Bitcoin Price Prediction using Facebook Prophet

Shay Hegarty,
00353-7491-86000,
Atlantic Technological University
Port Rd, Letterkenny, Co. Donegal,
Ireland
l00119781@student.lyit.ie

Brid McDevitt,
0000-0001-6813-920X,
Atlantic Technological University
Port Rd, Letterkenny, Co. Donegal,
Ireland
brid.mcdevitt@lyit.ie

Danny McFadden,
0000-0001-5373-3134,
Atlantic Technological University
Port Rd, Letterkenny, Co. Donegal,
Ireland
Danny.McFadden@lyit.ie

Ruth Lennon,
0000-0001-9917-2289,
Atlantic Technological University
Port Rd, Letterkenny, Co. Donegal,
Ireland
Ruth.Lennon@lyit.ie

I. Abstract

This paper uses an open-source software called Facebook Prophet to see if it is possible to accurately predict the price of bitcoin in 30days time. To achieve the task accurately, the model will be used in Python with the previous 5 years of bitcoin data, the data used will be primarily the closing price each day as that's what the model will be focusing on.

Keywords

AI, Machine learning Model, Facebook Prophet, Python, Bitcoin, Cryptocurrencies

II. Introduction

Cryptocurrencies have become increasingly more popular over the years and are seen by many experts as the most convenient era of exchange ever [1]. Compared to physical assets crypto is 100% virtual and is simply the transfer of digital assets. One of the main perks of crypto is it negates the need for banks entirely; international payments and transfers can be made instantly with no set limitations.[2]. Another advantage of cryptocurrencies is the extremely low exchange rates, interest rates and transaction fees are all close to zero[3].

Cryptocurrencies also have downsides with volatility being one of the reasons that lead individuals to avoid such currencies [4]. There is a very limited amount of services that actually accept cryptocurrency as a payment option and there are still major companies out there whose minds have changed on whether it will accept it as a form of payment or not; some of these companies include Microsoft, Tesla, Reddit, and Burger King[5]. Another concern is how much of an environmental impact these have. Bitcoin for example requires extremely large amounts of energy when it comes to mining bitcoins but in return it is the reason why it's so secure[5]. Studies from Cambridge University shows that Bitcoin uses around 136.87 terawatt-hours of electricity every year which is more than countries such as Argentina, Netherlands, and the United Arab Emirates[6].

Cryptocurrencies are extremely volatile and are definitely some of the riskiest financial assets on the market today[7]. The overall goal of this study is to try and predict the price of Bitcoin in the next 30days. Bitcoin has had its fair share of crashes throughout its time with the first major one reported back in 2011 when it's price dropped by 99.9% in one day.

Then the price in December 2013 was just over one thousand dollars and in January 2015 it was worth roughly around two hundred dollars. Another drop worth noting is from December 2017 to December 2018 it fell by 83% [8]. This really shows how volatile and essentially risky Bitcoin or any cryptocurrency for that matter is to invest in.

Price prediction/price forecasting powered by machine learning is an extremely powerful tool when it comes to finding out the best investment to choose. In our case the price prediction/price forecasting uses an algorithm based on market performance, current market trends, historical prices, and other related factors[9]. Price forecasting is predicting a commodity/product/service price by evaluating various factors such as a company's performance and prospects, inflation, trends, economic and political situation, and others. Machine learning may help users to identify trending stocks or to define how much budget to allocate for stocks. However, these algorithms may fail in predicting stock prices. But still, data scientists are looking for techniques that can provide solid forecasting results [10].

The four aims of this study: (1) Successfully extract the dataset from yahoo finance which will go into detail on the price of bitcoin since inception. (2) Review the dataset and clean the data if necessary. (3) Using the open-source forecasting tool in Python to create a script that will help predict the price of Bitcoin in the next 30days. (4) Visualize the data using a visualization tool such as Tableau/PowerBi.

III. MATERIALS & METHODS

As described in the introductory aim(s), the research is characterized by the topic of predicting the future price of bitcoin using Facebook Prophet which is an open-source software released by Facebooks data science team. The research question is can is it possible to predict the price of bitcoin and if so, how accurate will it be?

Software

Facebook Prophet is an open-source software released by Facebooks core data science team. Prophet is a procedure for forecasting time series data based on an additive model where nonlinear trends are fit with daily, weekly, and yearly seasons. It provides completely automated forecasts extremely quickly. These forecasts can then be modified by hand by data scientists and data analysts to suit their own needs[11]. Facebook Prophet is available in both R and Python but in this study, it will be used only in Python.

Data Collection

The data used for this study was collected through Yahoo Finance which is a media property that is part of the Yahoo network. It provides financial news, data, information on stock quotes, press releases, financial reports etc [12]. No licensing is required in using this data as it is public information accessible to anyone. The dataset will be downloaded as a csv file and then imported into Python for analysis.

Data Cleaning

The data did not require any extensive manual cleaning as the information included in the dataset was very basic information such as date, opening price, closing price etc. A few columns did need to be removed as the main information required to predict the price is the closing price and the date.

Methodology

Importing the necessary libraries

All of the code will be written within Google Collab, so the first step is to create a new notebook in there. Once a new notebook was created, Importing the necessary libraries was the next step as shown in figure 1. These are the following libraries that will be used:

- Pandas to import the dataset and to help analyse the data.
- plotly to help visualize the data and get a better representation of the data.
- fbprophet which is the algorithm used to help predict the future price of Bitcoin.

```
#Importing pandas, fbprophet and plotly

import pandas as pd
from fbprophet import Prophet
import plotly.express as px
```

Figure 1. Importing the libraries

Importing the dataset

To import the dataset/csv the files.upload() function contained with the import files function will be used, when this is run, a prompt will appear to select a file to upload to the notebook so I will select the csv file which was downloaded from Yahoo finance.

Next, A dataframe will be created to store the data and use pandas function read_csv to read the file and load the data into the dataframe as shown in figure 2. Once the data is loaded to the dataframe I ran a few checks to make sure the data loaded correctly, these checks consisted of running a head() and tail() command on the dataframe to make sure the full dataset was loaded, and to make sure it was not truncated and then running an info command to get a full overview of the dataset and to make sure we don't have any null values and also that the open/closing price are float figures.

```
#Using the read_csv function in pandas to the read the data and assign it to the dataframe df

df = pd.read_csv("BTC-Prices.csv")

#Showing the data
df.head()
```

	Date	Open	High	Low	Close	Adj Close	Volume
0	2021-04-03	59397.410156	60110.269531	57603.890625	57603.890625	57603.890625	59641344484
1	2021-04-04	57604.839844	58913.746094	57168.675781	58758.554688	58758.554688	50749662970
2	2021-04-05	58760.875000	59891.296875	57694.824219	59057.878906	59057.878906	60706272115
3	2021-04-06	59171.933594	59479.578125	57646.808594	58192.359375	58192.359375	66058027988
4	2021-04-07	58186.507813	58731.144531	55604.023438	56048.937500	56048.937500	75645303584

Figure 2. Creating the dataframe

Visualizing the data

I started by creating a simple area graph using plotly with the date on the x axis and closing price on the y axis, this gives a great overview of the data as it shows the closing price each day since the beginning of the dataset so you can visualize the price drops and rises very easily. I then created a violin plot which is similar to a box plot and is used to visualize the distribution of numerical data and can also show summary statistics and the density of each variable.

Implementing fbprophet

I need to select the date and closing price column and rename those to the column names that are required for the fbprophet model. Date column was renamed to 'ds' and closing price is renamed to 'y' which is required by the fbprophet model.

Forecasting

Once I have my columns renamed and ready to work with the fbprophet model I will create a new dataframe called 'future' and use the make_future_dataframe function, this function takes the input of 'periods' and for this report we are looking 30 days into the future so our periods will be set to 30. Once I have my future dataframe setup I need to create another dataframe called 'forecast' which will use the predict(future) function included in the fbprophet model. I can then take a look at the dataframe 'forecast', and it will include my full dataset plus another 30days added onto the end of the dataset which represents the 30 days in the future prediction.

The new dataframe will consist of 19 columns which provides a lot of information but the column we are most focused on is the column at the very end called 'yhat' and this column will contain the predicted price for each day in the future. Facebook Prophet includes some internal data visualization tools so now I will create a visualization comparing the actual price with the predicted price and then also include the predicted price alone for the next 30days.

Testing

I created a new notebook to do some testing on the dataset using Facebook Prophet. I used the same bitcoin prices data set, but I excluded the most recent 30 rows of data, so the model wasn't aware of them at all. I then created a new dataframe with all of the historical closing prices excluding the last 30 rows of data so we can test how accurate the model is without having to wait until 30 days into the future to find out the results, the data we are using is still in the past but its information that the model has never seen before. Figure 3 shows the actual closing prices as the back dots and the predicted price using the Facebook Prophet model is the blue line[13].

Figure 3. FBProphet predicted price

IV. RESULTS

Figure 4 shows the closing price each day for the price of bitcoin over the last year and this clearly shows how volatile bitcoin is by how much it has fluctuated over the past 365 days. On July 20th, 2021, the closing price was $29,800, comparing that figure to November 8th, 2021, the closing price was $67,566. In around 4 months bitcoin price increase by more than double. This goes to show that predicting the price accurately for the next 30days would be a challenge considering how much the price tends to fluctuate from month to month. Figure 5 is a violin plot which shows peaks in the data such as max, min, median, q1 etc.

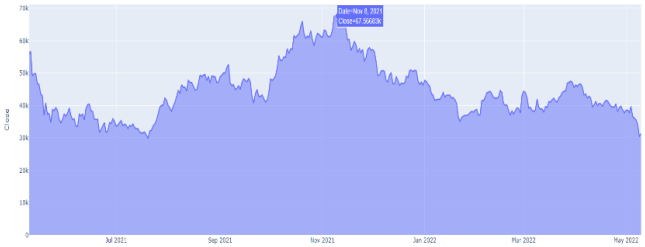

Figure 4. Closing price for Bitcoin over the last year

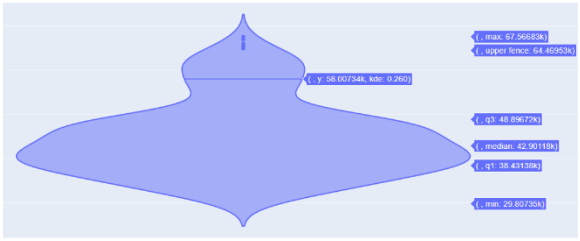

Figure 5. Violin plot

Testing the Model

Figure 6 shows the price of bitcoin over the last 5 years, the black dots represent the actual closing price of bitcoin for each day while the blue line is the predicted price using Facebook Prophet and the upper/lower limit showing the light blue area outside both of the lines. The figure clearly shows the points I mentioned above, the low point for the year in July of 2021 and then an all-time high in November of 2021. There are some clear and obvious limitations when it comes to Facebook Prophet as it has a difficult time predicting these spikes/drops and how large of a spike or a drop it will be.

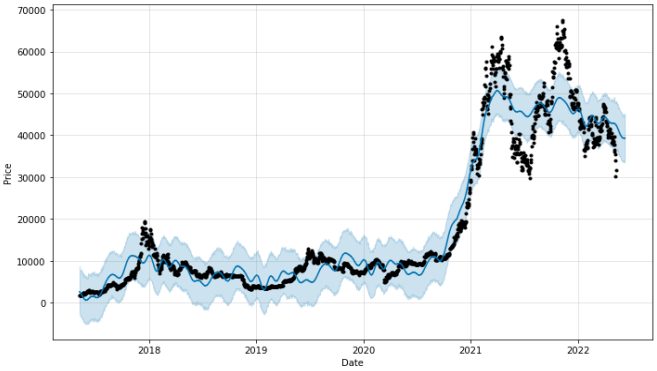

Figure 6. Bitcoin price over the last 5 years

Price prediction for the next 30days

Figure 7 shows the price prediction for the next 30 days in more detail using the previous 1 year of closing prices. The model has predicted the price to decrease steadily over the next 30days with no large spikes or drops predicted even though the actual prices for the last months has been consistently dropping.

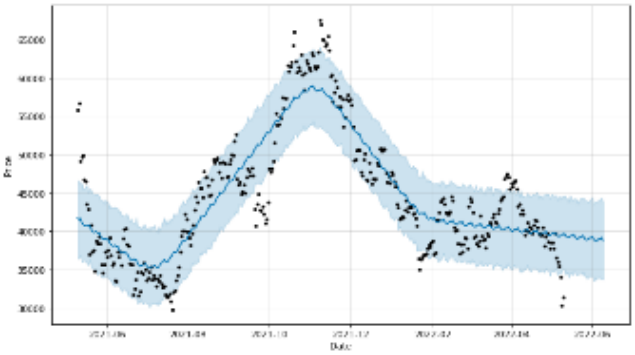

Figure 7. Price prediction for the next 30 days

How accurate is the model?

The next task is to test how good this model is at predicting the future price of bitcoin. It can be difficult to test the model now from todays date as it would then take 30 days to get the actual closing data to compare it against so instead a dataset that included the last 335 days of data was imported into Python and then trained using the Facebook Prophet price prediciton model. This means that the model will have never seen the price for the previous 30days and then it gives the opportunity the compare the data instntly without waiting 30days into the future.

Figure 8 shows the price prediction model for 30days that the model had never seen before, in this case the last closing price entered was on 2022-04-10 and has predicted the price on May 1st to be $43,503. The actual closing price was $ 38,469. Another comparison was for the final day in the models prediction which was May 9th the predicted price was $44,095 and the actual closing price was $30,296. Clearly the model is not very accurate when it comes to predicting the price of bitcoin or maybe any cryptocurrency, it could be more suitable and aimed towards stable stocks that do not fluctuate as much.

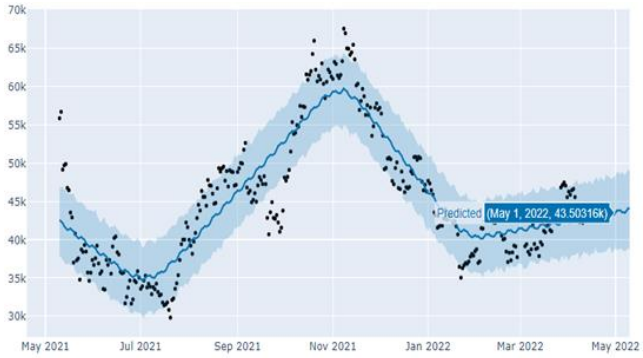

Figure 8. Testing the accuracy of the model

V. Conclusion

Looking at the final price prediction that was done the first result had a predicted price of $43,503 and the actual closing price was $ 38,469 and then the second prediction further into the 30day period was $44,095 and the actual closing price was $30,296. This shows that the model isn't very accurate at predicting the future price of bitcoin, it could be due to how volatile cryptocurrencies, and it can be extremely difficult to predict the spikes or drops for them. The model may work for very short periods of time such as predicting the next 3 days but the further out the prediction goes the larger the discrepancy will be between the predicted closing price and the actual closing price. I believe this model would work well with more stable stocks where large spikes and drops are not as common but rather a stable increase or decrease over time so this could be done as a future area of research.

VI. ACKNOWLEDGMENTS

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