

Developing a New Model Based on Artificial Intelligence Techniques for Predicting Bitcoin Fluctuations

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Abstract

In view of the significance of bitcoin in the global economy, various models have been developed to analyze the behavior of bitcoin prices. The models based on advanced techniques are considered more dependable and precise as they can account for the linear or nonlinear structures involved in the bitcoin pricing process. Furthermore, artificial neural networks (ANNs) are powerful techniques for forecasting in the presence of complex and nonlinear structures, while fuzzy inference systems have the capability of modeling human knowledge and inherent uncertainty. Therefore, the integration of these two techniques, known as ANFIS, has been applied in various areas of time series prediction. This paper proposes the use of an ANFIS model to overcome the linearity and limitations of traditional models, resulting in more accurate predictions. The experimental outcomes of the bitcoin price prediction demonstrate that the proposed model surpasses other methods and improves the precision of bitcoin price prediction. Hence, the proposed model can be a suitable option for forecasting financial time series.

Keywords: ANFIS, Bitcoin price forecasting, Time series, Blockchain, Fuzzy

1. Introduction

Cryptocurrency is a digital asset designed to work as an exchange broker that uses strong cryptography to finance transactions, control the creation of additional units, and confirm the transfer of assets (Schueffel, 2017). Cryptocurrencies use decentralized control unlike centralized digital systems and central banking systems (Allison, 2015). Bitcoin, first released in 2009 as open source software, is generally the first decentralized cryptocurrency. Since the release of Bitcoin, more than 4,000 altcoins (alternatives to bitcoin or other cryptocurrencies) have been created.

Bitcoin is a decentralized digital currency without a central bank or a single administrator that can be transmitted from user to user on the peer bitcoin network without the need for an intermediary. Transactions are verified by network nodes via cryptography and recorded in a distributed public ledger called blockchain. Bitcoin was invented in 2008 by an anonymous person or group of people using the name Satoshi Nakamoto, and began operating in 2009 with its source code being released as open source software. Bitcoin is created

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as a process bonus known as mining. They can be exchanged for other currencies, products and services. Research done by the University of Cambridge estimates that in 2017, there were 2.9 to 5.8 million unique users using a cryptocurrency wallet, most of them using bitcoin.

Bitcoin has been criticized for its use in illegal transactions, high power consumption, price fluctuations, currency theft, and by reputable economists saying it should be zero-priced. Bitcoin has also been used as an investment, though several regulatory agencies have issued investor warnings about Bitcoin. Bitcoin prices are in cycles of appreciation and amortization, some of which are referred to as bubbles and pants. In 2011, bitcoin's value rose rapidly from about 0.30 \$ to 32 \$ before returning to 2 \$. In the second half of 2012, during the Cyprus financial crisis 2012-13, bitcoin prices began to rise, reaching 266 \$ on April 10, 2013, before falling to about 50 \$. On November 29, 2013, the bitcoin cost reached 1.224 \$. In 2014, the price dropped sharply and remained depressed since April with just over half of 2013 prices. As of August 2014, it was under 600 \$. Gavin Andersen and Mike Harren warn that bubbles may occur at the time of Bitcoin developers. According to Williams (2014), bitcoin is seven times more volatile than gold, eight times higher than the S&P 500 and 18 times higher than the US dollar.

Mittal et al. (2019) presented a study that aims to investigate the correlation between Bitcoin price and user activity on Twitter and Google search. The decentralized and peer-to-peer nature of Bitcoin has led to its popularity among web search and social media users. The study used various analysis techniques, including linear regression, polynomial regression, Recurrent Neural Network, and Long Short-Term Memory, to analyze the relationship. The results showed a significant correlation between Bitcoin price and Google Trends and tweet volume data. However, there was no significant relation between Bitcoin price and tweet sentiments.

Sattarov et al. (2020) investigate whether public opinion on Twitter can be used to estimate Bitcoin returns. By analyzing Bitcoin-related tweets and financial data using a sentiment analyzer, the study found that Twitter sentiment has predictive power for Bitcoin's results. The findings confirm the existence of a correlation between Twitter sentiment and Bitcoin returns, with an accuracy of 62.48% in predictions based on bitcoin-related tweet sentiment and historical data.

Digital currencies, like Ethereum and XRP, allow for online transactions without third-party involvement, emphasizing their decentralized nature. Due to their appeal, there has been increased attention towards cryptocurrency price forecasting, which has gained importance with the rise of deep learning. This study presents a long short-term memory (LSTM) algorithm that accurately predicts the values of cryptocurrencies such as AMP, Ethereum, Electro-Optical System, and XRP. The LSTM model displays highly efficient performance, and the model's predictions can assist investors and traders in identifying trends in sales and purchases of different cryptocurrencies, which may have huge repercussions for the economy. The results of the study show that the proposed model outperforms existing systems in terms of accuracy and low prediction errors (Ammer and Aldhyani, 2022).

In terms of technique Shahriari (2017) made a new VIKOR method as a compromise ranking approach to solve multiple criteria decision-making (MCDM) problems through intuitionistic fuzzy analysis. Using compromise method in MCDM problems contributes to the selection of an alternative as close as possible to the positive ideal solution and far away from the negative ideal solution, concurrently. Also, Mohagheghi et al. (2017) introduced a practical model to select the best and the most proper project portfolio while considering project investment capital, return rate, and risk. The ever-changing and highly uncertain environment of projects is addressed by utilizing interval type-2 fuzzy sets.

However, a comprehensive analysis of the bitcoin volatility trend is essential for future investment decisions. There are two main ways to make an investment decision: (1) fundamental analysis involves analyzing a company's financial statements to determine the fair value of the business, and (b) technical

analysis attempts to understand market sentiment behind price trends and the process of determining future price movements.

Technical analysis is the study of statistical trends that are collected from historical price and volume data to identify business opportunities. Technical analysts look at patterns of price movements, trading signals and other analytical tools to assess the strength and weakness of an asset. Technical analysis can be applied to any security with historical transaction data such as Cryptocurrency, Forex, commodities and stocks. Price and volume charts are all past decisions made by market participants. This information in turn influences future participant decisions in two ways:

1. **Psychological:** What you did in the past affects how you approach future situations. For example, many traders tend to focus on the price at which they have bought an asset, and if it declines, they want to sell it when they come back.
2. **Reflexive:** Some traders identify trends and patterns of routine charts and act (buy or sell). If enough participants follow the same strategy, these chart patterns are expected to follow the expected outcome, and this trend is likely to continue with more and more participants in the process. There are three possible trends (Fig. 1):
 - i. **Uptrend:** In an uptrend, the asset is going up making, higher highs and higher lows.
 - ii. **Downtrend:** In a downtrend, the asset is going down making, lower highs and lower lows.
 - iii. **Sideways trend:** In a sideways trend the asset trades in a horizontal channel.

Fig. 1 Types of trends

Market movements are complex and rarely follow a straight and predictable path. Instead, the price of an asset like Bitcoin may encounter various levels of resistance as it rises, or support as it falls. These levels can be caused by a variety of factors such as investor sentiment, market trends, and fundamental analysis.



Resistance levels are areas in which the price of an asset encounters selling pressure, preventing it from moving higher. Support levels, on the other hand, are areas in which the price of an asset encounters buying pressure, preventing it from moving lower. These levels can be identified by analyzing historical price data, volume, and other technical indicators.

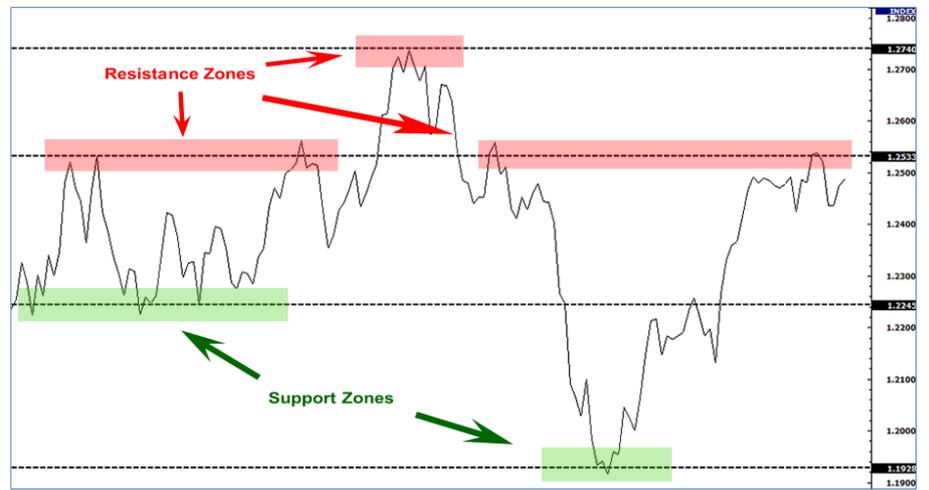
It is important to note that these levels are not fixed, and they can change over time as market conditions evolve. Traders and investors use this information to identify potential buying or selling opportunities based on how the price reacts to these levels. By understanding the concept of resistance and support levels, traders can make more informed decisions and manage their risk more effectively (Fig. 2).

Resistance: A level where an uptrend can be expected to pause or rebound that indicates a concentration of sellers.

Support: A level where a downtrend can be expected to pause or rebound due to a concentration of buyers.

In financial markets, the concepts of support and resistance are fundamental in identifying potential price levels where an asset's direction may change. When a price level is identified as support, it indicates that there are more buyers than sellers at that price, which means that if the price reaches that level, it is likely to bounce back up. Conversely, when a price level is identified as resistance, it means that there are more sellers than buyers at that price, and the price is likely to fall when it reaches that level.

Fig. 2 Trend description



When a resistance level is broken, it means that there are more buyers than sellers, and the price can continue to rise as the former resistance level becomes a new support level. Similarly, when a support level is broken, it means that there are more sellers than buyers, and the price can continue to fall as the former support level becomes a new resistance level.

In technical analysis, traders often use support and resistance levels as entry and exit points for their trades. For example, if the price is approaching a support level, traders may enter a long position, betting that the price will bounce back up from that level. Conversely, if the price is approaching a resistance level, traders may exit a long position or enter a short position, expecting the price to fall back down. However, in strong trends, the price can break through support or resistance levels without stopping, indicating a strong momentum in one direction. In such cases, traders may need to adjust their strategies or wait for a new support or resistance level to form before entering or exiting a trade.

Fundamental analysis is a widely used method for evaluating the intrinsic value of security. It involves analyzing various economic and financial factors that could impact the security's value. Fundamental analysts focus on studying macroeconomic factors such as the overall state of the economy and industry-specific conditions, as well as microeconomic factors such as the effectiveness of a company's management. One approach to conducting fundamental analysis is through the use of a neural-fuzzy system. This type of system combines elements of both fuzzy logic and neural network theory to create a powerful analytical tool. The system is trained using a learning algorithm derived from neural network theory, which allows it to make predictions and generate insights based on large amounts of data.

Unlike other methods of analysis, the neural-fuzzy system operates on local information, meaning that it only causes changes in the underlying fuzzy system on a local level. This allows it to provide more accurate predictions and insights while minimizing the risk of creating systemic changes that could impact the overall accuracy of the system. The use of a neural-fuzzy system for fundamental analysis is gaining popularity due to its ability to provide a comprehensive and accurate assessment of market conditions. This approach provides a unique perspective on market conditions, helping to identify potential opportunities and risks that might not be apparent using other methods of analysis. The neural-fuzzy system is a 3-layer neural network that can be viewed as a fuzzy nervous system. The first layer represents the input variables, the middle layer represents the fuzzy rules, and the third layer represents the output variables.

Fuzzy sets are encoded as fuzzy weights, which can be interpreted as a system of fuzzy rules. The learning algorithm operates on local information, causing only local changes in the underlying fuzzy system. The learning method of a fuzzy nervous system considers the semantic properties of the underlying fuzzy system. This limits the possible variations applicable to system parameters, which provides more stable results. Additionally, a fuzzy nervous system can be created from scratch using training data, initialized with prior knowledge in the form of fuzzy rules, and can be easily interpreted before, during, and after learning. Overall, the use of a neural-fuzzy system for fundamental analysis provides a powerful tool for investors and analysts to make more informed decisions about securities. With the ability to interpret and analyze market data using fuzzy logic and neural network theory, this approach can help identify trends and patterns that

might not be evident through other means. A fuzzy nervous system approximates a distinct function n -dimensional (unknown) that is partly defined by the training data. The fuzzy rules encoded in the system show ambiguous examples and can be seen as a prototype of the training data. A fuzzy nervous system should not be regarded as an expert (fuzzy) system and has nothing to do with fuzzy logic in the narrow sense. In this paper, a fuzzy nervous system is used to predict bitcoin oscillations.

2. Bitcoin

Satoshi Nakamoto, in January 2009, unveils his electronic peer-to-peer cash protocols to Bitcoin. This is a wave of your views in the community, and can be brought to you by referring to people who can be more focused. In the years that followed, bitcoin budgeted for use in the notorious black market. If you want to, we can face some limitations, but we can give you bitcoin and you can make full use of it. People can look for potential programs on the international community, and they can also be used as the best option for changing programs. Bitcoin and its infrastructure is a technology predicted by researchers to be publicly available for another year. Thanks to Satoshi Nakamoto's vision, Bitcoin is a highly-born and cryptic magician we can imagine. Since the birth of Bitcoin, shifting provided places have allowed you to keep your password and view it so that you can summarize your true artifacts. Why has no limited digital currency been able to visually price bitcoin?

Evaluation services are available for this phenomenon. Bitcoin is the key to the cryptographic movement and for good reason. Valid underpinnings, accessibility and a user user base can provide that position. You can use this date, depending on why you can change your shape with this argument. For a variety of reasons, bitcoin is encrypted by evaluating the market level and the value of getting a market cap. With the use of promotional material, more than 10 Bitcoin money ownership is possible worldwide. With this huge investment you can help you with IT and make it easy and safe. This number of user database bases can only increase your credibility, only allow you to invest and grow your company. Everything that can be explained through this myth is going up with demand and rising in price.

With industry titles like Amazon and McDonald's stopping bitcoin surveillance systems by the end of 2018, we can soon confirm and actually do bad things. Bitcoin's value is just enough to make it more powerful and it wants to be integrated around the world and it seems. If so, you can decide on your bid based on the bid price and try to make it possible for you and you can use it to make it possible for you. Given that we can have Bitcoin as a digital platform with your budget, you can introduce Cryptocurrency, and you can use it as well. This is important as stipulated. Using the services of curious physicians, you can join the movement, allow you to be entrusted to you, and help you through the various media. Bitcoin value is only available using blockchain and you can evaluate it more accurately, you can also protect bitcoin owners.

Bitcoin is limited by the invention of the concept of blockchain or distributed ledger. Other platforms are Ethereum and litecoin that are available to you and have the capability to protect them, so you can access these infrastructures. The real negative pressure associated with bitcoin is that it has a "bubble" and allows you to control it. Subtitles with this secure blockchain enables your asset to be able to concentrate with you and send you Bitcoin so it can be shared with you. For example, Coinbase is a real comment on your assets and the empowerment of third-party operating systems that endanger centralized servers.

3. Bitcoin vs. Other Cryptocurrencies

Cryptocurrencies around the world can be offered using Ethereum and EOS as digital assets and in many cases for use by modern society and service providers. Is the reason for this evaluation is that you can get through Bitcoin?

Answer is in confirmation of creation. Using the Internet resources, you can easily access the world through the other world, so you can have your own opinion and be your own. If you can come to your disposal, you can get a look at this. Using the overall value, you can be sure of this by visiting this database. Applications and developers that can facilitate Bitcoin can be used as Ethereum applications and more. Using the evaluation of Bitcoin, other platforms, different agents are already emerging and overlapping, now available to themselves and to the opportunity (Table 1).

Table 1 Differences between bitcoin and other cryptocurrency

	Bitcoin	Cryptocurrency
Main Aim	The main purpose of simplification and quick access without legal restrictions	To provide less, state-of-the-art and secure services
Trade	Bitcoin trading is limited to trading using it as a resource	Encrypted currencies are allowed which can be provided to offer services
Popularity	Bitcoin Popularity is the most popular bitcoin	Encrypted currency information of this triple position is allowed from Bitcoin
Strategy	Provide you with features that can allow you to provide financial services	Cryptocurrency to market for the amount of goods and services you offer and to use your services To improve
Status	The bitcoin status is anonymous to love, so it can be possible for you to be a linker, as well as a nonsense number to help you	This password is valid and can be used by other industries

4. Prediction

This is where it can get started to deliver products as forecast markets. Predicting the Stock Market Fundamental Stock Market, which can be given to people who can provide it to you. However, unlike stocks and securities, a market is predicted to allow you to be able to offer you, make your forecasts and sell, not the same. The benefits are that it is predicted from the markets. God can best be able to allow you to take a stand. In other words, forecast markets, everyone can be the creator of the market. For example, if you can create a year for 2020 using this law, you can give an example, so you can use 2050. If you want to market January 20 this year, you can snow in New York City, then you can do it. Forecasting the market can ease any look.

However, it is only if you can have an international market, necessarily own it, that you can decide on the bet. Forecast Markets Markets are very limited and possible and you can use this market. Some of the other major advantages of the Forecast markets are that we can hold hands and hold an official position. Having forecast markets, a reference can be made available to you if you are allowed. With market forecasting, manipulating the nature of the following markets with easy access is impossible. Predicted Markets You Can Predict Markets Amongst Lower Prices This is especially important for anyone who regularly bets on predicted markets. It allows you to be able to spend time. This is one of the benefits of anticipated markets in this area that you can take advantage of incredible forecasts about your offers. However, you can have 20,000 attendees and 3,000 attendees to make you happy, you can help companies to participate. Listening to the anticipated data gathered by the anticipated markets can provide you with the jobs you know you can provide to your users.

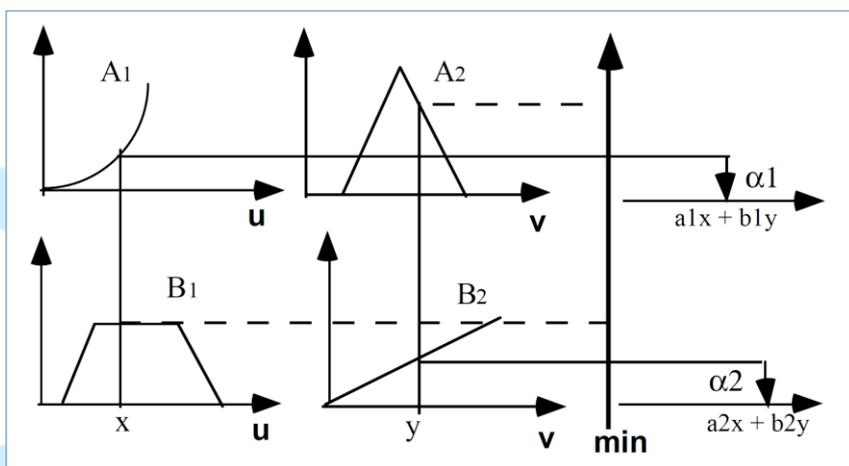
Using different blockchains, you can use the markets anticipated here. Artificial intelligence techniques from the expression of very practical methods with the aim of having full control over the presentation of the models presented in the reflector. The fuzzy nervous system is a powerful way to dispel its views. In the control of cooperative neural fuzzy systems, both the artificial neural network and the fuzzy system as

independent of the employers. The ANN tries to learn the parameters from the fuzzy system. This can be done offline or online as you watch the trial using the fuzzy system. Figure 3 shows four types of cooperative fuzzy neural networks.

The top left fuzzy neural network observes the fuzzy set of trained data. This is usually done by adjusting the neural network membership management. After fuzzy sets using fuzzy law that can be allowed, it can help you to create a fuzzy system. The neural-fuzzy system at the top right guides the fuzzy law of neural network data training. In consultation, the neural networks are offline before the fuzzy system starts. Ordinary note law with taxonomic cluster mapping using self-organization for reform (Rice, 1993; Rice, 1994). One can use fuzzy clustering methods to achieve the law. In the left-fuzzy neural model, the system can use all the membership parameters online, for example using this fuzzy system. You can start by law and plan sports activities in advance. This brother is an error in access and guidance.

You can exercise your right by having a right to anger. This is done online and offline. A law of weight can be interpreted as the effect of a law (Glurnock, 1994). It can be multiplied by the output law. Judge the semantics of weight so that it cannot be defined clearly. You can change it using the option. However, this can eliminate the interpretation of fuzzy sets. Brother punishment, same language values are allowed to be shown using a different law.

Fig. 3 ANFIS model



5. Prediction of the Bitcoin Price

The information used in this study includes 95 monthly observations of the bitcoin price from January 2012 to November 2019. The bitcoin price changes during this period are depicted in Fig. 3.

In order to develop ANFIS model for the bitcoin price, the available data set, which consists of 95 input data are entered the system. For achieving the aim, 90 observations are first applied to formulate the model and the last 5 observations are used to reflect the performance of the different models. According to the concepts of the ANFIS model and using productive algorithm in MATLAB 7.11 package software in order to obtain the optimum network architecture; several network architectures are established to compare the model's performance. Before constructing the model, the variables were normalized to the interval of 0 and 1.

The best fitted network based on the best forecasting accuracy with the test data is model No. 95 (see Fig. 4). This confirms that simple network structure that has a small number of hidden nodes often works well in out-of-sample forecasting. This can be due to the over fitting problem in ANFIS modeling process that allows the established network to fit the training data well, but poor generalization may happen.

According to there is not a unique and more appropriate unbiased estimators applied to see how far the model is able to forecast the values of bitcoin price, several measures of accuracy are employed. For this reason, the models are evaluated by two estimators containing of the coefficient of determination (R^2) and the mean absolute percentage error (MAPE).

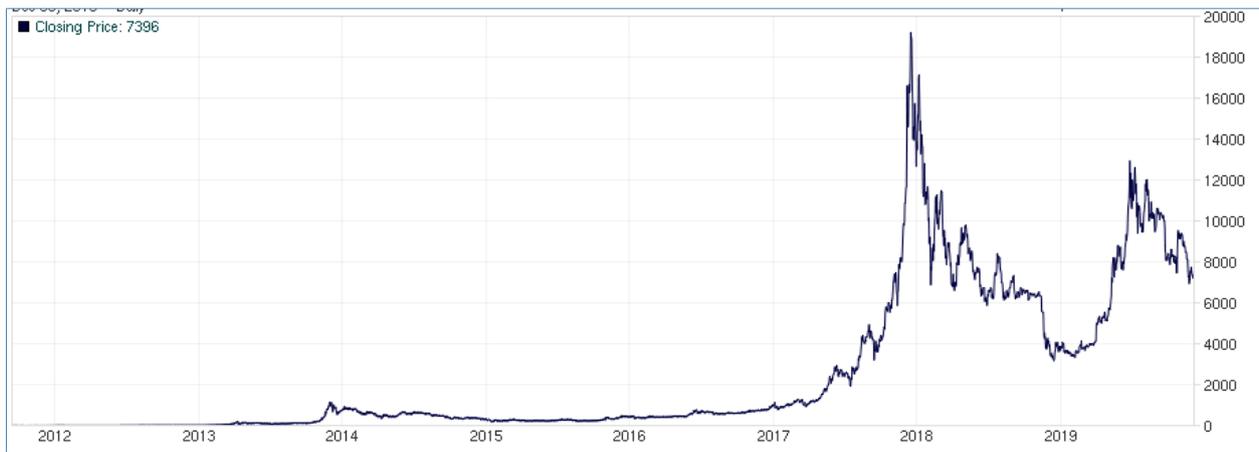


Fig. 4 Bitcoin prices

From Table 2, it is evident that the ANFIS model with 7 MFs outperforms others models. The forecasted value of the proposed model for test data are plotted in Fig. 5.

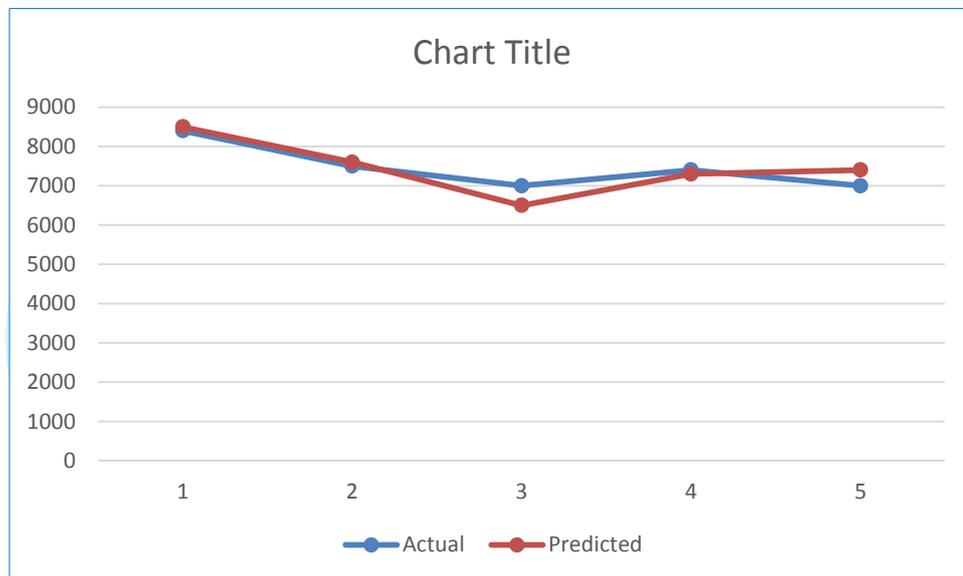


Table 2 Comparison between the performances of different models

MFs	In sample		Out of sample	
	R ²	MAPE	R ²	MAPE
3	0.934	6.34	0.55	22.43
4	0.942	6.31	0.58	21.01
5	0.943	6.25	0.59	20.21
6	0.931	6.30	0.54	23.22
7	0.971	4.01	0.88	7.21
8	0.915	7.33	0.56	25.67
9	0.951	5.22	0.75	13.33

6. Conclusion

This paper introduces a novel approach to modeling Bitcoin price quotes, incorporating a range of specialized

features to enhance its accuracy and versatility. The model is designed to accommodate both linear and nonlinear data patterns and is subject to rigorous evaluation using statistical techniques such as MAPE and R². One of the key advantages of the proposed model is its flexibility in dealing with uncertain and complex data environments, making it a valuable tool for practical applications. The model's efficacy is demonstrated through an empirical study using monthly Bitcoin price data, and the method presented is shown to be readily applicable in real-world settings, enabling users to develop their own analytical skills and decision-making processes. This article highlights the potential of the proposed approach to improve the understanding and

management of Bitcoin prices, offering a viable option for analysts and investors seeking to enhance their forecasting capabilities and gain a competitive edge in the marketplace.

Funding Information

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Conflict

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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