Predicting and Analyzing the Bitcoin's Price with the ARIMA Model

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Abstract. Virtual currencies have become one of the most welcomed financial investment properties by investors, managers, and researchers. In this essay, we analyze the Bitcoin price from 2017 to 2023 and forecast the price of the Bitcoin. ARIMA model plays an important role in time series prediction, and many researchers choose to use this model to analyze and forecast historical time series. Therefore, this paper is based on the Autoregressive Integrated Moving Average Model (ARIMA) mode, by using the previous Bitcoin price to forecast the future price of Bitcoin. The outbreak of COVID-19 in late 2019 which then spread from China to the world has had a huge negative impact on the global economy. At the same time, owing to the impact of COVID-19 being significant, this paper will also analyze the influence of the pandemic's influence on Bitcoin. The result shows that the epidemic has a great influence on it and reflect a different consequence of other industry. Investors and others should be cautious about investing in bitcoin.

Keywords: Virtual currency, Bitcoin, Arima model, Forecast, COVID-19.

1. Introduction

Owing to the imperatives of politics and economy combined with technology, which accelerate the development of the digital economy. In 2017, the digital economy dominated around 5% of global gross domestic product [1]. The development of the digital economy has seen the emergence of virtual currencies, and among all virtual currencies, Bitcoin is one of the most popular at present. According to Rainer, Bitcoin is a kind of global agreement on online communication, which facilitates the use of digital currencies, it has the potential to cover previous monetary systems [2]. Therefore, forecasting the value of Bitcoin is meaningful at present.

A sudden outbreak epidemic happened in Wuhan, Hubei province, China in December 2019, then it became a global pandemic [3]. The unparalleled trait of the COVID-19 outbreak has led to an enormous cost on humans but also has a profound and long-lasting impact on economic growth [4]. One of the most important intangible virtual currencies is its price, which can be easy to find out the value of Bitcoin undergoing a dramatic increase after the COVID-19 pandemic began. It showed a different price change from the rest of the real entity economy like the retail industry and real estate industry, which displayed different degrees of recession. In this case, it makes sense to analyze and forecast the price of Bitcoin.

2. Methods and Results

2.1. Database and Forecast Model

Owing to this essay will forecast the bitcoin price and analyze the impact of COVID-19 on the bitcoin price, the dataset of Bitcoin from November 1, 2017, to November 3, 2023, was chosen. The Bitcoin price data gained from Bloomberg Labs is one of the most popular applications of global financial firms. This paper will use an autoregressive integrated moving average (ARIMA model) to analyze the forecast of the price of Bitcoin. ARIMA model comes from a statistical model perspective, which is famous for its substantial efficiency in predicting short-term financial time series [5]. The historical dataset of Bitcoin is shown in Figure 1, which is formed by 2195 rows and 6 columns, including close price, open price, high, low, and volume of business, the unit of price of Bitcoin is US dollar. This essay chooses the daily close price of Bitcoin to analyze and forecast the future value

of Bitcoin. Owing to this essay will analyze the influence of pandemic on the prices, the data will be divided into 2 parts, the first part is the whole period from 2017 to 2023, and the second part is from 2017 to the end of 2019.

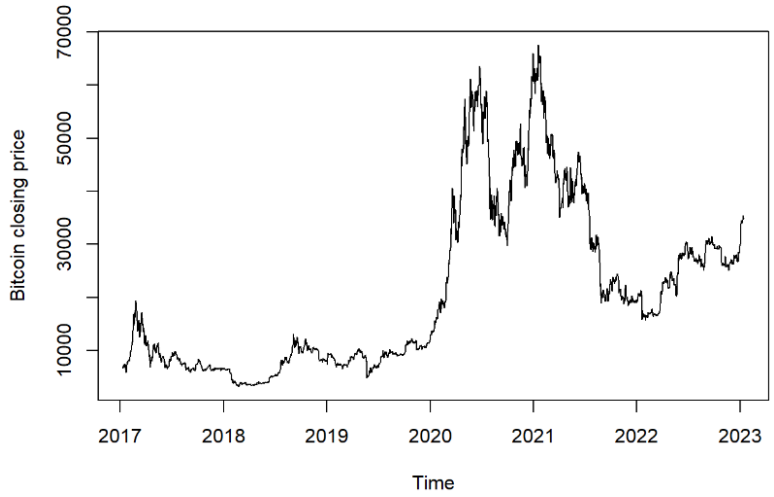


Figure 1. Chart of closing prices of Bitcoin from November 1, 2017, to November 3, 2023 (original).

2.2. Whole Data (2017-2023)

ARIMA model plays a significant role in time series data analysis. It is vital to test whether the data is stational or not in research, therefore, to use the ARIMA model to forecast the price of Bitcoin, the ADF test should be used to confirm whether it is a stationary time series. It is easy to find out the data of bitcoin price is non-stationary times series from Figure 2. Therefore, the next step is to perform a white noise test and turn it into stationery (Figure 3).

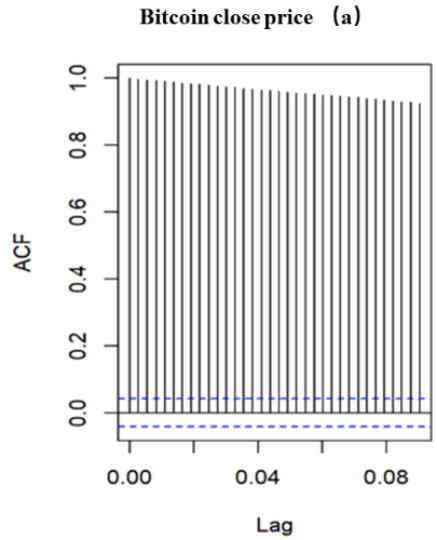


Figure 2. Analyze the Autocorrelation function based on Bitcoin close price from 2017 to 2023 (original).

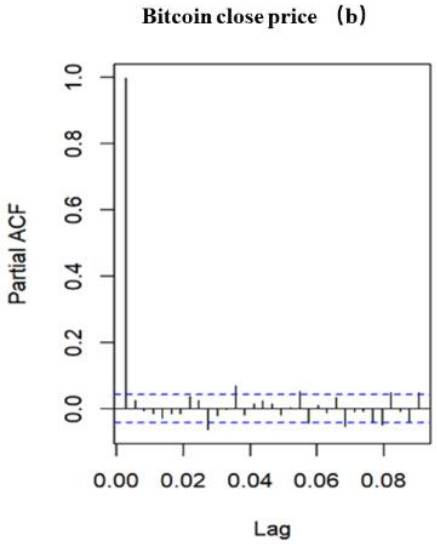


Figure 3. Analyze the Partial Autocorrelation function based on Bitcoin close price from 2017 to 2023 (original).

In the ARIMA model, parameters are different in seasonal and nonseasonal, to forecast such kind of data, the parameter is described as follows:

- p=number of autoregressive terms;
- d=number of seasonal differences;
- q=number of moving-average terms.

Through this, it is easy to forecast the price of Bitcoin based on the whole data. in Figure 4 the blue line in the middle represents the predicted price, and the surrounding part is the possible range based on the data.

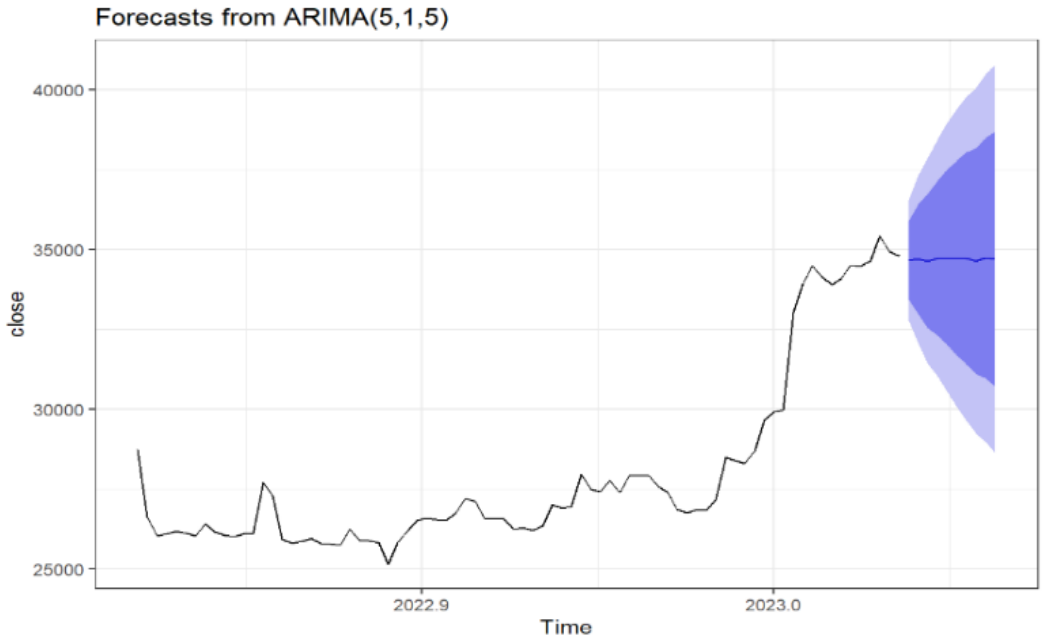


Figure 4. Forecast from ARIMA (5,1,5) (original).

Next, the residuals of this data need to be analyzed. All autocorrelations of the residuals seem insignificant, and the Box-Pierce test shows high p-values. In Figure 5, the residuals do not follow a normal distribution. This suggests that the residuals deviate from a perfectly normal distribution.

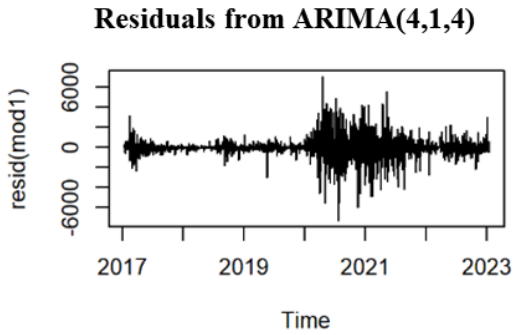


Figure 5. Analyze the residual (original).

2.3. Before COVID-19 Pandemic (2017-2020)

Figure 6 below points out the price of Bitcoin from 2017 to the end of 2019. Through the analysis of the data, it is easy to find out it is also non-stational data. Next, need to perform the same operations on the data as above. Figure 7 shows the forecast of Bitcoin prices before the pandemic. The blue line in the middle represents the predicted price, and the surrounding part is the possible range based on the data.

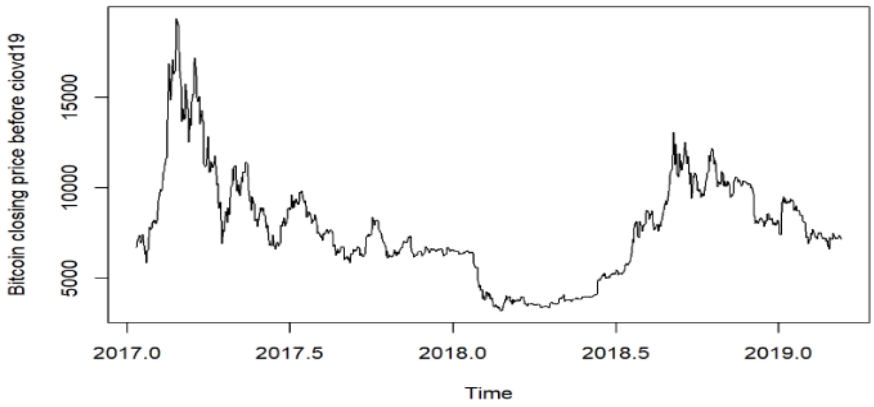


Figure 6. Chart of closing prices of Bitcoin from 2017 to 2020 (original).

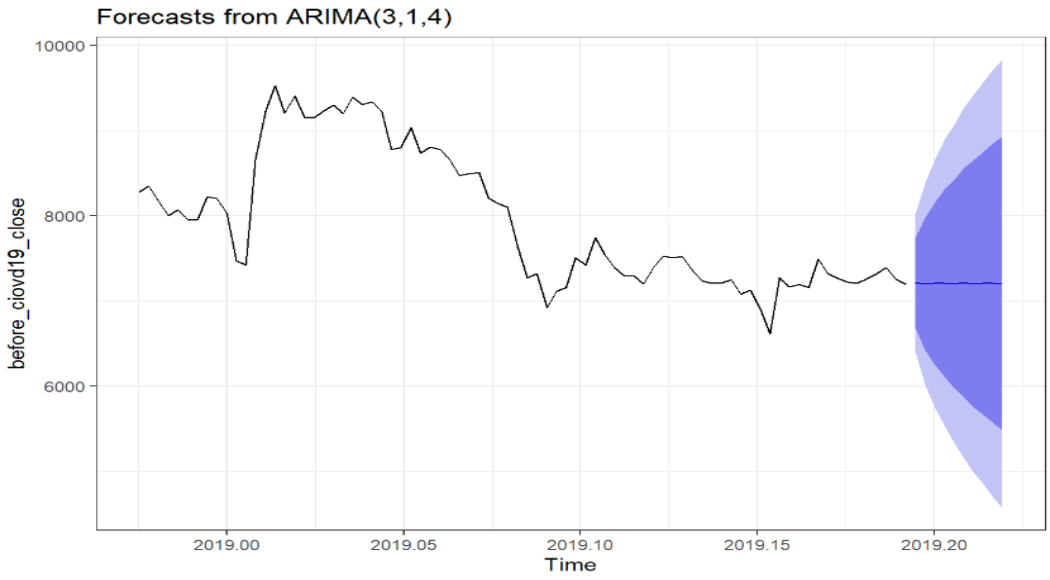


Figure 7. forecasts from ARIMA (3,1,4) (original).

Similarly, residuals also need to be analyzed in this case. All autocorrelations of the residuals seem insignificant, and the Box-Pierce test shows high p-values. The residuals do not follow a normal

distribution. This suggests that the residuals deviate from a perfectly normal distribution. The result of the residual is in Figure 8.

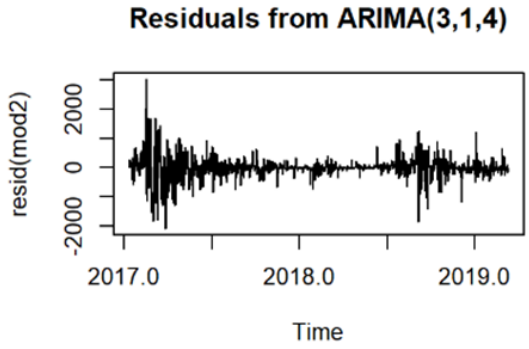


Figure 8. Analyze the residual (original).

3. Discussion

The object of this paper uses the ARIMA model to analyze and forecast the Bitcoin price, considering the impact of a pandemic on Bitcoin price. This model is based on the database between November 1, 2017, and November 3, 2023. Through the analysis and forecast above, it is easy to find out based on the price of previous Bitcoin price and the market impact, there was a significant difference in the price of Bitcoin before and after the pandemic.

Perhaps due to the downturn in the real industry, like real estate, retail industry, and tourist industry, more capital has focused on the network, and virtual currencies, especially bitcoin, have received greater benefits. This paper can conclude from the above analysis that the price of bitcoin has been rising in the epidemic, and there is a lot of room for appreciation in the future forecast. The COVID-19 pandemic has resulted in the use of digital technology on account of the limitation on social distancing and the lockdown in the whole country, which is a rationale for the price of Bitcoin increase during the hard period [6].

Comparing the price of Bitcoin before and after the pandemic, and the predictions based on its data, this paper can draw some conclusions. Since the use of the ARIMA model is largely based on the Bitcoin price, our predicted prices are also largely affected. Due to the sharp rise in the price of Bitcoin during the pandemic, our predictions using aggregate data were much higher than those based on pre-pandemic data. It is also important to note that Bitcoin is not legal tender, and its price is subject to a lot of uncertainty, including technology, policy, etc.

Bitcoin become an alternative to real currency nowadays, and it can be used all over the world due to convenience, privacy, and decentralization. The rules of Bitcoin were designed by engineers, which means lawyers and regulators do not influence it. Instead of storing transactions on a single server, Bitcoin has chosen to distribute them across the transaction logs of a network of participating computers [2]. Although the market of Bitcoin still has some opacity, and it has received some government restrictions, there is no doubt that it is an important part of the financial world today, Bitcoin has become a common currency for online payments. After the above series of analyses, this paper can conclude that bitcoin has not been seriously negatively affected by the epidemic like the real industry. In addition, it is easy to find out from Figure 4, that the price of bitcoin can maintain a stable price in the future, and there is room for further rise.

4. Conclusion

This paper is based on the historical close price of Bitcoin and uses the ARIMA model to forecast its future price. Through analyzing and forecasting, it is easy to find out the price of Bitcoin has room to increase in the future. This paper also analyzes the influence of the COVID-19 pandemic on the price of Bitcoin, through the analysis, this paper finds out the pandemic has had a very different

impact on the Bitcoin market as well as on traditional markets, during the pandemic, the price of Bitcoin increased dramatically, but in traditional markets, epidemic led to a significant recession, plenty of industries and firms are destroyed by the unexpected issue.

This paper also has some limitations. First, this paper only considered the price between November 1, 2017, and November 3, 2023. Although these numbers are huge, they are still not enough to predict the price of bitcoin. In addition, although the ARIMA model is one of the most popular models in forecasting, however, it also has some weaknesses. The ARIMA model has poor fitting and effect for non-stationary time series, so it can be predicted only after processing the data in this paper. Moreover, Bitcoin price is not subject to external supervision, it was also forbidden by some governments, therefore the price of Bitcoin is inaccurate owing to it being influenced by some policies. Suck kind of event cannot be analyzed by this paper.

In the future, more kinds of virtual currency will appear, and the market of virtual currency will be more regulated. Through the analysis of this paper, there is a belief that the price of Bitcoin will also increase in the future if only analyze the price. In this case, Bitcoin will receive the pursuit of investors.

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