Zero Theorem Literature Review

"An Empirical Study on Modeling and Prediction of Bitcoin Prices Using Bayesian Neural Networks (BNN) Based on Blockchain Information, H. Jang, J. Lee, 2017"

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Highlights

- Conducting an empirical analysis that reveals the effect of proposed BNN by analyzing the time series of Bitcoin process
- Comparison of BNN model with other benchmark models such as SVR and Linear Regression to predict accurate direction of the Bitcoin prices.

Background

Due to the intrinsic nature of merging encryption technology and monetary units, BitCoin has garnered a lot of attention. Hence, due to its fundamental nature, the BitCoin market establishes trust relationships by forming blockchains using cryptographic techniques. However, there are still issues with macroeconomic variables. Therefore, it is necessary to assess and characterize the Bitcoin pricing process by modelling and predicting Bitcoin prices using Blockchain data and macroeconomic factors.

Introduction

In this context, Jang and Lee (2017) conducted a practical analysis of the time series of the Bitcoin process using the Bayesian Neural Network (BNN) that is based on block chain information. Furthermore, Jang and Lee (2017) conducted the empirical study that compares the Bayesian neural network with other linear and non-linear benchmark models that will be helpful in modeling and predicting the Bitcoin process.

Proposed Methodology

For this purpose, the structure of BNN is designed with processing units which can be classified into three categories such as the output layer, the input layer and one or more hidden layers. Furthermore, between the hidden-output layer and the input-hidden layer, the weights of a BNN are learned. These weights of the hidden layers can be adjusted by the error of the hidden layers propagated by the output layer's error. This process for the adjustment is called backpropagation that minimizes the sum of error in such a way

$$E_B = \frac{\propto}{2} \sum_{n=1}^{N} \sum_{k=1}^{K} (t_{nk} - o_{nk})^2 + \frac{\beta}{2}{}_B^T B \tag{1}$$

Where E_{B} is the sum of the errors, K is the size of the output layer, N is the number of the training variables, o^{nk} is the k_{th} output variable of then_{th} training vector and β are the hyper-parameters.

Details of Proposed Methodology

In this context, the data used for the empirical analysis was collected from blockchain.info which includes categories like blockchain information, macroeconomic development, global currency ratio and response variable along with volume or log volume of Bitcoin.

For this purpose, firstly, the BNN was trained to model Bitcoin price formation. Following this training, model is evaluated in terms of test and training errors by using non-linear methodologies such as linear regression and Support Vector Regression. After the entire modeling process, a prediction model of the near-future price of Bitcoin is developed where forecasting models are configured by the rollover framework that allowed the trained machine to close out old information and acquire new data over time.

Results and Discussion

In order to evaluate the proposed methodology, Jang and Lee (2017) trained the BNN model through a 10-fold cross-validation where the performance of each trained model was measured by the mean absolute percentage error (MAPE) and root mean square error (RMSE) that is represented by $RMSE = \sqrt{\frac{\sum_{i=1}^{N}(y_i - \hat{y}_i)^2}{N}}$ and $MAPE = \frac{1}{N}\sum_{i=1}^{N}\left|\frac{y_i - \hat{y}_i}{y_i}\right|$ respectively.

To have a clear view on the performance of trained model, lets have a look at table 1 below:

Table 1: Test Error for the Bitcoin Price Formation

Response Variable		Log Price		Log Volatility	
No of Input Variables		26	16	25	16
Linear Regression	RMSE	-	0.0935	-	0.4823
	MAPE	-	0.0712	-	0.6263
Bayesian NN	RMSE	0.0039	0.0069	0.2546	0.2325
	MAPE	0.0138	0.0180	0.5090	0.5222
Support Vec. Regression	RMSE	0.3201	0.2742	0.5487	0.5297
	MAPE	0.0428	0.0404	0.7232	0.8629

Conclusion

This led to the conclusion that BNN model outperforms the other benchmark models such as SVR and Linear Regression that fail directional prediction by predicting accurate direction of the Bitcoin prices. From the results it is clear that as the variation of Bitcoin processes, the application and expansion of the BNN model will be effective.

References

Jang, H. and Lee, J. (2017). An empirical study on modeling and prediction of bitcoin prices with bayesian neural networks based on blockchain information. *Ieee Access*, 6:5427–5437.