Analysis of Causality Relationship Between the Composite Stock Price Index (CSPI) Jakarta with Large Companies in Indonesia

Sukono, Endang Soeryana, Natasa Belladina
Department of Mathematics, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran, Indonesia
sukono@unpad.ac.id; end.soeryana@unpad.ac.id; natasabelladina@yahoo.com

Agus Santoso
Department of Statistics, Faculty of Sciences and Technology, Universitas Terbuka, Indonesia
aguss@ecampus.ut.ac.id

Puspa Liza Ghazali
Faculty of Business and Management, Universiti Sultan Zainal Abidin, Terengganu, Malaysia
puspaliza@unisza.edu.my

Abdul Talib Bon
Department of Production and Operations, University Tun Hussein Onn Malaysia, Malaysia
talibon@gmail.com

Abstract

The process of globalization lately, causes most countries pay great attention to the capital market, because it has an important and strategic role for a country's economic security. The existence of the global economic crisis has a significant impact on the condition of the Indonesian capital market. Capital market movements can be seen from the ups and downs of stock prices recorded in an index movement or better known as the Composite Stock Price Index (CSPI). This paper intends to examine the causality relationship between the Indonesian stock market and the Jakarta CSPI. The aim is to investigate the causality of the returns of large companies in Indonesia with the movement of CSPI stocks. The method used is granger causality test with Vector Autoregression (VAR) modeling and volatility modeling using GARCH model approach. Causality test results show that there is a direct relationship that affects and is influenced by the CSPI, and the relationship that affects each other between the company's stock market and the movement of the CSPI.

Keywords:
Capital Market, CSPI, Causality, VAR, GARCH.

1. Pendahuluan

The process of globalization lately, causes most countries pay great attention to the capital market because it has an important and strategic role for a country's economic security. The existing capital market in Indonesia is an emerging market which in its development is very vulnerable to macroeconomic conditions in general. The capital market is one of the drivers of the economy in a country, because the capital market is a means of forming capital and accumulation of long-term funds aimed at increasing public participation in the mobilization of funds to support national development financing. In addition, the capital market is also a representation to assess the condition of companies in a country, because almost all industries in a country are represented by the capital market. Capital markets that have increased (bullish) or decreased (bearish) can be seen from the ups and downs of stock prices recorded in an index movement or better known as the Composite Stock Price Index (CSPI). JCI is the value used to measure the combined performance of all shares (companies / issuers) listed on the Indonesia Stock Exchange (IDX). So that the CSPI and the company's stock price can be analyzed as a causal relationship.

Research on the relationship of causality in the capital market has been carried out by several researchers. Halsted (2019) conducted a research to see the causality of the composite stock price index and the exchange rate in Indonesia. The study uses secondary data obtained from the official websites of Bank Indonesia and the World
Bank. In this study using nominal exchange rates and a composite stock price index. Data analysis was performed using the granger causality model between the composite stock price index variable and the exchange rate. The results of the study showed that the composite stock price index caused the exchange rate and not vice versa. (Kearney, 1998; Kanas, 2000; Chiang et al., 2000; Apergis and Reizitis, 2001, Fang and Miller, 2002; Yu Hsing, 2008; Adjasi et al, 2011; Kumar, 2013; Billah et al., 2014) conducted research on the relationship between the exchange rate and the stock market performance in Korea during the Asian crisis and found a significant exchange rate depreciation on the stock market performance. Lin (2012) found that there is causality from the stock market and exchange rates in both countries (Philippines and Thailand). Nieh (2009) shows a long-term positive causal relationship from either the Japanese or American exchange rates to stock prices in Taiwan. Zhao (2010) analyzed the exchange rates and indices in China and the results of observations of the absence of causality, this is in line with research Liu and Wan (2012) found no causal relationship between the stock market and the exchange rate. Jiranyakul (2012) in his research in Taiwan found a causal relationship from the exchange rate to the stock market. In his research, Bhunia (2012) found a causal relationship from the exchange rate to the stock market in India.

Based on the description above, this paper intends to conduct research on Causality Relationship Between the Composite Stock Price Index (CSPI) Jakarta with Large Companies in Indonesia. The object of research in this study is the number of joint stock prices of several large companies in Indonesia. The aim is to measure the level of significance of the causality relationship between CSPI and shares of large companies in Indonesia.

2. Research Methodology

the object being analyzed
The data used in this study are secondary data taken from www.finance.yahoo.com. For closing prices of Astra Graphia (ASGR), Bank Central Asia (BBCA), Citra Development (CTRA), Jasa Marga (JSMR), Indonesian Telecommunications (TLKM), Unilever Indonesia (UNVR), and Jakarta Composite Stock Price Index (JKSE). The data is daily data from January 4, 2015 to December 30, 2018.

The steps taken during the study are broken down as follows:

Stage 1: Data Transformation
For example \(X_t\) the closing value of the Jakarta Composite Stock Price Index at time \(t\), for \(t = 1, 2, \ldots, T\) with \(T\) the number of observations of the data. For example, also \(X_t\) return closing state CSPI at time \(t\), the return value can be calculated by the equation:

\[
X_t = \ln \left( \frac{X_t}{X_{t-1}} \right)
\]

Stage 2: Stationary Data Test
Testing the time series data stationarity for the variable returns of large company stock prices and the return of the Composite Stock Price Index used in this study uses the Augmented Dickey Fuller test (ADF) with the help of Eviews 8. The hypothesis used is,

\(H_0: ADF_{test} > MacKinnon Critical Value\) (there is a unit root)
\(H_1: ADF_{test} < MacKinnon Critical Value\) (no root unit)

where the test criterion is reject \(H_0\) if the t-statistic value of the ADF test is smaller than the p-value of each percentage level, percentage level.

Stage 3: Granger Causality Test
After the data is declared stationary, a granger causality test is carried out to see the causal relationship between the movement of the Jakarta Composite Stock Price Index and several share prices of large companies in Indonesia using Eviews 8 software. The hypotheses used are:

\(H_0: P_t does not affect X_t\)
\(H_1: P_t affects X_t\)

With test statistics seen from the value of prob. against the F test, where the criteria for testing results reject \(H_0\) if the test probability \(F < \alpha = 5\%\).

When there is a directional relationship but it is not simultaneous then it is advanced to the next level, and when there is a directional and simultaneous relationship then it is advanced to the 11th level.

Stage 4: Grouping Data into Regression Models
Data were grouped from the results of the granger causality test for direct but not simultaneous relationships. Then proceed to the next stage.

**Stage 5: Autocorrelation Test**
To see the form of the relationship between the Jakarta Composite Index and the company an approach was made using a regression model to see the pattern of relationships with the Jakarta Composite Index movement. The hypothesis used is: (Wei, 2006).

\[ H_0 : \text{There is no serial correlation to the residuals} \]
\[ H_1 : \text{There is the serial correlation of the residuals} \]

With the test statistics seen from the Watson durbin value close to 2, where the criteria for testing results reject \( H_0 \) if the value \( DW \leq 2 \).

**Stage 6: Heteroscedasticity Test**
After autocorrelation testing, heteroskedastis testing is performed to analyze the variance of errors. The hypothesis used is (Wei, 2006).

\[ H_0 : \text{The homoscedasticity assumption of the error component is fulfilled} \]
\[ H_1 : \text{error is heteroskedastic} \]

With the test statistics seen from the probability value Obs * R-Squared (p-value), where the criteria for testing results reject \( H_0 \) if \( p-value \leq 5\% \).

**Stage 7: Estimation of the ARCH / GARCH model**
To solve the heteroscedastic problem, an estimate is made using the Autoregressive Conditional Heteroscedasticity (ARCH) model or Generaly Autoregressive Conditional Heteroscedasticity (GARCH). In the GARCH model, the parameter values are estimated in the same way in estimating the Regression model. In general, estimating a GARCH model cannot be done just once. A number of trials are needed in forming the GARCH model in such a way that a coefficient of parameters that meets the required and significant requirements is obtained.

**Stage 8: Partial and Total Verification Test**
After selecting the best variance model, just like the next model the variance model needs to be done t-stat test to determine the significance of each independent variable in influencing the dependent variable.

- **Test constant** \( \alpha_0 \), with a hypothesis:
  \[ H_0 : \alpha_0 = 0 \]
  \[ H_1 : \alpha_0 \neq 0 \]

  Where the test statistics are \( t_{rasio} = \frac{\alpha_0}{S.E.\alpha_0} \) or prob value \( (t_{rasio}) \).

  Test criteria, reject \( H_0 \) if \( t_{rasio} > t_\alpha \) or value prob\( (t_{rasio}) < \alpha \).

- **Coefficient Test** \( \alpha_i \), with hypothesis:
  \[ H_0 : \alpha_i = 0 \]
  \[ H_1 : \text{Available} \alpha_i \neq 0 \]

  Where the test statistics are \( t_{rasio} = \frac{\alpha_i}{S.E.\alpha_i} \) or value prob\( (t_{rasio}) \).

  Test criteria, reject \( H_0 \) if \( t_{rasio} > t_\alpha \) or value prob\( (t_{rasio}) < \alpha \).

**Stage 9: ARCH / GARCH Model Diagnostic Test**
To define the GARCH model properly, residuals must be standardized as follows:

\[ Z_t = \frac{\epsilon_t}{\sigma_t} \]

If the model is suitable, then the series \( \{\epsilon_t\} \) does not contain the ARCH effect and the squared residuals of \( \{\epsilon_t\} \) are white noise, which means the squared residuals of \( \{\epsilon_t\} \) must be independent (uncorrelated) and normally distributed with an average approaching 0 (\( \mu = 0 \)) and standard deviation \( \sigma \). Meanwhile, to test whether the series \( \{\epsilon_t\} \) is white noise, it can be done by looking at the value of Q(m) Ljung-Box.

**Stage 10: VAR models**
The Vector Autoregressive (VAR) model is the development of the autoregressive model (AR). If the AR of the current observation is influenced by previous observations of the data, then in the VAR mode the observation of the
time is influenced by previous observations of the data and other data. VAR models with order notated VAR (p) are expressed in the following equation (Wei, 2006: 394).
\[ Z_t = \phi_1 Z_{t-1} + \cdots + \phi_p Z_{t-p} + \alpha_t \]

3. Discussion result

3.1 Analyzed Data

Data transformation is performed to calculate the return value in each company stock referring to Phase 1, for example Jakarta CSPI data notated by variable \( x \) has a close price on January 4, 2015 is IDR 2575.41 and on January 5, 2015 is IDR 2605.28 the results of the calculation are:
\[ x_1 = \ln \frac{2605.28}{2575.41} = 0.011531 \]

And so on to calculate the Jakarta return IHSG until the last data and done in the same way for the variable \( p_1 \) is the ASGR stock price return, \( p_2 \) is the BCA stock price return, \( p_3 \) is the CTRA stock price return, \( p_4 \) is the stock price return JSMR, \( p_5 \) is TLKM stock price return, \( p_6 \) is UNVR stock price return.

3.2 Stationary Data Test Results

The return data that has been calculated in sub-section 3.1, then carried out the stationarity test by referring to Phase 2. The stationarity test aims to make sure that the data return has been stationary, as a prerequisite for time series data analysis. Stationary test results for the six company shares are given in Table 1.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Critical Value at the level:</th>
<th>ADF_{test} Value</th>
<th>Prob.</th>
<th>Conclusion 1%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1%</td>
<td>5%</td>
<td>10%</td>
<td>p_1</td>
</tr>
<tr>
<td>( x )</td>
<td>-3.967547</td>
<td>-3.414458</td>
<td>-3.129363</td>
<td>-18.53363</td>
</tr>
<tr>
<td>( p_1 )</td>
<td>-3.967567</td>
<td>-3.414468</td>
<td>-3.129369</td>
<td>-20.55699</td>
</tr>
<tr>
<td>( p_2 )</td>
<td>-3.967518</td>
<td>-3.414444</td>
<td>-3.129355</td>
<td>-35.11327</td>
</tr>
<tr>
<td>( p_3 )</td>
<td>-3.967518</td>
<td>-3.414444</td>
<td>-3.129355</td>
<td>-31.58663</td>
</tr>
<tr>
<td>( p_4 )</td>
<td>-3.967547</td>
<td>-3.414458</td>
<td>-3.129363</td>
<td>-18.83595</td>
</tr>
<tr>
<td>( p_5 )</td>
<td>-3.967547</td>
<td>-3.414458</td>
<td>-3.129363</td>
<td>-19.37230</td>
</tr>
</tbody>
</table>

Based on Table 1, it can be seen that the results \( ADF_{test} < \text{MacKinnon Critical Value} \) for all observations of data return. So that all observations of the return data used are stationary at the level of significance at 1%, 5%, and 10%. To test the data, a significance level of 5% is chosen for each data test.

3.3 Granger Causality Test Results

After the data return of all companies has been declared stationary, with reference to Phase 3, the Granger causality test is then performed. This test is carried out with the aim to find out whether or not there is a causal relationship between the Composite Stock Price Index and shares of large companies in Indonesia. The results of Grenger's causality test are given in Table 2.

<table>
<thead>
<tr>
<th>( H_0 )</th>
<th>( \hat{F}_{\text{statistik}} )</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>( x ) does not affect ( p_1 )</td>
<td>2.68344</td>
<td>0.0456</td>
</tr>
<tr>
<td>( p_1 ) does not affect ( x )</td>
<td>1.10896</td>
<td>0.3445</td>
</tr>
<tr>
<td>( x ) does not affect ( p_2 )</td>
<td>7.63669</td>
<td>0.0005</td>
</tr>
<tr>
<td>( p_2 ) does not affect ( x )</td>
<td>0.35919</td>
<td>0.6983</td>
</tr>
<tr>
<td>( x ) does not affect ( p_3 )</td>
<td>5.67384</td>
<td>0.0032</td>
</tr>
<tr>
<td>( p_3 ) does not affect ( x )</td>
<td>1.53225</td>
<td>0.2166</td>
</tr>
<tr>
<td>( x ) does not affect ( p_4 )</td>
<td>1.89329</td>
<td>0.2446</td>
</tr>
<tr>
<td>( p_4 ) does not affect ( x )</td>
<td>2.65791</td>
<td>0.0472</td>
</tr>
<tr>
<td>( x ) does not affect ( p_5 )</td>
<td>0.25045</td>
<td>0.8610</td>
</tr>
</tbody>
</table>
Based on the results of Table 2, the above shows that the variables $p_1, p_2, p_3$ are influenced by the variable $x$, for the variable $p_4, p_5$ affects the variable $x$, whereas for the variable $p_6$ has a simultaneous direct relationship with the variable $x$.

### 3.4 Results of Grouping Data in Regression Models

From the results of granger causality testing, the variables $p_1, p_2, p_3$, referring to Stage 4, the data return can be grouped into the first group and the variable $p_4, p_5$ can be grouped into the second group, both groups are modeled with a regression model.

#### 3.4.1 The First Group Regression Model

Based on causality testing in which large companies do not have a simultaneous relationship with the movement of the Jakarta CSPI shares. The output of the regression model for the variables affected by the Jakarta CSPI can be seen in Table 3.

<table>
<thead>
<tr>
<th>Method</th>
<th>Variable</th>
<th>OLS Method</th>
<th>HC Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p_1$</td>
<td>0.00157</td>
<td>0.00081</td>
<td></td>
</tr>
<tr>
<td>$p_2$</td>
<td>0.014452</td>
<td>0.02365</td>
<td></td>
</tr>
<tr>
<td>$p_3$</td>
<td>0.007166</td>
<td>0.00967</td>
<td></td>
</tr>
</tbody>
</table>

Based on the results presented in Table 4, the comparison of standard error values for each method is different, but the results of the coefficient test with the $t$ statistic show all the regression coefficients are significant, it can be concluded that heteroscedasticity is not a serious problem for this regression.
3.4.1.3 ARCH / GARCH Model Estimation
Dalam model GARCH, nilai parameternya diestimasi dengan cara yang sama dalam mengestimasi model regresi. Estimasi model GARCH dilakukan dengan merujuk Tahap 7, dan hasil estimasi diberikan dalam Tabel 5.

<table>
<thead>
<tr>
<th>GARCH Model</th>
<th>AIC Value</th>
<th>SIC Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>GARCH (1,1)</td>
<td>-6.673605</td>
<td>-6.643510</td>
</tr>
<tr>
<td>GARCH (1,2)</td>
<td>-6.671646</td>
<td>-6.636535</td>
</tr>
</tbody>
</table>

Based on the results of Table 5, the above estimation can be concluded that the best model used to model stocks in the first group is GARCH (2.1) because it has the smallest AIC and SIC values.

3.4.1.4 Partial and Total Verification Test
After selecting the best model, then the chosen model needs to be t-stat tested to determine the significance of each independent variable in influencing the related variable. Partial and total tests are carried out by referring to Stage 8 using Eviews 8 software, and the results are given in Table 6. After partial testing, the \( \alpha_0, \alpha_1 \) constants influence the related variable \( (\sigma_t^2) \) but the \( \alpha_2, \beta_1 \) constant is not affect the related variable \( (\sigma_t^2) \).

Next, to find out whether or not there is a serial correlation in the model, a re-test of the presence of the ARCH effect in residuals is performed using the ARCH-LM test.

<table>
<thead>
<tr>
<th>Heteroskedasticity Test: ARCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic: Obs * R-squared</td>
</tr>
<tr>
<td>Obs * R-squared: 0.299402</td>
</tr>
</tbody>
</table>

Based on Table 6, the probability of Obs * R-squared is greater than the significance level of 0.05 (5%). So it can be concluded that there has been no ARCH effect in stock residuals in the first group.

3.4.1.5 GARCH Model Diagnostic Test
In the diagnostic test carried out by referring to Step 9, with the help of Eviews 8. The analysis will be used is to do the Ljung-Box \( Q(m) \) statistical test and the ACF / PACF plot of the squared residual correlogram standardized in Figure 1, to see if there are any serial correlation or not in residuals.

![Figure 1. Standardized Residual Squared Corelogram](image-url)
From Figure 1, the above shows that ACF and PACF are not significant, which is indicated by the probability value of the Ljung-Box \( Q(m) \) statistic that is greater than the confidence level of 0.05 (5\%) so that it can be concluded that the residuals of the model are white noise and there is no serial correlation in residuals. In addition, white noise testing is also performed using the GARCH model residual data normality test. Normality testing is carried out with the help of Eviews 8 software, and the results are given as Figure 2.

In Figure 2, the histogram shows that the residuals are normally distributed. This is shown by: (a) the graph that follows the bell curve, and (b) the statistical value of Jarque-Bera which has a very large probability.

So, from the diagnostic test it can be concluded that the GARCH model (2.1) is white noise and normally distributed. So that the GARCH (2.1) model is good enough to be used in the modeling of stock data in the first group, with the GARCH (2.1) equation as follows:

\[
X_t = 0.005578 p_{4t} + 0.371095 p_{2t} + 0.020058 p_{3t} + e_t,
\]

\[
\sigma_t^2 = 0.0000421 + 0.096757 e_{t-1}^2 + 0.013481 e_{t-1}^2 + 0.839765 \sigma_{t-1}^2.
\]

### 3.4.2 Model Regresi Kelompok Kedua

Based on causality testing where large companies do not have a simultaneous relationship with the Jakarta CSPI stock movements. The results of the regression model output for the variables affected by the Jakarta Composite Index can be seen in Table 7.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>0.004669</td>
<td>0.005737</td>
<td>0.851107</td>
<td>0.3896</td>
</tr>
<tr>
<td>P2</td>
<td>0.435308</td>
<td>0.014452</td>
<td>30.10418</td>
<td>0.0000</td>
</tr>
<tr>
<td>P3</td>
<td>0.020427</td>
<td>0.007196</td>
<td>2.800668</td>
<td>0.0045</td>
</tr>
</tbody>
</table>

Based on the outputs in Table 7 above, the equation is obtained: \( X_t = \beta_1 P_{4t} + \beta_2 P_{5t} \). Then do the research with the same steps for all stages in the second group, the GARCH equation (1.1) is obtained as the best model for modeling stock data in the second group, with the GARCH model equation (1.1) as follows:

\[
X_t = 0.102165 p_{4t} + 0.2843321 p_{3t} + e_t,
\]

\[
\sigma_t^2 = 0.800000464 + 0.145702 e_{t-1}^2 + 0.817790 \sigma_{t-1}^2.
\]
3.5 VAR Modeling Results
As has been proven in the causality test that between variables $p_6$ and $x$ have a two-way and simultaneous relationship, so the model used to describe the relationship between the two capital markets uses the VAR model. VAR modeling is carried out by referring to Stage 10, carried out with the help of Eviews 8 software, and the results are given in Table 8.

Table 8. Estimation of the VAR Model

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>P6</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.000424</td>
<td>-0.148022</td>
</tr>
<tr>
<td>P6(1)</td>
<td>0.031558</td>
<td>-0.031558</td>
</tr>
<tr>
<td>P6(2)</td>
<td>0.041659</td>
<td>-0.124549</td>
</tr>
<tr>
<td>X(1)</td>
<td>0.031558</td>
<td>-0.148022</td>
</tr>
<tr>
<td>X(2)</td>
<td>0.041659</td>
<td>-0.124549</td>
</tr>
<tr>
<td>X(3)</td>
<td>0.031558</td>
<td>-0.148022</td>
</tr>
</tbody>
</table>

From Table 8, the above modeling can be carried out as follows:

$x = 0.000424 + 0.031558x_{t-1} + 0.041659x_{t-2} + 0.020673p_{6t-1} + 0.036679p_{6t-2}$

$p_6 = 0.001419 - 0.148022x_{t-1} - 0.124549x_{t-2} - 0.31558x_{t-3} - 0.137784p_{6t-1} - 0.137784p_{6t-2}$

4. Conclusion
The equation model for the first group obtained the GARCH model (2.1), namely Jakarta’s Jakarta Composite Index movement increased influenced by the movement of the company PT. Astra Graphia Tbk (ASGR) by 0.005578 points, the company PT. Bank Central Asia Tbk (BBCA) amounted to 0.371095 point, and PT. Citra Development Tbk (CTRA) of 0.020058 points. For the second equation model, the GARCH model (1.1) is obtained, namely Jakarta’s JCI movement increased by PT. Jasa Marga Tbk (JSMR) by 0.102165 points, and PT. Telekomunikasi Indonesia Tbk (TLKM) of 0.284321 point. While Jakarta CSPI and PT Unilever (UNVR) have a simultaneous relationship with the movement that is directly proportional, if Jakarta CSPI rises, PT. Unilever (UNVR) also experiences an increase and vice versa.

References


**Acknowledgements**

Acknowledgments are conveyed to the Rector, Director of Directorate of Research, Community Involvement and Innovation, and the Dean of Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran, with whom the Internal Grant Program of Universitas Padjadjaran was made possible to fund this research. The grant is a means of enhancing research and publication activities for researchers at Universitas Padjadjaran.
Biographies

**Sukono** is a lecturer in the Department of Mathematics, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran. Currently as Chair of the Research Collaboration Community (RCC), the field of applied mathematics, with a field of concentration of financial mathematics and actuarial sciences.

**Endang Soeryana** is a lecturer in the Department of Mathematics, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran. The field of applied mathematics, with a field of concentration of financial mathematics and actuarial sciences.

**Natasa Belladina** is a graduate of Mathematics at Universitas Padjadjaran with honors in 2017. Miss Januaviani is currently continuing her studies in The Master Program in Mathematics, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran.

**Agus Santoso** is a lecturer in the Department of Statistics, Faculty of Sciences and Technology, Universitas Terbuka. Now is serving as Dean of the Faculty of Science and Technology, Universitas Terbuka. The field of applied statistics, with a field of concentration of Educational Measurement.

**Puspa Liza Ghazali** is an Associate Professor in Faculty of Business and Management at the Universiti Sultan Zainal Abidin. Research interest in Statistical Modelling, Financial Mathematics, Insurance, Islamic Insurance, Teaching and Learning, and Mathematical Science.

**Abdul Talib Bon** is a professor of Production and Operations Management in the Faculty of Technology Management and Business at the Universiti Tun Hussein Onn Malaysia since 1999. He has a PhD in Computer Science, which he obtained from the Universite de La Rochelle, France in the year 2008. His doctoral thesis was on topic Process Quality Improvement on Beltline Moulding Manufacturing. He studied Business Administration in the Universiti Kebangsaan Malaysia for which he was awarded the MBA in the year 1998. He’s bachelor degree and diploma in Mechanical Engineering which his obtained from the Universiti Teknologi Malaysia. He received his postgraduate certificate in Mechatronics and Robotics from Carlisle, United Kingdom in 1997. He had published more 150 International Proceedings and International Journals and 8 books. He is a member of MSORSM, IIF, IEOM, IIE, INFORMS, TAM and MIM.