Proposed Solution

Artificial Neural Network also the connectionist systems are computing systems that are based on and are theoretically alike, but not exactly identical to, biological neural networks of a human body. An ANN performs its task by taking in examples and requires no programming with task-specific rules . The purpose of a neural network is to construct or design an output pattern when given an input pattern. An artificial neural network (ANN) has an architecture which is parallelly-distributed with large number of nodes (neurons) and connections.

We use the Back-propagation learning algorithm and the error signal is cultivated through the network in the backward direction by changing and managing weights of the network to maximize the performance of the network. The procedure is done until the network is able to provide desired responses.

In the suggested model, there is only one dependent variable, the closing price of crude oil which has been considered, since it's a time series, we have followed the model for general time series forecasting in conducting the experiments, which have been represented in the form as follows[10]: where is vector of lagged variables . The input variables depicted in figure 1 are the lagged variables. The estimating problem is to approximate the function [10]. This can be done by iteratively adjustingthe weights in the modelling process. The diagram for the proposed model is depicted in figure 2. As an illustration, we have taken four phases in the formation of this suggested predictive model. Collection of data: We have taken the crude oil price data from investing.com. A period of 5 years and 11 months is the period of the collected data. The closing price of crude oil was comprised and approximately a total of 1500 records were extracted. (b) Data normalization: The process of Data Normalisation takes place before the start of the training process. The normalisation range of the closing price is [0.001, 0.005] using the following equation

$$P' = \frac{p - Min}{Max - Min} (l - m) + m$$

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Where we have taken as the normalized value; p is the value that is to be normalized; Min is the minimum value of the series that needs to be normalized; Max is the maximum value of the series that is to be normalized; m is the minimum value of the range l is the maximum value of the range. Activation function: The activation function or popularly known as the transfer function findsthe relationship among the inputs node and the output nodes of a network. The sigmoid function given below has been used to carry out this work. Training algorithm: The training for a neural network is extremely complex, it is an unconstrained nonlinear (change in output is not proportional to the change in input) problem of minimization where the arc weights of the neutral network are modified iteratively to minimize the total mean or overall squared error between the desired and the actual output values for the output nodes overall input patterns. The usual BP algorithm which is based on approach of steepest descent gradient has been taken to train the model and minimize the errors, and error function E is defined in

$$E = \frac{1}{2N}\sum_{p=1}^{n}(y_p - y_p^d)^2$$

The crude oil prices are taken out by implementing the performance of the proposed model. The proposed model is here used to predict the closing price of crude oil. The performance check of the suggested model has been evaluated using the Root Mean Square Error (RMSE) criterion.

The data set has been split into 2 parts of 70% and 30%, respectively for instructing, training and testing. The training data is used to find the optimal lagged value for our proposed model. The results are taken out by varying the lag value, the optimal lag is obtained with the least RMSE values. Table 1 shows the RMSE values corresponding to the lag values 2,3,4 and 5. Since the RMSE value is least for lag value 3, it has been used for our prediction.

LAG	RMSE VALUE
2	10.23
3	7.68
4	8.50
5	9.71