Underwriting and Investment Portfolio Optimization for Insurance Company based on Markowitz Portfolio Selection (Study on BRINS General Insurance)

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ABSTRACT

This study aimed to compare the performance of insurance portfolios based on Modern Portfolio Theory (MPT) and actual actively managed insurance portfolios. This study also compared the performance of a predictive insurance portfolio based on MPT and actual actively managed portfolio. A sample of the 32-month report of underwriting and investment performance in BRINS General Insurance was analysed using descriptive statistics, and Wilcoxon signed-rank test. This study found no significant difference between the performance of a portfolio based on MPT and the performance of the actual actively managed portfolio. However, the MPT based portfolio significantly underperformed compared to the actual actively managed portfolio when used predictively.

Keywords: *Modern Portfolio Theory, Insurance Portfolio, Underwriting Portfolio, Investment Portfolio.*

ABSTRAK

Penelitian ini bertujuan untuk membandingkan kinerja portofolio asuransi berdasarkan Modern Portfolio Theory (MPT) dan portofolio asuransi asli yang dikelola secara aktif. Penelitian ini juga membandingkan kinerja prediksi portofolio asuransi yang berdasarkan MPT dan portofolio asuransi asli yang dikelola secara aktif. 32 Sampel laporan bulanan kinerja underwriting dan investasi BRINS General Insurance dianalisis dengan menggunakan deskriptif statistik dan Wilcoxon signed-rank test. Penelitian ini menemukan bahwa tidak ada perbedaan signifikan antara kinerja portofolio berdasarkan MPT dan kinerja portofolio asli yang dikelola secara aktif. Namun, portofolio berdasarkan MPT secara signifikan bekerja lebih buruk dari kinerja portofolio asli yang dikelola secara aktif ketika digunakan sebagai prediksi.

Kata Kunci: *Modern Portfolio Theory, Insurance Portfolio, Underwriting Portfolio, Investment Portfolio.*

INTRODUCTION

In the most recent publication by Badan Perencanaan Pembangunan Nasional (Bappenas), GDP growth in Indonesia has fallen to -5.32% in the 2nd quarter of 2020. According to Bappenas, the Finance and Insurance sector grew by 4.2% in 2018. The growth rate increased in 2019 as finance and insurance sector grew by 6.6%. Due to the increase of Covid-19 case in Indonesia, most sectors showed a negative growth rate in the 2nd quarter of 2020. On the other hand, the finance and insurance sector showed positive growth for 1.0% in the 2nd quarter of 2020 (Kementerian PPN/Bappenas, 2020).

The main distinguishing characteristic of insurance companies is their income source. The main income sources of insurance companies are based on investment income and underwriting income. Investment income is based on investment assets such as time deposit, stock, corporate bond, government bond, and so on (OJK, 2016). Meanwhile, underwriting income is based on premium revenue, reinsurance premium revenue, and decreases on technical reserves such as premium reserve, claim reserve, and unearned premium reserve (Cadangan Atas Premi Yang Belum Merupakan Pendapatan/CAPYBMP). The amount of technical reserve is based on the current risk that the insurance company bears. Once the contract period of an insurance ends, insurance companies can decrease their reserve on that particular insurance and claim it as revenue (OJK, 2017).

In a paper published in the journal of management science, Yehuda Kahane (Kahane, 1977) argues that the activity of an insurance company may be viewed as the management of a portfolio of insurance policies, in addition to the handling of an investment portfolio. The rates of profit of every two insurance activities may be correlated, and this gives rise to interesting risk-reduction effects through diversification (e.g., through multiple-line operation). This study investigated whether Modern Portfolio Theory which may be applicable on stocks portfolio can also be applied to the insurance portfolio.

In a Magazine titled ’30 Best Insurance Companies 2020’ published by Beritasatu Media Holding (INVESTOR, 2020), 30 insurance

companies is listed as the best based on several indicators such as average assets growth rate from 2015 until 2019, average equity growth rate from 2015 until 2019, ROE 2019, ROA 2019, RBC 2019, and many other indicators. An interesting indicator is a Ratio of underwriting to Net Premium, which similar to gross margin to sales in other industries. Out of top 30 insurance companies, BRINS General Insurance is ranked as the highest performing in term of underwriting to net premium ratio in 2019. Thus, this may be an indication of well managed underwriting portfolio and a good object to be researched.

This study aims to suggest the optimal composition of the insurance and investment portfolio of an insurance company based on historical data by using the Markowitz portfolio selection model. Markowitz portfolio model (Markowitz, 1952) assumes that an optimum portfolio is a portfolio with the minimum variance of return on equity (risk) for any given level of profitability (expected return). Thus, Sharpe ratio (Sharpe, 1966) may be used as it measures the portfolio's expected return per portfolio's deviation to find out the optimal composition.

A study by Kierkegaard et al. (Kierkegaard, et al., 2006) investigated the possibility of beating an index portfolio by applying Modern Portfolio Theory (MPT). The study employed the quantitative method since the data input is gathered from historical data. The results show that actively managed optimal risky portfolios with guidance of the MPT can surpass the OMX 30 index within the selected timeframe. A similar result was also found in a study by Kirby and Ostdiek (Kirby & Ostdiek, 2012). In their study, Kirby and Ostdiek found that Mean-Variance optimization often outperforms Naïve diversification. Another study by Wang (Wang, 2008) shows that a test portfolio based on a single index underperforms the market but outperforms government bonds. All the previous studies objectives are similar to the objective of the current study which is to investigate the performance of the optimized portfolio. However, rather than comparing it to a market index or government bond, this study compared

the performance of the optimized portfolio and the current portfolio.

In addition to comparing the performance of the optimized portfolio and the current portfolio, the researcher also studied whether an optimized portfolio based on historical data may perform well in a predictive scenario. A study by Manning & Napier (Manning & Napier, 2014) suggests that using historical data may not be a good approach to MPT. By using historical data, the portfolio implies that future returns and volatility will reflect those of the past when, in fact, return and volatility statistics can vary greatly even over longer-term periods. A similar suggestion is also shown in a study by Rodrigues (Rodrigues, 2009) which suggests that instead of using historical data, MPT needs to use three to five years forecasting return as they represent the future market. Both of the studies argue that using historical data may not an excellent approach to MPT as future returns and volatility may not be reflected from past performance. This study investigated whether MPT, based on historical data, can perform well in a predictive scenario. Lastly, rather than focusing only on investment portfolio, this study investigated BRINS General Insurance underwriting portfolio and investment portfolio.

Literature Review

Insurance

Referring to the Law of the Republic of Indonesia (Republic of Indonesia, 2014), insurance is defined as an agreement between two parties, namely the insurance company and the policyholder, which becomes the ground for the receipt of premium by the insurance company as an exchange for providing compensations to the insured or policyholder due to loss, damage, incurring cost, profit loss, or legal liability towards third parties which may be suffered by the insured or policy holder due to an uncertain event; or providing payments based on the death of the insured or a payment based on the life of the insured with a benefit of which value has been determined and/or based on the result of fund management. Insurance business may also separate into two types, life insurance and general insurance business.

Life Insurance Business

In general, life insurance provides death benefit for the insured's

beneficiaries. Referring to the Law of Republic of Indonesia (Republic of Indonesia, 2014), Life Insurance Business is defined as a business organizing the service of risk alleviation providing payment towards the policy holder, the insured, or other parties entitled in the event of death or life of the insured, or other payments to the policy holder, the insured, or other parties entitled in a specific time as set in the agreement, of which amount has been stipulated and/or based on the result of the fund management. In Indonesia, life insurance products are provided by the government and private companies. In most cases, a life insurance contract excludes a death benefit caused by suicide, fraud, war, riot, and civil commotion

General Insurance Business

life insurance provides death benefit to the insured's beneficiaries, general insurance provides payment for a loss of the insured products. Referring to the Law of Republic of Indonesia (Republic of Indonesia, 2014), General Insurance Business is defined as a business of risk insurance service providing compensation to the insured or policy holder due to loss, damage, incurred cost, profit loss, or legal liability towards third parties which may be suffered by the insured or policy holder due to an uncertain event. General insurance can be defined as any insurance which is not life insurance.

History of Portfolio Theory

While it is unclear when did portfolio theory started to develop, the earliest portfolio model may be from a book called '*Theory of Investment Value'* written by John Burr Williams in 1938. Williams's book describes a stock valuation model based on the dividend. However, rather than diversification, Williams assumes that investors may purchase undervalued stocks in the market.

Another most cited portfolio theory may be a study by Harry Markowitz in 1952. In his journal, Markowitz proposed a model for an efficient portfolio based on the following assumptions:

1. Investors are rational and not only aiming for maximum return but also minimal risk.
2. Markets are perfectly efficient.
3. If there are two securities with the exact same return, the investor will prefer the one with lower risk.

4. If there are two securities with the exact same risk, the investor will prefer the one with a higher return.

A portfolio with the above assumptions is considered efficient as there are no other portfolios with a higher return at a given risk or lower risk at a given return. In his model, Markowitz argues that diversification should not only reduce the risk of security by reducing its standard deviation but also by reducing the covariance or interactive risk of two or more assets in the portfolio.

Sharpe argues that conditional risk should be considered. Sharpe breakdown the return from investment into two prices: the *price of time*, or the pure interest rate, and the *price of risk,* the additional expected return per unit of risk borne (Sharpe, 1964). Thus, he described that Markowitz, maybe a normative model. Later, the Capital Asset Pricing Model, which value the importance of Time Value of Money was developed by Treynor (1961, 1962), Sharpe (1964), Lintner (1965), and Mossin (1966), improving the previous work of Harry Markowitz on diversification and Modern Portfolio Theory.

Ross, in 1976 developed a model called Arbitrage Pricing Theory (APT) which is derived from the CAPM model. While CAPM focuses only on the *price of time* and *price of risk,* APT has multiple factors that include non-company factors, which require the asset's beta in relation to each separate factor. Although the Ross model may create a more accurate prediction of the expected return, Ross did not determine the relevant factors. In other words, portfolio managers that use APT may need to determine the relevant factors themselves (Ross, 1976).

Although Modern Portfolio Theory mostly focuses on stocks portfolio, Kahane in 1977 developed a portfolio model for insurance companies line of products and investment. In his dissertation, Kahane argues that the rates of profit for two insurance activities may be correlated, giving rise to interesting risk-reduction effects through diversification. While the Kahane model was derived from MPT, he modified the model with Sharpe's single index. Thus, he used the correlation between the product compared to the index instead of the correlation between each product. His

main objective was to reduce the needed parameters as computers were not as powerful as today (Kahane, 1977).

The latest development of portfolio theory may be the theory called Post-Modern Portfolio Theory (PMPT), introduced in 1993 by Rom and Ferguson. They argue that MPT may have significant flaws: 1) variance of portfolio returns in the correct measure of investment risk, and 2) that the investment returns of all securities and assets can be adequately represented by the normal distribution (Rom & Ferguson, 1993). Rom and Ferguson illustrate the difference between the *downside-risk* they proposed and the *mean-variance* approaches derived from MPT. With the MPT approach, risks are symmetrical, whereas PMPT assumes risks are asymmetrical. In other words, MPT approach optimal portfolio may result in two possibilities: 1) expected return may increase at the similar rates overtime, and 2) expected return may decrease at the similar rates overtime. Thus, PMPT focus on measuring target semi-deviation (downside deviation) and captures what investors fear the most: having negative returns.

Portfolio Return and Deviation

Derived from Markowitz Portfolio Model (Markowitz, 1952), the portfolio return and deviation are denoted as follows:

$$E = \sum_{i=1}^{N} X_i r_i$$

Where:

E = Expected Return of the Portfolio

N = Number of Products/Assets

X_i = Weight of each product/asset, with its total weight i as 1 or 100%

r_i = return of each individual Products/Assets

Using product/asset i and j as examples, the standard deviation of the portfolio denoted as follows:

$$\sigma_p = \sqrt{{X_i}^2 {\sigma_i}^2 + {X_j}^2 {\sigma_j}^2 + 2X_i X_j (r_{ij} \sigma_i \sigma_j)}$$

Where:

σ_p = Standard Deviation of the Portfolio

X_i = Weight of product/asset i

X_j = Weight of product/asset j

σ_i = Standard Deviation of product/asset i

σ_j = Standard Deviation of product/asset j

r_{ij} = Correlation Coefficient of i and j $= \frac{Covariance_{ij}}{\sigma_i \sigma_j}$

Sharpe Ratio

Sharpe ratio is calculated to find the expected return after *risk-free-rate* per deviation of the portfolio. By maximizing the *Sharpe ratio*, the portfolio deviation is minimized. As suggested by Sharpe (Sharpe, 1966), *Sharpe ratio* is denoted as follows:

$$Sharpe\ Ratio = \frac{r_p - r_f}{\sigma_p}$$

Where:

σ_p = Standard Deviation of the Portfolio

r_p = expected portfolio return

r_f = risk-free-rate

Hypothesis Model

A hypothesis is an idea or explanation of something based on a few known facts but has not yet been proved to be true or correct. (Oxford Learner's Dictionaries, 2020) A hypothesis is a tentative, yet testable, statement predicting what the researcher expects to find his empirical data. (Sekaran & Bougie, 2016). Therefore, hypothesis can be defined as an idea or statement that has not yet been proven true. Although the research objective tends to be followed with research hypotheses, the first objective of this study is not necessarily needed to be followed with a hypothesis. The first objective of this study is to suggest a composition of the BRINS General Insurance underwriting portfolio and investment portfolio. The first objective can be solved by finding the expected monthly return of each product or asset (represented by average monthly return), finding the variance and covariance of each product or asset, and maximizing the portfolio ratio of return to deviation. It must be noted that there must be no product or asset with negative weight in the portfolio.

The hypotheses for the two other objectives are as follows:

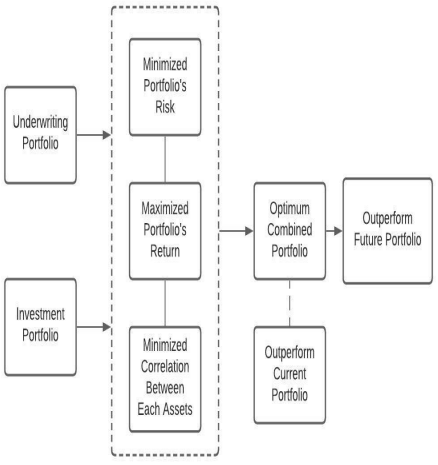


Figure 1. The Hypothesis Model

Source: Primary data processed, 2020

H1: Optimum combined portfolio performance significantly outperforms current portfolio

Kierkegaard *et al.* discovered that an optimal portfolio provides investor with a higher return during the chosen frame time (Kierkegaard, et al., 2006). Wang, on the other hand, found that the test portfolio based on MPT underperform the market index but still outperform the government bond (Wang, 2008). Lastly, Kirby and Ostdiek (Kirby & Ostdiek, 2012) found that mean-variance optimization often outperforms naïve diversification. In this study, the researcher investigated whether a combined portfolio optimized by maximizing the *Sharpe ratio* can significantly outperform the current portfolio. Referring to the past studies mentioned above, the researcher hypothesized that optimized portfolio using MPT may significantly outperform the current portfolio

H2: Optimum combined portfolio based on historical data performance significantly outperforms actual portfolio

An article published by Manning & Napier (Manning & Napier, 2014) suggests that MPT use of historical data implies that future asset class and volatility will reflect those of the past, which can vary greatly even over longer-term periods. A study by Rodrigues (Rodrigues, 2009) recommends using three to five years of forecasting returns instead of using historical data to calculate the optimal portfolio as they should represent future market prediction. In this study, the researcher investigated whether combined portfolio optimized by maximizing the *Sharpe ratio* based on historical data can significantly outperform the actual portfolio.

Research Method

Research Design

This study used a quantitative method with explanatory approach. Sugiyono (Sugiyono, 2013) suggests that quantitative research method can be defined as a research method that is based on the philosophy of positivism sample and is used to examine the population or a particular sample using the research data, an instrument of research, quantitative data analysis or statistics to test the hypothesis that has been set. Explanatory research, as defined by Singarimbun and Effendi (Singarimbun & Effendi, 2011) explains the relationship between the

variable and the previous study that have been formulated before.

This study replicates the portfolio model suggested by Markowitz (Markowitz, 1952) to maximize *Sharpe ratio* as suggested by Sharpe (Sharpe, 1966). This study is inspired by a study proposed by Kahane (Kahane, 1977) which suggests that the rates of profit of every two insurance activities may be correlated.

Research Location

This study utilized the BRINS General Insurance underwriting portfolio and investment portfolio. The data were obtained from BRINS General Insurance main office located in Jakarta. Although the data was obtained in Jakarta, it covers performance from all Brins General Insurance Branches in Indonesia.

Research Data & Source

This study used secondary data in the forms of monthly financial report, underwriting performance report, and non-underwriting performance report. There is a total of 32 monthly reports used for this study ranging from January 2018 to August 2020. The data are undisclosed to the public and obtained from an authorized key person in BRINS General Insurance.

Data Collection Method

The data for this study are obtained through documentation. The documented data are obtained through an authorized key person in BRINS General Insurance. The obtained data are undisclosed, and the researcher permission to use the data is solely for this research

Data Analysis Method

In this study, the optimal portfolio for the period is based on actual data for the period. The optimal portfolio can be found by the following methods:

1. *Calculate the monthly return*

   In this study, the return is derived from net underwriting income and investment return. This study eliminated any expenses which are not directly related to the underwriting or investment income.

2. *Calculate the expected monthly return for each product or investment (represented by average monthly return)*

$$Expected\ Monthly\ Return = \frac{\sum Monthly\ Return}{Number\ of\ sample}$$

3. *Create variance and covariance matrix*

$$VAR(X) = \frac{\sum(X - \bar{X})}{N}$$

$$COVAR(X,Y) = \frac{\sum(X - \bar{X})(Y - \bar{Y})}{N}$$

4. *Create an optimal portfolio by maximizing Sharpe ratio*

Optimal portfolio in this study is created by maximizing the portfolio's *Sharpe ratio*. The *Sharpe ratio* is calculated by dividing the expected portfolio's revenue with the portfolio's standard deviation. The expected return of the portfolio is calculated by multiplying the matrix of each product or investment portfolio weight and the matrix of each products or investment's expected return. Portfolio's deviation is calculated by multiplying the matrix of each products or investment portfolio weight and the variance covariance matrix, then multiplying the result with the matrix of each product or investment portfolio weight again and square rooting the result. Some constraints which must be fulfilled are the total portfolio weight must be equal to 1, and there must be no products or investment with negative weight.

It must be noted that although *Sharpe ratio* is denoted as $\frac{\text{(Return – Risk free rate)}}{Standard\ Deviation}$, this study eliminates the risk-free rate aspect as some insurance products might have return lower than risk-free rate. Thus, if the risk-free rate is not eliminated, some products may have a negative ratio that implies investing in risk free rate asset is better than operating the core business of insurance company.

5. *Compare the portfolio's performance before and after optimalization*

After the optimal portfolio composition is created, the performance is compared with the current portfolio. It must be noted that this study assumed that the return percentage of each instrument remains the same after the change of portfolio's weight composition. As an example, stock X may give a monthly return of 2% during the sample period. Thus, this study assumed that increasing or decreasing the weight of stock X on the portfolio will not change the return percentage given by investing in stock X. Lastly, this study used the return means to represent the expected return

In contrast, the performance stability is represented by the standard deviation and the distribution kurtosis.

Hypothesis Test Method

This Study used Wilcoxon Signed-Rank Test to test the hypothesis. According to Statistics Solutions (Statistics Solutions, 2021), the Wilcoxon signed-rank test works with metric (interval or ratio) data that is not multivariate normal or with ranked/ordinal data.

Finding and Discussion

Portfolio Optimization for 32-month Period

Table 1. Optimal Underwriting Portfolio

OPTIMAL UNDERWRITING PORTFOLIO	
Property	0.00%
Motor Vehicle	7.32%
Marine Cargo	9.33%
Marine Hull	5.07%
Aviation Hull	0.21%
Satellite	1.59%
Energy	58.54%
Engineering	0.65%
Liability	0.00%
Accident & Health	0.29%
Bonds	11.97%
Miscellanous	5.02%
Credit	0.00%
Standard Deviation	14.89%
Expected Return	32.99%
Sharpe Ratio	2.22

Source: Primary data processed, 2021

Table 1 shows the optimum weight combination for each insurance product during the 32-month sample period. Energy Insurance is the most preferred as the product represents 58.54% of the underwriting portfolio.

Table 2. Optimal Investment Portfolio

OPTIMAL INVESTMENT PORTFOLIO	
Time Deposit	9.16%
Mandatory Deposit	1.52%
Cash or Equivalent	84.92%
Bond	4.40%
Stocks	0.00%
Standard Deviation	0.07%
Expected Return	0.16%
Sharpe Ratio	2.15

Source: Primary data processed, 2021

Table 2 shows the optimum weight combination for each investment product during the 32-month sample period. Cash or Equivalent and Time Deposit is the most preferred as the investment represents 84.92% and 9.16% of the investment portfolio respectively.

Portfolio Performance

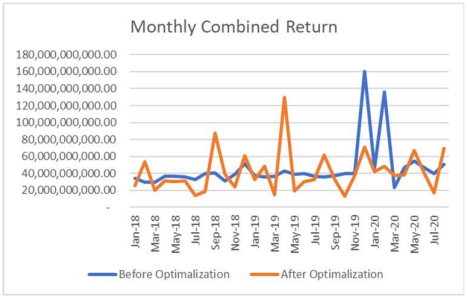


Figure 2. Monthly Performance Comparison for 32-Months Period

Source: Primary data processed, 2021

Out of a 32-month period, the optimal portfolio outperforms the current portfolio for 10 months while

the current portfolio outperforms the optimal portfolio for 22 months.

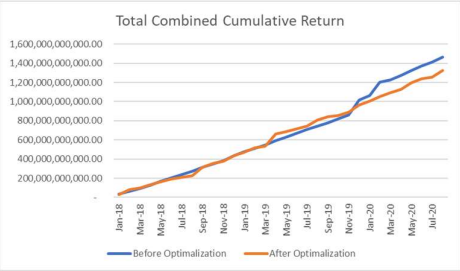


Figure 3. Cumulative Performance Comparison for 32-Months Period

Source: Primary data processed, 2021

When calculated cumulatively, out of a 32-month period, the optimal portfolio outperforms the current portfolio for 14 months, while the current portfolio outperforms the optimal portfolio for 18 months

Table 3. Descriptive Statistics for 32-Month period

Descriptives

			Statistic	Std. Erro
Return_Before_Optimalization_32_Months	Mean		4.5766E+10	49200004
	95% Confidence Interval for Mean	Lower Bound	3.5732E+10	
		Upper Bound	5.5801E+10	
	5% Trimmed Mean		4.1013E+10	
	Median		3.9097E+10	
	Variance		7.746E+20	
	Std. Deviation		2.78317E+10	
	Minimum		2.37E+10	
	Maximum		1.61E+11	
	Range		1.37E+11	
	Interquartile Range		9208115071	
	Skewness		3.521	.4
	Kurtosis		12.326	.8
Return_After_Optimalization_32_Months	Mean		4.1342E+10	43587825
	95% Confidence Interval for Mean	Lower Bound	3.2453E+10	
		Upper Bound	5.0232E+10	
	5% Trimmed Mean		3.8848E+10	
	Median		3.5410E+10	
	Variance		6.080E+20	
	Std. Deviation		2.46570E+10	
	Minimum		1.35E+10	
	Maximum		1.30E+11	
	Range		1.16E+11	
	Interquartile Range		2.81E+10	
	Skewness		1.734	.4
	Kurtosis		4.211	.8

Source: Primary data processed, 2021

Table 3 Above shows that the median return after optimization is lower than the median return before optimization. However, the return after optimization shows a lower deviation compared to the return before optimization. It may indicate that although the optimal portfolio may underperform the current portfolio, the optimal portfolio may give more stable returns.

Both portfolios show positive skewness, which indicate higher frequency distribution below the median of the data. However, the optimal portfolio skewness is closer to 0 compared to the current portfolio, which may indicate a more symmetrical return distribution compared to the current portfolio. Both current and optimal portfolio show kurtosis >3, which indicate a leptokurtic data distribution. However, the optimal portfolio indeed had lower kurtosis compared to the current portfolio.

Normality Test

Table 4. Test of Normality for a 32-month Period

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Return_Before_Optimalization_32_Months	.323	32	<.001	.491	32	<.001
Return_After_Optimalization_32_Months	.180	32	.010	.855	32	<.001

a. Lilliefors Significance Correction

Source: Primary data processed, 2021

As the normality test result shows p value lower than 0.5 which indicates that both portfolios are not normally distributed, this study

decided to use the non-parametrical Wilcoxon signed-rank test to test the hypothesis.

Hypothesis Test

As the data for both portfolio on a 32-month period is not normally distributed, a non-parametrical Wilcoxon signed-rank test was conducted to test the hypothesis.

Table 5. Hypothesis Test Result for 32-Month Period

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The median of differences between return Before optimization And Return after Optimization equals 0.	Related-Samples Wilcoxon Signed-rank Test	.313	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Source: Primary data processed, 2021

Table 5 shows that the p value of the test between a portfolio of 32-month period before and after optimization is 0.313. With a significance level of 0.050, the most appropriate decision is to retain the null hypothesis.

Portfolio Optimization for 16-month Period

Table 6. Optimal Underwriting Portfolio

OPTIMAL UNDERWRITING PORTFOLIO	
Property	5.03%
Motor Vehicle	4.04%
Marine Cargo	0.25%
Marine Hull	0.00%
Aviation Hull	0.07%
Satellite	0.48%
Energy	84.18%
Engineering	1.01%
Liability	0.05%
Accident & Health	4.08%
Bonds	0.46%
Miscellanous	0.30%
Credit	0.03%
Standard Deviation	1.87%
Expected Return	7.97%
Sharpe Ratio	4.26

Source: Primary data processed, 2021

Table 6 shows the optimum weight combination for each insurance product during the 16-month sample period. Energy Insurance is the most preferred as the product represents 84.18% of the underwriting portfolio.

Table 7. Optimal Investment Portfolio

OPTIMAL INVESTMENT PORTFOLIO	
Time Deposit	0.00%
Mandatory Deposit	66.86%
Cash or Equivalent	33.02%
Bonds	0.00%
Stocks	0.12%
Standard Deviation	0.05%
Expected Return	0.28%
Sharpe Ratio	5.76

Source: Primary data processed, 2021

Table 7 shows the optimum weight combination for each investment product during the 16-month sample period. Mandatory Deposits and Cash

or equivalent are the most preferred as the investment represents 66.86% and 33.02% of the investment portfolio respectively.

Portfolio Performance

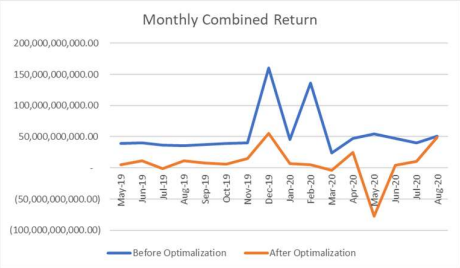


Figure 4. Monthly Performance Comparison for 16-Months Period

Source: Primary data processed, 2021

Out of a 16-month period, the optimal portfolio outperforms the current portfolio for 0 months while the current portfolio outperforms the optimal portfolio for 16 months.



Figure 5. Cumulative Performance Comparison for 16-Months Period

Source: Primary data processed, 2021

When calculated cumulatively, out of the 16-month period, the optimal portfolio outperforms the current portfolio for 0 months while the current portfolio outperforms the optimal portfolio for 16 months.

Table 8. Descriptive Statistics for 16-Month period

Descriptives

			Statistic	Std. Error
Return_Before_Optimalization_16_Months	Mean		5.4601E+10	9367583216
	95% Confidence Interval for Mean	Lower Bound	3.4634E+10	
		Upper Bound	7.4567E+10	
	5% Trimmed Mean		5.0431E+10	
	Median		4.0023E+10	
	Variance		1.404E+21	
	Std. Deviation		3.74703E+10	
	Minimum		2.37E+10	
	Maximum		1.61E+11	
	Range		1.37E+11	
	Interquartile Range		1.22E+10	
	Skewness		2.401	.564
	Kurtosis		4.926	1.091
Return_After_Optimalization_16_Months	Mean		8168738950	7013618579
	95% Confidence Interval for Mean	Lower Bound	-6780435184	
		Upper Bound	2.3118E+10	
	5% Trimmed Mean		1.0287E+10	
	Median		7144011668	
	Variance		7.871E+20	
	Std. Deviation		2.80545E+10	
	Minimum		-7.71E+10	
	Maximum		5.53E+10	
	Range		1.32E+11	
	Interquartile Range		9756833588	
	Skewness		-1.527	.564
	Kurtosis		6.050	1.091

Source: Primary data processed, 2021

shows that the median return after optimization is lower than the median return before optimization. However, the return after optimization shows a lower deviation compared to the return before optimization. It may indicate that although an optimal portfolio may underperform the current portfolio, the optimal portfolio may give a more stable return.

The portfolio before optimization shows positive skewness, which indicates a higher frequency distribution below the median of the data. While the portfolio after optimization shows negative skewness, which indicates a lower frequency distribution below the median of the data. Additionally,

optimal portfolio skewness is closer to 0 compared to the current portfolio, which may indicate that the return distribution is more symmetrical compared to the current portfolio. Both current and optimal portfolio show that kurtosis is >3, which indicates leptokurtic data distribution is. However, the optimal portfolio had higher kurtosis compared to the current portfolio.

Normality Test

Table 9. Test of Normality for a 16-month Period

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Return_Before_Optimalization_16_Months	.374	16	<.001	.592	16	<.001
Return_After_Optimalization_16_Months	.269	16	.003	.763	16	<.001

a. Lilliefors Significance Correction

Source: Primary data processed, 2021

As the normality test result shows p value lower than 0.5 which indicates that both portfolios are not normally distributed, this study decided to use the non-parametrical Wilcoxon signed-rank test to test the hypothesis.

Hypothesis Test

As the data for both portfolio on a 16-month period is not normally distributed, a non-parametrical Wilcoxon signed-rank test was conducted to test the hypothesis.

Table 10. Hypothesis Test Result for 16-Month Period

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The median of differences between Return Before Optimization and Return After Optimization equals 0.	Related-Samples Wilcoxon Signed-rank Test	.000	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Source: Primary data processed, 2021

Table 10. shows that the p value of the test between portfolio of 16-month period before and after optimization is 0.000. With a significance level of 0.050, the most appropriate decision is to reject the null hypothesis.

Research Implication

In this study, both optimal portfolio underperforms current portfolio for both periods. The first comparison between the 32-month period portfolio before and after optimization suggested that the optimal portfolio may underperform the current portfolio. This result is in correspondence with a study by Wang (Wang, 2008), which stated that MPT portfolio underperforms the market. However, it contradicts Kierkegaard et al. (Kierkegaard, et al., 2006) study, which stated that MPT portfolio could outperform the market.

Additionally, the 16-month period optimal portfolio significantly underperforms the current portfolio.

The researcher believes that this may indicate the fact that past performance may not reflect future performance. Products such as Liability and Accident & Health were expected to provide a well positive return based on the first 16-month period, while in fact, it provides a negative return on average during the second 16-month period. This issue was addressed by Manning & Napier (Manning & Napier, 2014), which stated that return and volatility statistics within a given asset class can vary greatly even over longer-term time periods. A better approach to MPT is probably by using forecasting return instead of historical return as suggested by Rodrigues (Rodrigues, 2009).

There are some impracticalities for underwriting portfolio based on MPT Those issues are *Marketing Constraints* and *Stakeholder Interest*. In his dissertation, Kahane (Kahane, 1977) addressed the *Marketing Constraints* which are imperative. Unlike investing in stocks or bonds or any other investment product, underwriting revenue is based on the demand on the market. Thus, an insurance company may not be able to change the composition of the revenue they earned as simple as changing the composition of an investment portfolio. Lastly, it is important to consider the *Stakeholder Interest* when creating the underwriting portfolio composition. As described in the general description, BRINS General Insurance is subsidiary of Bank Rakyat Indonesia. Hence, a product such as credit insurance composition may not be simply changed, although it may give negative returns on average. Thus, the credit insurance may secure the stability of return for Bank Rakyat Indonesia.

Conclusion and Recommendation

Conclusion

After discussing the study results, the following conclusions were drawn:

1. Using the 32-month sample period, optimal portfolio composition for BRINS General Insurance based on MPT model for both the underwriting and investment portfolio are as shown in Table 1 and Table 2, respectively. Whereas optimal composition based on the 16-month sample period is as shown in Table 6 and Table 7, respectively.

2. Although the descriptive statistics indicate that an optimal portfolio may provide lower return and higher stability compared to the actual portfolio, the hypothesis test suggests that there is no significant difference between an optimal portfolio and the current portfolio.
3. When used to predict future performance, the optimal portfolio may provide a lower return and higher stability compared to the actual portfolio. The hypothesis test suggests that there is a significant difference between prediction portfolio performance and the actual portfolio.

Recommendation

Several recommendations were drawn for both future researcher and practitioner of the insurance business, and the suggestions are as follows:

1. Instead of using MPT approach when constructing the portfolio, PMPT approach is recommended as it also takes the downside risk into account.
2. If possible, adding a mathematical model of the marketing constraints when constructing the optimal portfolio is recommended as it reflects actual business practice.
3. If possible, adding a mathematical model of the stakeholder interest is recommended as the stakeholder interest may limit the change of portfolio composition.

This study is limited by the available sample of the data. If possible, using annual reports as sample instead of monthly reports is recommended as annual reports tend to be less volatile compared to monthly reports.

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