

# Optimal Portfolio Creation Using Markowitz Model on Food and Beverage Companies in Indonesian Stock Exchange

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## Optimal Portfolio Creation Using Markowitz Model on Food and Beverage Companies in Indonesian Stock Exchange

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**Abstract:** Investment is an activity that related to investing some funds in real assets or financial assets such as land, gold, stocks, deposits, bonds and other forms. The high level of risk that will be faced by investors, make investors to take anticipatory steps. One of the solutions is through diversification in portfolio forming. The importance of portfolio forming is to maximize the function and value of an asset in order to make greater returns with a certain level of risk, or to obtain certain returns with the minimum level of risk. Portfolio analysis is carried out to find the most optimal company as an investment object. This research uses the Markowitz model for food and beverage company stocks based on data from December 2019 to November 2020. The results showed there are 7 stocks that were selected as candidate for optimal portfolio forming. A proportion of the allocation of each stock are PT Antar Top Tbk (STTP) 10.14%, PT Sentra Food Indonesia Tbk (FOOD) 8.95%, PT Pratama Abadi Nusa Industri Tbk (PANI) 5.06%, PT Prima Cakrawala Abadi Tbk (PCAR) 37%, PT Ultrajaya Milk Industry & Trading Company Tbk (ULTJ) 20.61%, PT Nippon Indosari Corpindo Tbk (ROTI) 48.05%, and PT Sekar Bumi Tbk (SKBM) 6.82%. With that combination, it gives the expected return of 21.12% and level of risk 7.95%.

**Keywords:** Optimal portfolio, Markowitz model, food and beverage companies, BEL.

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## INTRODUCTION

Investment is an activity that related to investing some funds in real assets or financial assets such as land, gold, stocks, deposits, bonds and other forms. The investment's awareness by the society is progressively increasing, in addition to saving in banks, other investment alternatives such as investing in stocks, mutual funds, investing in the money market, etc. The choice of investing depends not only on the expected level of profit but also on the high level of risk that may be faced. An investor will be faced with various investments that have different returns and risks. This requires the investors to be able to make investment analysis before investing their funds [1].

The high level of risk that will be faced by investors, make investors to take anticipatory step that is a diversification step. Diversification is done through the portfolio forming. The importance of portfolio forming is to maximize the function and value of an asset in order to make greater returns with a certain level of risk, or to obtain certain returns with the

minimum level of risk [2]. One of the analytical tools that researchers usually use to conduct portfolio analysis is the Markowitz model [3].

The capital market is an investment medium for investors and an alternative medium for long-term investment. The capital market has an important role as a place of financial investment in the economic field. In addition, the capital market is also a place to meet the parties who have excess funds or lenders and parties who need funds or borrowers [4]. The existence of a capital market can help lenders and borrowers carry out business activities efficiently and effectively.

There is a logical reason to make investors prefer to invest in financial assets, it is more liquid, easier to diversify (stocks selection) and easy to change the combination of stocks purchased. Investments in stocks offer a fast rate of return with comparable risk. To obtain a high level of return, the investors should be willing to take a high risk as well. Return and risk plays an important role in making investment decisions [5]. Therefore, by doing portfolio analysis, an investor must

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be rational in choosing and determining strategies to minimize risk and maximize returns.

One of the characteristics of investing in stocks is the ease of diversification. Diversification is aimed to reduce the risk. With diversification, if one of the stocks owned collapse, it will be compensated by the other stocks value. The basis used in a portfolio forming is to choose an optimal portfolio [4].

There are several indices formed of the stock data listed in Indonesia Stock Exchange, namely the 45 liquid index (*ILQ-45*), the Jakarta Islamic Index (*JII*), the composite stock price index (*IHSG*), *IDX* (Indonesia Stock Exchange) sectoral index, Main Board and Development Board Indices, *Kompas 100* index, *BISNIS-27* index, *SRI-KEHATI* index, Indonesia Sharia Stock Index (*ISSI*), *PEFINDO25* index, and *IDX30* index, *Infobank15*, *Smintra 18*, and *MNC36*.

Portfolio analysis is carried out to find the combination of various company stocks that can produce the most optimal expected rate of return. The selection of these 70 companies is based on the criteria for the most optimal level of return with a certain level of risk. The optimal portfolio can be determined by the Markowitz model or by the Single Index Model.

Investment frequently interpreted as an activity to invest funds that are owned with the expectation that there will be benefits in the future. Return is a form of repayment received by the investors for their courage to take investment risks and it is one of the factors that motivate the investors to continue the investment. If investors buy a stock, yield is the amount of profit that is distributed to investors which is also known as dividends. However, if the company takes a policy of not dividing the dividend, the company's profit will become retained earnings which will be used for further investment. The second component of the return is capital gain/capital loss, which is the difference between the selling price and the purchase price of the stock.

The various risks which come up as a result of the investment activity are always tried to be minimized by investors. Investment risk occurs when there is a difference between the rate of actual return and the rate of return expected by investors. There are several risks based on sources that affect the amount of investment, such as inflation risk, interest rate risk, liquidity risk, market risk, currency risk, and business risk.

Investment consists of systematic risk (market risk) and unsystematic risk (management risk). Diversification is an activity to form a portfolio, while reducing the risk of the portfolio is the aim of this activity. Portfolio is a collection or combination of various securities that are formed in such a way as to achieve the goals of investors. The Portfolio theory of

the Markowitz model is based on several assumptions, they are: The period of making a single investment, for example one year, the transaction costs are eliminated, investors base their preferences on expected returns and risk, and there are no risk-free loans and deposits.

Stock investment is not something complicated nowadays. Thanks to the support of technology, the society can easily obtain information and manage their stocks portfolio. However, to start the stocks investment, knowledge is needed to prevent losses, especially during a pandemic like this.

The consumer goods industry is an industry that produces goods for the people's daily consumption. Therefore, even in a pandemic condition, this industry should remain stable. This study conducted an investment analysis to determine the optimal portfolio using the Markowitz model on the Indonesian stock exchange in the Food and Beverage Consumer Good Industry for the period December 2019 to November 2020 to find out which stocks that still have a tendency to be stable during the pandemic as a recommendation for the stocks investment in 2021.

Based on the description above, this study aims to form an optimal portfolio, determine the portion of funds invested in each stock, as well as the expected return and risk generated using the Markowitz Model for food and beverage companies on the Indonesia Stock Exchange.

## LITERATURE REVIEW

In the current globalization era, investment is not something new to society. The meaning of investment according to [6] is the investment of funds made by a company into an asset (assets) with an expectation of obtaining future income. So that investment can be interpreted as one way that can be chosen in managing finances.

Based on the time period, investments can be divided into 2 types, there are short-term investments and long-term investments. Short-term investments are investments that allow investors to earn profits within one to three years. While in long-term investment, profits can be obtained after more than three years.

Based on the form, there are two types of investment, namely investment in real assets and investment in financial assets. Investments in real assets are investments in tangible forms, such as gold, property and land. Investments in financial assets are other kinds of investments in the form of securities, such as deposits and stocks.

According to [7], the definition of an investment decision is a decision to release current funds with the expectation of generating future cash flows and greater amount than the funds released at the

first time investment. In addition, an investment decision means giving an answer on what suitable business field to step in, because there are many investment alternatives that can be implemented so that the owner's wealth is expected to increase.

<sup>5</sup> On its website, IDX defines a stocks as a sign of a person's or party's capital participation (business entity) in a company or limited liability company which the party has a claim on company income, claims on company assets, and have a right to attend the General Meeting of Shareholders (GMS). Profits obtained from stock investments can be in the form of capital gains or dividends. Capital gain is the difference between the purchase price and the selling price of the stock. For example, when investors buy the stocks with the price around Rp. 1,000, then they sell them when the stock's price reaches Rp. 2,000, as the result the investor gets a profit around Rp. 1,000 per stock. Dividends are profit sharing given by the companies that come from the profits generated by the company which are given after obtaining approval from the shareholders at the GMS.

Stock investment in the capital market is classified as a high-risk high-return investment, which means that stock investments have the possibility of getting large profits, but caution and good analysis are needed in order to minimize possible risks. One alternative that can be done is to diversify the stocks by buying them from several companies. According to [8], investors can use two ways to diversify (portfolio), which is random diversification (naive), and Markowitz model. Random diversification is taking several stocks without paying attention to returns, while the Markowitz model is the determination of stock taking uses a certain method so that it can produce an optimal portfolio.

According to [5], Markowitz shows that the variance of the return rate is <sup>26</sup> measure of portfolio risk based on an understandable set of assumptions, and he derives the formula to calculate <sup>13</sup> portfolio variance as the variance to measure risk. The Markowitz model is also based on several assumptions about investor behavior. Thus, through this model, investors can also decide the proportion given to each stock to be able to produce an optimal portfolio.

## METHODOLOGY

This research uses descriptive analysis with a quantitative approach. Descriptive research is an activity that aimed to explain an object with several variables, without connecting one variable to another. The research sample was conducted on food and beverage companies from December 2019 to November 2020. The portfolio was formed using the Markowitz Model. Others portfolio researches with Markowitz model were done by [9-13, 18]. Meanwhile [14, 15]

compared between using Markowitz model and Single index model. The data in this research was from IDX Monthly Statistics or the Indonesia Stock Exchange. Application used Solver for processing data. [16], he used Lagrange and profitability for analysis.

The initial stage in the portfolio forming is to collect data <sup>2</sup> of the closing price from each stock. The next stage is to calculate the return of each sample with the formula [5]:

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

<sup>9</sup> Note:

Rit = The Return of Stock i in t period

Pit = The Price of Stock i in t period

Pit-1 = The Price of Stock i in t-1 period

The next stage is the third stage, calculating the expected return of each sample company stock, the equation or formula for calculating the expected return is as follows [5]:

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

Note: <sup>32</sup>

E(Ri) = Expected return on stock i

Ri = Return on stock i that may occur

n = Number of observation periods

Calculating the stock risk is the fourth stage, calculation with the standard deviation, while the formula for calculating the stock risk is as follows [5]:

$$SD = \sqrt{\sum_{t=1}^n \frac{[R_{it} - E(R_i)]^2}{n}}$$

Note:

SD <sup>9</sup> = The standard deviation of Rit = The stock's value of i

E(Ri) = The <sup>4</sup> Expected return value of the i Stock

N = The number of historical data observations for large samples with n (at least 30 observations) and for small samples using (n-1)

Calculating the covariance between stocks is the fifth stage to determine the tendency between the stocks simultaneously. Covariance is calculated by the formula [5]:

$$\sigma_{RA, RB} = \sum_{i=1}^n \frac{[(R_{Ai} - E(R_A))(R_{Bi} - E(R_B))]}{n}$$

Note:

$\sigma_{RA,RB}$	=	The return covariance between stock A and B
$RA_i$	=	The Return of stock A in t period
$RB_i$	=	The Return of stock B in t period
$E(RA)$	=	Expected return of Stock A
$E(RB)$	=	Expected return of Stock B
$N$	=	The number of historical data observations for large samples with n (at least 30 observations) and for small samples using (n-1)

The sixth stage is calculating the correlation coefficient between stocks to measure how big the relationship between stocks is, the correlation coefficient can be calculated using the formula [5]:

$$r_{AB} = \rho_{AB} = \frac{Cov(R_A, R_B)}{\sigma_A \sigma_B}$$

Note:

$r_{AB}$  = Correlation Coefficient of stock return A and B  
 $Cov(R_A, R_B)$  = the value of stock covariance  
 $\sigma_A$  = standard deviation A  
 $\sigma_B$  = standard deviation B

The seventh stage is to calculate the expected return of the portfolio that has been formed with the formula [5]:

$$E(R_p) = \sum_{i=1}^n W_i E(R_i)$$

Note:

$E(R_p)$  = The expected return of the portfolio  
 $E(R_i)$  = The expected return of stock i  
 $W_i$  = The portion of Stock i to the whole stock in the portfolio  
 $N$  = The number of stock in the portfolio

The eighth stage is calculating portfolio risk, the calculation uses the standard deviation combined with the covariance value to calculate the tendency of stock movements simultaneously [5] portfolio risk can be calculated by the formula:

$$\sigma_p = \sqrt{\sum_{i=1}^n \sum_{j=1}^n W_i W_j \sigma_{ij}}$$

Note:

$\sigma_p$  = Standard deviation of the portfolio  
 $\sigma_{ij}$  = The covariance between stock i and j  
 $W_i$  = The portion of fund invested in stock i  
 $W_j$  = The portion of fund invested in stock j  
 $\Sigma_{ij}$  = The sign of double addition  
 $N$  = The number of stock in the portfolio

The ninth stage is calculating the optimal weight or proportion using Solver program. The

purpose of Solver program is to calculate the optimal distribution of weights or proportions of funds from each stock in each portfolio. In using the Solver program, the Sharpe Ratio approach proposed by William F. Sharpe in 1966 is used. The Sharpe Ratio is a comparison between expected return with standard deviation expressed in the following formula [16]:

$$S_p = \frac{R_p}{\sigma_p}$$

$S_p$  = Sharpe ratio  
 $\sigma_p$  = Portfolio standard deviation  
 $R_p$  = expected return portfolio

The higher the Sharpe ratio, the more optimal the portfolio formed. Performing calculations with solver program to optimize the Sharpe ratio value by changing the proportion of each stock for optimal portfolio forming. Then the last stage is to calculate the expected return and standard deviation of the optimal portfolio, this calculation uses the following formula [5].

$$\sigma_p = \sum_{i=1}^n W_i \sigma_i^2 + 2 \sum_{i=1}^n \sum_{j=1}^n W_i W_j \sigma_{ij}$$

Note:

$\sigma_p$  = Standard deviation of the portfolio  
 $W_i$  = The portion of fund invested in stock i  
 $\Sigma_{ij}$  = The sign of double addition  
 $n$  = The number of stock in the portfolio

After following the steps correctly, the stocks will be formed that become the optimal portfolio and shown when looking for the optimal proportion of funds.

## RESULTS AND DISCUSSION

Based on the data of stock value for the period of December 2019 to November 2020, from the 30 stocks in the Consumer Good Industry with the Food and Beverage sub category, 16 stocks have a positive expected return value, thus becoming candidate the optimal portfolio. For the other 14 stocks, they are not included in the optimal portfolio forming. The calculation results for the 16 stocks can be seen in the following table:

**Table-1: Expected return of each stock**

No	The Name of company	Stock code	$\sum R_{it}$	$E(R_i)$
1	PT Siantar Top Tbk	STTP	135.86%	11.32%
2	PT Sentra Food Indonesia Tbk	FOOD	46.12%	3.84%
3	PT PratamaAbadi Nusa IndustriTbk	PANI	40.21%	3.35%
4	PT AkashaWira International Tbk	ADES	32.83%	2.74%
5	PT Wilmar Cahaya Indonesia Tbk	CEKA	28.01%	2.33%
6	PT BuyungPoetraSembadaTbk	HOKI	16.29%	1.36%
7	PT Mayora Indah Tbk	MYOR	16.22%	1.35%
8	PT. Tunas Baru Lampung Tbk	TBLA	11.70%	0.98%
9	PT SekarLautTbk	SKLT	11.46%	0.95%
10	PT Mulia Boga Raya Tbk	KEJU	7.93%	0.66%
11	PT WahanaInterfood Nusantara Tbk	COCO	7.38%	0.61%
12	PT 34ma CakrawalaAbadiTbk	PCAR	4.61%	0.38%
13	19 Ultrajaya Milk Industry & Trading Company Tbk	ULTJ	3.28%	0.27%
14	PT Budi Starch & Sweetener Tbk	BUDI	2.56%	0.21%
15	PT Nippon IndosariCorpindoTbk	ROTI	0.95%	0.08%
16	PT SekarBumiTbk	SKBM	0.43%	0.04%

Source: The data processed, 2021

The calculation results in Table 1 show that STTP stock have the highest average expected return with a value of 11.32% and SKBM stock have the lowest average expected return with a value of 0.04%.

In addition to the average expected return, a calculation is made for the risk of each stock that has a positive expected return. The calculation results can be seen in Table 2, as follows:

**Table-2: Standard deviation of each stock**

No	Stock code	Standard deviation	No	Stock code	Standard deviation
1	STTP	40.74%	9	SKLT	9.34%
2	FOOD	29.45%	10	KEJU	14.09%
3	PANI	22.89%	11	COCO	6.70%
4	ADES	13.75%	12	PCAR	45.02%
5	CEKA	13.86%	13	ULTJ	6.93%
6	HOKI	9.00%	14	BUDI	6.84%
7	MYOR	5.69%	15	ROTI	4.14%
8	TBLA	16.89%	16	SKBM	20.88%

Source: The data processed, 2021

The data in table 2 shows that PCAR stock has the highest standard deviation or risk with 45.02%. Moreover, there are some stocks that do have a high expected return and a high level of risk, and some stocks that have a relatively small average expected return, but in fact have a high level of risk, such as PCAR and SKBM.

Furthermore, the calculation of covariance and correlation between stocks is carried out to see how the relationship between stocks is in a portfolio forming. The positive value indicates that both stocks are probably moving in the same direction. The zero or negative value indicates the possibility that the two stocks will move simultaneously. The calculation results can be seen in Table 3, as follows:

**Table-3: The correlation value between stocks**

	STTP	FOOD	PANI	ADES	CEKA	HOKI	MYOR	TBLA	SKLT	KEJU	COCO	PCAR	ULTJ	BUDI	ROTI	SKBM
STTP	1	-0.36	-0.21	-0.18	0.2	0.05	0.19	-0.14	0.09	-0.13	0.38	0.04	-0.64	0.18	-0.01	-0.59
FOOD	-0.36	1	-0.18	-0.22	0.2	-0.2	0.29	0.17	-0.03	-0.18	0.01	-0.05	0.33	-0.12	-0.55	0.2
PANI	-0.21	-0.18	1	0.58	0.20	0.33	-0.09	0.28	0.06	0.31	-0.07	0.01	0.36	0.52	0.05	0.08

ADES	-0.18	-0.22	0.58	1	0.48	0.33	0.35	0.55	0.24	0.49	-0.4	0.27	0.22	0.66	0.41	0.07
CEKA	0.2	0.2	0.2	0.48	1	0.21	0.43	0.39	0.21	0.03	-0.17	-0.12	0.17	0.6	-0.05	-0.17
HOKI	0.05	-0.2	0.33	0.33	0.21	1	0.05	0.51	0.13	-0.06	0.38	0.24	-0.12	0.47	0.52	-0.13
MYOR	0.19	0.29	-0.09	0.35	0.43	0.05	1	0.4	0.01	0.16	0.11	0.32	-0.35	0.36	0.06	0
TBLA	-0.14	0.17	0.28	0.55	0.39	0.51	0.4	1	0.17	0.16	-0.07	0.46	0.13	0.66	0.18	-0.21
SKLT	0.09	-0.03	0.06	0.24	0.21	0.13	0.01	0.17	1	0.13	-0.39	0.36	0.02	0.25	0.12	0.04
KEJU	-0.13	-0.18	0.31	0.49	0.03	-0.06	0.16	0.16	0.13	1	-0.25	0.54	0.2	0.17	0.23	0
COCO	0.38	0.01	-0.07	-0.4	-0.17	0.38	0.11	-0.07	-0.39	-0.25	1	1.13	-0.49	-0.09	0.02	-0.36
PCAR	0.04	-0.05	0.01	0.27	-0.12	0.24	0.32	0.46	0.36	0.54	1.13	1	-0.07	-0.01	0	-0.05
ULTJ	-0.64	0.33	0.36	0.22	0.17	-0.12	-0.35	0.13	0.02	0.2	-0.49	-0.07	1	-0.05	-0.19	0.42
BUDI	0.18	-0.12	0.52	0.66	0.6	0.47	0.36	0.66	0.25	0.17	-0.09	-0.01	-0.05	1	0.06	-0.24
ROTI	-0.01	-0.55	0.05	0.41	-0.05	0.52	0.06	0.18	0.12	0.23	0.02	0	-0.19	0.06	1	-0.05
SKBM	-0.59	0.2	0.08	0.07	-0.17	-0.13	0	-0.21	0.04	0	-0.36	-0.05	0.42	-0.24	-0.05	1

Source: The data processed, 2021

The next stage in the optimal portfolio forming is to calculate the expected return and risk in equal proportions. With these 16 stocks, each stock gets a proportion of 6.25%. The calculation result using Microsoft Excel program can be seen in Table 4 as follows:

Table 4: The calculation results of expected return and risk with the same proportion

No	Stock code	Proportion	No	Stock code	Standard deviation
1	STTP	6.25%	9	SKLT	6.25%
2	FOOD	6.25%	10	KEJU	6.25%
3	PANI	6.25%	11	COCO	6.25%
4	ADES	6.25%	12	PCAR	6.25%
5	CEKA	6.25%	13	ULTJ	6.25%
6	HOKI	6.25%	14	BUDI	6.25%
7	MYOR	6.25%	15	ROTI	6.25%
8	TBLA	6.25%	16	SKBM	6.25%
Expected return of the portfolio				22.87%	
The portfolio risk				21.42%	

Source: The data processed. 2021

To form an optimal portfolio, a solver application is used to determine the proportion of each

stock. The calculation results <sup>23</sup> can be seen in Table 5 as follows:

**Table-5: The calculation results of expected return and risk with different proportions**

No	Stock code	Proportion	No	Stock code	Proportion
1	STTP	10.14%	9	SKLT	0.00%
2	FOOD	8.95%	10	KEJU	0.00%
3	PANI	5.06%	11	COCO	0.00%
4	ADES	0.00%	12	PCAR	0.37%
5	CEKA	0.00%	13	ULTJ	20.61%
6	HOKI	0.00%	14	BUDI	0.00%
7	MYOR	0.00%	15	ROTI	48.05%
8	TBLA	0.00%	16	SKBM	6.82%
<b>Expected return of the portfolio</b>			<b>21.12%</b>		
<b>The portfolio risk</b>			<b>7.95%</b>		

Source: The data processed. 2021

<sup>36</sup> From the table 5, it can be seen that there are 7 stocks that will be selected in the optimal portfolio forming. They are: STTP (10.14%), FOOD (8.95%), PANI (5.06%), PCAR (0.37%), ULTJ (20.61%), ROTI (48.05%) and SKBM (6.82%). From the combination of these 7 stocks, an expected return of 21.12% can be obtained with a risk of 7.95%.

When the calculation results in Table 4 compared to Table 5, it shows that in Table 4 is investments with the same proportion in each stock have a higher expected return when compared to the results in Table 5. However, the level of risk in the calculation results in Table 4 much higher than Table 5. These results indicate that in the optimal portfolio forming needs diversification and anal<sup>30</sup> of the correlation between stocks. The purpose is to maximize the expected return and reduce the level of risk.

## CONCLUSIONS AND SUGGESTIONS

Determination of the optimal portfolio using the Markowitz model on stocks in the Food and Beverage sector based on the data of stock value in the period of December 2019 to November 2020 resulted in the selection of 7 stocks that could be candidates. The 7 <sup>20</sup> stocks are owned by *Siantar Top Tbk.*, *Sentra Food Indonesia Tbk.*, *Pratama Abadi Nusa Industri Tbk.*, *Prima Cakrawala Abadi Tbk*, <sup>38</sup> *Ultra Jaya Milk Industries & Trading Company Tbk.*, *Nippon Indosari Corpindo Tbk.*, and *Sekar Bumi Tbk.*

The proportions of each stock are as follows STTP (10.14%), FOOD (8.95%), PANI (5.06%), PCAR (0.37%), ULTJ (20.61%), ROTI (48.05%), and SKBM (6.82%). With the combination of these 7 stocks, an expected return of 21.12% can be obtained with a risk of 7.95%.

The Food and Beverage sector is one sector that is quite reliable during the current pandemic. It is because this sector is the primary need of the community, So that the commodity becomes a top

priority for the community to consume, and that the company's business can survive.

However, the author recommends investing not only in one sector, but in other sectors that are reliable. This can be analyzed through Markowitz's model. By the support of Microsoft Excel and Solver, stock calculations and analysis for the optimal portfolio forming can be done easily.

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