Predicting Bitcoin Price Direction and Exchange Rate Using Machine Learning Algorithms

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Highlights

- Predicting the Bitcoin price direction and forecasting the Bitcoin exchange rates on daily data by proposing a methodology based on the analysis of attribute selection methods combined with ML.
- Understanding the details of proposed methodology that verified the relevance of different attributes for both factor under consideration.

Background

With the advancements in technology, virtual currencies are becoming more and more popular around the globe. Hence, the prediction of this most accepted currency received much attention by the media and investors. But due to its high volatility there remains the challenges in predicting the BitCoin exchange rate along with some other challenges regarding security aspects of anonymity for Bitcoin transactions. Therefore, there is a need to predict its behavior to improve these aspects by adapting the current architecture of the BitCoin that supports the evolution of its demands and advances in the domain of cryptography and data security.

Introduction

To overcome the loopholes related to high volatility, there is a need of solution that can reduce the risks by generating better returns for investors through identifying relevant attributes and machine learning algorithms to make predictions of BitCoin exchange rate behavior. In this context, Mallqui and Fernandes

(2019) comes up with the study that improves the accuracy of forecast of the daily exchange rate behavior of Bitcoin by considering its direction, minimum, maximum and closing price. For this purpose, Mallqui and Fernandes (2019) used machine learning techniques to predict the price direction as well as the maximum, minimum and closing prices of daily Bitcoin exchange rate. The machine learning algorithms used include Artificial Neural Networks (ANN), Support Vector Machines (SVM) and Ensemble algorithms.

Proposed Methodology

To know how these machine learning algorithms predict the price direction as well other factors, let's have a look at proposed methodology which consist of various steps. In this regard, first of all data sources are needed where the data was collected. Once the data is collected it is necessary to do data pre-processing. On the basis of which data partitioning is done for training and testing purposes. Once all this data partitioning is done, attribute selection methods are applied to select features on which ML techniques are applied to predict the price direction and other factors. At the end performance evaluation metrics is used to obtain results. To have a better understanding of proposed methodology let's have a look at the Fig 1 below:

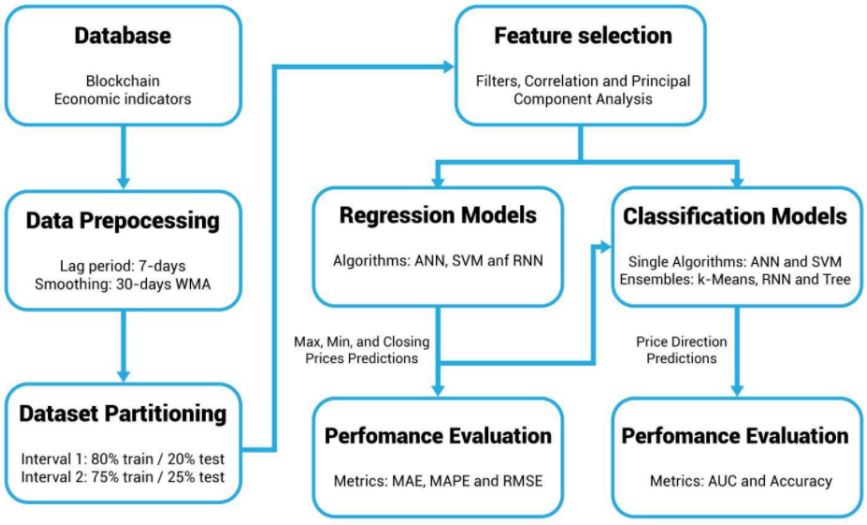

Figure 1: An Overview of the Methodology used by Mallqui and Fernandes (2019)

Details of Proposed Methodology

For this purpose, two datasets were used that was obtained from both internal and external sources which contains the behavior of different parameters of Bitcoin and the economic factors along with external demand or information obtained from social networks respectively. Once the data is collected, pre-processing of data is done where the value of 0 and 1 is assigned to the classes by considering a lag period of 7 days through calculating Weighted Moving Average (WMA) for 30 days to identify possible trends in the exchange rate on the basis of which training and testing data is partitioned.

Furthermore, to reduce the high dimensionality most relevant attributes were selected by using attribute selection techniques such as Correlation Analysis, Relief, Information gain method, Principle Component Analysis and Correlation-based Feature Subset selection. After this soft computing algorithms like ANN, SVM and Ensembles are applied on the features to compare the performance of each algorithm and ensemble, sensitivity and specificity which are represented by Sensitivity $= \frac{TP}{TP+FN}$ and Specificity $= \frac{TN}{TN+FP}$ respectively. At the end to compare the models used Mallqui and Fernandes (2019) employed the following equation:

$$\text{Accuracy } = \frac{TP + TN}{TP + FP + TN + FN} \times 100\%$$

Results and Discussion

In order to evaluate the results factors like prediction of price direction and forecasting of minimum, maximum and closing BitCoin exchange rates are considered. For the **prediction of price direction** factor, two datasets were evaluated which shows that for first dataset, Ensemble A shows the best result by yielding an AUC score of about 0.58 and accuracy of 62.91%. For the second data set, the SVM algorithm gave the best performance with 59.45% of accuracy and AUC score of 0.58. When dealing with **forecasting of minimum, maximum and closing BitCoin exchange rates** factor, the best results were obtained by the SVM algorithm (in its regression version) in both datasets.

Conclusion

This led to the conclusion that proposed methodology verified the relevance of different attributes for both factor under consideration such as prediction of price direction and forecasting of minimum, maximum and closing BitCoin exchange rates. From the results it is clear that the best model obtained a MAPE between 1.28% and 1.91% with and an MAE between 6.70 and 9.63. Although these figures are still quite high, this is owing to Bitcoin's extreme volatility, which poses a hurdle for future research.

References

Mallqui, D. C. A. and Fernandes, R. A. S. (2019). Predicting the direction, maximum, minimum and closing prices of daily Bitcoin exchange rate using machine learning techniques. *Appl. Soft Comput.*, 75:596–606.