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Bitcoin Investment Returns Prediction using ARIMA Model

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Abstract

Bitcoin stands as an immensely volatile cryptocurrency gaining increasing popularity. It signifies a pivotal shift in the perception of currency as the world's most valuable and costly cryptocurrency. This study aims to forecast the daily return on Bitcoin. Historical data of Bitcoin prices from 24/5/2020-23/5/2023 was collected and forecasted the Bitcoin return for a short 8 days (24/5/2023-31/5/2023). The objective was to validate the practicality of the traditional univariate Autoregressive Integrative Moving Average (ARIMA) model in predicting Bitcoin prices. We successfully projected the closing prices of Bitcoin for the initial seven days of May 2023. Bitcoin's value fluctuates similarly to a stock, but different in its features. The preprocessing stages were stationary tests using an Augmented Dickey-Fuller Unit Root Test, Jarque-Bera Test, and Lagrange Multiplier Serial Correlation Test utilizing EViews software with series line graph, Q-Q plot, histogram. The selection of potential model was selected through the utilization of the correlogram test looking at the ACF and PACF graph. This study used the ARIMA model and has chosen ARMA (1, 0) as the forecasting model based on the readings on Akaike Information Criterion (AIC), Schwarz Criterion (SIC), and Hannan-Quinn Criterion (HQC), Mean Absolute Error, was run as an accuracy measurement. Our study shows 2 findings, where (1) the forecasted daily return between 24/5/2023-31/5/2023 shows constant return of 0.1%, leading to an annual return of 36.5%; (2) the forecast of using ARMA (1, 0) model is weak in its accuracy.

Keywords: *bitcoin, cryptocurrency, prediction, auto regressive integrated moving average, ARIMA*

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Introduction

In 2009, an individual named Satoshi Nakamoto from Japan introduced Bitcoin. This marked the initial successful endeavor in creating a virtual currency and has since become one of the most debated digital currencies (Katsiampa, 2017). Moreover, the Industrial Revolution 4.0 has risen a lot of new technology, and these have raised the importance of cryptocurrencies that is expected to be one of the mainstream investment tools and is traded in a regular basis in the future (Senate RPC, 2020). Moreover, as cryptocurrency mining has becoming difficult than Bitcoin first announced, household investors do not possess the technology to mine and therefore is more interested in trading these investments tools. Malladi and Dheeriya (2021) studied cryptocurrency return and volatilities using the time series analysis. In their study, both Bitcoin and Ripple cryptocurrency has been studied using the Autoregressive Moving Average Model with exogenous inputs model (ARMAX), Vector Autoregression (VAR) model, Generalized Autoregressive Conditionally Heteroscedastic (GARCH) model, and Granger causality tests. Similarly, Qin et al. (2021) studied Bitcoin returns and volatility in relation to the global economic policy uncertainty engaging the Granger causality tests. In the study, they argued that Bitcoin market has relevant information to predict the global economic policy uncertainty, while the global economic policy uncertainty too contains information to predict the Bitcoin market. Therefore, it is important to understand the pattern of Bitcoin, which has been chosen as the main objective in this study.

Methodology

Daily data on Bitcoin's closing price has been collected from Yahoo Finance, starting from May 24, 2020, to May 23, 2023. It is then computed into logarithmic return by using the log function, for further analysis. Academics argued that evaluating returns over multiple time periods using logarithmic returns rather than simple returns has theoretical and practical advantages (Hudson & Gregoriou, 2015). The reason is that logarithmic returns are time-additive and returns for each individual time period can be added together to calculate the overall return over multiple time periods. As a result, the time series characteristics of additive processes are simpler to derive compared to multiplicative processes (Campbell *et al.*, 1997). For the study, we selected Auto Regressive Integrated Moving Average

(ARIMA) model without considering trends and seasonal patterns to forecast Bitcoin's return. The ARIMA model represents a multipurpose model utilized for time series forecasting. This model can be rendered stationary through differencing and can incorporate nonlinear transformations like logging or deflation. Notably, random-walk and random-trend models, autoregressive models, and exponential smoothing models are all specific instances falling under the umbrella of ARIMA models. Before processing through the time series forecasting, normalization and smoothing are essential, several tests were conducted to confirm the return data has reached at its stationarity, normality, and serial correlation benchmark. In the later stage, Bitcoin's logarithmic return's line graph has been observed and Augmented Dickey-Fuller Unit Root Test was run. Secondly, normality testing has been observed through Bitcoin return's histogram chart, Q-Q plot chart, and Jarque-Bera Test. Lastly, OLS assumption of Serial Correlation has been observed (Valchanov, 2021). Serial correlation is an important relevant diagnostic test in time series. Lagrange Multiplier Serial Correlation Test LM Test has been conducted.

When the series have observed to achieved Stationarity, Normality, and Serial Correlation, ARIMA model is used to forecast and study the return of Bitcoin. It is a combination of Autoregressive model (AR), Integration (I), and Moving Average model (MA). To be specific, the formula can be shown as:

$$Y_t = C + \phi_1 Y_{d\,t-1} + \phi_p Y_{d\,t-p} + \cdots + \theta_1 e_{t-1} + \theta_q e_{t-q} + e_t$$

Where ϕ denotes the coefficient for the lags of the variables, while θ denotes the coefficient of the error terms. The number of lags, error terms, and degree of integrating is defined by (p, d, q). To find the sequence of (p, d, q), several Information Criterion must be observed, and in this research, Akaike Information Criterion (AIC), Schwarz Criterion (SIC), and Hannan-Quinn Criterion (HQC) has been observed to find the best (p, d, q) for the forecast of Bitcoin's return.

Lastly, for accuracy measurement Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), and Root Mean Squared Error (RMSE) has been conducted to study the accuracy of our study. The lower the figure computed from these Forecast Accuracy Measurement, the more accurate the forecasting can be established.

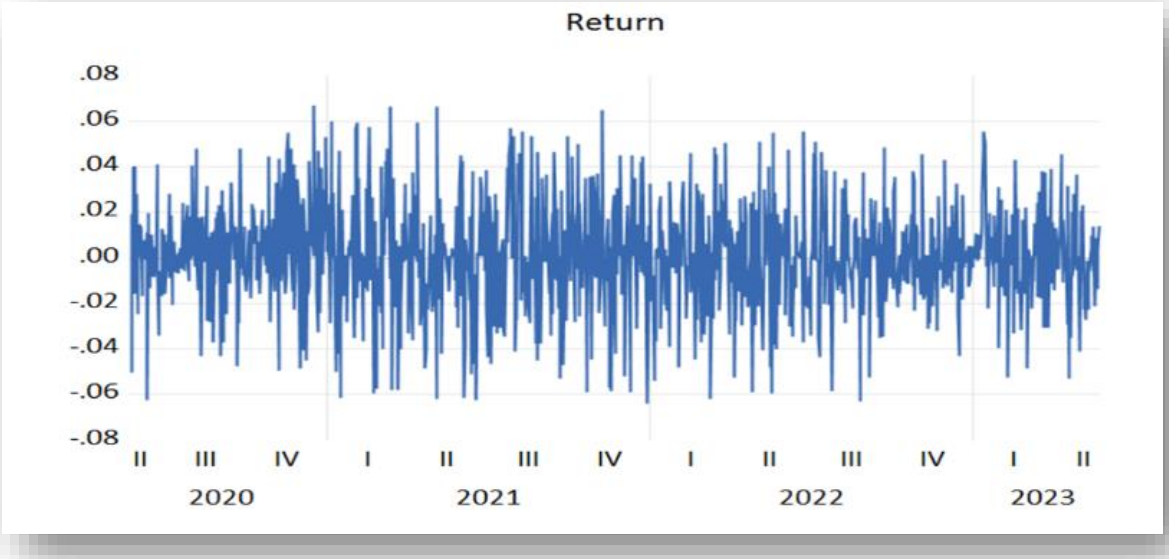
Findings

For the data analysis, after running a stationary test the Bitcoin return is first found stationary on its own level without going any integration and has achieved normality and serial correlation. Hence, the d figure in ARIMA (p, d, q) has been set to 0 as no integration has been done. By looking through the ACF and PACF Correlogram, 8 possible ARMA model has been computed in EViews. They are ARIMA (1,0,0), ARIMA (0,0,1), ARMA (1,0,1), ARMA (2,0,1), ARMA (1,0,2), ARMA (2,0,0), ARMA (0,0,2), ARMA (2,2,0). As a result, ARMA (1,0,0) has found to be the most accurate model among the others.

ARMA (1,0, 0) model shows the 8 days of forecasted daily return between 24/5/2023 – 31/5/2023 is kept on a constant return of 0.1%. Where if it is computed into an annual return, 36.5% return per annum can be achieved by the investors. However, the Forecast Accuracy Measurement showed that this forecast contains a very weak accuracy, containing a 115.6% error computed in MAPE. In short, investors can achieve an average of 0.1% daily return investing in Bitcoin, which will receive a 36.5% return annually.

Figure 2

Bitcoin's daily return line graph (24 May 2020 - 23 May 2023)



Conclusion

In conclusion, the findings showed that Bitcoin daily return is kept in a constant 0.1%, while the univariate time-series ARMA (1,0) is less accurate. Hence, this shows that

the emergence of cryptocurrency market is still in unstable. Bitcoin is emerging currency as an alternative to traditional currencies, penetrating its global recognition across various communities due to its inherent benefits. Firstly, investors are highly recommended to invest in the cryptocurrency market as a diversifying tool to mitigate the price risk and to not refuse such new and potential financial assets. Secondly, it is recommended that future studies should not only focus on Bitcoin return, but also the Bitcoin risk factor to help investors and researchers to have an in-depth understanding of other cryptocurrencies. Thirdly, with the help of Granger Causality test, and Granger Causality in Quantile, multivariate time-series analysis is also recommended to forecast and study the pattern of Bitcoin. Although it increases the complexity and time-consumption, it also contributes to the improvement of human being and investors' financial decision making. Despite its limitations, significant drawbacks such as government-imposed restrictions due to concerns of tax evasion are still prevalent.

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