STOCK PORTFOLIO OPTIMIZATION IN PENSION FUND COMPANY (CASE STUDY : PT XYZ)

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ABSTRACT :*PT XYZ is State Owned Enterprise that manages Indonesia civil servant pension funds that has very large investment assets compared to other pension fund companies. Even so, in 2019 to 2021 the rate of return from the company's investment assets was not sufficient to meet the interest rate of the products offered and the level of claim ratio from insurance was too high compared to the premium earned. In order to cover investment needs and development of the business, it is expected that investment assets managed by PT XYZ can be more optimal in order to generate better returns. However, it is known that PT XYZ's stock portfolio has a very poor performance, where in 2019 to 2021 the income from stock sales and dividends did not reach the set target. The existence of these problems then shows that it is necessary to do stock portfolio optimization in order to achieve a maximum return on investment with an acceptable level of risk. In this study, optimization is carried out on the 2021 portfolio using the Markowitz Portfolio Method which is analyzed using historical stock price data for 5 years, where the performance of the portfolio is measured using the Sharpe Ratio. The results show that the Markowitz Portfolio Selection Method can improve portfolio performance, where the actual portfolio in 2021 has poor performance, and after optimization the experienced portfolio increases in performance from 2.39% to 21.67%.%. The result of the study recommend for the companies to use Markowitz Portfolio Method in order to improve their portfolio performance in evaluating or forming portfolio stocks in the future.*

KEYWORDS – *Markowitz Portfolio Method,Pension Funds, Portfolio, Sharpe Ratio, Stock*

I.   INTRODUCTION

Pension insurance is a financial guarantee that is given when the insurance participant retires from his job. Pension insurance is a form of incentive for companies to be able to attract the best workers and increase worker satisfaction by ensuring welfare when workers have retired.The benefits provided by pension insurance make the Indonesian Government as the employer to provide pension insurance to Civil Servants which is regulated through Government Regulation number 10 of 1963 concerning Insurance and Civil Servant Savings. Through this regulation, all civil servants automatically become participants in the pension insurance managed by PT XYZ, so that the welfare of civil servants after retirement will be guaranteed.

PT XYZ is a state-owned company, involved in old-age savings insurance and pension funds for State Civil Servants and State Officials. Indonesia that having a relatively large number of civil servants due to decentralized government in all regions, creating a large number of pension insurance participants managed by the company. In 2021, the company manages 3.9 million participants in the pension insurance program which makes PT XYZ one of the pension fund companies with the largest assets in Indonesia, compared to other pension fund companies in the country such asJiwasraya, Manulife, Allianz, Generali and BPJS TK.

However, despite of the company big assets, PT XYZ faces a number of business challenges that points to the importance of managing its investments more appropriately [1].Firstly, the return on investment rate of the company with a value of 9.07% in 2021 is still below the interest rate calculated for actuarial obligations set by the government, which is 9.75%. Secondly, The company's claim ratio in 2019 to 2021 is the highest compared to other pension fund companies and continues to increase to the point of 213.09% in 2021.This high claim ratio causes big problems for the company, because to cover the shortfall in payment of insurance benefit claims, companies need to use funds from investment results so that the company's ability to develop its investment will decrease and its investment will be further eroded due to the high interest rate of the pension program. Thirdly, stock investment which is one of the most striking investment asset has also decreased significantly in value where in 2019 to 2021 the stock investment value is dropped by 28.29%, 23.31% and 32.05%, respectively. Fourth, the companysale of shares is hampered because of the company investment policy that prohibited negative value share sales and causes the set annual sales target cannot be achieved.due to the existence of the issue discussed above, there is a need for the company to engage in stock portfolio optimization in order to achieve a maximum return on investment with an acceptable level of risk.

II.   LITERATURE REVIEW

PT XYZ Tunjangan Hari Tua (THT) Program

PT XYZ Pension insurance program called "Tunjangan Hari Tua" that is consisting of Dwiguna Insurance which is linked based on retirement age plus death insurance. Participants in the THT program including Indoneisan Civil Servants and State Officials.

Stock

Stock is a financial instrument which is a form of financing activity carried out by a company through an initial public offering (IPO) where the shares owned by the investor represent ownership of the company's equity [2]. Shareholders can get two benefits from stock investment, namely from capital gains from buying and selling shares in the capital market and dividends from profits distributed by the company.

Risk and Return

Risk is an uncertainty of danger or consequences that may occur as a result of an ongoing process or future events [3]. In investment, risk is defined as the difference between the expected return and the realization received by the investorStandard deviation is the square root of variance which is used to measure risk based on dispersion data [4]. The higher the standard deviation value of an investment, the higher the risk because the higher the uncertainty of the investment returns.The following is the formula for the Standard Deviation (σ_p):

$$\sigma_p = \sqrt{Var(r_p)} = \sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j Cov(r_i, r_j)} \#1$$

Where, $Var(r_p)$adalah variance, w adalah proportion of the funds invested, and$Cov(r_i, r_j)$adalah Coefficient correlation between assets

Return is the net gain or loss of an investment within a certain period of time. In making investments, the rate of return can be measured using a comparison of historical data on share prices at the time of acquisition and sale [2]. Portfolio expected return$E(r_p)$can be calculated with the following equation:

$$E(r_p) = \sum_{i=1}^{n} w_i E(r_i) \#2$$

Where, $E(r_i)$ adalah Stock return for individual stock, n adalahnumber of stocks, and w adalahProportion of the funds invested (weight)

Markowitz Portfolio Model

Markowitz Portfolio Model or Efficient Frontier is a mathematical framework for establishing an optimal portfolio from risky assets. The Markowitz portfolio model considers the expected rate of return and the level of risk to be able to determine the most appropriate allocation in an investment portfolio so that a portfolio with the highest return can be achieved within the risk range that is still acceptable to investors [4].Markowitz portfolio model using several assumptions concerning the behavior of investors and the condition of the financial market :

- A probability distribution of possible returns over some holding period can be estimated by investors
- Investors have single-period utility function
- Investor decisions only consider expected return and risk of the portfolio
- Financial markets are frictionless
- There is no transaction cost or taxes
- Expected returns of assets have normal distribution

Sharpe Ratio

Sharpe ratio or Reward to volatility measure is a measure of portfolio performance by using portfolio risk premium and the standard deviation of excess returns [5]. Besides being able to be used to evaluate investment managers, the Sharpe ratio can be used to obtain the maximum amount of allocation for the portfolio to get the maximum return at the lowest risk[6]. The following is the formula for Sharpe Ratio:

$$S_p = \frac{E(r_p) - r_f}{\sigma_p} \#3$$

Where, $E(r_p)$ are expected return, r_f are risk free rate, and σ_p are standard deviation.

III.   RESEARCH METHOD

This study uses the Markowitz Portfolio Model to form the optimum portfolio allocation for the 2021 stock portfolio.In order to analyze the data, data collection is conducted where in the company 2021 stock portfolio, there are 27 stocks that can be optimized and stock price data was taken for the past 5 years, from 2017 to 2021, which was obtained from yahoo finance. The risk free rate using SBR-010 with a coupon value of

5.1% in December 2021. Data collection is also carried out by observing the rules for investing in PT XYZ , which is regulated by the ministry of finance because the company is a state-owned company that regulates pension funds for civil servants.Data analysis is carried out after the data is obtained using the Solver feature of Microsoft Excel to be able to determine the historical return of the portfolio, return and risk of the portfolio, and portfolio optimization.The following are the steps in conducting an analysis using the Solver feature of Microsoft Excel:

1. The rate of return of each stock is calculated for 60 periods (five years), then the standard deviation and expected return are measured using the rate of return that has been calculated based on its weight on the portfolio
2. In Microsoft Excel's Solver feature, the target of the analysis is to maximize the sharpe ratio by changing the weight of the stock to be optimized
3. Set the constraint solver as follows:
· Maximum of the total weight of all shares is 1
· The maximum value of the weight of each optimized share is 0.1
· The minimum value of the weight is 0 to avoid negative weight values

After the analysis has been conducted, an evaluation of the existing stock portfolio is carried out to determine whether the current stock allocation is appropriate or requires future adjustments to obtain optimum results..

IV.   RESULT AND DISCUSSION

According to the existing stock portfolio in 2021, the following is a portfolio composition and portfolio performance measurement using the Sharpe Ratio:

Table 1. PT XYZ 2021 Portfolio Composition and Performance

Stocks	Weight	Stocks	Weight
BBRI	0.07509	WTON	0.00364
ANTM	0.00010	WSBP	0.00362
PTBA	0.04946	GMFI	0.00386
TOWR	0.00020	PPRE	0.00465
ADRO	0.00008	UNVR	0.04015
TBIG	0.00001	LSIP	0.03384
BBCA	0.01830	BSDE	0.02856
SMGR	0.04174	AALI	0.02075
WSKT	0.01253	SGRO	0.01868
JSMR	0.02182	BWPT	0.00597
PGAS	0.01183	HMSP	0.00607
GIAA	0.00037	INKP	0.00498
WIKA	0.02085	BEST	0.00200
PTPP	0.00923	GGRM	0.02869
Other Stocks Weight	0.53293		
Total	1		
Return	.0.56%		
Risk	5.61%		
Risk Free Rate	0.43%		
Sharpe Ratio	2.39%		

From the table, it can be seen that the stock portfolio in 2021 has a sharpe ratio performance of 2.39%, with a return rate of 0.56% per month and with a risk measured by a standard deviation of 5.61%. To be able to find out the optimal portfolio of the 2021 stock portfolio, a Markowitz analysis with maximum sharpe portfolio selection is carried out.The following tables are results of the Markowitz Portfolio Model :

Table 2. Portfolio Optimization Result

Stocks	Weight
PTBA	0.042
TOWR	0.0775
ADRO	0.0454
TBIG	0.1
BBCA	0.1
INKP	0.1
Other Stocks Weight	0.53293
Total	1
Return	1.62%
Risk	5.53%
Risk-Free Rate	0.43%
Sharpe Ratio	21.67%

Optimal portfolio in 2021 using Markowitz Maximizing Sharpe Portfolio Selection consisting of PT Tower Bersama Infrastructure (TBIG), PT Bank BCA (BBCA), and PT Indah Kiat Pulp and Paper (INKP) with a weight of 10% each, PT Bukit Asam (PTBA) at 4.42%, PT Tower Bersama Infrastructure (TBIG) at 7.75%, PT Adaro Energy (ADRO) at 4.54%, and other shares that were not optimized with a total weight of 53%. The optimization results show that the portfolio has a sharpe ratio value of 21.67%, with a given rate of return of 1.62% per month and a standard deviation of 5.53%.

The actual portfolio performance is very poor compared to the optimal portfolio, with a return rate of 0.56% or 34% of the optimal portfolio return with a return rate of 1.62%. The risk level of the actual portfolio is also quite high, which has a standard deviation of 5.61% compared to the optimal portfolio with a standard deviation of 5.53%. The low return and high risk in the actual portfolio in 2021 then make the sharpe value of the actual portfolio far below the optimal portfolio, which has a value of 2.39% or 11% of the optimal sharpe portfolio level with a value of 21.67%. Based on these results, it can be concluded that the actual portfolio in 2021 has a smaller return and greater risk than the optimal portfolio, so optimization is needed to improve its performance. To get alternative portfolios with different levels of return in order to adjust the company's risk profile, an efficient frontier simulation is carried out by using Markowitz Portfolio Selection. The following is the efficient frontier table for 2021 stock portfolio:

Table 3. PT XYZ Portfolio Efficient Frontier Simulation

STOCKS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
BBRI	0.0%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.0%	0.4%	0.0%
ANTM	0.0%	0.6%	0.6%	0.7%	0.7%	0.8%	0.7%	1.1%	1.1%	1.2%	1.2%	1.3%	1.6%	0.0%	6.4%	10.0%
PTBA	2.2%	2.2%	2.8%	3.4%	3.9%	4.3%	2.3%	5.8%	8.8%	8.3%	6.0%	5.5%	4.7%	4.4%	0.0%	0.0%
TOWR	1.5%	1.5%	1.7%	1.9%	2.0%	2.1%	1.6%	3.3%	3.3%	3.2%	3.2%	3.0%	2.5%	7.8%	0.5%	0.0%
ADRO	2.3%	2.3%	2.9%	3.5%	4.1%	4.6%	2.2%	5.6%	5.8%	5.9%	6.0%	5.7%	4.4%	4.5%	8.8%	6.7%
TBIG	1.1%	1.1%	1.3%	1.5%	1.6%	1.8%	1.3%	3.0%	3.4%	3.9%	4.2%	5.2%	10.0%	10.0%	10.0%	10.0%
BBCA	3.1%	3.1%	4.3%	5.8%	7.4%	10.0%	0.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
SMGR	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.0%	0.1%	0.0%
WSKT	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
JSMR	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%	0.0%
PGAS	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%	0.0%
GIAA	0.0%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.0%	0.1%	0.0%
WIKA	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
PTPP	0.8%	0.8%	0.8%	0.9%	0.9%	0.9%	0.8%	1.0%	1.0%	0.9%	0.9%	0.8%	0.6%	0.0%	0.0%	0.0%
WTON	10.0%	10.0%	9.7%	6.1%	6.0%	4.5%	4.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
WSBP	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
GMFI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PPRE	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
UNVR	10.0%	10.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
LSIP	0.0%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.0%	0.1%	0.0%
BSDE	0.0%	0.0%	7.0%	7.1%	3.5%	3.1%	2.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AALI	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%	0.0%
SGRO	10.0%	10.0%	10.0%	10.0%	10.0%	8.3%	0.0%	10.0%	6.0%	4.3%	3.8%	2.5%	0.9%	0.0%	0.0%	0.0%
BWPT	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
HMSP	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
INKP	0.0%	1.0%	1.4%	1.7%	2.0%	2.5%	1.1%	3.0%	3.9%	5.8%	8.2%	10.0%	10.0%	10.0%	10.0%	10.0%
BEST	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
GGRM	5.7%	2.8%	2.9%	2.9%	3.0%	2.7%	2.4%	2.4%	2.0%	1.7%	1.6%	1.3%	0.6%	0.0%	0.0%	0.0%
Other Stocks	53.29%	53.29%	53.29%	53.29%	53.29%	53.29%	53.29%	53.29%	53.29%	53.29%	53.29%	53.29%	53.29%	53.29%	53.29%	53.29%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Return	0.41%	0.50%	0.60%	0.70%	0.80%	0.90%	1.00%	1.10%	1.20%	1.30%	1.40%	1.50%	1.60%	1.62%	1.70%	1.74%
Risk	3.91%	3.99%	4.32%	4.45%	4.37%	4.51%	4.60%	4.68%	4.93%	5.11%	5.48%	5.61%	6.07%	5.53%	6.28%	6.31%
SR	-0.38%	1.88%	4.05%	6.18%	8.58%	10.53%	12.50%	14.42%	15.72%	17.12%	17.79%	19.16%	19.36%	21.67%	20.30%	20.84%

The table shows that the portfolio with the highest sharpe ratio on the efficient frontier is portfolio 14, which is shown in figure 2's third from the right.There is only one portfolio option that has a negative sharpe value, so the company can choose many options as the goal of optimizing its portfolio according to the company's risk profile. However, for each portfolio with a positive return, it is known that BBCA which has the highest individual sharpe value in the stocks optimized in 2021 has a maximum weight of 10% each on portfolio options 6, and 8 to 16. The following is the efficient frontier graph of the 2021 stock portfolio:
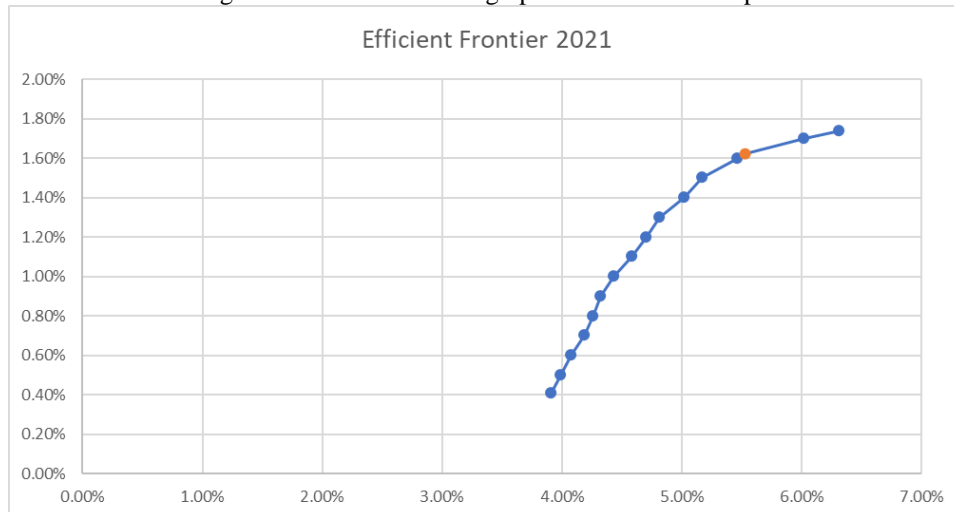

Figure 2. Efficient Frontier Graph of PT XYZ 2021 Stock Portfolio

V.   CONCLUSION

Based on the results of the analysis, the actual stock portfolio of PT XYZ has a poor performance compared to the optimal portfolio. The actual portfolio has a sharpe value of 2.39%, with a return rate of 0.56% and a standard deviation of 5.61%, or only 11% compared to the sharpe value of the optimal portfolio which has a value of 21.67%, with a return rate of 1.62% and a standard deviation of 5.53%. The result of the study recommend for the companies to use Markowitz Portfolio Method in order to improve their portfolio performance in evaluating or forming portfolio stocks in the future.

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