Bitcoin Price Forecasting: A Comprehensive Time Series Analysis Integrating Statistical Models and Machine Learning Techniques

Abstract

- The study focuses on Bitcoin price forecasting using a combination of statistical models and machine learning techniques.
- Various models such as Prophet, ARIMA, SARIMA, GARCH, LSTM, and XG-Boost are utilized.
- The LSTM model performs exceptionally well, with a low Mean Absolute Error (MAE) of 637.830, a minimal Mean Absolute Percentage Error (MAPE) of 2.368%, and a precise Root Mean Squared Error (RMSE) of 903.149.
- The GARCH model effectively addresses volatility, as indicated by its competitive RMSE of 3.516, MAE of 3.031, and notable MAPE of 28.902%.
- The study provides valuable insights for stakeholders navigating the dynamic landscape of cryptocurrency markets.

Methodology

- The methodology involves data retrieval, data pre-processing, exploratory data analysis (EDA), and model implementation.
- The models implemented include LSTM, XG-Boost, FBProphet, ARIMA, SARIMA, and GARCH.
- Various data handling techniques such as checking missing values, duplicated rows, data type handling, and scaling are utilized.
- EDA is performed to analyze data distribution, stationarity, decomposition, and autocorrelation.
- The dataset is split into training and testing subsets (80% and 20%, respectively) for model comparison.

Problem statements

- The problem addressed in the study is Bitcoin price forecasting.
- The objective is to assess the accuracy and performance of different forecasting models in predicting Bitcoin prices.

Objectives

- The main objective is to forecast Bitcoin prices using statistical models and machine learning techniques.
- The specific objectives include assessing the performance of Prophet, ARIMA, SARIMA, GARCH, LSTM, and XG-Boost models in Bitcoin price prediction.

Discussion

- The LSTM model emerges as the standout performer with remarkable accuracy, capturing complex temporal dependencies in Bitcoin price data.

Models	MAE	MAPE	MSE	RMSE	ACCURACY
LSTM	637.830	2.368%	815677.439	903.149	97.66%
XGBOOST	792.815	3.127%	815677.439	1097.647	97.09%

- The GARCH model excels in addressing volatility aspects.

Models	MAE	MAPE	RMSE
FBProphet	55187.826	2.216%	56870.995
ARIMA	1565.713	49.754%	2986.754
SARIMA	1095.970	51.179%	2749.462
GARCH	3.031	28.902%	3.516

- The study successfully forecasts Bitcoin prices using a combination of statistical models and machine learning techniques.
- The LSTM model demonstrates remarkable accuracy, while the GARCH model effectively addresses volatility.