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Generative Adversarial Network (GAN) Model for Stock Market Prediction (GAN-SMP)

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ABSTRACT

As of late, forecast of stock costs acquires significance in the rising affordable area, as a basically precise expectation holds the likelihood to acquire monetary preferences and be careful against market hazard factors. In light of the high level improvement of Internet and calculation draws near, the likelihood to perform capacities on the financial exchange had raises to a small portion of seconds [1]. In 2009, Brazilian stock trade worked high frequencies and has expanded from 2.5-36.5% from the year 2009 to 2013. [2-14] assessed that high-recurrence exchanging happens in 2016 where normal of 10%–40% of exchanging amount values and 10%–15% of sum in unfamiliar trade and items. These qualities suggested that the high recurrence securities exchange is an overall style.

Keywords: Stock prices; Feature selection; Classification; GAN; PSO

I. INTRODUCTION

Recently, prediction of stock prices gains more importance in the rising economical sector, as a practically accurate prediction holds the probability to gain more financial advantages and be cautious against market risk factors. Because of the advanced development of Internet and computation approaches, the possibility to perform functions on the stock market had raises to a fraction of seconds [1]. In 2009, Brazilian stock exchange operated high frequencies and has increased from 2.5-36.5% from the year 2009 to 2013. [2-14] estimated that high-frequency trading takes place in 2016 where average of 10%–40% of trading quantity in equities iand 10%–15% of amount in foreign exchange and commodities. These values recommended that the high frequency stock market is a worldwide style.

Under diverse scenarios, the assessment of prediction performance takes place in two distinct ways namely forecast error which can be determined by the use of Root Mean Square Error (RMSE) among actual and predicted prices [15-35]. The next one indicates the predictive accuracy implies the proportion of accurate forecast of price series direction like up and down actions are actually needed to make decisions. A slight increase in the predictive results can also be highly beneficial. But, the SMP is a difficult task owing to the complex and hectic adaptive nature of the market and unstable parameters are employed. Several research works from diverse fields have examined the active pattern in the economic time series and presented models to forecast stock prices. For obtaining significant results, various models need cautious choice of input parameters, constructing predictive model with qualified financial facts, and employing distinct algebraic models for arbitrage investigation, that makes it hard for normal people to utilize these techniques for SMP. It can be treated as a classification problem and diverse methods can be employed to solve it [36-65].

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Based on the existing studies presented in SMP, the methods can be classified to two ways. The former type is based on econometric model that comprises econometric methods to predict data. The widely employed models are moving average (MA),

autoregressive (AR), AR moving average (ARMA), and so on. Generally, these approaches take every new signal as a noisy linear integration of the previous signals and self-regulating noise term. But, many methods are based on the assumption based on the noise term as well as loss function whereas the actual financial data might not completely fulfil the considerations. Through the application of a generalized autoregressive conditional heteroscedastic (GARCH) approach for conditional variances, [5] employed ARIMA-GARCH approach to predict the financial time series. The next type comprises artificial intelligence that is inspired from the biological processes. Some of them are fuzzy logic (FL), artificial neural networks (ANN), support vector regression (SVR), and so on.

A few works depend on the combination of fluffy ideas with the intervention in alternative estimating methods. [6] presented the fluffy ideas and [7] indicated the adequacy of the fluffy based expectation and planned enrollment capacities at the stock costs in Europe utilizing the fuzzification of the loan fee, precariousness, and opening stock cost. Recently, huge consideration is given to the zone of profound realizing where the central association is characterized as a multilayer neural organization [8]. Barely any strategies which have applied profound learning models for improving the grouping capacity of high-recurrence monetary time arrangement is introduced here [9]. The capacity of profound learning lies in the extraction of required highlights from the gave information is likewise critical. [10] utilized a profound component learning-based SMP procedure that removes the subtleties from the stock return time arrangement with no reliance on prior data of the forecast models and approved it on high recurrence information from Korean SMP. [11] built up a double layer neural organization (NN) to figure information utilizing the associations especially produced for catching reliance structures between stock returns in different business areas.

Here, PSO algorithm is applied to select the required features. It is initially developed by Kennedy and Eberhart in 1995 [12]. It is based on the foraging nature of flocking of birds and schooling of fishes. The basic idea of PSO algorithm lies in the optimization of information through social communication in the population where thoughts are individual as well as social. It depends upon the concept that every solution is defined as a particle in the swarm. Every individual particle holds a position in the search space that is indicated using a vector $x_i = (x_{i1}, x_{i2}, \ldots, x_{iD})$, where D indicates the dimensionality of the search space.

GAN based classification

GAN is a novel model that performs training of two models: generative model which gathers the distribution of data and discriminative model which performs the possibility that a instance comes from the training data instead of G [13]. The training process for G lies in the maximization of generating a mistake. It represents a min-max two-player game. At the domain of random functions and D, an exclusive solution is present by retrieving the training data distribution and is identical to 0.5. During the adversarial procedure, the generator could be viewed as a cheater for generating the identical data as the real world data whereas the discriminator acts a part of differentiating the real time and produced data. It could attain an optimal point where the discriminator has the inability to distinguish two kinds of data. In this case, the generator could gather the data distribution from this game. Using this concept, the GAN model can be applied for the classification and prediction of stock market prices.

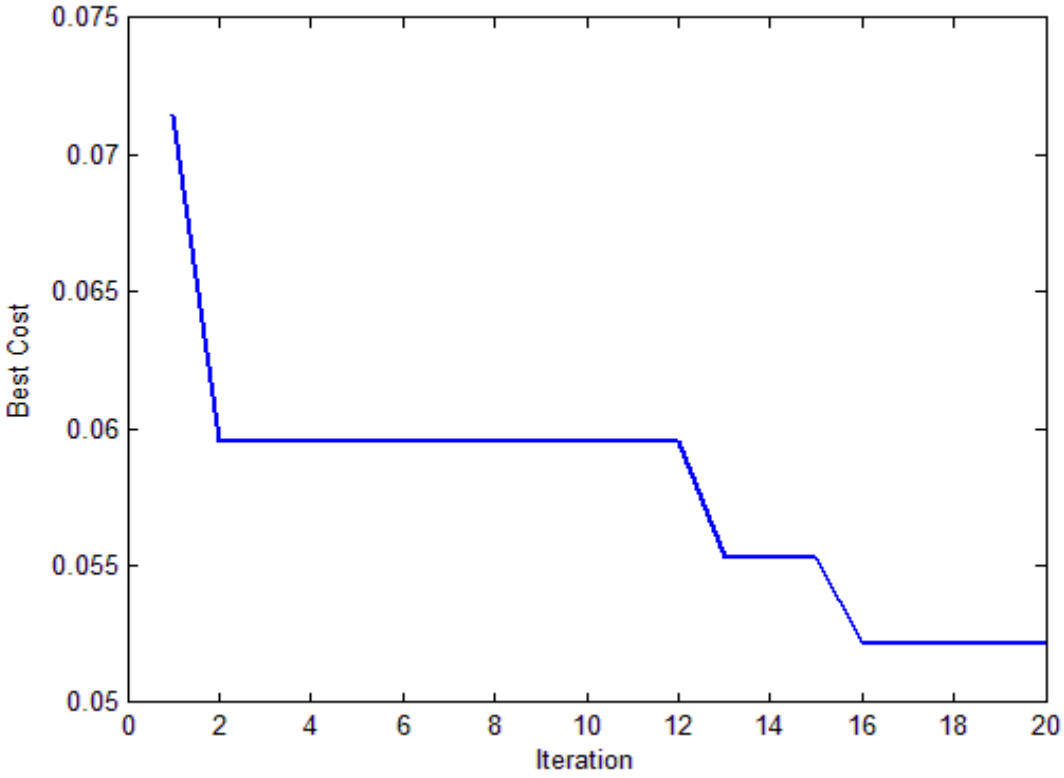
Discriminator

The goal of the discriminator lies in the constitution of a differentiable function D for the classification of the input data. The discriminator is expected to output 0 when a fake data is provided as input and outcome will be one incase of providing real time. In this case, MLP is chosen as a discriminator along with a set of 3 hidden layers $h_1, h_2 \; and \; h_3$ comprising a set of 72, 100, 10 neurons, correspondingly. The Leaky ReLU is utilized as an activation function between the hidden layers and sigmoid function is applied in the output layer. Additionally, cross entropy loss is selected as the loss function for the optimization of the MLP. Particularly, the $X = \{x_1, \ldots, x_t\}$ and $\hat{x}_{t+1} \; are \; concanated \; to \; \{x_1, \ldots, x_t, \hat{x}_{t+1}\}$ as fake data X_{fake}. Likewise, $X = \{x_1, \ldots, x_t\}$ and x_{t+1} are concatenated to generate a $\{x_1, \ldots, x_t, x_{t+1}\}$ as the real data X_{real}.

ZHere, G_{loss} contains g_{MSE} and gloss with λ_1 and λ_2, correspondingly. Here, λ_1 and λ_2 represents the hyperparameters which can be set in a manual way. Fig. 4 provides the architectural model of GAN. The X_{fake} and X_{real} is used instead of $\hat{x}_{t+1}$ and x_{t+1} in the discriminator because of the fact that it is expected that the discriminator captures the correlation and time series information between x_{t+1} and X.

II. PERFORMANCE EVALUATION

To validate the presented model, the Istanbul stock exchange data or BIST dataset is employed. The



Istanbul stock exchange gains interest among foreign investors and is considered as top ten largest emerging markets. The experiments are carried out on the BIST's 100 index because of low frequency of trading. Every public sector company shows exclusive trading on BIST and it reflects zero market fragmentation. The short selling is obtainable for every listed stock without one in the watch list. Istanbul stock exchange data is utilized here due to various facts.

Best cost analysis of GA based feature selection

The comparative analysis of the predicted results with the actual results on different dates. For comparison purposes, SVR and ANN models are employed. The table 2indicates the data, open price, closing price and actual result whether 0 or 1 (i.e. down or up). On the date of 11-05-2019, it is shows that the open price and close price are 247.6 and 250.35. These values indicate that the prices are up. The presented and compared methods are also properly predicted that the stock prices are increased. Similarly, on the date of 14-05-2019, it is depicted that the open and close prices are 249.95 and 253.6. These values indicate that the prices are up. However, the compared methods SVR and ANN provide an identical outcome of 0 indicating that the prices are down. Interestingly, the presented model accurately performs SMP accurately by predicting the increased stock price.

III. CONCLUSION

Several researches have been done to foresee the stock prices which will be helpful for users to identify the direction of stock price movement. Though classification methods perform wells on SMP, the presence of numerous factors in the stock process decreases the efficiency of the applied classification algorithm. So, feature selection methods are applied to reduce the complexity level and enhance the classification accuracy of SMP. To achieve this, a novel feature selection based classification model for SMP is presented in an effective way. At the initial stage, the feature selection process is executed using PSO algorithm to pick out the required features from the available feature set. Then, the GAN classifier is applied to predict the stock market prices. An extensive validation takes place on BIST dataset. By observing the values presented in the table and figure, it is noted that the presented model shows proper forecasting over other methods in a significant way.

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