



Using Forecasting Models in Cryptocurrency Price Prediction

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ABSTRACT Predicting cryptocurrency price has become a central focus for investors and traders in the rapidly evolving landscape of digital assets. Cryptocurrencies like Bitcoin, Ethereum, and other altcoins have captured global attention, with their prices subject to fluctuations influenced by various factors, from market sentiment to technological developments. With the unprecedented volatility of these markets, the need for accurate forecasting models has never been more crucial. In this research, we conduct an in-depth analysis using various models including Linear regression (LR), Autoregressive Integrated Moving Average (ARIMA), Recurrent Neural Network (RNN), Gated Recurrent Unit (GRU), Long Short-Term Memory (LSTM), Seasonal Autoregressive Integrated Moving Average with eXogenous factors (SARIMAX), Neural Basis Expansion Analysis Time Series (NBEATS), Random Forest (RF) to predict cryptocurrency price and determine the effectiveness of each model.

INDEX TERMS Cryptocurrency, price prediction, Bitcoin, Ethereum, Linear regression, ARIMA, RNN, GRU, LSTM, SARIMAX, NBEATS, RF.

I. INTRODUCTION

Cryptocurrency, a digital form of currency, has transformed the traditional concept of money. Unlike cash, cryptocurrencies exist purely in electronic form, utilizing encryption techniques for secure transactions. Bitcoin, the pioneering cryptocurrency introduced in 2009 by Satoshi Nakamoto, paved the way for a myriad of digital currencies that followed. The decentralized nature of cryptocurrencies means they operate without a central authority, using blockchain technology to record and verify transactions across a network of computers. This decentralization provides a level of transparency and security previously unseen in financial systems. As interest and adoption continue to grow, cryptocurrencies are reshaping the landscape of finance, offering individuals around the globe new avenues for transactions, investments, and financial freedom.

By using forecasting models and machine learning algorithms to analyze historical data of Bitcoin, Ethereum, and BNB, the research objective is to provide valuable insights for investors and traders to forecast the cryptocurrency price movement. To evaluate the performance of each predictive model, we use three metrics Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), and Root Mean Squared Error (RMSE).

II. RELATED WORKS

Mahir Iqbal and his team [1] applied a machine learning based time series analysis in predicting the price of Bitcoin. They used ARIMA, FBProphet, and XG Boosting for time series analysis and evaluated these models by using three parameters RMSE, MAE, and R Squared (R^2). After conducting the analysis, they concluded that ARIMA is the best of three with RMSE score and MAE score are 322.4 and 227.3 respectively.

Harsha Nanda Gudavalli and Khetan Venkata Ratnam Kancharla [2] identified four machine learning algorithms RF, Gradient Boosting (GB), LSTM, and GRU to make long-term predictions of cryptocurrency prices. Overall, LSTM is the most accurate model based on RMSE score of 0.01083, MSE score of 0.00011, and R Squared score of 0.80618.

Junyi Zhu [3] applied LR for Bitcoin price prediction with the accuracy rate for training RSS and testing RSS are 94.6% and 96.99% respectively.

Namrata Hemraj Gawali [4] developed predictive models to predict the price of Bitcoin using LSTM, Seasonal Autoregressive Integrated Moving Average (SARIMA), SARIMAX, and RNN. In conclusion, LSTM outperformed all other models with R Squared score of 0.9519, MAE score of 2476.68, MSE score of 10958440.29 and RMSE score of 3310.35.

Alikhan Bulatov [5] used N-BEATS trained on Bitcoin daily,

hourly, and up-to-the-minute data in comparison with LSTM and ARIMA. In this analysis, it is concluded that N-BEATS is the best model for forecasting the Bitcoin price with the RMSE score in daily, hourly, and minute data are 308.859, 59.303, and 13.678 respectively.

III. MATERIALS

A. DATASET

This research focuses on analyzing cryptocurrency trends through three data sets of three cryptocurrencies:

- BTC/USD
- ETH/USD
- BNB/USD

Those data sets are extracted from the website investing.com with the selected period from March 1, 2019, to March 1, 2024. Each data set contains 1828 data rows and has 6 attributes:

- Price: The last transacted price in a day.
- Open: The opening price in a day.
- High: The highest price in a day.
- Low: The lowest price in a day.
- Vol: The total amount traded in a day.
- Change %: The percentage change in the closing price compared to the previous day's closing price.

B. DESCRIPTIVE STATISTICS

TABLE 1. BTC, ETH, BNB's Descriptive Statistics

	BTC	ETH	BNB
Count	1828	1828	1828
Mean	25,983.05	1,488.75	212.44
Std	16,801.607	1,160.628	171.7707
Min	3,715	107.58	9.28
25%	10,255.075	256.75	25.3325
50%	23,637.8	1,573.75	242.4
75%	38,686.75	2,152.043	318.675
Max	67,520	4,808.09	676.12

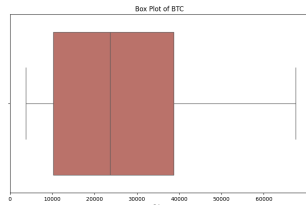


FIGURE 1. Bitcoin price's boxplot

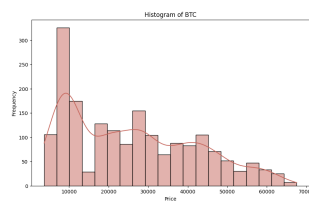


FIGURE 2. Bitcoin price's histogram

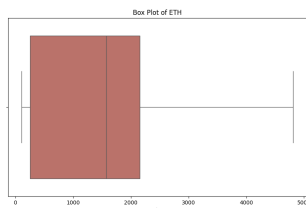


FIGURE 3. Ethereum price's boxplot

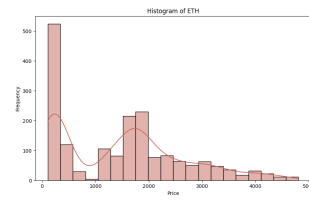


FIGURE 4. Ethereum price's histogram

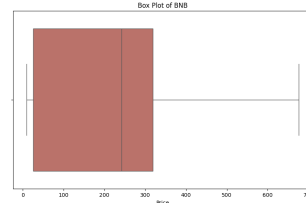


FIGURE 5. BNB price's boxplot

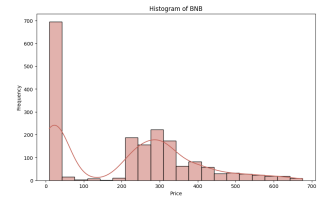


FIGURE 6. BNB price's histogram

IV. METHODOLOGY

A. LINEAR REGRESSION

Linear regression is an algorithm that provides a linear relationship between an independent variable and a dependent variable. A linear regression model with more than one independent variable is called a multiple linear regression model. A multiple linear regression model has the form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k + \varepsilon$$

Where:

- Y is the dependent variable.
- X_1, \dots, X_k are the independent (explanatory) variables.
- β_0 is the intercept term.
- β_1, \dots, β_k are the regression coefficients for the independent variables.
- ε is the error term.