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Heikin-Ashi Transformation and Its Effect on Neural Network Learning for Stock Market Data

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ABSTRACT: Stock market data is very dynamic and very susceptible for information flow. In shorter time frame such data can contain noise which can interfere with neural network learning and reduce its effectiveness. In this paper we discuss a very effective way to reduce stock market noise using Heikin-Ashi transformation. The result show that Heikin-Ashi transformation based learning has better prediction than normal stock market data.

KEYWORDS: Artificial Neural Network, Machine Learning, Stock Index, Prediction, Time series filtering, Heikin-Ashi.

I. INTRODUCTION

Modern era has been dominated by the machines and data. As the power of computation escalated towards sky, we were able to create better system that can harness this computational power and turn them into sophisticated system. The art of analyzing data is priceless. The data itself is meaningless unless we can find some hidden pattern or information within. But this becomes even better when this is performed by machine themselves. Identifying patterns among data is a key area of research. Since we have enough computational power at our disposal, we can device methods that allow machine to teach themselves and find pattern within the data.

Neural network provide an excellent way to understand the given data and make prediction based on the learning (Guresen et al., 2011). One of the most promising field of such research includes finance. Stock market is a very dynamic place. Understanding the pattern within the stock market data is a key field of research. But stock market data can contain noise. Noise is short term variations in stock market data. Such Noise is unwanted within the data and may or may not be related to the underlying stock data trend. While training our neural network, such data can interfere with learning and hence reduces the effectiveness of learning. Proper reduction of noise leads to better learning and hence better results. This paper suggests the Heikin-Ashi transformation for reducing noise and its effect on learning of artificial neural network.

II. RELATED WORK

The Sources of noise are countless. Such noises are result of market overreaction to news and other factors (Howe, 1986) such as short term traders exiting their positions too early. Filtering of data has been suggested by many researchers. The use of Kalman filters has proved to be effective in signal processing (Haykin, 2001) (Wan and Merwe, 2000). Researchers have used wavelet transformation for neural network (Hosseinioun, 2016) and results have been remarkably well. Many optimization have been suggested to improve the neural network for performance and accuracy (Qiu and Song, 2016) including modular neural network (Kimoto et al., 1990). This strongly suggests that transformation can benefit a neural networks performance. Researcher have already suggested that volatility interferes with learning and hence the reliability drops (Adam et al., 2016). Neural network performance can be easily measured in percentage accuracy as discussed by researchers (Brownstone, 1996). The concept of transformation is heavily used in signal processing as demonstrated by researchers (Kuan et al., 1985) in signal processing. Beals smoothing function

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for community analysis ("Improving community analysis with the Beals smoothing function: Écoscience: Vol 1, No 1," n.d.) further strengthens the fact that many system require transformation. The wavelet transformation in ECG system has been proven to be beneficial as suggested by authors (Sahambi et al., 1997). A least square method has been suggested in improving signal to noise ratio as demonstrated by C.G. Enke & Timothy A Nieman (Enke and Nieman, 1976).

III. ARTIFICIAL NEURAL NETWORK

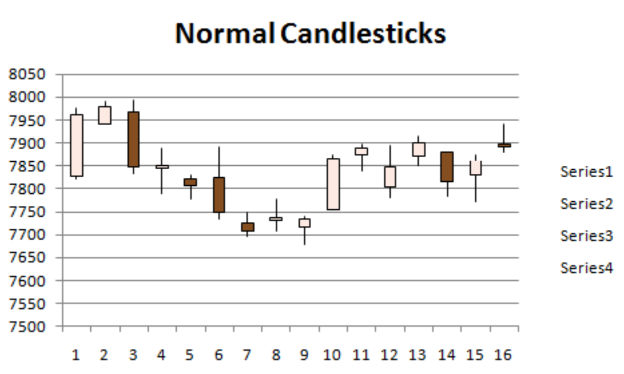
The first neural network model was established by W.S.Mcculloch and W.Pitts in 1943 (McCulloch and Pitts, 1943). It was called MP Model and they used MP model to put forward the neuron's mathematical description, network construction method and proved that each single neuron can perform logic function, thereby laying a new era of Neural Network research. Artificial neural network has been successfully applied in the field of stock market, pattern recognition, decision making and health care. An artificial neural network is inspired from human brain. Human brain contains approx. 10 billion nerve cells (neurons) and many thousand times connection between them. Such design allows the determination of non linear relationships between input and output. The capability of neural network to identify patterns and the fact it can be trained with sufficient training data makes it really desirable in many situations.

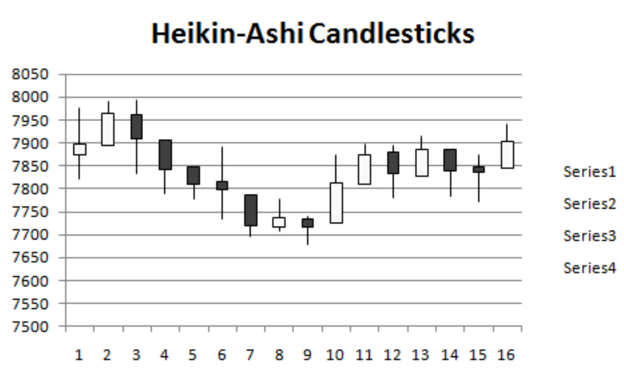
IV. METHODOLOGY

Here we define Heikin-Ashi Transformation for Stock market data. Heikin-Ashi is widely used in candlestick charts. In Japanese, Heikin means "average" and "Ashi" means "pace". since it is based on candle stick patterns. We give a brief intro to candlesticks.
A candlestick contains information of a given time period and the trade within that time frames. Every candlestick has 4 values Open, High, Low and Close. These values represent the value at which stock or index opened, highest value of stock, lowest value of stock and closing value of the stock in that time period.
Heikin-Ashi transforms these 4 values using following formulas to create new candlesticks. New set of candlesticks are smoothen out and better equipped for learning.

Transformation rules:
Let $O_{current}$, $H_{current}$, $L_{current}$, $C_{current}$ represents current open, high, low, close values.
Let O_{Prev}, H_{Prev}, L_{Prev}, C_{Prev} represents Previous day/period open, high, low, close values.
Then Heikin-Ashi values (HA) are calculated as:-

HA-Close = $(O_{current} + H_{current} + L_{current} + C_{current})/ 4$
HA-Open = $(\text{HA-Open}_{Prev} + \text{HA-Close}_{Prev}) / 2$
HA-High = Maximum of the $H_{current}$, HA-Open or HA-Close
HA-Low = Minimum of the $L_{Current}$, HA-Open or HA-Close





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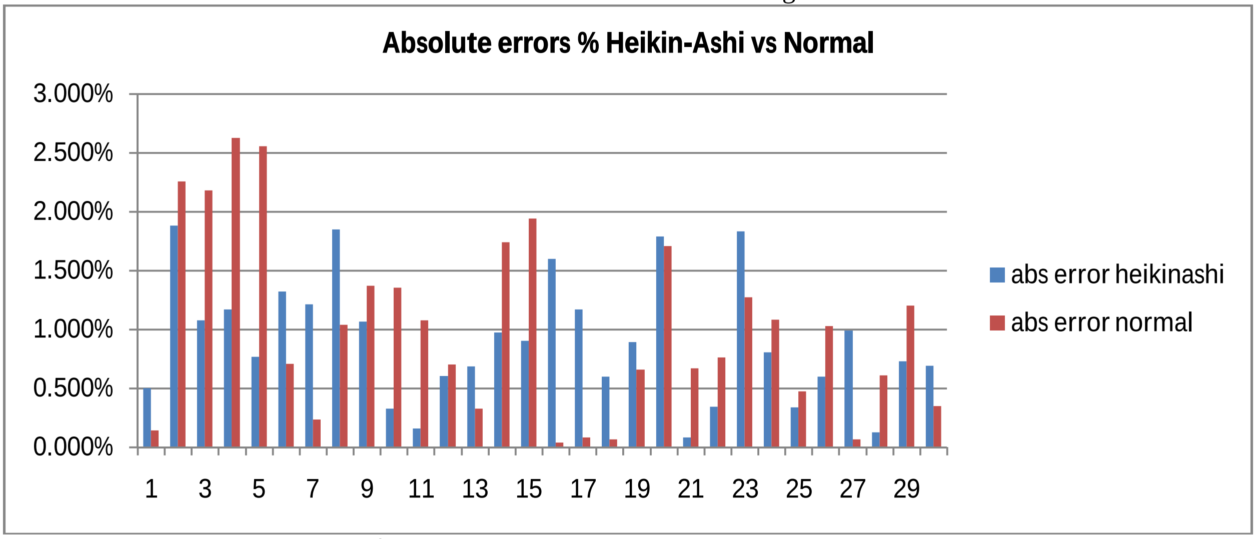
Above figure demonstrate the effect of Heikin-Ashi transformation on candlestick data. As we can see that Heikin-Ashi transformation produces less volatile candlesticks. In case $HA\text{-}Open_{Prev}$, $HA\text{-}Close_{Prev}$ the previous high and low of untransformed data is used respectively. As we can see that it is a chicken and egg problem. But after 7 to 8 candle sticks the effect of Heikin-Ashi becomes consistent. It is also pointed out that a sufficient large dataset is used to remove any discrepancy that may arise from chicken-egg problem. The real benefit of Heikin-Ashi lies in its capabilities of producing better results with neural network.

V. SIMULATION AND RESULTS

Given set of data is converted into two training set. One set is kept as normal market data and on second set Heikin-Ashi transformation is applied. Two Neural network with structure (4,3,1) is trained on normal and Heikin-Ashi data and then both are tested on the same test data. Then we calculate the % age error from the actual values in both cases.



Above chart shows the deviation of the Neural Network with actual stock market values. The chart includes results both normal data as well as Heikin-ashi transformed data. Dark bars (Red) represents absolute %age error when using normal candlestick data. Lighter bars (blue) represents absolute %age errors with Hekin-ashi transformed data. With above chart it is clear that Heikin ashi produces less errors in most of the cases then normal non transformed data.

Transformation	Absolute Average % Error	Std Dev
Normal	1.015%	0.007516
Heikin-Ashi Tranformation	0.907%	0.005115

This table provides a summary of results. On the given dataset we calculate the absolute average % age error for both normal as well as Heikin-ashi Transformed data and their standard deviation. Here we observe that absolute average error in case of Heikin-Ashi transformation is reduced by approximately (10%). Also standard deviation confirms that Hekin-Ashi transformation also produces less fluctuating predictions (a reduction of 33% in standard deviation for absolute percentage error).

The testing results show remarkable improvement in prediction by neural network (improvement by 10%) when it had transformed data as training. This demonstarte that an existing system can be improved by careful transformation of data and removing unwanted noise in learning.Although there are times when this transformation actually increased errors but the error reduction was far greater then the error increase, making this method relatively better.

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VI. CONCLUSION AND FUTURE WORK

With this research paper we conclude that transformation can make a neural network perform better in prediction. Future work can include the structure of the Neural Network or making further improvement in transformations.

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BIOGRAPHY

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