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# Cluster Analysis of Jakarta Islamic Index (JII) Stocks Based on Risk Adjusted Return

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## Abstrak

Penelitian ini untuk mengkaji klaster saham Jakarta Islamic Index (JII) berdasarkan kinerja saham yang diukur menggunakan risk-adjusted return selama periode 2009 - 2019. Penelitian ini menunjukkan alternatif yang dapat dimanfaatkan oleh investor yang mendukung keputusan mereka untuk berinvestasi di industri keuangan syariah Indonesia. Data dikumpulkan melalui fitur layanan online *Yahoo! Finance* dan *Google Finance* total 43 perusahaan dengan return positif. Penelitian ini menggunakan analisis kuantitatif, rasio Sharpe digunakan untuk mengukur kinerja stok, K-mean clustering untuk analisis cluster dan metode Elbow digunakan untuk menentukan jumlah cluster yang optimal. Hasil penelitian menunjukkan bahwa 4 jumlah cluster optimal. Dimana cluster 1 menentukan pengembalian ekstrim (5 perusahaan), cluster 2 merupakan pengembalian tinggi (12 perusahaan), cluster 3 pengembalian medium (17 perusahaan) dan cluster 4 pengembalian cukup (9 perusahaan).

Kata kunci: Cluster analysis, Islamic Index, Risk Adjusted return

## Abstract

This study is to examine the Jakarta Islamic Index (JII) stock clusters based on stock performance as measured using risk-adjusted returns for twenty-one semester periods 2009 - 2019. This study shows an alternative that can be utilized by investors supporting their decision to invest in the Indonesian Islamic finance industry. Data were collected through the online service feature of Yahoo! Finance and Google Finance total 43 companies with positive return. This study used quantitative analysis, Sharpe ratio was used to measure stock performance, K-mean clustering for cluster analysis and the Elbow method was used to determine the optimal number of clusters. The results showed that the 4 optimal number of clusters. Where cluster 1 determines the extreme return (5 companies), cluster 2 represents high return (12 companies), cluster 3 medium return (17 companies) and cluster 4 sufficient return (9 companies).

Keywords: Cluster analysis, Islamic Index, Risk Adjusted return

## 1. Introduction

Islamic investment adheres to Sharia principles that forbid involvement in activities involving usury (riba), gambling (maisir), and ambiguity (gharar). Additionally, Sharia principles forbid the production and delivery of services that are considered morally harmful or immoral, such as pornography, casinos, tobacco products, and the use of pork or pork products.

With its large Muslim population, Indonesia provides a significant market for the growth and advancement of the sharia finance industry. To facilitate the trading of public companies in line with the sharia business code, the Jakarta Islamic Index (JII) was established on July 3, 2000, on the Indonesian Stock Exchange (formerly known as Jakarta Stock Exchange or IDX).

Similar to other Islamic indexes around the world, JII prohibits the inclusion of companies that produce or provide products or services that conflict with sharia law. The standards for being considered for JII are both procedural and performance based. These include requirements such as the company's shares being listed on the stock exchange for a minimum of three months before applying to JII, the company's annual or mid-year financial report showing an Obligation Asset Ratio of no more than 90 percent, and the company ranking in the top sixty shares based on the previous year's average Market Capitalization and top thirty shares based on the previous year's average liquidity in the regular market. The JII index is made up of only thirty sharia-compliant securities listed on IDX, and a review of the listed shares is conducted every six months in January and July. Companies can maintain their position on the JII if they meet the criteria, but they may also be replaced by other firms applying for JII.

The fundamental principles of Islamic finance, which promote risk-sharing instruments and prohibit interest-based transactions, offer advantages in modern capital markets. According to Pranara et al. (2015), JII carries less risk than IDXLQ45. While Islamic equity investments exhibit similar returns to conventional investments during economic growth periods, they are a safer option during economic downturns, as noted by Saiti B. (2015). Furthermore, Saiti and Noordin (2018) argue that Islamic countries provide superior diversification benefits compared to Far East countries, which has significant policy implications for domestic and international investors looking to diversify their portfolios and hedge against unforeseen risks. Additionally, it is worth noting that the Islamic portfolio had higher adjusted returns than conventional stocks, (Reddy et al., 2017).

Creating a diversified investment portfolio is a fundamental aspect of building a strong financial foundation, as noted by Jayeola, Ismail, and Sufihani (2017). Diversification seeks to increase returns by investing in different areas that react differently to the same event. Although it does not guarantee against losses, most investment professionals agree that diversification is crucial in achieving long-term financial goals while minimizing risk. Cluster analysis, as explained by León et al. (2017), can be used to recognize and classify patterns in market data, enabling quick and effective further analysis. By identifying and discovering the distribution of JII stocks based on their performance, measured through risk-adjusted returns, this study offers an alternative approach to grouping JII stocks. As a result, investors can benefit from this analysis, providing support for their decision to invest in the Jakarta sharia industry.

## 2. Literatur Review

### Risk Adjusted Return

Risk-adjusted returns are a way of refining an investment's return by measuring the level of risk involved in generating that return, usually represented as a rating or number, according to Instovedia. Such returns can be used to evaluate individual securities, investment funds, and portfolios. By determining the highest return possible for the lowest risk, investors can use risk-adjusted returns to make more informed investment decisions, as noted by Rahadi (2016). Three commonly used ratios for measuring a portfolio's risk-return tradeoff are the Sharpe ratio, Treynor ratio, and Jensen Alpha, according to Qur'anitasari et al. (2019).

### Sharpe Ratio

The Sharpe ratio measures the risk-adjusted return of a portfolio, and it is calculated by dividing the difference between the total return of the portfolio and the risk-free rate by the standard deviation of the portfolio. In other words, the Sharpe ratio represents the amount of additional return earned per unit of risk taken, which is determined by the standard deviation of the portfolio. Sharpe Ratio formula is as follows (Sharpe 1966):

$$s(x) = \frac{(r_x - R_f)}{StdDev(x)} \quad (1)$$

Where:

- **x** is investment
- **rx** is the average rate of return of x
- **Rf** is the best available rate of return of risk-free security
- **StdDev(x)** is the standard deviation of rx

Sharpe (1966) analyzed the Sharpe ratio to determine whether a portfolio's returns were a result of wise investment decisions or excessive risk-taking. It's not enough for a portfolio or fund to simply have higher returns than its competitors, as this may come with an unacceptable level of additional risk. A higher Sharpe ratio indicates superior performance when adjusting for risk. Conversely, a negative Sharpe ratio suggests that a risk-free asset would have performed better than the security being evaluated.

### Treynor Ratio

The Treynor ratio, which is also called the reward-to-volatility ratio, is a measure of portfolio performance that evaluates how much additional return was obtained for each level of risk assumed.

Treynor (2007) measure for returns that surpass what could have been achieved with a risk-free investment. The Treynor Ratio compares the excess return earned by a portfolio to the systematic risk of the portfolio, as indicated by its beta. Treynor Ration formula (Treynor, 2007):

$$Treynor\ Ratio = \frac{r_p - r_f}{\beta_p}$$

(2)

Where:

- **p** is investment
- **rp** is the average rate of return of x
- **rf** is the best available rate of return of risk-free security
- **βp** is portfolio investment beta

Whiley (2016) examined whether a high Treynor ratio suggests that an investor has achieved significant returns on the market risks they have taken. The Treynor ratio helps to assess the performance of each investment in a portfolio and provides insight into how effectively capital is being utilized.

### Jensen Alpha

Jensen (1972), Jensen Alpha is a risk-adjusted performance calculates the average return on an investment or portfolio, compared to what the capital asset pricing model (CAPM) predicts, given the investment's beta and the average market return. Alpha is specific to each firm and is affected by market volatility, as determined by the firm's beta relative to the market beta (β.). The alpha coefficient is directly proportional to the excess return of a portfolio above its expected or required return, considering the investment's risk as measured by its beta (β.) formula as follows, (Jensen, 1972):

$$Jensen\ \alpha = R_p - r_f - \beta_p(b - r_f)$$

(3)

Where:
• **Rp** is annualized average portfolio return
• **rf** is the best available rate of return of risk-free security
• **b** is benchmark return
• **βp** is portfolio investment beta

Therefore, the alpha (α) value is based on the intrinsic value of the companies included in the portfolio, while beta (β) measures the portfolio's return due to its volatility. The Jensen alpha (α) can have a positive, negative, or neutral value. It's important to note that, according to its definition, the Jensen alpha (α) of the market is zero. If the alpha (α) is negative, then the portfolio is performing worse than the market, so higher alpha (α) values are more preferable.

**Excess Return**

Excess returns refer to investment gains from a particular security or portfolio that go beyond the expected returns of a low-risk security such as a government-issued bond or a certificate of deposit. When excess returns are positive, it indicates that the investment performed better than the benchmark or riskless rate. Conversely, negative excess returns show that the investment performed worse than the benchmark or riskless rate.

Defusco et al., (2015), The excess return can be evaluated by comparing it to the benchmark or annual expense ratio, using a risk-adjusted measure such as β (beta). This can be expressed using the following equation:

$$\overline{R^e} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(R_i - Rf_i)}$$

(4)

Where:
• **R e** is average monthly excess return of the portfolio
• **Ri** is Return of the Portfolio in month i
• **RFi** is Retrun of the risk-free benchmark in i
• **n** is number of months

**Risk Free Rate**

According to Suryani and Herianti (2015), the risk-free rate is a rate that can be obtained from a government security that is considered to be default-free. The purpose of using the risk-free rate of return is to assess the additional compensation needed for taking on a risky asset. The risk-free rate is typically represented by the rate of the shortest-dated government Treasury bill, such as a T-Bill.

**Standard Deviation**

Morningstar (2005) defines standard deviation as a statistical measure of dispersion around an average. It shows how much a stock or portfolio's returns fluctuated during a specific time period. The monthly standard deviation can be expressed as follows:

2 $$\sigma_M = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(R - \bar{R})}$$

(5)

Where:
• **σM** is standard deviation
• **n** is number of periods
• **Ri** is return of the investment in month i
• **R** is average monthly return of investment

The arithmetic mean, denoted as R, is obtained by adding up all the monthly returns for a portfolio and dividing by the number of months. The Sharpe ratio, on the other hand, is commonly used to compare the overall risk-return profile of a portfolio when a new asset or asset class is introduced. For instance, if a portfolio manager is considering adding a hedge fund allocation to an existing 50/50 investment portfolio of stocks, which has a Sharpe ratio of 0.67, the effect of the new investment can be evaluated. If the new allocation of the portfolio is 40% stocks, 40% bonds, and 20% diversified hedge fund allocation (such as a fund of funds), the Sharpe ratio would increase to 0.87. This suggests that, despite the hedge fund's standalone risk, its inclusion in the portfolio enhances the risk-return characteristics and provides diversification benefits. If the addition of the new investment leads to a reduction in the Sharpe ratio, it should not be added to the portfolio.

**Cluster Analysis**

According to León et al. (2017), cluster analysis is a collection of techniques used to form clusters or groups of multivariate data objects. The objective is to create clusters with similar characteristics from large and diverse datasets. The aim is to make the clusters as homogeneous as possible while maximizing the differences between them. Gulagiz and Sahin (2017) have categorized the methods of cluster analysis as follows:

A. Hierarchical methods

Hierarchical clustering can be divided into two main types:

(1) Agglomerative clustering is a popular method of cluster analysis that involves merging similar clusters together to form larger clusters. The process starts by assigning each subject to its own cluster and then repeatedly merging the two clusters that are most similar until all subjects belong to a single cluster. The optimal number of clusters is then selected from all of the possible cluster solutions. There are several

techniques used within the agglomerative method to determine which clusters should be merged at each stage. Some of the most common techniques are:

(2) The nearest neighbor method, also known as the single linkage method, measures the distance between two clusters based on the distance between their closest members. Although this method is straightforward, it is often criticized for ignoring the structure of clusters and may result in "chaining," where clusters become elongated and irregular in shape. Nevertheless, this method performs better than others when the natural clusters are not spherical or elliptical in shape.

(3) The furthest neighbor method, also known as the complete linkage method, calculates the distance between two clusters based on the maximum distance between their members, i.e., the distance between the two farthest members. This method generally yields compact clusters of similar size, but like the nearest neighbor method, it does not consider the structure of clusters and is sensitive to outliers.

(4) The average linkage method, also known as the UPGMA method, calculates the distance between two clusters by taking the average distance between all pairs of subjects in the two clusters. This method is considered fairly robust.

(5) In the centroid method, the mean value for each variable is calculated to determine the centroid of each cluster, and the distance between centroids is used to measure the distance between two clusters. Clusters with the closest centroids are merged. This method is also considered fairly robust.

(6) Ward's method combines all possible pairs of clusters and calculates the sum of squared distances within each cluster, which is then summed across all clusters. The combination that results in the lowest sum of squares is chosen. This method typically produces clusters of similar sizes, which may not always be desirable, and is sensitive to outliers. Nevertheless, it is one of the most commonly used methods, along with the average linkage method.

Divisive clustering starts with a top-down approach where a single cluster contains all the data points. This cluster is then recursively divided into smaller and more homogeneous sub-clusters based on a chosen criterion, such as maximizing the distance or minimizing the variance between the sub-clusters.

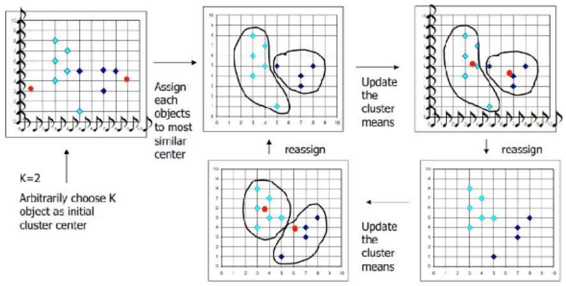
B. Non-hierarchical methods (often known as k-means clustering methods)

Cluster analysis is a useful tool for analyzing interval, ordinal, or categorical data. However, analyzing data that contains a mixture of variable types can be challenging, as it requires using different distance measures for each type of variable. Therefore, the choice of distance measure depends on the type of data being analyzed.

The K-means algorithm is a type of unsupervised learning method used to solve clustering problems. This algorithm is simple and involves classifying a dataset into a specific number of clusters (known as k clusters) that are predetermined before running the algorithm. define it by using equation as follow:

$$\sqrt{(x_i - x_{avg})^2 + (y_i - y_{avg})^2 + (z_i - z_{avg})^2} \quad (6)$$

K-means uses relatively simple similarity measures because the algorithm calculates the similarity of each point to each centroid repeatedly. In some cases, it is possible to speed up the K-means algorithm by avoiding the computation of many similarities, especially when the data is in low-dimensional Euclidean space. The K-means algorithm consists of the following steps: (1) selecting initial cluster centers that are far apart from each other, (2) assigning each subject to its nearest cluster based on the distance to the centroid, (3) calculating the centroids of the formed clusters, (4) re-calculating the distance from each subject to each centroid and moving observations that are not in the cluster they are closest to, (5) repeating the process until the centroids remain relatively stable.



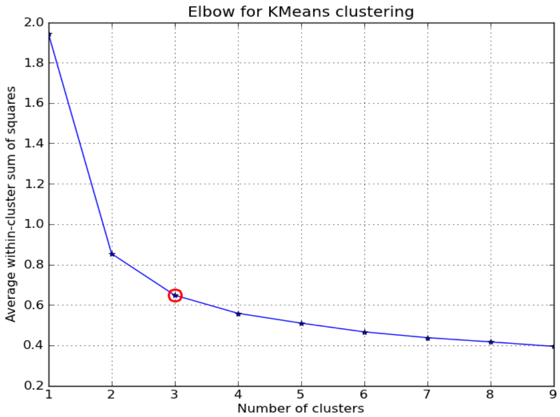

Source: Tavish Srivastava — Published On November 12, 2013 and Last Modified On June 25th, 2020

**Figure 1. K-means Clustering Method Example**

When dealing with large data sets, non-hierarchical cluster analysis is often the preferred method (Cornish, 2007). Non-hierarchical methods are advantageous in that they allow subjects to move from one cluster to another, unlike hierarchical cluster analysis, which assigns a subject to a fixed cluster. However, non-hierarchical methods can be challenging to use because it can be difficult to determine the optimal number of clusters, and the results may be sensitive to the choice of initial cluster centers. One approach to address these challenges is to use a hierarchical method first to determine the number of clusters needed, and then use the resulting centers as initial centers for the non-hierarchical method. This can help ensure that the non-hierarchical method produces more reliable and accurate results, as it starts from a more optimal configuration.

### Optimal Cluster

The elbow method is a common approach used to determine the optimal number of clusters for a K-means clustering algorithm (Wolfgang, 2015). This method involves plotting the sum of squared errors (SSE) for various values of k (the number of clusters) and selecting the value of k at the "elbow" or point of inflection on the plot. The SSE is computed as the sum of the squared distance between each data point and its assigned cluster centroid. The elbow point is the number of clusters at which the SSE begins to level off, indicating that adding more clusters does not significantly improve the clustering performance. This approach is widely used because it is simple to implement and provides a clear and objective way to determine the optimal number of clusters. However, it is important to note that the elbow method may not always provide a clear elbow point, particularly when dealing with complex data sets with high levels of noise or outliers. In such cases, other methods may be required to determine the optimal number of clusters. The example of elbow method chart presented in Figure 2.




**Source: Jeremy Jordans, 15 dec 2016, Grouping data points with k-means clustering ([https://www.jeremyjordan.me/grouping-data-points-with-k-means-clustering/](https://www.jeremyjordan.me/grouping-data-points-with-k-means-clustering/))**

**Figure 2 Elbow method example chart Source: A Simple Approach to Clustering in Excel (2010)**

The SSE is formally defined as follows:

$$SS_E = \sum_{j=1}^{k} \sum_{x \epsilon Cj} dist^2(x, c_j) \quad (7)$$

There are several choices available at each step of the k-means clustering algorithm. The basic algorithm involves the following steps:
Step 1. Make an initial selection of k centroids.
Step 2. Calculate the distance from each data point to the center of a cluster.
Step 3. Assign each data point to the nearest centroid to form k clusters.
Step 4. Calculate the mean (average) of each cluster set. Step 5. Repeat Steps 2-4 until the centroids no longer change or a stopping criterion is met.
Step 6. Graph and summarize the clusters.

It is important to note that the performance of the k-means clustering algorithm can be sensitive to the initial selection of centroids. Therefore, multiple runs with different initial selections of centroids may be necessary to obtain the best clustering results. Additionally, the stopping criterion used can impact the final clustering results.

## 3. Research Methodology

The data set used in this study is all companies with positive return enlisted on the JII for 21 semi-annual periods between the years of 2008-2018. Each semi-annual period consists of 30 companies that must meet the aforementioned criteria prior to application to the JII. The reevaluation of the 30 companies is for six months – once in January and again in July – where the results vary on how well the stocks perform. The first half and annual financial reports of the companies are used to evaluate performance. Some companies may retain their position in JII, while others are replaced by applicants.

Industries in which the sample firms used in the data set were not a factor since the total candidates is relatively small. Overall, there were 89 separate firms enlisted on the JII. However, there were only 43 firms that showed positive return.

Method of Collecting Data the Data used in this research was collected through online services feature of Yahoo! Finance and Google Finance.

Data Processing Method Data analysis method used in this research is quantitative analysis. It is used to analyze performance of Jakarta Islamic Stock index over the study period. This study used Sharpe ratio to measure stock performance. K-mean clustering is used for cluster analysis. As for the Elbow method is used to determine the optimal number of clusters.

### Sharpe Ratio

The Sharpe ratio is a popular risk/return measure in finance, which is calculated using excess return and standard deviation to determine reward per unit of risk. A higher Sharpe ratio indicates better historical risk-adjusted performance. It was developed by William Sharpe in 1966 and gained further credibility when he won a Nobel Memorial Prize in Economic Sciences in 1990 for his work on the capital asset pricing model (CAPM).

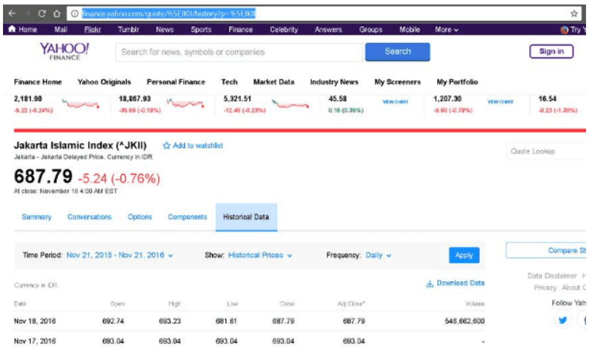
The standard Sharpe ratio equation is:

$$s(x) = \frac{(r_x - R_f)}{StdDev(x)}$$

(8)

The hands-on work and the Sharpe Ratio calculation in MS Excel are as follow:

Step1 - To calculate the monthly returns for the variables that compose the Sharpe Ratio, you will need to obtain the historical prices for the stocks of interest. The historical prices can be obtained from various sources, such as Yahoo! Finance or Google Finance.



**Source: develop for this study**

**Figure 3. Yahoo! Finance**

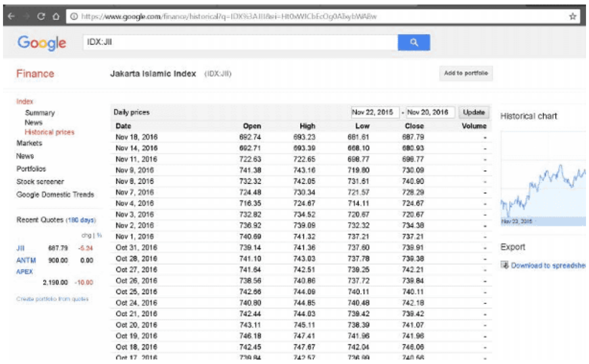


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**Figure 4. Google Finance**

Step 2 - Input the monthly prices into Excel worksheet and calculate monthly expected returns for analyzed time period. The formula to calculate the monthly return is Monthly Return = (Price 1 – Price 0) / Price 0 or Monthly Return = (Price 1 / Price 0) -1

Where Price 1 is the following month close price and Price 0 is the previous month close price as seen in Figure 5

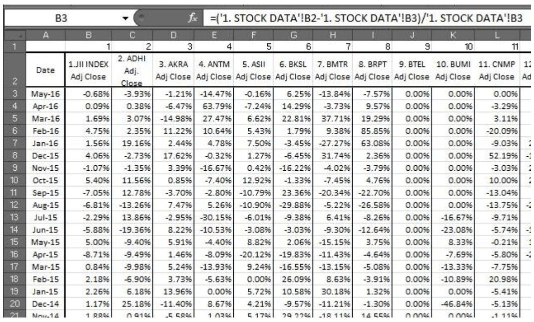


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**Figure 5. Monthly Return in Excel**

Step 3- After getting all the monthly returns, the next step is calculating the expected return for each stock. To do this, calculate the average of the monthly returns of the period being analyzed with Excel's average formula:

=AVERAGE (Range of Returns) (9)

Step 4 - get the Risk-Free Rate and put all the variables together. The Indonesian Sharia T-Bill rate can be found at Central Bank of Indonesia website (www.bi.go.id); referred as Sertifikat Bank Indonesia Syariah (SBIS). The risk-free rate for this research is 6.75.

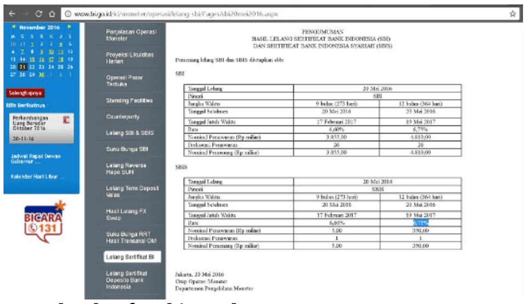

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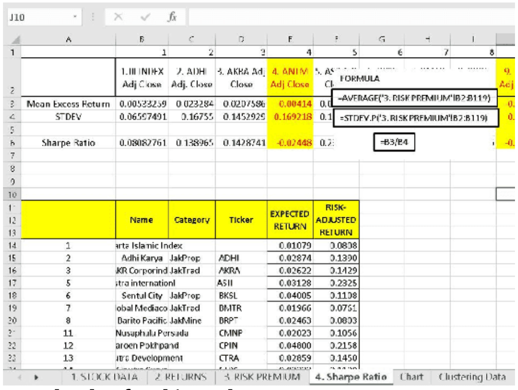
**Figure 6. Bank Indonesia Sharia Auction**

Step 5 - Following the Sharpe Ratio formula, another variable that needs to calculate is the Standard Deviation of the portfolio. Chauhan (2015). declare this input can be calculated in Excel by formula STDEVP if the period for calculating the ratio is the same for all assets. Else, use sample standard deviation STDEVS. So, this study used STDEVP because all stocks data have the same period. Finally, divide the average excess return by standard deviation of excess returns to get the Sharpe ratio.




**Source: develop for this study**

**Figure 7. Sharpe ratio calculation**

Based on those clustering steps, this study made an excel sheet formula compilation referring to Fripp (2016). So, if there were any changes in the data set, it could calculate the cluster automatically. It is defined as follows: Step 1 – This study used LARGE function formula for the initial selection of the first k centroids. The syntax for this function is =LARGE (array, k). Naftali (2014) notice how well it works in the "Packed Circles" data, for example: With k=6, the farthest point heuristic will usually initialize each centroid into a different true cluster. This procedure initializes the centroids to be well spread-out from each other.

=LARGE($FW$5:$FW$104,$FX$3-$FY$2+1)

| FW | FX | FY | FZ | GA | GB | GC | GD | GE | GF | GG | GH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 5 | 14 | 24 | 33 | 42 | | | | | |
| | 47 | 9 | 19 | 28 | 38 | 47 | =ROUND($FX2*0.1,0) | | | | |
| avail | 47 | | | | | | | | | | |
| 1 | 0.054513 | 0.272925 | | | | | | | 0.327430 | | |
| 2 | 0.02381 | 0.255457 | | | | | | | 0.279267 | | |
| 3 | 0.03107 | 0.238418 | | | | | | | 0.269487 | | |
| 4 | 0.048002 | 0.21581 | | | | | | | 0.263812 | | |
| 5 | 0.031284 | 0.232496 | | | | | | | 0.26378 | | |
| 6 | 0.050344 | 0.174504 | | | | | | | 0.224848 | | |
| 7 | 0.037704 | 0.161028 | | | | | | | 0.2 | | |
| 8 | 0.024024 | 0.168548 | | | | | | | 0.192568 | | |
| 9 | 0.029249 | 0.165903 | | | | | | | 0.189152 | | |
| 10 | 0.028276 | 0.156146 | | | | | | | 0.184422 | | |
| 11 | 0.018726 | 0.159669 | | | | | | | 0.178395 | | |
| 12 | 0.020506 | 0.145005 | | | | | | | 0.173591 | | |
| 13 | 0.030301 | 0.140565 | | | | | | | 0.170067 | | |
| 14 | 0.026217 | 0.142874 | | | | | | | 0.169091 | | |
| 15 | 0.028742 | 0.138965 | | | | | | | 0.167707 | | |
| 16 | 0.040052 | 0.1100 | | | | | | | 0.150052 | | |
| 17 | 0.019041 | 0.128256 | | | | | | | 0.147297 | | |
| 18 | 0.024669 | 0.119397 | | | | | | | 0.144066 | | |
| 19 | 0.024155 | 0.112952 | | | | | | | 0.137107 | 2 | 9 |
| 20 | 0.023221 | 0.110793 | | | | | | | 0.134014 | | 47 |
| 21 | 0.022234 | 0.110640 | | | | | | | 0.132002 | | |
| 22 | 0.018155 | 0.110058 | | | | | | | 0.128213 | 3 | 9 |
| 23 | 0.022446 | 0.104837 | | | | | | | 0.127283 | | 28 |
| 24 | 0.020234 | 0.105601 | | | | | | | 0.125835 | | 47 |
| 25 | 0.025196 | 0.099374 | | | | | | | 0.12457 | | |
| 26 | 0.019829 | 0.095954 | | | | | | | 0.115783 | 4 | 9 |
| 27 | 0.017572 | 0.095993 | | | | | | | 0.113565 | | 19 |
| 28 | 0.02469 | 0.080266 | | | | | | | 0.104096 | | 38 |
| 29 | 0.017511 | 0.086891 | | | | | | | 0.104402 | | 47 |
| 30 | 0.018287 | 0.084458 | | | | | | | 0.102745 | | |
| 31 | 0.019650 | 0.076105 | | | | | | | 0.095763 | 5 | 9 |
| 32 | 0.017118 | 0.076597 | | | | | | | 0.093715 | | 19 |
| 33 | 0.019418 | 0.073596 | | | | | | | 0.093013 | | 28 |
| 34 | 0.01571 | 0.077172 | | | | | | | 0.092882 | | 38 |
| 35 | 0.010791 | 0.080828 | | | | | | | 0.091618 | | 47 |
| 36 | 0.012631 | 0.060822 | | | | | | | 0.073453 | | |

**Source: develop for this study**

**Figure 8. Initial selection of k centroids**

The model as presented in Figure 8 used the total number of available data set as array (column FW) and subtract by the number of total available data (cell FX3) plus random k calculation (from 0,1 until 1). So, the initial cluster 1 centroid for six cluster analysis is data point number 5. Step 2 & 3 – Use Sum Square Error (SSE) to calculate the distance fromeach data point to the closest centroid. At the same time, also calculate the meaning for each cluster.

The syntax for SSE is.

=SUMXMY2(array_x, array_y). (9)

The SUMXMY2 function syntax has the Array_x as the first array or range of values and Array_y as the second array or range of values. IFERROR function used to trap and handle errors in a formula. It will return a specified value if a formula evaluates to an error; otherwise, returns the result of the formula.

The literation as presented on Figure 9 shows the syntax that used in this study is.

=IFERROR(SUMXMY2($Q5:$X5,cent1_6),""). (10)

The first array is the range of data set, and the second array is the random center from step 1. Lastly, use syntax =MIN (C772:H772) on cell I772 to determine closest distance.

C772 =IFERROR(SUMXMY2($Q5:$X5,cent1_6),"")

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 769 | | | 6 Cluster Split - First Run | | | | | | |
| 770 | | | | | | | | | |
| 771 | | Data No. | Cent 1 | Cent 2 | Cent 3 | Cent 4 | Cent 5 | Cent 6 | Min |
| 772 | | 35 | 0.0022 | 0.0124 | 0.0410 | 0.0493 | 0.0591 | 0.0718 | 0.0022 |
| 773 | | 47 | 0.0006 | 0.0080 | 0.0331 | 0.0404 | 0.0492 | 0.0609 | 0.0006 |
| 774 | | 17 | 0.0000 | 0.0053 | 0.0273 | 0.0340 | 0.0422 | 0.0531 | 0.0000 |
| 775 | | 9 | 0.0006 | 0.0031 | 0.0210 | 0.0271 | 0.0345 | 0.0443 | 0.0006 |
| 776 | | 4 | - | 0.0045 | 0.0254 | 0.0319 | 0.0398 | 0.0504 | - |
| 777 | | 18 | 0.0037 | 0.0008 | 0.0111 | 0.0157 | 0.0214 | 0.0292 | 0.0008 |
| 778 | | 33 | 0.0051 | 0.0002 | 0.0080 | 0.0119 | 0.0169 | 0.0240 | 0.0002 |
| 779 | | 25 | 0.0041 | 0.0000 | 0.0090 | 0.0131 | 0.0183 | 0.0257 | 0.0000 |

**Source: develop for this study**

**Figure 9. Distance and cluster average**

=IF($P772=1,Q5,"")

| I | J | K | L | M | N | O | P |
|---|---|---|---|---|---|---|---|
| | Cluster | Cluster | Cluster | Cluster | Cluster | cluster | Choice |
| Min | | | | | | | |
| 0.0022 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 0.0006 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 0.0000 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 0.0006 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| - | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 0.0008 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| 0.0002 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| 0.0000 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| - | 0 | 2 | 0 | 0 | 0 | 0 | 2 |

**Source: develop for this study**

**Figure 10. Cluster group**

Step 4 – after finding the initial cluster as presented on figure 10 The next step is to revise the meaning for each cluster and repeat steps 2 & 3. Calculate the meaning for each cluster as presented in figure 11. Those value are the newcentroid for the next clustering round.

=IF($P772=1,Q5,"")

| Q | R | S |
|---|---|---|
| | Revised Means - Cent 1 | |
| | 1 | 2 |
| | 0.054513 | 0.272925 |
| | 0.02381 | 0.255457 |
| | 0.03107 | 0.238418 |
| | 0.048002 | 0.21581 |
| | 0.031284 | 0.232496 |
| Min | 0.02 | 0.22 |
| Max | 0.05 | 0.27 |
| Mean | 0.04 | 0.24 |
| SD | 0.01 | 0.02 |
| N | 5.00 | 5.00 |

**Source: develop for this study**

**Figure 11. Revised Mean**

Step 5 - K-means essentially is about having k cluster centroids. In every iteration, the cluster to which data points belong and then recomputed the k centroids. So, the best way to stop the k-means run is not by how many times the algorithm runs but by whether the centroid computed in this run is the same as the previous one. When the points stabilize in the clusters, the centroids will stabilize too, and this means that any further iteration would not change the clusters and that is the step to stop. But Fripp (2016) defined based on his experience it can be done less than 6 iterations round. So, this excels sheet formula model in this study uses 6 iteration round as preliminary calculations. With notes, it needs more iteration if there is a diversity of data that needs additional iterations.

## Optimal Cluster

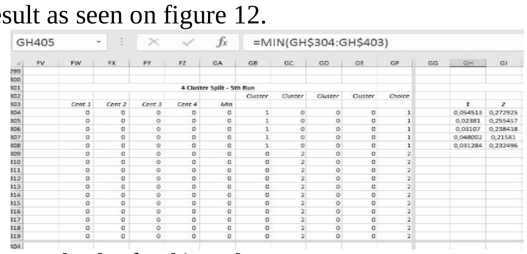
The elbow method is a commonly used technique to determine the optimal number of clusters in a k-means clustering algorithm. The basic idea is to plot the value of the sum of squared distances between the data points and their assigned cluster centers (SSE) against the number of clusters and look for an "elbow" point where the SSE starts to level off. This elbow point indicates the number of clusters at which adding more clusters does not significantly improve the clustering performance and is often taken as the optimal number of clusters. The idea of the elbow method is to run k-means clustering on the dataset for a range of values of k and for each value of (k) calculates the sum of squared errors (SSE) (Umargono et al., 2020). In this study, we determined the distance between each data point and the nearest centroid using the Euclidean distance measure. Then added up the squares of these distances to calculate the total sum of squared errors for two separate sets of clusters that were generated by running the k-means algorithm twice with different initializations, (Kodinariya and Makwana, 2013). The most accurate way to represent the points within a cluster is by using the smallest squared error, as the centroid values in the clustering provide a better representation of the points in the cluster. The SSE is examined formally because minimizing the distance is equivalent to minimizing the square of the distance. Therefore, the algorithm examines dist2(x, y) = (dist(x, y))^2. If there are k clusters, namely C1, C2, ..., Ck with corresponding centroids c1, c2, ..., ck, then for each data element x in S, step 3 of the k-means algorithm involves finding the value j that minimizes dist2(x, cj), that is, the square of the distance between x and cj.

$$C_j = \left\{ x : \min_h dist^2(x, c_h) = j \right\} \tag{11}$$

The distance between x = (x1, …, xn) and y = (y1, …, yn) can be defined using the Euclidean distance formula, which calculates the straight-line distance between the two points in n-dimensional space:

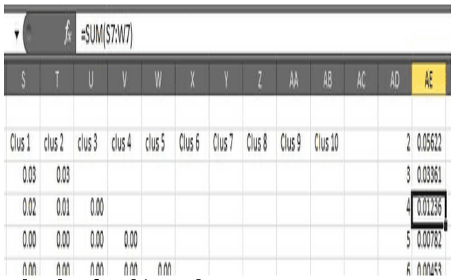
$$dist(x, y) = \sqrt{\sum_{i=1}^{n} (x_i - y_i)^2} \tag{12}$$

This study already used SSE to calculate the centroid distance. The minimum value is chosen to be the centroid for each cluster result (Figure 12). So, the point of each cluster in the graph is given by using =SUM(..) to add all cluster centers in each cluster result as seen on figure 12.




**Source: develop for this study**

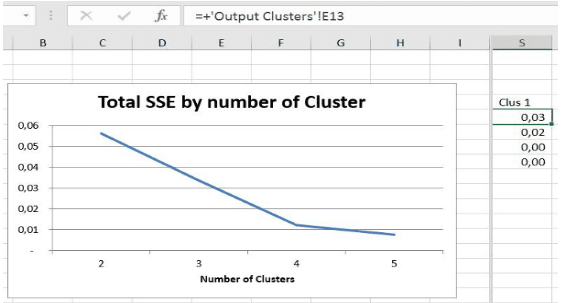
**Figure 12. Minimum SSE as centroid**




**Source: develop for this study**

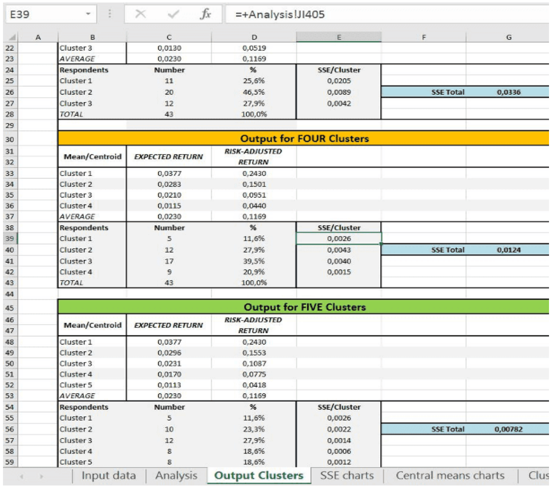
**Figure 13. Analysis Sheet**

The graph show an elbow in cluster four as seen on **figure 14. Therefore, this study requires four clusters.**




**Source: develop for this study**

**Figure 14. SSE Chart**



E39 =+Analysis!JI405

| | B | C | D | E | F | G |
|---|---|---|---|---|---|---|
| 22 | Cluster 3 | 0,0130 | 0,0519 | | | |
| 23 | AVERAGE | 0,0230 | 0,1169 | | | |
| 24 | Respondents | Number | % | SSE/Cluster | | |
| 25 | Cluster 1 | 11 | 25,6% | 0,0205 | | |
| 26 | Cluster 2 | 20 | 46,5% | 0,0089 | SSE Total | 0,0336 |
| 27 | Cluster 3 | 12 | 27,9% | 0,0042 | | |
| 28 | TOTAL | 43 | 100,0% | | | |
| 29 | | | | | | |
| 30 | Output for FOUR Clusters | | | | | |
| 31–32 | Mean/Centroid | EXPECTED RETURN | RISK-ADJUSTED RETURN | | | |
| 33 | Cluster 1 | 0,0377 | 0,2430 | | | |
| 34 | Cluster 2 | 0,0283 | 0,1501 | | | |
| 35 | Cluster 3 | 0,0210 | 0,0951 | | | |
| 36 | Cluster 4 | 0,0115 | 0,0440 | | | |
| 37 | AVERAGE | 0,0230 | 0,1169 | | | |
| 38 | Respondents | Number | % | SSE/Cluster | | |
| 39 | Cluster 1 | 5 | 11,6% | 0,0026 | | |
| 40 | Cluster 2 | 12 | 27,9% | 0,0043 | SSE Total | 0,0124 |
| 41 | Cluster 3 | 17 | 39,5% | 0,0040 | | |
| 42 | Cluster 4 | 9 | 20,9% | 0,0015 | | |
| 43 | TOTAL | 43 | 100,0% | | | |
| 44 | | | | | | |
| 45 | Output for FIVE Clusters | | | | | |
| 46–47 | Mean/Centroid | EXPECTED RETURN | RISK-ADJUSTED RETURN | | | |
| 48 | Cluster 1 | 0,0377 | 0,2430 | | | |
| 49 | Cluster 2 | 0,0296 | 0,1553 | | | |
| 50 | Cluster 3 | 0,0231 | 0,1087 | | | |
| 51 | Cluster 4 | 0,0170 | 0,0775 | | | |
| 52 | Cluster 5 | 0,0113 | 0,0418 | | | |
| 53 | AVERAGE | 0,0230 | 0,1169 | | | |
| 54 | Respondents | Number | % | SSE/Cluster | | |
| 55 | Cluster 1 | 5 | 11,6% | 0,0026 | | |
| 56 | Cluster 2 | 10 | 23,3% | 0,0022 | SSE Total | 0,00782 |
| 57 | Cluster 3 | 12 | 27,9% | 0,0014 | | |
| 58 | Cluster 4 | 8 | 18,6% | 0,0006 | | |
| 59 | Cluster 5 | 8 | 18,6% | 0,0012 | | |

Input data | Analysis | Output Clusters | SSE charts | Central means charts | Clus

**Source: develop for this study**

**Figure 15. Output Sheet**

## 4. Research Result and Discussion

Stock selection is based on the observation sample in 10-year periods from 2009 to 2019. It consists of 21 semi-annual periods and only 43 firms that show positive return as seen at Table 1. This study excludes the firms with negative return because the investors want positive return for their investment.

**Table 1, Expected Return and Risk Adjusted Return Calculation Result**

| No | Name | Ticker | EXPECTED RETURN | RISK-ADJ. RETURN | ANUAL ART. RETURN | ANNUAL GEO. RETURN | VARI ANCE | STD. DEV | ANNUAL RISK ADJ. RETURN |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Jakarta Islamic Index | | 0,0108 | 0,0805 | 0,1300 | 0,1049 | 0,0530 | 0,2302 | 0,2788 |
| 2 | Adhi Karya | ADHI | 0,0287 | 0,1390 | 0,4133 | 0,1919 | 1,0005 | 1,0003 | 0,4814 |
| 3 | AKR Corporindo | AKRA | 0,0262 | 0,1429 | 0,3621 | 0,1419 | 0,4366 | 0,6608 | 0,4949 |
| 4 | Astra international | ASII | 0,0313 | 0,2325 | 0,4055 | 0,3375 | 0,2144 | 0,4630 | 0,8054 |
| 5 | Sentul City | BKSL | 0,0401 | 0,1108 | 1,5160 | 0,1098 | 21,8007 | 4,6691 | 0,3838 |
| 6 | Barito Pacific | BRPT | 0,0246 | 0,0803 | 0,1821 | 0,0255 | 0,4582 | 0,6769 | 0,2780 |
| 7 | Citra Nusaphala Persada | CMNP | 0,0202 | 0,1056 | 0,5017 | 0,1431 | 2,0156 | 1,4197 | 0,3658 |
| 8 | Charoen Pokhpand | CPIN | 0,0480 | 0,2158 | 0,8416 | 0,2635 | 2,1573 | 1,4688 | 0,7476 |
| 9 | Ciputra Development | CTRA | 0,0286 | 0,1450 | 0,3200 | 0,2070 | 0,2803 | 0,5294 | 0,5023 |
| 10 | Ciputra Surya | CTRS | 0,0232 | 0,1108 | 0,3067 | 0,1360 | 0,4350 | 0,6595 | 0,3838 |
| 11 | XL Axiata | EXCL | 0,0126 | 0,0608 | 0,1609 | 0,0625 | 0,3126 | 0,5591 | 0,2107 |
| 12 | Gajah Tunggal | GJTL | 0,0130 | 0,0508 | 0,3048 | 0,0326 | 1,0438 | 1,0217 | 0,1759 |
| 13 | Hexindo Perkasa | HEXA | 0,0252 | 0,0994 | 0,2050 | 0,0969 | 0,2825 | 0,5315 | 0,3442 |
| 14 | Humpus Intemoda Transportasi | HITS | 0,0194 | 0,0736 | 0,3413 | 0,0524 | 0,8590 | 0,9268 | 0,2549 |
| 15 | Indofood CBP Sukses Makmur | ICBP | 0,0311 | 0,2384 | 0,4386 | 0,3415 | 0,2660 | 0,5158 | 0,8259 |
| 16 | Inti Kapuas Arowana | IIKP | 0,0503 | 0,1745 | 0,3999 | 0,3447 | 0,1605 | 0,4006 | 0,6045 |
| 17 | Indofood Sukses Makmur | INDF | 0,0232 | 0,1659 | 0,2989 | 0,2260 | 0,1803 | 0,4246 | 0,5747 |
| 18 | Indah Kiat Pulp & Paper | INKP | 0,0164 | 0,0543 | 0,1041 | 0,0063 | 0,2848 | 0,5336 | 0,1881 |
| 19 | Indocement | INTP | 0,0190 | 0,1283 | 0,2159 | 0,1694 | 0,1449 | 0,3807 | 0,4443 |
| 20 | Indosat | ISAT | 0,0088 | 0,0342 | 0,0950 | 0,0506 | 0,1100 | 0,3316 | 0,1184 |
| 21 | Jaya Real Property | JRPT | 0,0198 | 0,0960 | 0,3981 | 0,0339 | 0,6173 | 0,7857 | 0,3324 |
| 22 | Kawasan Industri Jababeka | KIJA | 0,0171 | 0,0766 | 0,1623 | 0,0712 | 0,2182 | 0,4671 | 0,2653 |
| 23 | Kalbe Farma | KLBF | 0,0240 | 0,1685 | 0,3298 | 0,2351 | 0,2726 | 0,5221 | 0,5839 |
| 24 | Lippo Karawaci | LPKR | 0,0099 | 0,0345 | 0,1553 | 0,0059 | 0,3457 | 0,5880 | 0,1196 |
| 25 | PP London Sumatera | LSIP | 0,0183 | 0,0845 | 0,1395 | 0,0778 | 0,1297 | 0,3601 | 0,2926 |
| 26 | Mitra Adiperkasa | MAPI | 0,0242 | 0,1130 | 0,5146 | 0,1661 | 1,7922 | 1,3387 | 0,3913 |
| 27 | Matahari Putra Prima | MPPA | 0,0176 | 0,0960 | 0,3149 | 0,1278 | 0,5008 | 0,7077 | 0,3325 |
| 28 | Persahaan Negara | PGAS | 0,0081 | 0,0252 | 0,0674 | 0,0297 | 0,0791 | 0,2813 | 0,0871 |
| 29 | Palm Asia Corpora | PLAS | 0,0118 | 0,0527 | 0,0973 | 0,0543 | 0,1114 | 0,3338 | 0,1827 |
| 30 | Tambang Batubara Bukit Asam | PTBA | 0,0175 | 0,0869 | 0,2114 | 0,0970 | 0,3732 | 0,6109 | 0,3010 |
| 31 | Pakuwon Jati | PWON | 0,0377 | 0,1610 | 0,4626 | 0,0266 | 1,0414 | 1,0205 | 0,5578 |
| 32 | Ramayana Lestari Sentosa | RALS | 0,0088 | 0,0283 | 0,0681 | 0,0234 | 0,0930 | 0,3050 | 0,0981 |
| 33 | Surya Citra Media | SCMA | 0,0545 | 0,2729 | 1,2683 | 0,6154 | 6,9547 | 2,6372 | 0,9454 |
| 34 | SMART | SMAR | 0,0139 | 0,0547 | 0,1374 | 0,0213 | 0,3220 | 0,5674 | 0,1896 |
| 35 | Holcim Indonesia | SMCB | 0,0157 | 0,0772 | 0,1528 | 0,0826 | 0,1758 | 0,4193 | 0,2673 |
| 36 | Summarecon Agung | SMRA | 0,0283 | 0,1561 | 0,3535 | 0,2310 | 0,2801 | 0,5292 | 0,5409 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 37 | Tunas Baru Lampung | TBLA | 0,0247 | 0,1194 | 0,3501 | 0,1660 | 0,7860 | 0,8865 | 0,4136 |
| 38 | Timah | TINS | 0,0303 | 0,1406 | 0,7209 | 0,2202 | 3,2066 | 1,7907 | 0,4869 |
| 39 | Telekomunikasi Indonesia | TLKM | 0,0187 | 0,1597 | 0,2360 | 0,1978 | 0,1168 | 0,3417 | 0,5531 |
| 40 | Total Bangun Persada | TOTL | 0,0224 | 0,1048 | 0,3673 | 0,1170 | 0,7654 | 0,8749 | 0,3632 |
| 41 | Tunas Ridean | TURI | 0,0130 | 0,1208 | 0,1693 | 0,2601 | 0,1394 | 0,3733 | 0,4185 |
| 42 | United Tractors | UNTR | 0,0182 | 0,1101 | 0,1944 | 0,1241 | 0,1711 | 0,4136 | 0,3813 |
| 43 | Unilever Indonesia | UNVR | 0,0238 | 0,2555 | 0,3200 | 0,2828 | 0,1055 | 0,3247 | 0,8849 |

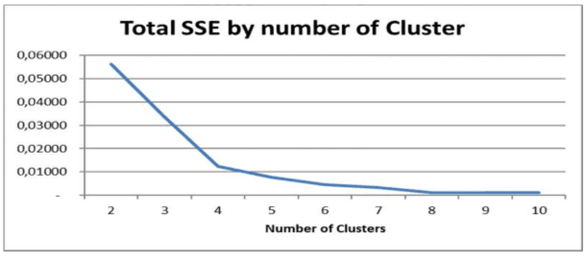
**Source: develop for this study**

Expected monthly return over the research period has a range of minimum0.0081 (PGAS) and maximum range 0.0545 (SCMA). It calculated by the equation (Price 1 – Price 0) / Price 0. The average return for all stocks return is 0.04221.

The excess return between 2010 and 2016 is determined by subtracting the expected return from the risk-free rate. The larger the value, the greater the excess return earned return compared with the interest rates. During the study period the average lowest excess return is 0.0117 contained in the company PGAS, while the highest excess return of 0.00490 contained in SCMA.

The Sharpe ratio is a measure of return that takes into account the level of risk and is commonly utilized to assess portfolio performance. This ratio facilitates comparison of the performance of one portfolio to another by accounting for the risk factor. Stock performance based on Sharpe ratio in the study period can be found at Table 4.1. The best firm with 0.2729 is Surya Citra Media (Surya Citra Media). While Perusahaan Gas Negara (PGAS) gain the lowest value 0.00252.

After ensure Risk Adjusted Return and determine the cluster analysis. The elbow method reaches a plateau as shown in figure 16. As the value of K increases, the distortion decreases and reaches an inflection point at K=4, after which the rate of decrease slows down. Based on this, it can be concluded that four clusters would be the most appropriate number for this study, since the distortion continues to decrease gradually after reaching a minimum at K=3. As a result, it can be determined that this study requires four clusters.




**Source: develop for this study**

**Figure 16. Elbow Method**

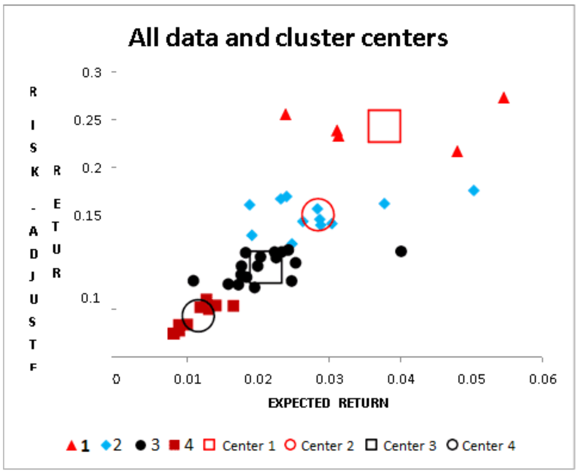
The K-mean clustering for four clusters obtained the data as follows:

**Table 2. Cluster Centers and Allocations**

| Mean/Centroid | EXPECTED RETURN | RISK-ADJUSTED RETURN | |
|---|---|---|---|
| Cluster 1 | 0,0377 | 0,2430 | |
| Cluster 2 | 0,0283 | 0,1501 | |
| Cluster 3 | 0,0210 | 0,0951 | |
| Cluster 4 | 0,0115 | 0,0440 | |
| *AVERAGE* | 0,0230 | 0,1169 | |
| **Alocation** | **Number** | | **SSE/Cluster** |
| Cluster 1 | 5 | | 0,0026 |
| Cluster 2 | 12 | | 0,0043 |
| Cluster 3 | 17 | | 0,0040 |
| Cluster 4 | 9 | | 0,0015 |
| *TOTAL* | 43 | 100,0% | 0,0124 |

**Source: develop for this study**

Here are the results of k-mean clustering for 43 Stocks agglomeration:




**Source: develop for this study**

**Figure 17. Cluster Analysis Scatterplot**

Here are the results of k-mean clustering for 43

Stocks agglomeration:

Table 3 List of Company Based on Each Cluster

| Cluster | Ticker Code |
|---|---|
| 1 | ASII, CPIN, ICBP, SCMA, UNVR |
| 2 | ADHI, AKRA, CTRA, IIKP, INDF, INTP, KLBF, PWON, SMRA, TBLA, TINS, TLKM |
| 3 | BKSL, BRPT, CMNP, CTRS, HEXA, HITS, JRPT, KIJA, LSIP, MAPI, MPPA, PTBA, SMCB, TOTL, TURI, UNTR |
| 4 | EXCL, GJTL, INKP, ISAT, LPKR, PGAS, PLAS, RALS, SMAR |

**Source: develop for this study**

The number of companies which have been grouped in clusters from the K- Means cluster analysis is as follows:

According to the above findings, Cluster 1 pertains to a collection of stocks that exhibit highly unusual returns. It is our belief that such exceptional returns fall within a specific range but surpass a predetermined threshold value. This threshold value may be established as a particular percentage or multiple of the standard deviation. In this study we find only 5 companies, PT. Astra Internasional (ASII), PT. Charoen Pokphand Indonesia Tbk (CPIN), PT. Indofood CBP Sukses Makmur Tbk. (ICBP), PT Surya Citra Media Tbk (SCMA), PT. Unilever Indonesia (UNVR). Companies in this cluster calculated has expected return > 0,03 and the risk-adjusted return > 0,2. Constituents Group those five companies is JakCons (Consumer goods), JakBind (Basic Industry and Chemical) and JakMind (Miscellaneous Industry).

The stocks in cluster 2 represent stock with high return, investment in companies on this cluster may offer the chance of higher returns than other investments might produce, based on our calculation there are 12 companies in this cluster, PT Adhi Karya Tbk (ADHI), PT. PT AKR Corporindo Tbk (AKRA), PT Ciputra Development Tbk (CTRA), PT. Inti Kapuas Arowana Tbk (IIKP), PT Indofood Sukses Makmur Tbk (INDF), PT Indocement Tunggal Prakarsa Tbk (INTP), PT Kalbe Farma Tbk (KLBF), PT. Pakuwon Jati Tbk (PWON), Summarecon Agung Tbk (SMRA), PT. Tunas Baru Lampung Tbk (TBLA), PT Timah Tbk (TINS), PT Telkom Indonesia Tbk (TLKM). As seen from the result most of the companies in this cluster engaged in business is Basic Industry and Chemical, Infrastructure, Utility, Transportation and Construction, Property, Real Estate and communication. The outcome indicates that the Government of Indonesia has made a commitment to enhance the development of infrastructure in order to boost economic growth. There is a noteworthy demand for investing in various types of infrastructure such as roads, toll roads, ports, airports, railways, water supply systems, chemical facilities, power plants, telecommunication networks, and real estate.

Thus, most of stocks are in cluster 3 that represents medium return, medium return investment is a return on investment that is neither high nor small, but the benefits gained by investing in this cluster investment can offer sufficient and profitable return opportunities. In this study, the number of companies in this cluster is 17 companies. PT Sentul City Tbk (BKSL), PT Barito Pacific Tbk (BRPT), PT Citra Marga Nusaphala Persada Tbk (CMNP), PT. Ciputra Surya Tbk (CTRS), PT Hexindo Adiperkasa Tbk (HEXA), PT. Humpuss Intermoda Transportasi Tbk (HITS), PT. Jaya Real Property Tbk (JRPT), PT Jababeka Tbk (KIJA), PT Perusahaan Perkebunan London Sumatra Indonesia Tbk (LSIP), PT Mitra Adiperkasa Tbk (MAPI), PT Matahari Putra Prima Tbk (MPPA), PT Bukit Asam Tbk (PTBA), PT Solusi Bangun Indonesia Tbk (SMCB), PT Total Bangun Persada Tbk (TOTL), PT Tunas Ridean Tbk (TURI), PT United Tractors Tbk (UNTR).

Clusters 4 consists of all stocks categories. It represents a group of stock that has sufficient return, we find only 9 listed companies in this cluster, PT PT XL Axiata Tbk (EXCL), PT Gajah Tunggal Tbk (GJTL), PT Indah Kiat Pulp & Paper Tbk (INKP), PT Indosat Tbk (ISAT), PT Lippo Karawaci Tbk (LPKR), PT Perusahaan Gas Negara Tbk (PGAS), PT. Polaris Investama Tbk (PLAS), PT. Ramayana Lestari Sentosa Tbk (RALS), PT Sinar Mas Agro Resources & Technology Tbk (SMAR). There are only eight of nine stocks categories in Jakarta Islamic Index. JakFin (Finance) never be included in the Index. It is because most financial products or services are prohibited by sharia. In Indonesia, there are banks that follow Sharia principles, but they do not comply with procedural and performance standards. For example, these banks are not required to meet the criteria of being among the top sixty shares based on the previous year's average Market Capitalization, or to rank in the top thirty shares based on the previous year's average liquidity in the regular market.

According to Saiti et al., (2014) Islamic index is less risky than the IDX LQ45. They confirmed that Islamic index is less volatile than conventional index. As clustering result, this study tried to examine the portfolio performance ability in the economic instability during the global financial crisis in late 2008. The portfolio is formed by taking one stock from each cluster. There are Indofood CBP Sukses Makmur (ICBP), Summarecon Agung (SMRA), Tunas Ridean (TURI), SMART (SMAR). These are stocks with the smallest risk- adjusted return from each cluster. The investigation used historical price data during the period July 2008 to June 2009. It is done to calculate the return and risk of a portfolio and to compare it with the stock index.

**Table 5. Example Return and Risk vs Index**

| (Annualized) | Portofolio | JII | LQ45 |
|---|---|---|---|
| Return | 0,1896 | -0,1151 | -0,1401 |
| Risk | 0,1906 | 0,2545 | 0,5390 |

**Source: develop for this study**

Table 5 shows that the sample portfolios formed a positive return with higher risk than the index during the global financial crisis in late 2008. Furthermore, this study found that the positive return is caused by stocks of cluster 1 and 2 conditions. It's providing high return in normal conditions and turned out to provide a low return even negative in unstable conditions. On the other hand, stocks in cluster 4 turned out to consistently provide a low return and didn't impose this return in unstable condition period.

## 5. Conclusions

The Optimal cluster numbers for cluster analysis on Jakarta Islamic Index based on risk adjusted return are 4 (four) clusters. Each cluster has variation on its risk-adjusted return. Cluster 1 shows an extreme return on investment, only 5 companies are included in cluster 1 in this study. Constituents Group those five companies in Cluster 1 are JakCons (Consumer goods), JakBind (Basic Industry and Chemical) and JakMind (Miscellaneous Industry).

Cluster 2 represent the shares with high return investment. The number of companies in this cluster is 12. Meanwhile most of Constituents Group in this cluster JakInfr, JakProp, JakCons, JakBind and JakMine.

Cluster 3 represents medium return; we calculate most companies in our study are included in this cluster. Cluster 4 consisted of all stock categories. It represents a group of stocks that have sufficient return, and 9 companies are included in this cluster. Therefore, if investor would like to diversify their portfolio in Jakarta Sharia industry, they need to pay attention to the characteristics of return and risk in Jakarta Islamic Index.

In General, this research demonstrates a different way of categorizing the Jakarta Islamic Index based on risk-adjusted return. So, Investors can consider their decision for portfolio diversification in Jakarta Sharia Industry. As if in economic instability, the portfolio formed based on cluster analysis is able to deliver good performance above the market's performance.

## 6. Suggestion for Future Research

Considering the shortcomings and limitations of this thesis, during the course of this research several ideas and potential research areas became apparent. The purpose of this section is to serve as a source of inspiration for further researchers who wish to write research papers within this area of work.

This study only uses one clustering method. In order to justify the clustering result reader can use another method to compare the cluster result. Nevertheless, K-Means clustering also has its limitations, including its susceptibility to being influenced by outliers and noise, poor performance with clusters that have non-circular shapes, and the requirement of specifying the initial seed value and number of clusters before conducting the analysis.

The Sharpe ratio is a simple and convenient way to assess the risk and return of a portfolio. While it has many benefits, the equation also has some drawbacks to consider. One of the advantages of the Sharpe ratio is that it is straightforward to calculate and only requires a few basic inputs. However, this simplicity can also be a limitation because certain factors that may affect the results, such as abnormally skewed data or inflation, may not be fully captured by the equation. To address these limitations, future research could explore the use of other ratios or indices that provide more comprehensive information about portfolio performance. For example, the Reward to Market Risk ratio considers the return of a portfolio in relation to the risk of the overall market, while the Reward to Diversification ratio assesses the effectiveness of a portfolio in reducing risk through diversification. The Information Ratio is another ratio that takes into account the risk-adjusted returns of a portfolio and can be used to assess the performance of investment managers.

Investors can use cluster analysis to identify securities with similar returns and eliminate any duplication in their portfolio. Investors could apply the portfolio in this study as reference. This approach increases diversification, which provides the investor will a less risky portfolio. However, investors need to adjust the stock data every period because the time domain and data set number could change the number of clusters.

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