	-0,0298	15	2/13/25	-0,0384
3	1/23/25	-0,0413	16	2/14/25	-0,0461
4	1/24/25	-0,0283	17	2/17/25	-0,0436
5	1/30/25	-0,0371	18	2/18/25	-0,0385
6	1/31/25	-0,0223	19	2/19/25	-0,0359
7	2/3/25	-0,0465	20	2/20/25	-0,0284
8	2/4/25	-0,0343	21	2/21/25	-0,0374
9	2/5/25	-0,028	22	2/24/25	-0,0294
10	2/6/25	-0,0289	23	2/25/25	-0,0357
11	2/7/25	-0,0364	24	2/26/25	-0,0404
12	2/10/25	-0,0319	25	2/27/25	-0,0367
13	2/11/25	-0,0437	26	2/28/25	-0,0211

Source: Data Processing

Based on Table 6, the Adj-ES loss predictions range from -0.01 to -0.05. The largest predicted loss occurred on February 14, 2025, with a loss value of 4,61%. Meanwhile, the smallest predicted loss occurred on January 24, 2025, with a loss value of 2,24% of the total investment capital.

Accuracy Testing of Prediction Results

For the loss risk models VaR-SDPP and Adj-ES, accuracy testing was conducted using violation probability values m_0 of 1% and 5%. Table 8 shows the results of the accuracy test for the VaR-SDPP and Adj-ES models.

Since both models have a VR value < 1, this indicates that the risk predictions produced are accurate. Therefore, investors can choose either model for risk prediction, especially on the Indonesian IDX stock market.

Table 8. Backtesting Accuracy Test Results

	m_0	V_1	VR
VaR-SDPP	10%	2	0.769
Adj-ES	10%	1	0,384

Source: Data Processing

CONCLUSION AND SUGGESTION

The loss risk is a variable that cannot be eliminated in the stock investment process. Thus, investors need to make accurate risk predictions through risk measures. Based on the studies and analysis that have been carried out in this study, the prediction of the risk of loss on AMRT.JK is obtained as follows: (i) the VaR-SDPP prediction in the period 1/21/25 to 2/28/25 is estimated to be in the range of 1% - 4%. This value is still categorized as a small risk of loss. (ii) The largest loss prediction was recorded on 2/26/25 with a value of 3.45% and the smallest risk of loss was 1.64% which was estimated to occur on 1/31/25. Furthermore, the prediction with the Adj-ES model obtained: (i) the Adj-ES risk of loss in the period 1/21/25 to 2/28/25 is estimated to be in the range of 1% - 5%. This value is still categorized as a small risk of loss. The largest loss prediction was recorded on 2/14/2025, with a loss value of 4.61%. (ii) The smallest risk of loss was recorded on 1/24/25 with a value of 2.24%. The results of the accuracy test show that VaR-SDPP and Adj-ES have VR values < 1, this condition indicates that the accuracy of risk prediction is very good. The research results can be a reference for investors to properly assess and manage the risk of loss on the stock assets they own so that they can still provide optimal profits with the smallest possible loss risk. The limitation of this study lies in the assumption of normality of return that must be met when predicting losses with the SDPP model. Therefore, in future research, the author recommends analyzing the risk of loss using a risk measure that is able to overcome the abnormality in historical return data. Thus, the resulting risk prediction will remain accurate rather than continuing to use a risk measure that is bound by the assumption of normality.

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