Does Artificial Intelligence Dream of Bitcoin Trading?: Forecasting Bitcoin Returns with Machine Learning Techniques

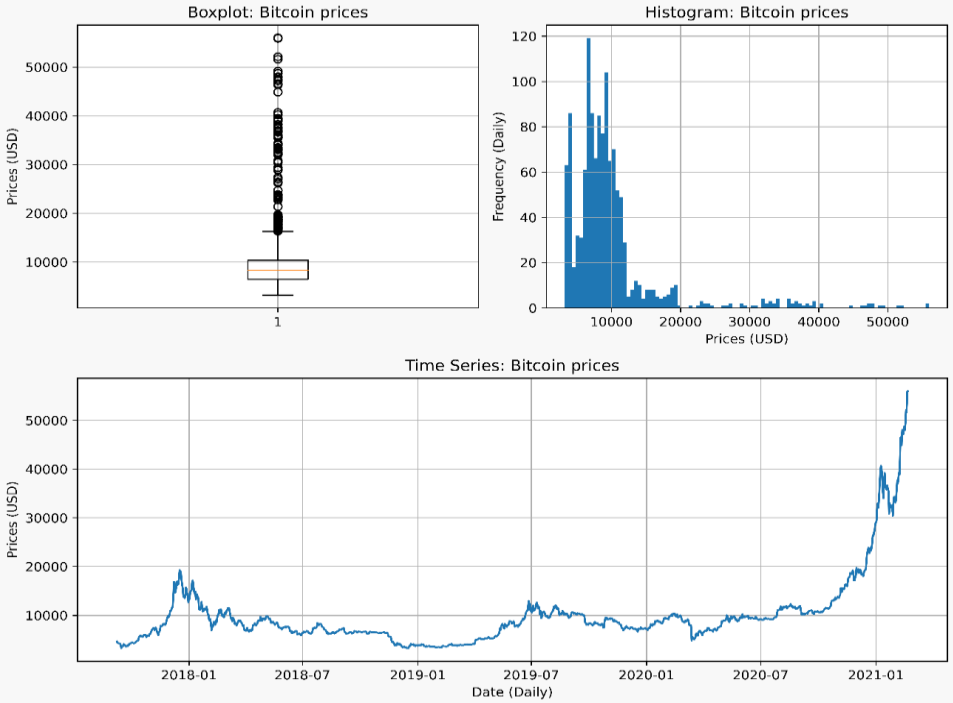
Student ID: 3219B014

Name: Hayashi Yuji

Supervisor: Professor. Tamaki

Motivation

1. Growing Popularity of Bitcoin Among Investors



→ More and more investors have been interested in the ways to make high profits by forecasting.

2. The Unique Determinants of Bitcoin Prices

1. The mechanics of Blockchain

2. The relationship between Bitcoin and other cryptocurrencies (called Altcoins)

3. The Purpose of The Research

To investigate whether it is possible to make high profits in the Bitcoin market by forecasting future Bitcoin returns with the variables of the Bitcoin blockchain and the other cryptocurrencies (called Altcoins) market.

Literature Review

1. The efficient market hypothesis (EMH)

- Fama(1970): Three forms of the market efficiency
- Kyriazis(2019): The Bitcoin market was **more inefficient than a weak-form efficiency** before 2018.

2. The empirical forecasting approach

Authors	Data range	Variables	Forecasting models	Best accuracy
Mcnally (2016)	2013-2016	Bitcoin Blockchain	LSTM, RNN, ARIMA	52% with LSTM
Mallqui (2019)	2013-2017	Bitcoin prices, Macroeconomics	ANN, RNN, SVM, Ensembles of them	62% with an ensemble
Mudassir (2020)	2013-2019	Bitcoin Blockchain	FNN, SVM, SANN, LSTM	65% with every model
Chen (2020)	2017-2019	Bitcoin Blockchain, Media Sentiment	Logistic Regression, LDA, RFC, XGB, QDA, SVM, LSTM	65% with Logistic Regression

Data

- Data range: 1266 days between Sep 05, 2017 and Feb 21, 2021

- Observation units: Daily

- The independent variables came from:
- The Bitcoin blockchain
- The prices and trading volumes of 15 major Altcoins
- The macroeconomics

- The dependent variable is:
- Bitcoin binary returns

- Data preprocessing

- Time Series Analysis on the preprocessed data
- Autocorrelation test

→The Bitcoin return series did not have autocorrelation.

- Stationarity test

→ All the variables were stationary.

Methods

Bitcoin Return Forecasting

Input:
Independent variables at time *t*

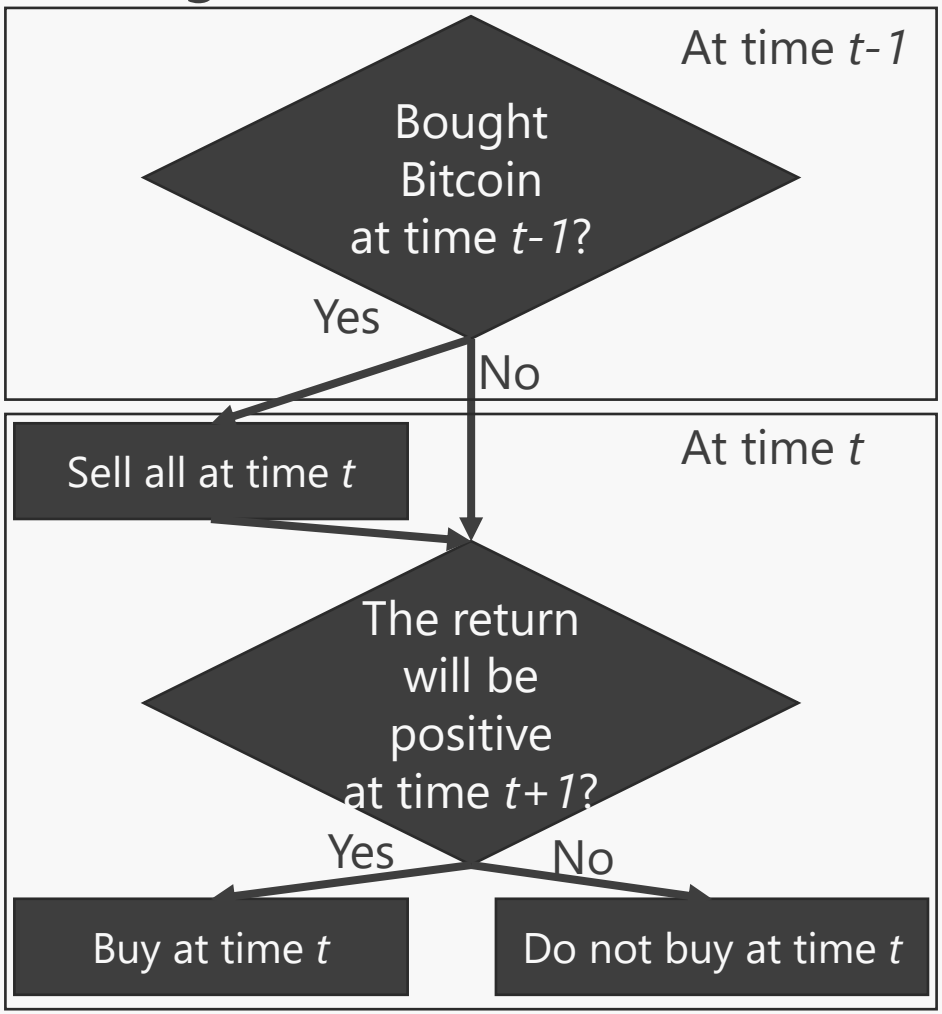
- Data splitting
- Standardization
- Variable selection
- Forecasting models:
{Logistic Regression, RFC, LGBMC, FNN}
- Hyperparameters optimization

Binary Forecast

Output:
Forecasts of the dependent variable
Bitcoin binary return
at time *t+1*

→ Evaluation metrics: f1 score & accuracy score

Trading Simulation



→ Visualize cumulative returns and conducted Wilcoxon Signed-Rank test on average returns.

Results

Bitcoin Return Forecasting

Figure1: The f1 scores of each cross-validation trial for End of Day forecasting

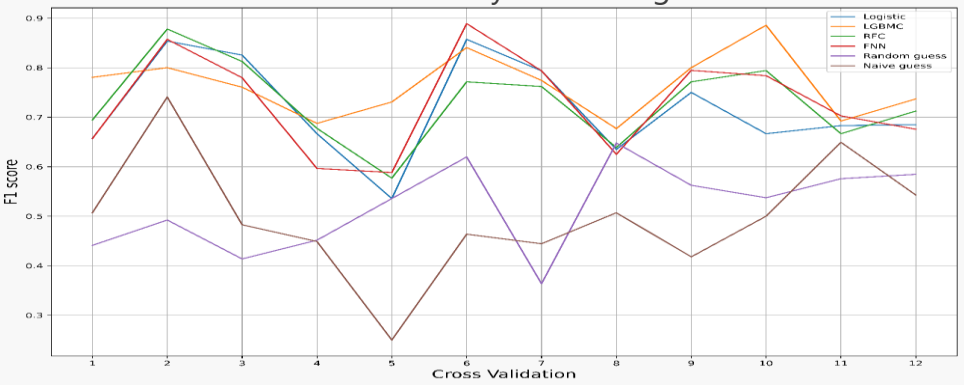


Table1: The average f1 and accuracy scores over 12 cross-validation trials for End of Day forecasting

model	dataset	test f1	test accuracy
LGBMC	Blockchain AltcoinMacro	0.764	0.715
FNN	Blockchain Macro	0.763	0.744
Logistic	Blockchain Macro	0.753	0.707
RFC	Blockchain AltcoinMacro	0.730	0.694

Trading simulation

Figure2: Cumulative returns over the whole test period in everyday trading

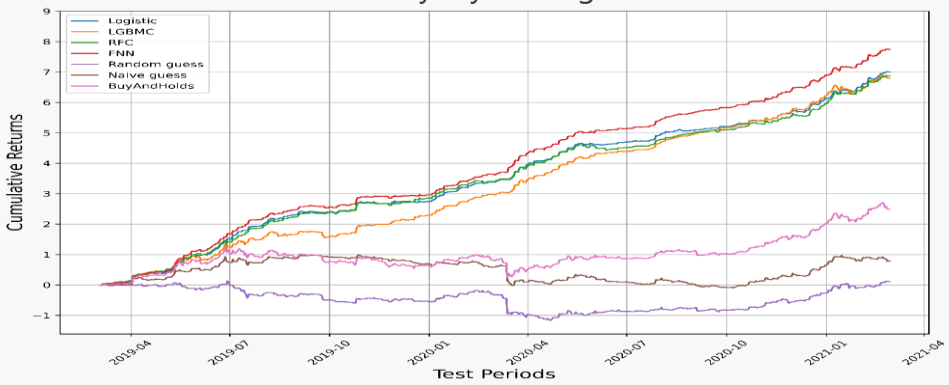


Table2: Wilcoxon Signed-Rank Test for everyday trading

model	BuyAndHolds	Random guess	Naive guess
Logistic	0.000***	0.000***	0.000***
LGBMC	0.000***	0.000***	0.000***
RFC	0.000***	0.000***	0.000***
FNN	0.000***	0.000***	0.000***

Conclusion

Findings

- The Bitcoin market was efficient in a weak form between 2019 and 2021. We found that it is possible to make high profits in the Bitcoin market by forecasting future Bitcoin returns with the variables of the Bitcoin blockchain and the Altcoins market.
- The variables of the Bitcoin blockchain and the Altcoins market were essential to forecast Bitcoin returns in End of Day, two, and three days ahead.

Limitations

- Not focusing on a certain cryptocurrency exchange when simulating trading strategies
- Not identifying the effects of the independent variables and the dependent variables
- Not including transaction costs in profitability analysis

Economic interpretation

Investors need to consider:

- The internal factors of the Bitcoin blockchain
- The external factors of the cryptocurrency market

rather than relying solely on the prices to forecast Bitcoin returns.

As the miners mine the Bitcoin for miner revenues, investors should mine the data for investing profits.

References

Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance*, *25*(2), 383-417.

Kyriazis, N. (2019). A Survey on Efficiency and Profitable Trading Opportunities in Cryptocurrency Markets. *Journal of Risk and Financial Management*, *12*(67)

McNally, S. (2016). *Predicting the price of Bitcoin using Machine Learning.* National College of Ireland.

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

Mudassir, M. (2020). Time-series forecasting of Bitcoin prices using high-dimensional features: a machine learning approach. *Neural Computing and Applications*, *4*, 1-15.

Chen, Z., Li, C., & Sun, W. (2020). Bitcoin price prediction using machine learning: An approach to sample dimension engineering. *Journal of Computational and Applied Mathematics*, *365*(112395).