# Predicting Changes in Bitcoin Price Using Grey System Theory

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## Highlights

- Implemented Grey System Theory that provides a simple and an effective solution for Bitcoin price prediction.
- Working of Grey Model that provides excellent prediction results with high reliability.

## Background

Recently the hype around the crypto space has increased significantly, where cryptocurrencies are not only attracting attention from frequent traders, but also investors, tech-entrepreneurs and the general public. Currently, Bitcoin is the most popular cryptocurrency and is widely used for trading and normal transactions. It is especially popular among traders who use it to profit on their transactions. Due to the massive interest in the trends related to the changing Bitcoin value, there is an increased interest in it by researchers who are working to create and test algorithms to predict value of Bitcoin. Researchers have used ANNs, RNNs, VAR and others methods to predict Bitcoin values. One of the methods to do so, is by using the Grey System Model, which is a non-statistical way to conduct this process.

## Introduction

Cryptocurrencies are digital money; they are digital data that hold value and can be used to buy and sell items. Based upon the blockchain technology, these cryptocurrencies are highly secure and easy to use. One such cryptocurrency is Bitcoin (BTC). Like other crypto currencies, BTC value is always changing. To predict these changes, Jalali and Heidari (2020) have used the grey system

model. The grey system model is a method applied on grey systems to evaluate the behavior of the system. A grey system contains information which is only partially available; it classifies information as black - unknown information, white - known information , and grey - partially known information. Therefore, the random and the volatile data associated with the prices of BTC can be used for this method. This method is simple to model, implement and requires comparatively less input data. Hence, it is preferred for currency predictions over other methods.

## Proposed Methodology

For this purpose, the grey model GM(n, m) uses $n^{\text{th}}$ order differential equation along with $m$ variable(s) to estimate the behavior of the system. It is particularly utilized to forecast non-linear time series. In the case of predicting cryptocurrency values, the GM $(1, 1)$ model is preferred. The GM $(1, 1)$ signifies that a first-order differential equation along with one variable is used to make the prediction in a time series.

The steps taken in this method are summarized as follows:

1. The model maps a differential equation for the data inputted to it which is updated every time there is a new entry to the data. This system then generates a value $n$ steps ahead of the system.
2. Another value is predicted by using the accumulative generation operator (AGO). The AGO coincides the randomness of the data. To obtain the value, this is inversed using the inverse accumulative generation operator (I-AGO).
3. The main prediction value is obtained by using the two values formulated as above.

## Details of Proposed Methodology

A study conducted by Jalali and Heidari (2020) used data of Bitcoin prices to predict future prices using the GM $(1, 1)$. This study considers a period of 5 days and another period of 6 months to predict a value i.e. for a data set of six months, the method uses the data of the five sequential months to predict the values of the $6^{\text{th}}$ month . This study predicts the fifth value by considering four initial data points. The study also used the mean average percentage error (MAPE) to evaluate the error of the predictions.

## Results and Discussion

The results of the study are promising, yielding errors of as minute as 0.34% and high as 13.67%. According to the MAPE measure, these errors give a 'Good Accuracy' of the model. One of the generated results is shown in Table 1.

Table 1: May 23, 2018-May 27, 2018; MAPE = 0.34

| | | | | | |
|---|---|---|---|---|---|
| BTC | 7502.56 | 7578.69 | 7460.69 | 7334.16 | 7344.97 |
| Predicted | 7502.56 | 7554.60 | 7470.60 | 7387.60 | 7305.40 |

Further analysis shows that a five-day time window is best for prediction of BTC (Bitcoin) value. This is so because using the five days time window generates accurate, robust and unbiased results. This was evaluated using a Lilliefors test which investigates the normality of error distribution.

## Conclusion

This leads to conclude that Bitcoin is an extensively used cryptocurrency which is increasingly demanding new methods to predict its price. Therefore, Jalali and Heidari (2020) have come up with the Grey Model to accurately predict Bitcoin value. On testing the GM $(1, 1)$ method over the data of Bitcoin prices of 6 months, it is seen that the model produces accurate predictions for a five day window. Current work only utilizes data associated with the prices of Bitcoin; performance can be increased using other factors associated with Bitcoin e.g. attractiveness of Bitcoin on search engines and social media.

## References

Jalali, M. F. M. and Heidari, H. (2020). Predicting changes in Bitcoin price using grey system theory. *Financial Innovation*, 6(1):1–12.