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# Monte Carlo Simulation for Data Volatility Analysis of Stock Prices in Islamic Finance for Malaysia Composite Index

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***Abstract*—** *The objective of this study is to evaluate the volatility rate of sharia-company in Malaysia Stock Exchange using Monte Carlo Simulation (MCS). This study collected daily stock price form Thomson Reuters Datastream for calculating monthly return and volatility rate. In validating the findings of volatility rate, this study performed normality diagnostics test, and Monte Carlo Simulation (MCS). Result indicates the distribution of volatility rate is follows normal distribution. In addition, Monte Carlo Simulation also proved the volatility rate is 4.85% and standard deviation is 2.23. Result of process capability shows the value of volatility rate is under statistical control with implementation on Monte Carlo Simulation. The significant of this study is it provides a better understanding for investors regarding the financial environment in Malaysia Stock Exchange. This information will help investors to make proper selection of their investment portfolio.*

***Keywords*— Monte Carlo Simulation, Malaysia Stock Exchange, Volatility, Islamic Finance.**

## I. INTRODUCTION

Financial economists, market participants and international organizations view shariah-compliant companies as a main key in contributing capital into financial market in Malaysia. An accurate forecast of future volatility delivers important information to market participants and, consequently, there is an option to essentially bet on volatility (Kongsilp, Mateus, 2017).

Various empirical investigations have been performed to analyze the volatility of shares price. Forecasting volatility of shares price plays important roles in investment market (Abu Bakar and Rosbi, 2017). Volatility is measure variation of price of financial instrument over time, and as much the market is volatile, it creates risk which is associated with the degree of dispersion of returns around the average (Siddikee and Begum, 2016). Lack of efficiency in monitoring, regulating and supervising would result with the collapse of stock market such as high volatility and bad company performance in term of revenue, dividend and etc. (Abu Bakar, et al., 2018a).

Therefore, the purpose of this paper is to determine level of volatility among shariah-compliant companies on Malaysia Stock Exchange. The main important to be listed on the shariah board is that companies must be free from prohibited element in shariah law such as riba, gharar and maisir (Abu Bakar and Rosbi, 2016).

The method implemented in this study is volatility calculation, normality checking procedure and Monte Carlo Simulation. Monte Carlo Simulation approach is widely used in the literature (Prakash and Mohanty, 2017; Watzenig et al., 2011; Ghiani, et al., 2004). Currently, Monte Carlo approach is tested in the financial field. According to Adkins and Gade (2012) Monte Carlo simulations are a very powerful way to demonstrate the basic sampling properties of various statistics in econometrics. The main function of Monte Carlo approach is to develop large data set. Thus, this study try to fulfill the gap by investigate the level of volatility among shariah-compliant companies listed on the Malaysian Stock Exchange using a Monte Carlo Simulation method.

## II. LITERATURE REVIEW

Investment is the complex process involving decision making regarding the possible expected rate of return (Abu Bakar and Rosbi, 2018b). Investors can reduce risk even more substantially if they hold an internationally diversified fund as globally diversified portfolios would dominate domestic-only ones on the efficient frontier (Bahlous and Mohd. Yusof, 2014). Study by Mohd Thas Thaker, et al., (2018) regarding the influence of information content and the informativeness of analyst reports towards cumulative abnormal return in the Malaysian market found target price, earnings forecast, return on equity, cash flows to price and sales to price ratio variables are shown to have a strong association with the returns.

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Messis and Zapranis (2014) investigate the existence of herding in the Athens Stock Exchange over the 1995-2010 periods and examine the effects on market volatility. They found that the large differences are observed among the portfolios regarding the herding periods. The results confirm a linear effect of herding on all volatility measures considered. Stocks exhibiting higher levels of herding or adverse herding will also present higher volatility, and from this point of view, herding can be regarded as an additional risk factor. Study from Coskun and Ertugrul (2016) regarding volatility housing price in Turkey suggest several points. First, city/country-level house price return volatility series display volatility clustering pattern and therefore volatilities in house price returns are time varying. Then, a significant economic event may change country/city-level volatilities. Lastly, house price return volatilities differ across geographic areas, volatility series may show some co-movement pattern.

Ismal (2010) uses Value at Risk (VaR) approach to compute the volatility (risk) of returns and expected losses of Islamic bank financing in Indonesia found that the equity and debt-based financing produce sustainable returns of bank financing. He also found that the performance of service-based financing is very sensitive to the economic conditions and finds that risk of investment and expected losses are well managed. While studying the materials of Floros and Salvador (2015) regarding the effect of trading volume and open interest on the volatility of futures, markets found that market depth has an effect on the volatility of futures markets but the direction of this effect depends on the type of contract. Akhtar and Khan (2016) analyzing the nature of volatility on the Karachi Stock Exchange and develop an understanding as to which model is most suitable for measuring volatility among those used. The results reveal that daily, weekly and monthly return series show non-normal distribution, stationary and volatility clustering. The study shows the high persistence of volatility, a mean-reverting the process and an absence of a risk premium in the Karachi Stock Exchange market with an insignificant leverage effect only in the case of weekly returns. In addition, to analyze the impact of global financial crises upon volatility, their findings show that the sub-periods demonstrated a slightly low volatility and the global economic crisis did not cause a rise in volatility levels. Therefore, this study tries to fulfill the gap by investigate the volatility of shariah companies using Monte Carlo Simulations method.

## III. RESEARCH METHODOLOGY

The purpose of this paper is to determine level of volatility among sharia-compliant companies on Malaysia Stock Exchange. The method implemented in this study is volatility calculation, normality checking procedure and Monte Carlo Simulation.

3.1 Data selection and volatility calculation

This study selected daily stock prices from database of Thomson Reuters Datastream. Then, this study calculated average monthly price and calculated return for each month using Equation (1).

$$\mathrm{Re}_t = \left( \frac{P_t - P_{t-1}}{P_{t-1}} \right) \times 100\% \quad \text{(1)}$$

In Equation (1), the parameters are described as follows:

$\mathrm{Re}_t$ : Return rate at observation monthly period *t*,

$P_t$ : Stock price at observation monthly period *t*, and

$P_{t-1}$ : Stock price at observation monthly period *t*-1.

Next, volatility in this study is represented by using standard deviation in Equation (2).

$$s = \sqrt{\frac{\sum_{i=1}^{N} \left( x_i - \bar{x} \right)^2}{N-1}} \quad \text{(2)}$$

The parameters in Equation (2) are described as follows:

$s$ : Standard deviation of sample

$x_i$ : Observed variable

$\bar{x}$ : Mean of observed variable $x$

$N$ : Number of observations in the sample.

3.2 Normality checking for data distribution

This study performed normality for volatility data distribution. All statistical tests discussed in this study assume normal distributions. The probability density of the normal distribution is represented by Equation (3).

$$f\left( x \middle| \mu, \sigma^2 \right) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \quad \text{(3)}$$

The parameters in Equation (2) are described as follows:

$\sigma^2$ : Variance of sample

$x$ : Observed variable

$\mu$ : Mean of observed variable $x$

Next, Shapiro-Wilk normality test is represented by Equation (4).

$$W = \frac{\left( \sum_{i=1}^{n} a_i x_{(i)} \right)^2}{\sum_{i=1}^{n} \left( x_i - \bar{x} \right)^2} \quad \text{(4)}$$

$a_i$ : constants generated from the means, variances and covariance of the order statistics of a sample of size *n* from a normal distribution

$x_{(i)}$ : variable *x* for *i*th order statistic

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3.3 Monte Carlo approach for volatility rate

Monte Carlo Simulation is probability simulation to develop large data set. By using probability distributions, variables can have different probabilities of different outcomes occurring. Probability distributions are a much more realistic way of describing uncertainty in variables. The Monte Carlo method is method for analyzing uncertainty propagation to determine variation affects the sensitivity and reliability of the system that is being modeled. Monte Carlo Simulation is defined as a sampling method because the inputs are randomly generated from probability distributions to simulate the process of sampling from an actual population.

A Monte Carlo method is a technique that involves using random numbers and probability to solve problems. Monte Carlo simulation uses random sampling and statistical modeling to estimate mathematical functions and mimic the operations of complex systems. Monte Carlo simulation produces distributions of possible outcome values. Figure 1 shows Monte Carlo Simulation framework. Input variables are represented by variables X, that as independent variables for mathematical system. Next, all of input variables is transformed using mathematical function model of particular system. Finally, the outcome of study is produced and represented by Y variable.

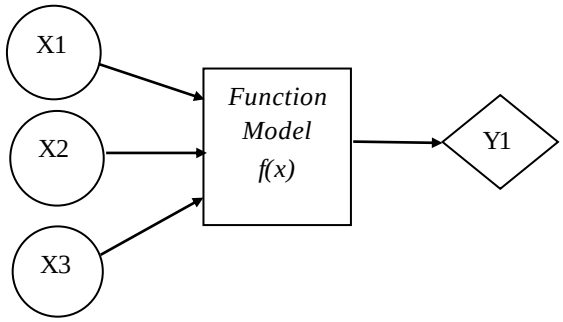


*Fig. 1: Monte Carlo Simulation (MCS) framework*

## IV. RESULT AND DISCUSSION

Main objective of this study is to develop evaluation method for volatility rate among sharia-compliant companies listed on Malaysia Stock Exchange. This study performed normality diagnostics using graphical and numerical approach. In addition, in producing a valid finding, this study implemented Monte Carlo Simulation method.

*4.1 Data selection and return analysis*

This study collected daily stock prices from Thomson Reuters Datastream. Then, average monthly returns are calculated for 19 companies that sharia-compliant. Table 1 indicates the companies with corresponding average monthly return.

*Table.1: Average monthly return for 19 companies*

| No. | Company name | Average monthly return (%) |
|---|---|---|
| 1 | Axiata Group Berhad | -2.0114 |
| 2 | Dialog Group Berhad | 1.5649 |
| 3 | DiGi.Com Berhad | -0.3985 |
| 4 | Hartalega Holdings Berhad | 0.8898 |
| 5 | IHH Healthcare Berhad | -0.1053 |
| 6 | IOI Corporation Berhad | 0.1589 |
| 7 | Kuala Lumpur Kepong Berhad | -0.0659 |
| 8 | Maxis Berhad | -0.3394 |
| 9 | MISC Behad | -0.4377 |
| 10 | Nestle (Malaysia) Berhad | 3.1582 |
| 11 | Petronas Chemicals Group Berhad | 1.1685 |
| 12 | Petronas Dagangan Bhd | 0.4660 |
| 13 | Petronas Gas Berhad | 0.7287 |
| 14 | PPB Group Berhad | 1.7246 |
| 15 | Press Metal Aluminium Holdings Berhad | -0.7758 |
| 16 | Sime Darby Berhad | 0.8678 |
| 17 | Sime Darby Plantation Berhad | -0.2969 |
| 18 | Tenaga Nasional Berhad | -0.8097 |
| 19 | Top Glove Corporation Berhad | 2.9111 |

Table 1 shows average value for monthly return is 0.442% with standard deviation is 1.248 %. The value of average return for companies is positive that is indicates all companies shows a positive gain. In addition, low value of standard deviation indicates the stock price market is stable.

*4.2 Volatility analysis*

The volatility of this study is calculated from return data for each of 19 companies. Figure 1 indicates histogram of data distribution for volatility rate. Figure 1 indicates data distribution of volatility close to normal distribution line (red line). Therefore, data distribution of volatility is follows normal distribution.

Next, this study performed normal probability analysis. Figure 2 shows normal probability plot for volatility rate. The data distribution of volatility is close to normal straight line (red line). Therefore, data distribution of volatility follows normal distribution.

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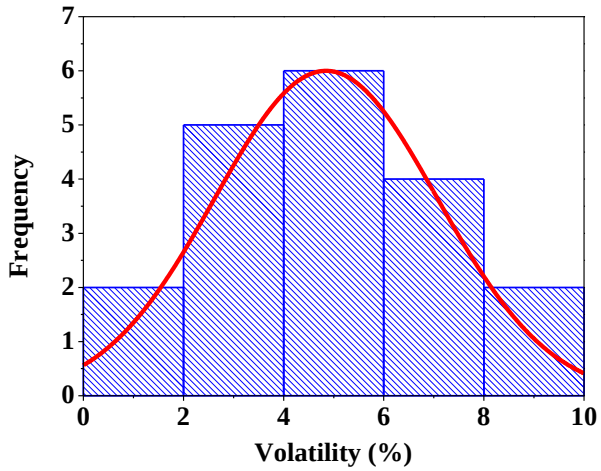


*Fig. 1: Histogram of data distribution for volatility*

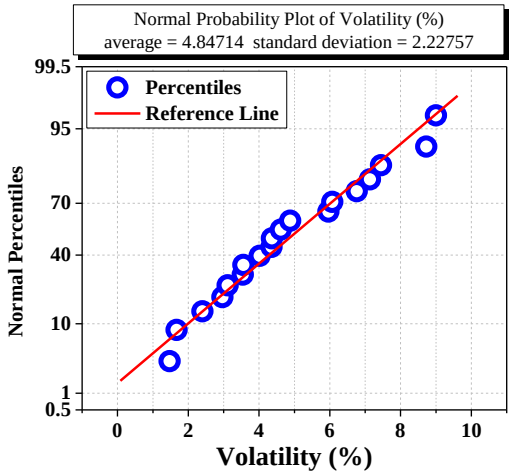


*Fig. 2: Normal probability plot for volatility*

Next, this study validated the normality findings using statistical test. This study implemented Shapiro-Wilk normality because sample size is less than 50. Table indicates statistical test for normality checking of data distribution. The probability value (p-value) is 0.562 that larger than 0.05. Therefore, this study failed to reject null hypothesis. As a conclusion, data distribution of volatility rate follows normal distribution.

Then, this study analyzed outlier detection using box-and-whisker plot. Figure 3 shows box-and-whisker plot for volatility rate. Figure 3 indicates there is no outlier exists in data distribution.

*Table.1: Statistical test for normality checking*

| Shapiro-Wilk normality test | | |
|---|---|---|
| Statistics | Degree of freedom, df | Probability value (p-value) |
| 0.959 | 19 | 0.562 |

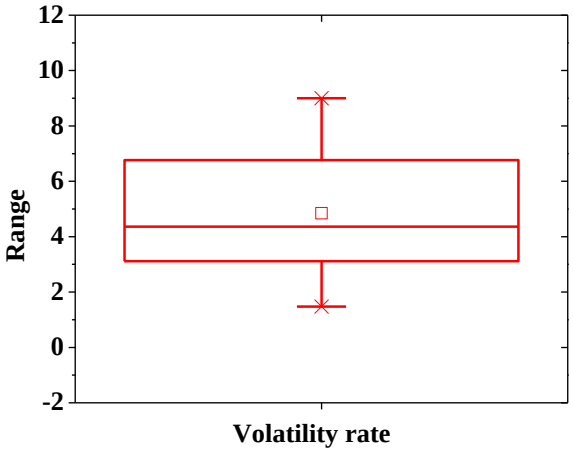


*Fig. 3: Box-and-whisker plot for volatility rate*

*IV.2 Monte Carlo Simulation for volatility rate*

This study performed process capability analysis to inherent statistical variability which can be evaluated by statistical methods. Figure 4 shows process capability for volatility rate. Number of sample data is 19 observations. The sample mean is 4.847. Data distribution of volatility is indicated using standard deviation of within is 1.95 and overall is 2.227. Main objective of this analysis is to evaluate statistical control for volatility data. The difference value between $C_{pk}$ and $P_{pk}$ is 0.15 that indicates processes are in a state of statistical control.

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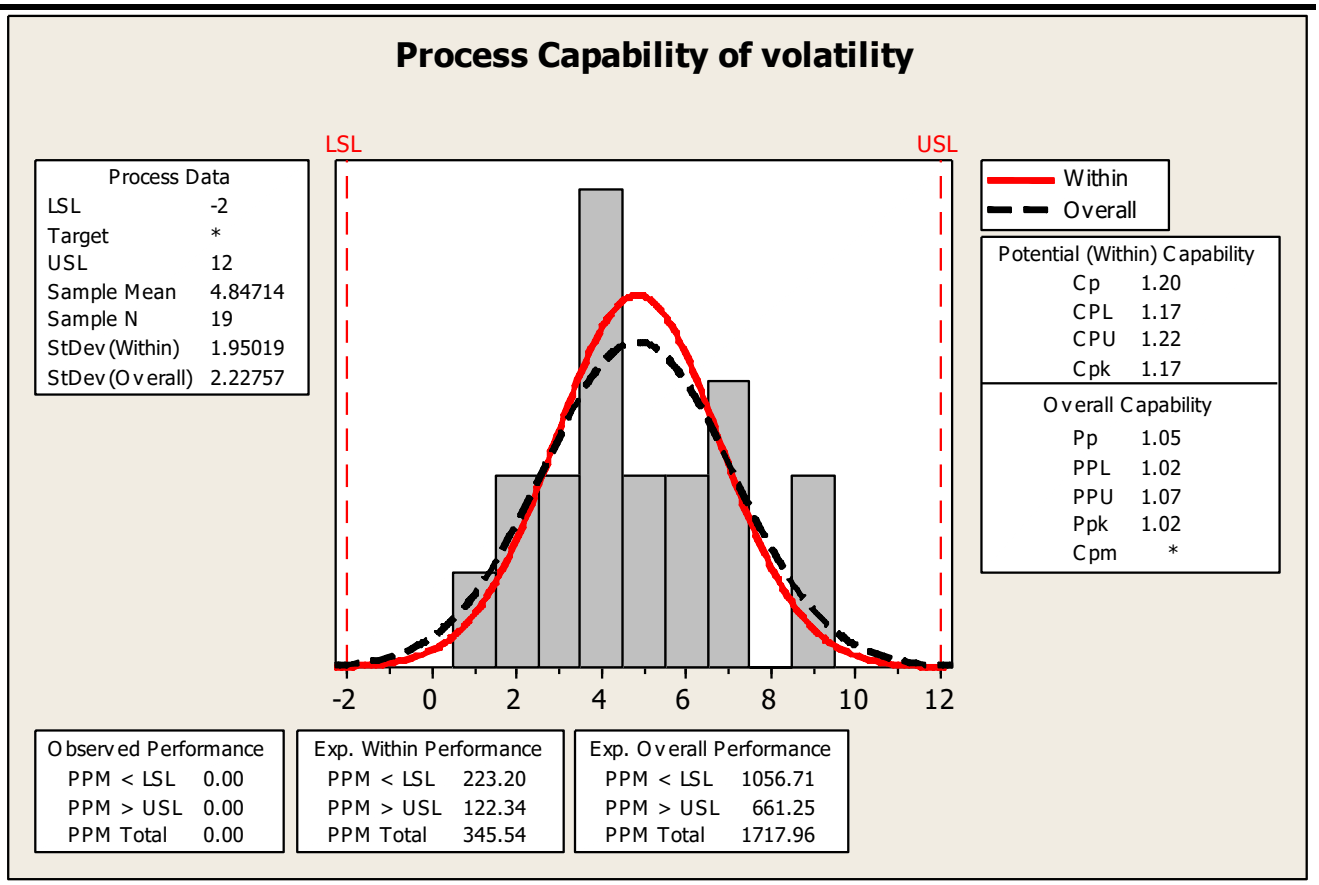


*Fig. 4: Process capability of volatility rate*

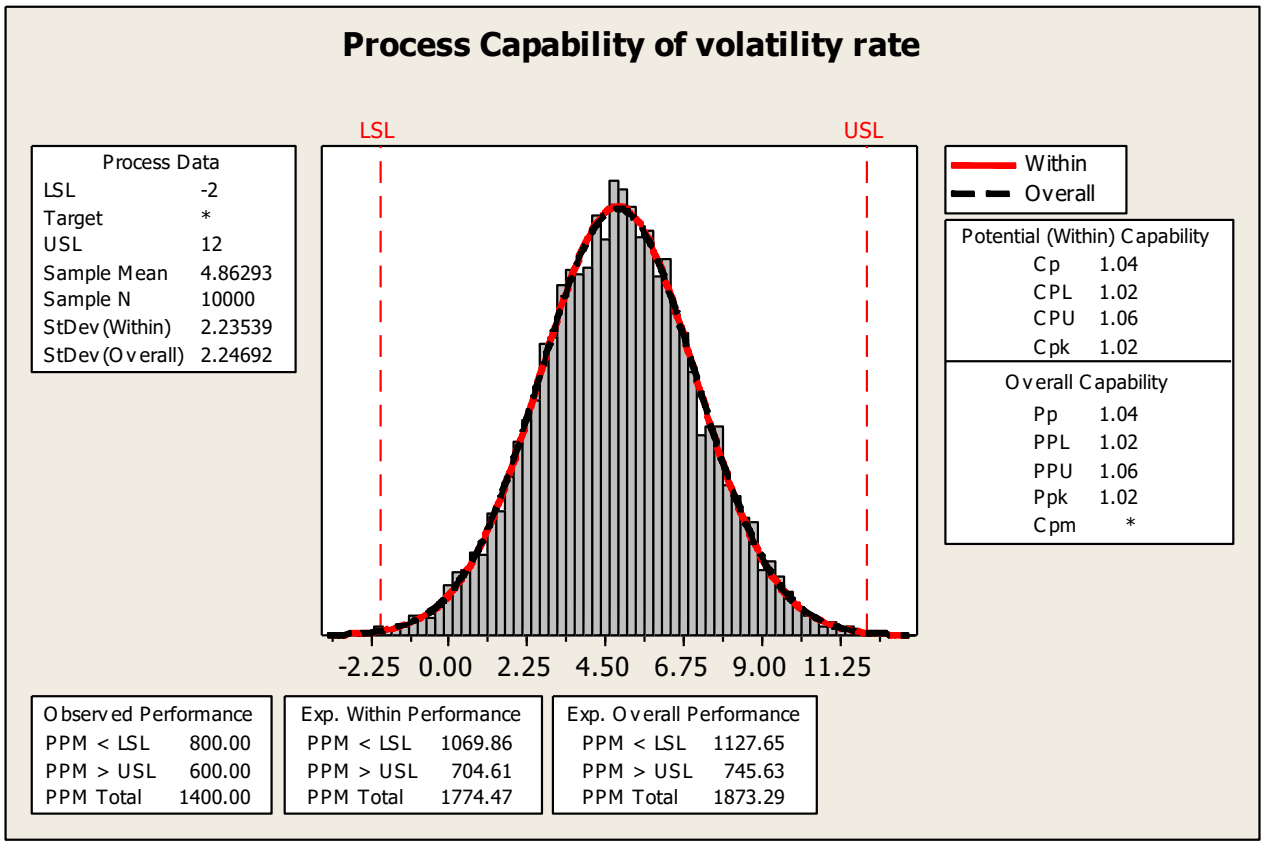


*Fig. 5: Process capability of volatility rate*

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Next, this study implemented Monte Carlo Simulation for simulating volatility rate in process capability method. Figure 5 shows process capability of volatility rate. This study increased number of samples to 10000 samples to attain valid and reliable findings of volatility rate. The difference value between $C_{pk}$ and $P_{pk}$ is almost zero that indicates processes are in a state of statistical control. As conclusion, with the implementation of Monte Carlo Simulation, the level of reliability of process control is increased.

## V. CONCLUSION

Main purpose of this study is to analyze volatility rate of 19 sharia-compliant companies listed on Malaysia Stock Exchange. Findings of this study are listed as follows:

(a) Average value for monthly return is 0.442% with standard deviation is 1.248 %. The value of average return for companies is positive that is indicates all companies shows a positive gain. In addition, low value of standard deviation indicates the stock price market is stable.

(b) This study validated the normality findings using statistical test. The probability value (p-value) is 0.562 that larger than 0.05. As a conclusion, data distribution of volatility rate follows normal distribution.

(c) Monte Carlo Simulation has proved that reliability of process control is increased with implementation of large data set.

The important of this findings are enabling investors to gain knowledge about real financial market condition in Malaysia Stock Exchange. In the same time, Monte Carlo Simulation can be implemented to get reliable result although the real sample size is small.

Future work of this study can be venture to development of determinants that contribute to dynamic behavior of volatility in Malaysia Stock Exchange.

## REFERENCES

[1] Abu Bakar, N. and Rosbi, S. (2016). Long Term Performance of Islamic Share Price for Initial Public Offerings (IPOs) in Malaysia: Evidence from Sharia-Compliant Companies Listed on the Malaysian Stock Exchange (2006-2010). *International Journal of Management Science and Business Administration, 2* (6), 43-57.

[2] Abu Bakar, N. and Rosbi, S. (2017). Dynamic Forecasting method for Shariah-compliant Share Price of Healthcare sector in Malaysian Stock Exchange. *International Journal of Advanced Engineering, Management and Science, 3* (8), 855-863.

[3] Abu Bakar, N. and Rosbi, S. (2018). Efficient Frontier Analysis for Portfolio Investment in Malaysia Stock Market. *Science International (Lahore), 30* (5), 723-729.

[4] Abu Bakar, N. Rosbi, S. and Uzaki, K. (2018). Evaluating Forecasting Method Using Autoregressive Integrated Moving Average (ARIMA) Approach for Shariah Compliant Oil and Gas Sector in Malaysia. *Journal of mathematics and computing science, 1* (1), 19-33.

[5] Adkins, L. C., Gade, M. N. (2012). Monte Carlo Experiments Using Stata: A Primer with Examples, in Dek Terrell, Daniel Millimet (ed.) 30th Anniversary Edition (Advances in Econometrics, Volume 30) Emerald Group Publishing Limited, pp.429 – 477.

[6] Akhtar, S. and Khan, N.U. (2016). Modeling volatility on the Karachi Stock Exchange Pakistan. *Journal of Asia Business Studies, 10* (3), 253 – 275.

[7] Bahlous, M., Mohd. Yusof, R. (2014). International diversification among Islamic investments: is there any benefit. *Managerial Finance, 40*(6): 613-633.

[8] Coskun, Y. and Ertugrul, H.M. (2016). House price return volatility patterns in Turkey, Istanbul, Ankara and Izmir. *Journal of European Real Estate Research, 9* (1), 26-51.

[9] Floros, C. and Enrique Salvador, E (2016). Volatility, trading volume and open interest in futures markets. *International Journal of Managerial Finance, 12* (5), 629 – 653.

[10] Ghiani, E., Locci, N., Muscas, C. and Sulis, S. (2004). Uncertainty estimation for DSP-based power quality measurements. COMPEL - The international journal for computation and mathematics in electrical and electronic engineering, 23(1), 92-103.

[11] Ismal, R. (2010). Volatility of the returns and expected losses of Islamic bank financing. *International Journal of Islamic and Middle Eastern Finance and Management, 3*(3), 267 – 279.

[12] Kongsilp, W. and Mateus, C. (2017). Volatility risk and stock return predictability on global financial crises. *China Finance Review International, 7* (1), 33-66.

[13] Messis, P. and Zapranis, A. (2014). Herding behaviour and volatility in the Athens Stock Exchange. *The Journal of Risk Finance, 15*(5), 572-590.

[14] Mohd Thas Thaker, H., Mohamad, A., Mustaffa Kamil, N.K. and Duasa, J. (2018). Information content and informativeness of analysts' report: evidence from Malaysia. Journal of Financial Reporting and Accounting, 16(4), 742-763.

*https://dx.doi.org/10.22161/ijaers.6.3.2* *ISSN: 2349-6495(P) | 2456-1908(O)*

[15] Prakash, A. and Mohanty, R.P. (2017). DEA and Monte Carlo simulation approach towards green car selection. *Benchmarking: An International Journal*, *24*(5), 234-1252.

[16] Siddikee, M. N. and Begum, N. N. (2016). Volatility of Dhaka Stock Exchange. *International Journal of Economics and Finance*, *8(*5), pp. 220-229.

**[17]** Watzenig, D., Neumayer, M. and Fox, C. (2011). Accelerated Markov chain Monte Carlo sampling in electrical capacitance tomography. COMPEL - The international journal for computation and mathematics in electrical and electronic engineering, 30(6), 1842-1854.