



UNIVERSITI
TEKNOLOGI
MARA

Cawangan Kedah
Kampus Sungai Petani



e-PROCEEDINGS

of The 5th International Conference
on Computing, Mathematics and
Statistics (iCMS2021)

4-5 August 2021

Driving Research Towards Excellence



e-Proceedings of the 5th International Conference on Computing, Mathematics and Statistics (iCMS 2021)

Driving Research Towards Excellence

Editor-in-Chief: Norin Rahayu Shamsuddin

Editorial team:

Dr. Afida Ahamad
Dr. Norliana Mohd Najib
Dr. Nor Athirah Mohd Zin
Dr. Siti Nur Alwani Salleh
Kartini Kasim
Dr. Ida Normaya Mohd Nasir
Kamarul Ariffin Mansor

e-ISBN: 978-967-2948-12-4

DOI

Library of Congress Control Number:

Copyright © 2021 Universiti Teknologi MARA Kedah Branch

All right reserved, except for educational purposes with no commercial interests. No part of this publication may be reproduced, copied, stored in any retrieval system or transmitted in any form or any means, electronic or mechanical including photocopying, recording or otherwise, without prior permission from the Rector, Universiti Teknologi MARA Kedah Branch, Merbok Campus. 08400 Merbok, Kedah, Malaysia.

The views and opinions and technical recommendations expressed by the contributors are entirely their own and do not necessarily reflect the views of the editors, the Faculty or the University.

Publication by
Department of Mathematical Sciences
Faculty of Computer & Mathematical Sciences
UiTM Kedah

TABLE OF CONTENT

PART 1: MATHEMATICS

	Page
STATISTICAL ANALYSIS ON THE EFFECTIVENESS OF SHORT-TERM PROGRAMS DURING COVID-19 PANDEMIC: IN THE CASE OF PROGRAM BIJAK SIFIR 2020 <i>Nazihah Safie, Syerrina Zakaria, Siti Madhihah Abdul Malik, Nur Bains Ismail, Azwani Alias Ruwaidiah Idris</i>	1
RADIATIVE CASSON FLUID OVER A SLIPPERY VERTICAL RIGA PLATE WITH VISCOUS DISSIPATION AND BUOYANCY EFFECTS <i>Siti Khuzaimah Soid, Khadijah Abdul Hamid, Ma Nuramalina Nasero, NurNajah Nabila Abdul Aziz</i>	10
GAUSSIAN INTEGER SOLUTIONS OF THE DIOPHANTINE EQUATION $x^4 + y^4 = z^3$ FOR $x \neq y$ <i>Shahrina Ismail, Kamel Ariffin Mohd Atan and Diego Sejas Viscarra</i>	19
A SEMI ANALYTICAL ITERATIVE METHOD FOR SOLVING THE EMDEN-FOWLER EQUATIONS <i>Mat Salim Selamat, Mohd Najir Tokachil, Noor Aqila Burhanddin, Ika Suzieana Murad and Nur Farhana Razali</i>	28
ROTATING FLOW OF A NANOFUID PAST A NONLINEARLY SHRINKING SURFACE WITH FLUID SUCTION <i>Siti Nur Alwani Salleh, Norfifah Bachok and Nor Athirah Mohd Zin</i>	36
MODELING THE EFFECTIVENESS OF TEACHING BASIC NUMBERS THROUGH MINI TENNIS TRAINING USING MARKOV CHAIN <i>Rahela Abdul Rahim, Rahizam Abdul Rahim and Syahrul Ridhwan Morazuk</i>	46
PERFORMANCE OF MORTALITY RATES USING DEEP LEARNING APPROACH <i>Mohamad Hasif Azim and Saiful Izzuan Hussain</i>	53
UNSTEADY MHD CASSON FLUID FLOW IN A VERTICAL CYLINDER WITH POROSITY AND SLIP VELOCITY EFFECTS <i>Wan Faezah Wan Azmi, Ahmad Qushairi Mohamad, Lim Yeou Jiann and Sharidan Shafie</i>	60
DISJUNCTIVE PROGRAMMING - TABU SEARCH FOR JOB SHOP SCHEDULING PROBLEM <i>S. Z. Nordin, K.L. Wong, H.S. Pheng, H. F. S. Saipol and N.A.A. Husain</i>	68
FUZZY AHP AND ITS APPLICATION TO SUSTAINABLE ENERGY PLANNING DECISION PROBLEM <i>Liana Najib and Lazim Abdullah</i>	78
A CONSISTENCY TEST OF FUZZY ANALYTIC HIERARCHY PROCESS <i>Liana Najib and Lazim Abdullah</i>	89
FREE CONVECTION FLOW OF BRINKMAN TYPE FLUID THROUGH AN COSINE OSCILLATING PLATE <i>Siti Noramirah Ibrahim, Ahmad Qushairi Mohamad, Lim Yeou Jiann, Sharidan Shafie and Muhammad Najib Zakaria</i>	98

RADIATION EFFECT ON MHD FERROFLUID FLOW WITH RAMPED WALL TEMPERATURE AND ARBITRARY WALL SHEAR STRESS	106
<i>Nor Athirah Mohd Zin, Aaiza Gul, Siti Nur Alwani Salleh, Imran Ullah, Sharena Mohamad Isa, Lim Yeou Jiann and Sharidan Shafie</i>	

PART 2: STATISTICS

A REVIEW ON INDIVIDUAL RESERVING FOR NON-LIFE INSURANCE	117
<i>Kelly Chuah Khai Shin and Ang Siew Ling</i>	
STATISTICAL LEARNING OF AIR PASSENGER TRAFFIC AT THE MURTALA MUHAMMED INTERNATIONAL AIRPORT, NIGERIA	123
<i>Christopher Godwin Udomboso and Gabriel Olugbenga Ojo</i>	
ANALYSIS ON SMOKING CESSATION RATE AMONG PATIENTS IN HOSPITAL SULTAN ISMAIL, JOHOR	137
<i>Siti Mariam Norrulashikin, Ruzaini Zulhusni Puslan, Nur Arina Bazilah Kamisan and Siti Rohani Mohd Nor</i>	
EFFECT OF PARAMETERS ON THE COST OF MEMORY TYPE CHART	146
<i>Sakthiseswari Ganasan, You Huay Woon and Zainol Mustafa</i>	
EVALUATION OF PREDICTORS FOR THE DEVELOPMENT AND PROGRESSION OF DIABETIC RETINOPATHY AMONG DIABETES MELLITUS TYPE 2 PATIENTS	152
<i>Syafawati Ab Saad, Maz Jamilah Masnan, Karniza Khalid and Safwati Ibrahim</i>	
REGIONAL FREQUENCY ANALYSIS OF EXTREME PRECIPITATION IN PENINSULAR MALAYSIA	160
<i>Iszuanie Syafidza Che Ilias, Wan Zawiah Wan Zin and Abdul Aziz Jemain</i>	
EXPONENTIAL MODEL FOR SIMULATION DATA VIA MULTIPLE IMPUTATION IN THE PRESENT OF PARTLY INTERVAL-CENSORED DATA	173
<i>Salman Umer and Faiz Elfaki</i>	
THE FUTURE OF MALAYSIA'S AGRICULTURE SECTOR BY 2030	181
<i>Thanusha Palmira Thangarajah and Suzilah Ismail</i>	
MODELLING MALAYSIAN GOLD PRICES USING BOX-JENKINS APPROACH	186
<i>Isnewati Ab Malek, Dewi Nur Farhani Radin Nor Azam, Dinie Syazwani Badrul Aidi and Nur Syafiqah Sharim</i>	
WATER DEMAND PREDICTION USING MACHINE LEARNING: A REVIEW	192
<i>Norashikin Nasaruddin, Shahida Farhan Zakaria, Afida Ahmad, Ahmad Zia Ul-Saufie and Norazian Mohamaed Noor</i>	
DETECTION OF DIFFERENTIAL ITEM FUNCTIONING FOR THE NINE-QUESTIONS DEPRESSION RATING SCALE FOR THAI NORTH DIALECT	201
<i>Suttipong Kawilapat, Benchlak Maneeton, Narong Maneeton, Sukon Prasitwattanaseree, Thoranin Kongsuk, Suwanna Arunpongpaisal, Jintana Leejongpermpool, Supattra Sukhawaha and Patrinee Traisathit</i>	

ACCELERATED FAILURE TIME (AFT) MODEL FOR SIMULATION PARTLY INTERVAL-CENSORED DATA	210
<i>Ibrahim El Feky and Faiz Elfaki</i>	
MODELING OF INFLUENCE FACTORS PERCENTAGE OF GOVERNMENTS' RICE RECIPIENT FAMILIES BASED ON THE BEST FOURIER SERIES ESTIMATOR	217
<i>Chaerobby Fakhri Fauzaan Purwoko, Ayuning Dwis Cahyasari, Netha Aliffia and M. Fariz Fadillah Mardianto</i>	
CLUSTERING OF DISTRICTS AND CITIES IN INDONESIA BASED ON POVERTY INDICATORS USING THE K-MEANS METHOD	225
<i>Khoirun Niswatin, Christopher Andreas, Putri Fardha Asa OktaviaHans and M. Fariz Fadilah Mardianto</i>	
ANALYSIS OF THE EFFECT OF HOAX NEWS DEVELOPMENT IN INDONESIA USING STRUCTURAL EQUATION MODELING-PARTIAL LEAST SQUARE	233
<i>Christopher Andreas, Sakinah Priandi, Antonio Nikolas Manuel Bonar Simamora and M. Fariz Fadillah Mardianto</i>	
A COMPARATIVE STUDY OF MOVING AVERAGE AND ARIMA MODEL IN FORECASTING GOLD PRICE	241
<i>Arif Luqman Bin Khairil Annuar, Hang See Pheng, Siti Rohani Binti Mohd Nor and Thoo Ai Chin</i>	
CONFIDENCE INTERVAL ESTIMATION USING BOOTSTRAPPING METHODS AND MAXIMUM LIKELIHOOD ESTIMATE	249
<i>Siti Fairus Mokhtar, Zahayu Md Yusof and Hasimah Sapiri</i>	
DISTANCE-BASED FEATURE SELECTION FOR LOW-LEVEL DATA FUSION OF SENSOR DATA	256
<i>M. J. Masnan, N. I. Maha3, A. Y. M. Shakaf, A. Zakaria, N. A. Rahim and N. Subari</i>	
BANKRUPTCY MODEL OF UK PUBLIC SALES AND MAINTENANCE MOTOR VEHICLES FIRMS	264
<i>Asmahani Nayan, Amirah Hazwani Abd Rahim, Siti Shuhada Ishak, Mohd Rijal Ilias and Abd Razak Ahmad</i>	
INVESTIGATING THE EFFECT OF DIFFERENT SAMPLING METHODS ON IMBALANCED DATASETS USING BANKRUPTCY PREDICTION MODEL	271
<i>Amirah Hazwani Abdul Rahim, Nurazlina Abdul Rashid, Abd-Razak Ahmad and Norin Rahayu Shamsuddin</i>	
INVESTMENT IN MALAYSIA: FORECASTING STOCK MARKET USING TIME SERIES ANALYSIS	278
<i>Nuzlinda Abdul Rahman, Chen Yi Kit, Kevin Pang, Fauhatuz Zahroh Shaik Abdullah and Nur Sofiah Izani</i>	

PART 3: COMPUTER SCIENCE & INFORMATION TECHNOLOGY

- ANALYSIS OF THE PASSENGERS' LOYALTY AND SATISFACTION OF AIRASIA PASSENGERS USING CLASSIFICATION** 291
Ee Jian Pei, Chong Pui Lin and Nabilah Filzah Mohd Radzuan
- HARMONY SEARCH HYPER-HEURISTIC WITH DIFFERENT PITCH ADJUSTMENT OPERATOR FOR SCHEDULING PROBLEMS** 299
Khairul Anwar, Mohammed A.Awadallah and Mohammed Azmi Al-Betar
- A 1D EYE TISSUE MODEL TO MIMIC RETINAL BLOOD PERFUSION DURING RETINAL IMAGING PHOTOPLETHYSMOGRAPHY (IPPG) ASSESSMENT: A DIFFUSION APPROXIMATION – FINITE ELEMENT METHOD (FEM) APPROACH** 307
Harnani Hassan, Sukreen Hana Herman, Zulfakri Mohamad, Sijung Hu and Vincent M. Dwyer
- INFORMATION SECURITY CULTURE: A QUALITATIVE APPROACH ON MANAGEMENT SUPPORT** 325
Qamarul Nazrin Harun, Mohamad Noorman Masrek, Muhamad Ismail Pahmi and Mohamad Mustaqim Junoh
- APPLY MACHINE LEARNING TO PREDICT CARDIOVASCULAR RISK IN RURAL CLINICS FROM MEXICO** 335
Misael Zambrano-de la Torre, Maximiliano Guzmán-Fernández, Claudia Sifuentes-Gallardo, Hamurabi Gamboa-Rosales, Huizilopoztli Luna-García, Ernesto Sandoval-García, Ramiro Esquivel-Felix and Héctor Durán-Muñoz
- ASSESSING THE RELATIONSHIP BETWEEN STUDENTS' LEARNING STYLES AND MATHEMATICS CRITICAL THINKING ABILITY IN A 'CLUSTER SCHOOL'** 343
Salimah Ahmad, Asyura Abd Nassir, Nor Habibah Tarmuji, Khairul Firhan Yusob and Nor Azizah Yacob
- STUDENTS' LEISURE WEEKEND ACTIVITIES DURING MOVEMENT CONTROL ORDER: UİTM PAHANG SHARING EXPERIENCE** 351
Syafıza Saila Samsudin, Noor Izyan Mohamad Adnan, Nik Muhammad Farhan Hakim Nik Badrul Alam, Siti Rosiah Mohamed and Nazihah Ismail
- DYNAMICS SIMULATION APPROACH IN MODEL DEVELOPMENT OF UNSOLD NEW RESIDENTIAL HOUSING IN JOHOR** 363
Lok Lee Wen and Hasimah Sapiri
- WORD PROBLEM SOLVING SKILLS AS DETERMINANT OF MATHEMATICS PERFORMANCE FOR NON-MATH MAJOR STUDENTS** 371
Shahida Farhan Zakaria, Norashikin Nasaruddin, Mas Aida Abd Rahim, Fazillah Bosli and Kor Liew Kee
- ANALYSIS REVIEW ON CHALLENGES AND SOLUTIONS TO COMPUTER PROGRAMMING TEACHING AND LEARNING** 378
Noor Hasnita Abdul Talib and Jasmin Ilyani Ahmad

PART 4: OTHERS

- ANALYSIS OF CLAIM RATIO, RISK-BASED CAPITAL AND VALUE-ADDED INTELLECTUAL CAPITAL: A COMPARISON BETWEEN FAMILY AND GENERAL TAKAFUL OPERATORS IN MALAYSIA** 387
Nur Amalina Syafiqa Kamaruddin, Norizarina Ishak, Siti Raihana Hamzah, Nurfadhlina Abdul Halim and Ahmad Fadhly Nurullah Rasade
- THE IMPACT OF GEOMAGNETIC STORMS ON THE OCCURRENCES OF EARTHQUAKES FROM 1994 TO 2017 USING THE GENERALIZED LINEAR MIXED MODELS** 396
N. A. Mohamed, N. H. Ismail, N. S. Majid and N. Ahmad
- BIBLIOMETRIC ANALYSIS ON BITCOIN 2015-2020** 405
Nurazlina Abdul Rashid, Fazillah Bosli, Amirah Hazwani Abdul Rahim, Kartini Kasim and Fathiyah Ahmad@Ahmad Jali
- GENDER DIFFERENCE IN EATING AND DIETARY HABITS AMONG UNIVERSITY STUDENTS** 413
Fazillah Bosli, Siti Fairus Mokhtar, Noor Hafizah Zainal Aznam, Juaini Jamaludin and Wan Siti Esah Che Hussain
- MATHEMATICS ANXIETY: A BIBLIOMETRIX ANALYSIS** 420
Kartini Kasim, Hamidah Muhd Irpan, Noorazilah Ibrahim, Nurazlina Abdul Rashid and Anis Mardiana Ahmad
- PREDICTION OF BIOCHEMICAL OXYGEN DEMAND IN MEXICAN SURFACE WATERS USING MACHINE LEARNING** 428
Maximiliano Guzmán-Fernández, Misael Zambrano-de la Torre, Claudia Sifuentes-Gallardo, Oscar Cruz-Dominguez, Carlos Bautista-Capetillo, Juan Badillo-de Loera, Efrén González Ramírez and Héctor Durán-Muñoz

MODELLING MALAYSIAN GOLD PRICES USING BOX-JENKINS APPROACH

Isnewati Ab Malek¹, Dewi Nur Farhani Radin Nor Azam², Dinie Syazwani Badrul Aidi³ and Nur Syafiqah Sharim⁴

^{1, 2, 3, 4} Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA Cawangan Negeri Sembilan, Kampus Seremban, 70300 Seremban, Negeri Sembilan, Malaysia
(¹ isnewati@uitm.edu.my, ² j.dewifarhani@gmail.com, ³ diniesyazwanie256@gmail.com, ⁴ syaaaafiqahs@gmail.com)

Nowadays, gold is an excellent choice of investment for many reasons. It can be used as a hedge against inflation, the function of money and it will always be valuable because of rarity. The Malaysian Kijang Emas is Malaysia's official gold bullion coin and is minted by Malaysia's Royal Mint. This study aims to describe the trend of Kijang Emas and to find the best-fitted model of the ARIMA model in modelling volatile data. The general finding of this study is that the Kijang Emas prices indicate the presence of an upward trend, and no seasonality component exists in the data series. In estimating the parameters for the Box-Jenkins ARIMA model, Maximum Likelihood Estimation (MLE) is used. The modelling performance of ARIMA is evaluated by using the value of Akaike's Information Criterion (AIC), Bayesian Information Criterion (BIC), Root Mean Square Error (RMSE) and Mean Absolute Error (MAE). In terms of forecasting performance, ARIMA (2,1,1) is the more appropriate model for forecasting the future Kijang Emas prices because it has the smallest value of RMSE and MAE.

Keywords: Box-Jenkins, ARIMA, Gold, Kijang Emas, Stationary

1. Introduction

In 2018, with the gold prices volatile market conditions, investor turn their cash investments with gold by either purchasing jewellery or gold bullion coin. This is to ensure that the investor does not lose their purchasing power in the forthcoming days. The increasing demand for gold initiates the price of gold to rise. Kijang Emas Gold Bullion Coins is an alternative form of investment. The Kijang Emas is minted by Malaysia's Royal Mint and is sold by Malayan Banking Berhad. Tun Dr Mahathir Mohamad, the former Prime Minister of Malaysia, released the gold bullion on 17 July 2001. The gold bullion coins come in three sizes; 1 oz, ½ oz and ¼ oz. Price movement for gold is determined by the international gold market.

The gold prices are known for their volatility, which is a condition where the conditional variance changes between extremely high and low values (Miswan et al., 2013). According to Choong et al. (2012) gold is one of the best ways to save for the future and prepare for the worst. Gold prices can be very high at some point and can be very low. Some people are making money by buying gold at a low price and selling it later at a higher price. However, they cannot predict accurately the right time to buy and sell the gold due to inconsistent gold prices.

Based on the previous study, Ho et al. (2017) said that the ARIMA model is the best forecasting technique when involving time-series data. In addition, the study was done by Tripathy and Naliniprava (2017) mentioned that one of the widely used models for predicting the gold price nowadays is the ARIMA model by assuming the future values of time series have a functional relationship with current and past values. Moreover, in the Ali et al. (2016) study, the Box-Jenkins methodology has been applied for forecasting the daily gold price from the USA GOLD website. At the first difference, it is known that the data is stationary by using the Line Diagram, Correlogram and ADF Test. Both models for ARIMA (0,1,1) and (1,1,0) have very close values of AIC and BIC

to each other after model estimation. As a result, it indicates that ARIMA (0,1,1) is more appropriate model than ARIMA (1,1,0) by comparing the values of MAE, MAPE and RMSE.

A study was done by Guha and Bandyopadhyay (2016) also use the Box-Jenkins method to predict the future values of gold prices. The estimated ARIMA models, which is ARIMA (1,1,1) and ARIMA (0,1,1) are selected. The result showed that ARIMA (1,1,1) was selected as the best model because it has the lowest value of AIC and BIC.

In 2020, the world faced a shocking situation caused by a coronavirus (Covid-19) that affected the whole world which caused deflection. This causes many consequences that affect people, economies, the environment, and daily life. Yousef and Shehadeh (2020), indicate that the number of Covid-19 global cases has positively impacted gold price. In addition, they said that the global recession likely to be caused by the Covid-19 pandemic may mean investors will continue to seek refuge in gold for some time to come. As the world economy fell, people worried that coronavirus might worsen in the future, so they overcame it by investing in gold for their safe assets. Consequently, the demand for gold can continue to rise, at the same time pushing its price upwards until a vaccine appears to stabilize the world economy (Grima et al., 2020).

Due to the volatility of gold prices, it is a good choice to predict gold prices as it can help those people who are planning to invest in gold in the future. Therefore, this study is important to describe Kijang Emas's trend and find the best-fitted model to forecast the prices.

2. Methodology

2.1 Data Description

This data is available on the Central Bank of Malaysia (BNM) website. This study focuses on the buying price of bullion coin Kijang Emas for 1 troy ounce collected in daily terms starting from 1st September 2016 until 30th September 2020.

2.2 Box-Jenkins Methodology

Box-Jenkins's method is a widely used process to find out the best model for time series data. According to Lazim (2013), the Box-Jenkins approach is synonymous with the general ARIMA modelling. This method is used to fulfil the second objective which is to determine the best fitted ARIMA model of Kijang Emas price. The term ARIMA is in the short, stands for the combination that comprises the Autoregressive Integrated Moving Average, model. The model, thus, obtained is represented in a general term as ARIMA (p, d, q) where the symbol ' d ' denotes the number of times the variable buying prices need to be differenced to achieve stationary. A simple model case ARIMA (1,1,1) can be written as,

$$w_t = \mu + \phi_1 w_{t-1} - \theta_1 \varepsilon_{t-1} + \varepsilon_t \quad (1)$$

where $w_t = y_t - y_{t-1}$ represents the first difference of the buying price series and is assumed stationary. In (1), the values of $p = 1$, $d = 1$ and $q = 1$. The values of p and q were the number of significant spikes in the Partial Correlation Function (PACF) and Autocorrelation Function (ACF), respectively.

To choose the best ARIMA model, some statistical measures were applied. Some of the common statistical measures used to validate the best ARIMA models are the Akaike's Information Criteria (AIC) and the Bayesian Information Criteria (BIC). The AIC was implemented to compare distinct possible models and discover which one is the best fit for the data (Bevans, 2020). Meanwhile, the BIC aimed to choose a model that achieves the most accurate out-of-sample forecast by stabilizing

between the models' complexity and goodness of fit (Hyndman, 2018). The lower the value of AIC and BIC, the model is said to be the best ARIMA model.

Finally, the best model is selected based on the results of comparing their respective measures in which the model that produced the smallest value of Root Mean Square Error (RMSE). The model is ready to be used for forecasting when all criteria are fulfilled, and the model is significant.

3. Result and Discussions

The results and analysis of the research will be discussed in this section. The process of selecting the best parameter is done by using EViews software.

3.1 The Overall Trend of Malaysian Gold Prices

At the initial stage, a simple data investigation was conducted to understand the basic pattern of the series and hence to identify any characteristic existing. Figure 1 shows the historical plot of the buying price for 1 troy ounce of Kijang Emas Gold Bullion Coins. The graph indicates an upward trend over the four years which began a steady climb in 2019 to 2020 for Kijang Emas. The average 1 troy ounce gold price is RM 5404 in 2016 and jumped to RM 7492 in 2020, which about 38.6% of increment.



Figure 1: Historical Plot of Buying Price of Kijang Emas Bullion Gold Coins

3.2 Analysis of ARIMA (p, d, q) Model

The application of the Box-Jenkins lies in the assumption that the data series is stationary. A series is said to be stationary if it does not show an upward or downward trend over time. If the assumption is not met, then the necessary procedures are performed to achieve stationary in the series. A series can be made stationary by taking the differencing on the data set. Differencing is the process of removing the trend pattern from the actual data. Data of gold price buying price is plotted in Figure 1, and the plot is clearly indicating that it is not stationary because there is an upward trend in the series. Besides, the stationary of a time series model also can be determined by statistical testing. The appropriate statistical test for stationary testing is the unit root test.

Table 1: Unit Root Test of Actual Data Series

	t-Statistic	Probability value
Augmented Dickey-Fuller test statistic	-1.435817	0.8501

The H_0 (null hypothesis) stated that the data is not stationary. The decision rule involve is rejected H_0 if the probability value less than $\alpha = 0.05$. The p-value = 0.8501 which is greater than α , the null hypothesis has failed to reject. Hence the data is not stationary. Since the data is not stationary, the difference between the current value of Kijang Emas price, y_t , and the preceding value of Kijang Emas price, y_{t-1} is taken to fulfil the main assumption of the Box-Jenkins methodology.

Table 2: The Unit Root Test After First Order Differencing

	t-Statistic	Probability value
Augmented Dickey-Fuller test statistic	-21.79584	0.0000

Table 2 shows the output of the Unit Root Test after the first order differencing. From the table, it shows that the probability value is 0.0000 which is less than $\alpha = 0.05$. Back to the hypothesis statement, p-value less than α leads to rejecting the null hypothesis and it results that the data does not have a unit root and is stationary. The order of difference is defined as the number of times the series needs to be differenced to achieve stationary. After the data is stationary, the order of $d = 1$ for the ARIMA ($p, 1, q$) model. The order of p and q are chosen based on observing the lags of PACF and ACF, respectively. Figure 2 shows the correlogram after performing the first-order differencing.

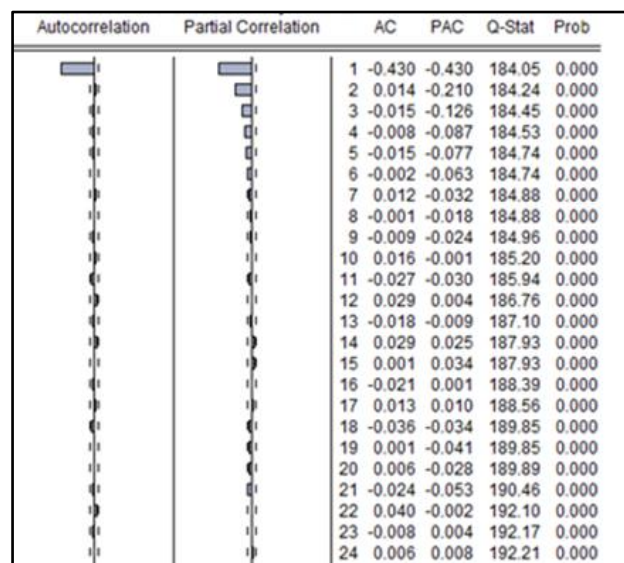


Figure 2: Correlogram After First Order Differencing

After a stationary condition has been achieved, the next stage is to perform model identification. The process of identifying the suitable model for the data series involved the analysis of the ACF and PACF as shown in Figure 2. Based on the ACF diagram, there is one significant spike at lag 1 that determine the order for MA, $q=1$. On the other hand, the PACF shows several spikes, the most significant at lag 1 (exceeding the standard error line), and the spike at lag 2, 3, 4 and 5 that suggest the order for AR, $p=5$.

In addition, confidence limits also can be used to determine the parameters for ARIMA (p, d, q). By using the confidence limit formula which is $= \pm \frac{2}{\sqrt{n}}$, the confidence limit for this study is $(-0.064, +0.064)$. The lags that are outside of the confidence limit are considered significant.

Table 3: The ACF and PACF of ARIMA

Lags	Autocorrelation Function (ACF)	Partial Autocorrelation Function (PACF)
1	-0.430	-0.430
2	0.014	-0.210
3	-0.015	-0.126
4	-0.008	-0.087
5	-0.015	-0.077
6	-0.002	-0.063
7	0.012	-0.032
8	-0.001	-0.018
9	-0.001	-0.024
10	-0.016	-0.001

Based on the ACF values in Table 3, there is only one significant spike at lag 1. While in PACF, there are five significant spikes at lag 1 until 5 since the values are outside the value of -0.0064 . By referring to Figure 2 and Table 3, the following five models have been identified and estimated using EViews software. The models are ARIMA (1,1,1), ARIMA (2,1,1), ARIMA (3,1,1), ARIMA (4,1,1) and ARIMA (5,1,1). To determine which of the models fits the best, two criteria will be used, that is AIC and BIC, and the results are summarized in Table 4.

Table 4: The AIC and BIC of the ARIMA Model

Model	Akaike Info Criterion (AIC)	Bayesian Information Criteria (BIC)
ARIMA (1,1,1)	12452.44	12467.15
ARIMA (2,1,1)	12452.42	12472.03
ARIMA (3,1,1)	12472.03	12478.78
ARIMA (4,1,1)	12456.22	12485.63
ARIMA (5,1,1)	12457.86	12492.16

According to AIC, ARIMA (2,1,1) has the lowest value. Whereas, based on the BIC, ARIMA (1,1,1) is considered to be the best model since it has the lowest value. As mentioned earlier, the lower the value of AIC and BIC, the model is said to be the best ARIMA model. To validate the above result is correct, further analysis using the error measures as a comparison was performed and the result is shown in Table 5.

Table 5: The RMSE and MAE of the ARIMA Model

ARIMA Model	Root Mean Square Error (RMSE)	Mean Absolute Error (MAE)
ARIMA (1,1,1)	128.2214	50.7927
ARIMA (2,1,1)	128.0901	50.6864

Based on the smallest value of RMSE and MAE, the resulting point towards ARIMA (2,1,1). On these results, ARIMA (2,1,1), is therefore the winner and be proposed as the best forecasting model.

4. Conclusion

The Kijang Emas price data examined in this study can be characterized with the ARIMA (2,1,1) model. ARIMA (1, 1,1) and ARIMA (2, 1, 1) were selected based on five different model parameters, as it provides the best model that meets all the criteria of the fit statistics. However, the lower value of RMSE and MAE for ARIMA (2,1,1), when compared to that of ARIMA (1,1,1), showed that ARIMA (2,1,1) is the more appropriate model in predicting the future values of Kijang Emas price.

References

- Ali, Asad, Muhammad Iqbal Ch, Sadia Qamar, Noureen Akhtar, Tahir Mahmood, Mehvish Hyder, and Muhammad Tariq. (2016). Forecasting of daily gold price by using box-jenkins methodology. *International Journal of Asian Social Science*, 6(11):614-24.
- Bank Negara Malaysia. (n.d.). Retrieved from <https://www.bnm.gov.my/kijang-emas-prices>.
- Choong, P. S., Kwoo, P. Y., Piong, C. K., & Wong, W. X. (2012). Determinants of gold price: using simple and multiple linear regression. [Unpublished master's thesis]. Universiti Tunku Abdul Rahman.
- Grima, S., Dalli Gonzi, R., & Thalassinou, E. (2020). The impact of COVID-19 on Malta and its economy and sustainable strategies. *Journal of Corporate Governance, Insurance, and Risk Management*, 7(1):53-73.
- Guha, B., & Bandyopadhyay, G. (2016). Gold price forecasting using ARIMA Model. *Journal of Advanced Management Science*, 4(2).
- Ho, Thanh Tri, Dao Phan, Van Ninh Nguyen, and Juraj Sipko. (2017). Application of ARIMA model to forecast gold price in Vietnam. *Proceedings The 11th International Days of Statistics and Economics*, 469-77.
- Khan, M. M. A. (2013). Forecasting of gold prices (Box-Jenkins Approach). *International Journal of Emerging Technology and Advanced Engineering*, 3(3):662-670.
- Lazim, M. (2013). *Introductory business forecasting. A practical approach 3rd edition*. Penerbit Press, Universiti Teknologi Mara.
- Miswan, Nor Hamizah, Pung Yean Ping, and Maizah Hura Ahmad. (2013). On parameter estimation for Malaysian gold prices modelling and forecasting. *International Journal of Mathematical Analysis*, 7(21-24):1059-68.
- Tripathy, Naliniprava. 2017. Forecasting gold price with auto regression integrated moving average model. *International Journal of Economics and Financial*, 7(4):324-29.
- Yousef, I., Shehadeh, E., et al. (2020). The impact of the covid-19 on gold price volatility. *International Journal of Economics & Business Administration (IJEBA)*, 8(4):353- 364.



**20
21** **ICMS**
INTERNATIONAL CONFERENCE ON COMPUTING,
MATHEMATICS AND STATISTICS

e ISBN 978-967-2948-12-4



9 7 8 9 6 7 2 9 4 8 1 2 4