

Machine Learning as method of Bitcoin price forecasting

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Background



- In 2008 Wall Street started the global financial crisis, which devalued currency not only in US, but around the world.
- After the crisis began, Satoshi Nakamoto introduced Bitcoin as an alternative to the traditional banking infrastructure.
- I was interested in bitcoin waaay after it was cool, but before I was interested ML.

Data & Models



- Data for this analysis has been taken from the Binance exchange through its API for the time period of 500 days (2020-07-13 2021-11-24) with 1 day interval.

Close price for each period was taken.

- 4 models has been fit to predict the outcome
 - 2 time series prediction models - ARMA and ARIMA;
 - 2 machine learning models - one-step and multi-step LSTM.

close	
timestamp	
2020-07-13	9200.00
2020-07-14	9116.00
2020-07-15	9156.00
2020-07-16	9044.02
2020-07-17	9087.00



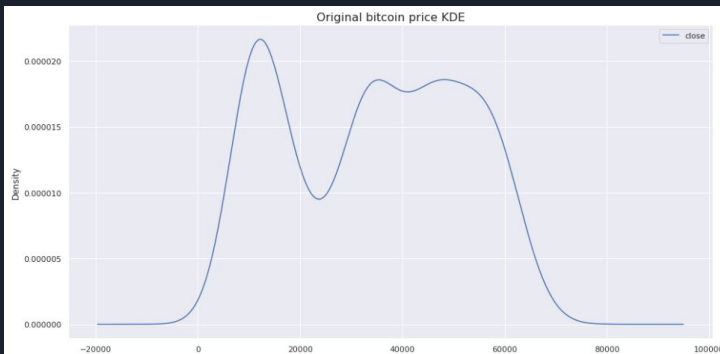
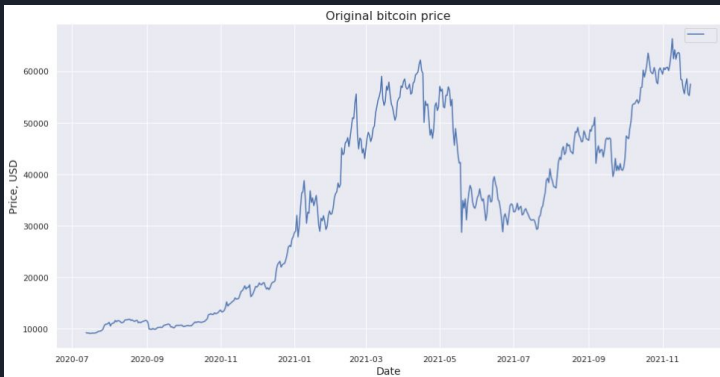
Model 1 - ARMA

- Log transformation, rolling means and differencing were used to minimize non-stationarity.
- Rolling statistics, visualization and Dickey-Fuller test were used to check for stationarity.
- Result: Predicted price was hard to interpret as it required many transformations.

Model 1 - ARMA

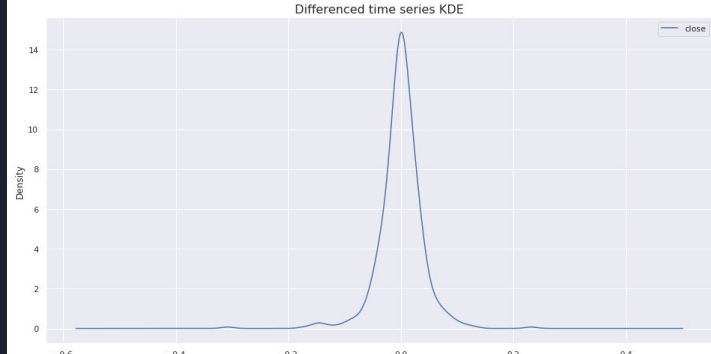
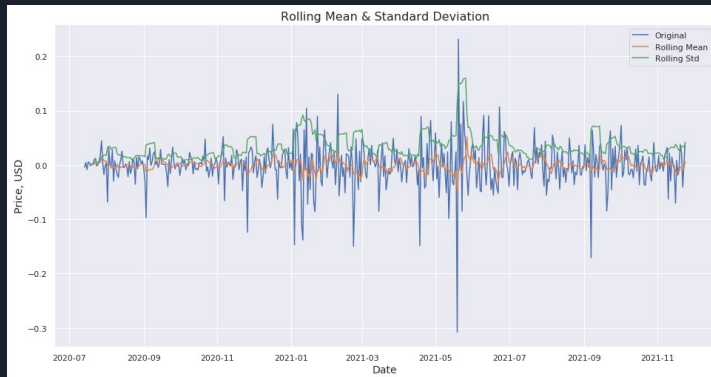
Non-Stationary data

Dickey-Fuller $p = 0.70$ (8 lags used)



Stationary data

Dickey-Fuller $p = 4.8e-19$ (7 lags used)



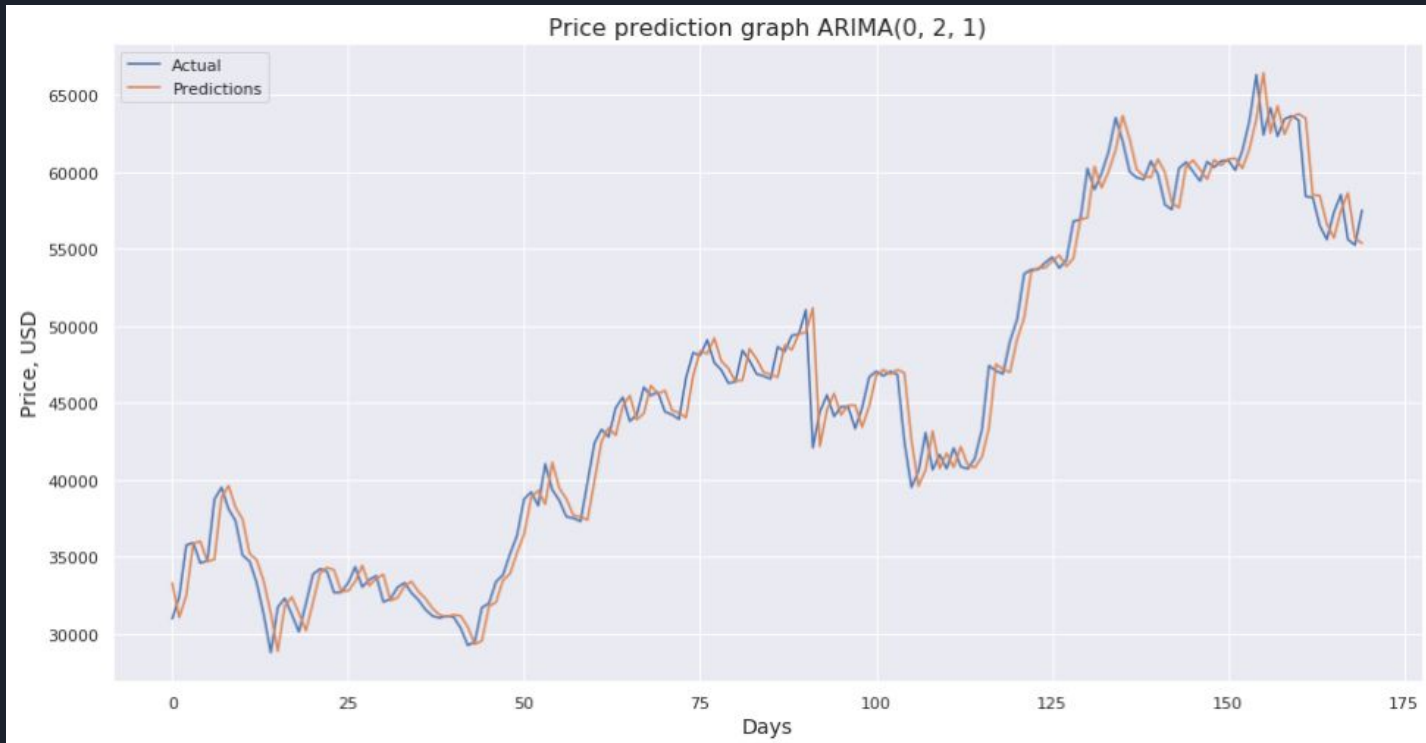


Model 2 - ARIMA

- ARIMA model requires less data preparation, thus is easier to use.
- Grid search was performed to find optimal parameters (p, d, q in range 0-3)
- The lowest RMSE (1684) was given by the model with:
 - Autoregressive (AR) order= 0;
 - Number of differencing = 2;
 - Moving average (MA) order = 1.

Model 2 - ARIMA

Daily price prediction graph using ARIMA model





Model 2 - ARIMA

- It is clearly seen that predicted price repeats actual price with a lag of 1 day, thus should not be used .
- Given both ARMA and ARIMA models, I concluded that time series prediction techniques were not enough to predict bitcoin price and more advanced method was required.
- Machine Learning 🎉



Model 3 - One-Step LSTM

Price at Obs X	Pred price Y
1, 2, 3	4
2, 3, 4	5
3, 4, 5	6

- Univariate one-step LSTM model with closing price was used to predict the closing price.
- Data was divided into multiple samples with 3 input / 1 output sequence for the one-step prediction each to be learned by the model.
- This model had 50 LSTM units in the hidden layer and an output layer that predicts a single output value.



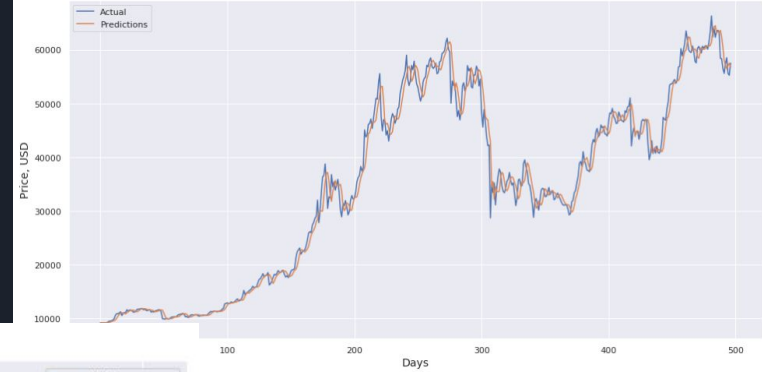
Model 3 - LSTM

Zoomed in price prediction over 120 days

Univariate one-step Bitcoin stock price prediction LSTM model



Univariate one-step Bitcoin stock price prediction LSTM model



- Predictive ability of this model does not differ much from ARIMA model



Model 4 - Multi-Step LSTM

Price at Obs X	Pred price Y
1, 2, 3	4, 5
2, 3, 4	5, 6
3, 4, 5	6, 7

- Univariate multi-step LSTM model with closing price was used to predict the closing price.
- Data was divided into multiple samples with 3 input / 2 output sequence for the multi-step prediction each to be learned by the model. The 2 predicted outputs are the following day closing price and the next following day closing price.
- This model had 100 LSTM units in each of the 2 hidden layers and an output layer that predicts 2 output values.

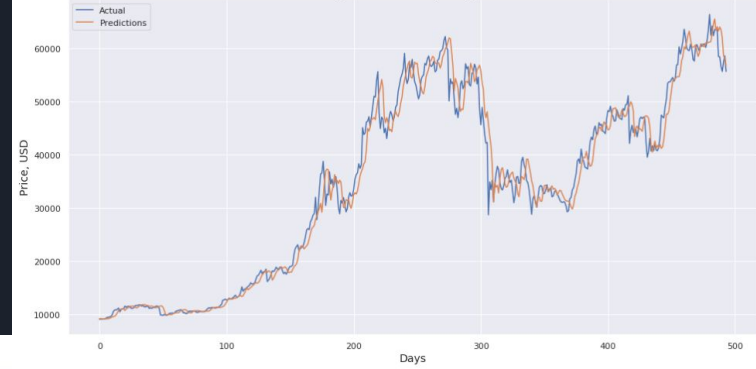
Model 4 - Multi-Step LSTM

Zoomed in price prediction over 120 days

Univariate multi-step Bitcoin stock price prediction LSTM model



Univariate multi-step Bitcoin stock price prediction LSTM model



- Predictive ability of this model remained unchanged



Conclusions

- This study analyzed the predictability of bitcoin price. None of 4 models proved to be particularly useful in forecasting the price of bitcoin stock.
- One of the problems in the bitcoin price forecast remains to be the economists' difficulties in assessing bitcoin fundamental value; thus, inability to predict its stock price.
- Predicting the price of bitcoin is highly problematic - it seems to be more sensitive to the factors other than its own price in the past (e. g. Twitter).



Next Steps

- Analysis can be performed on shorter period time series(e.g. 1 hour, 15 minutes).
- Multivariate LSTM model can be used (e.g. using not only candlestick OHLC price data, but volume and number of trades).
- Forecasting bitcoin price using its past price and information from Twitter.
- Include sentiment analysis from Twitter as a predictor. (Maybe assign higher weight to tweets from more influential people).



THANK YOU

