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# Applications of Machine Learning in FOREX Market

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**Abstract -** *In this paper, we will discuss various machine learning techniques such as natural language processing, data mining, association rules, etc. which are applied to the FOREX market and how they influence or enhance the whole process of investment. The main goal of investing in the FOREX market is to amplify the profit in a certain period of time. In this paper we will see some of the trendy and classic techniques used by analysts, traders in the market, and how technology is making their tasks simpler and faster.*

## 1.INTRODUCTION

The foreign exchange market or FOREX (FX or the currency market) is an over-the-counter (OTC) Global market that determines the exchange rate for currencies around the world. In terms of trading, it is, by far the largest financial market in the world. The FOREX market is one of the biggest and most liquid markets worth **$1,934,500,000,000** (that's **$1.93** quadrillion) $5.3 trillion dollars are traded every day in the FOREX market [1]. Currencies are traded in pairs, the "Value" of one currency in the pair is relative to the value of the other one. This defines how much of country X's currency country Y can buy, and vice versa. This is the essence of the foreign exchange market. The main objective for the existence of FOREX trading is the need to buy foreign goods and services. speculative trading is also the motivation for private banks, central banks, corporations, financial companies, individual retail traders, and pension funds. speculative trading can be explained as doing a financial transaction that has higher risks but also holds the possibility of significant gain if everything goes right.

### 1.1 Machine Learning In FOREX

Many ML algorithm models learn from the data given and make predictions on the data. They can either be used for predicting a category or predict the direction and magnitude.

Example: 1) Predict the price of a stock after 2 months based on the company's past result

2)Predict whether Fed will hike its benchmark interest rate [2].

The exchange rate of currency pairs can be predicted using supervised machine learning models which can predict the uptrend and downtrend of FOREX and can help traders, investors to make right and statistically accurate decision

## 2.Supervised Algorithms in FOREX

The supervised algorithms help to make decisions in FOREX trading based on the previous exchange rate of the currency pair. In a supervised learning algorithm, we train the model with historic data and based on this data the model predicts the outcome. In supervised algorithms, we fed the data as input to the machine learning model also show them the output that is predictions based on the input data doing this, we are teaching our model to understand the patterns between input and output.

So that when we introduce new data set to this model it should be able to predict the outcomes on its own.

### 2.1 Support vector Regression

Before understanding how support vector regression works let's quickly understand the working of the Support vector machine (SVM). The main objective of SVM is classification. The best example of classification can be considered as classifying emails as spam, social, etc. another example could be classifying cats and dogs into two different classes. SVM model learns through training data images about the features of cats and dogs and then predicts or classifies new images of (which were not part of the training dataset) cats and dogs in their respective classes. Now the concept is the same in support vector regression too the only difference is that the SVR is used for continuous data values, for example. Predicting the exchange rate for tomorrow based on the exchange rates of the past few weeks or months. In a normal regression model, we try to minimize the error rate while training the model but in SVR we try to fit the error in a certain range in simple terms if we try to fit the model according to the training dataset it will sure be accurate but only for that particular dataset if we want our model to give better performance it is a best practice to train the model for generalized dataset and not only for the training dataset.

## 3. Algorithmic trading in forex

Much growth has been seen in the FOREX market since the use of algorithmic trading in FOREX. certain processes in trading have been automated reducing the time required in forex exchange transactions.

Automating such processes leads to less execution cost. Algorithms are nothing but the set of procedures or rules defined against certain criteria.

In the FOREX market, these algorithms contain the steps for the computer to follow in order to perform the transactions these processes are defined against the criteria such as cost, timing, a quantity that determine the trades [3]. There are various types of algorithmic trading in the FOREX market. The statistical algorithm trading is based on the time series analysis of historical data. To understand Auto-hedging let's quickly see what is hedging in the FOREX market when a trader opens buy trade as well as sell trade in the same currency pair in a way eliminating all the risks is called hedging. now auto-hedging is nothing but auto-generated steps or strategies to reduce this risk by defining steps (algorithm) to be taken by computer. According to the risk and cost of currency pairs in the market, it takes necessary actions as defined in the algorithm. Algorithmic trading has also caused great significance in spot contracts of forex where specific currency pairs can be purchased or sell with immediate delivery. Algorithms define the rules of transaction reducing the manual work involved before the 2000s. The option is another financial tool in the FOREX market that has been made easy through algorithmic trading, option can be understood with an example if a stock is trading at $50 and the trader thinks that it will go up to $60 trader can buy a "call" option of $55 for say 20 cents now if the stock rose to 60 dollars trader can buy that at 55 dollars even if its current market value is 60 gaining profit of $4.80. Now considering the same example if a stock is trading at $50 and you the trader thinks it will go down to $40, he might buy a "put" option of $45 for 20 cents. if the stock dropped to $40 that would allow the trader to sell it for $45 even if its value is $40 with a profit of $4.80. keeping track of all such transactions and all the calculations involved is tedious work for traders, algorithmic trading facilitates them to make all these transactions automatic making trades simpler.

**4. Natural language processing**

Natural language processing or NLP plays a significant role in FOREX trading. it is mainly used to understand the sentiment of the market through press releases on different social media platforms such as an official page of any news channel on Facebook, official accounts of such media sources on Instagram, their tweeter handles, and Twitter handles of politicians, ministers, etc. news or statements released by any such ministers, politicians, a businessman has a significant impact on the market and it is very crucial for traders to keep up with all the changes that are happening in various sectors while making decisions in trading. But due to the vast social media platforms, it is very difficult to keep track of all that is happening. In earlier days there were only a few sources of news such as T.V, radio, newspapers but now traders need the help of a machine-learning algorithm to make their task simple, let them keep track of all the news and impact of certain events on the market. This is where Natural language processing comes into the picture. for unstructured data such as data available on social media platforms contains many non-textual contents such as hashtags, mentions, emoticons, etc. In natural language processing, there are many libraries available to process this raw data which removes all non-textual content, punctuations then clean the data. now scores are assigned to this text-based data on the basis of each word, for example, words like hate, a loss will have a lower score resulting in negative sentiment whereas words like profit, growth will have a higher score resulting in positive sentiment. based on these values average score is calculated helping traders to understand the sentiment or depth of certain events, reactions of people on it, how it can all cause an effect on the market will it be positive or negative and what needs to be done in both scenarios, etc. many python libraries such as Vader, re module (regular expression), can be used in natural language processing.

**5. Technical analysis**

Technical analysis is one of the important pillars in forex trading alongside sentiment analysis i.e., natural processing and fundamental analysis where the natural language processing allows us to read the sentiment of the market while making the trade, technical analysis is the study of historical data.[5] here analysts study the historical prices, trends, patterns analyze them, and make the decision. charts are one of the most important tools of analyst, traders and by looking at the charts they analyze the patterns and can predict. now where can the market go from this point. though we use the term prediction technical analysis is more about probability. there are various techniques used in technical analysis such as Fibonacci retracement, it is a technique where the sequence of Fibonacci numbers and the relationship between those numbers is used for the retracement of the market. To understand this let us understand what the Fibonacci series is? it is nothing but a sequence of numbers starting from 0, 1 and each number after 1 is the addition of the previous two numbers for example 0,1,1,2,3,5,8,13,21,34,55,89..... here 0+1 is 1 then 1+1 is 2 and so on. now there is an important association between these numbers also known as the golden ratio, take any number let us take the number 89 then 89/89=1 take the previous number which is 55 and divide 55/89=0.61 then 34/89=0.38 then 21/89=0.23 these numbers 1, 0.61, 0.38, 0.23 are the golden ratio.[4] which helps traders determine the retracement of the market. let us understand these two terms Fibonacci and retracement together at this point we understand the Fibonacci series and golden ratio now retracement can be explained in simple terms as retracing the current direction or going in the opposite direction

i.e., if the market is going in an upward direction or say showing bullish trend it is bound to come down at some point when the downfall of the market starts golden ratio of Fibonacci series helps traders to predict till which point this downfall will continue or at which point the market will start going up again so that they can maintain their position in the market accordingly.

the same logic can be applied in reverse situations i.e., when the market is going down or showing a bearish trend and then it started going up again Fibonacci helps to determine to which point the market will go up, so that trader can act accordingly. This is one of the ways how historic data can be used to study the previous pattern of the market and form probabilities of the future.

**6. Fundamental analysis**

As we saw earlier technical analysis is more of a study of charts and historic data to predict the currency rate in the future, but now the fundamental analysis is more of a study of political events, countries internal economic affairs, crisis, and the effect of all this on that country's economy and currency value. If the country's economy is stable the investors and traders are more likely to invest in that country's businesses, increasing the supply-demand chain and value of the currency. for example, if U.S.'s economy is stable the investors around the world would more invest in the country's assets, businesses and also would like to set up their businesses for all this they need to buy U.S. dollars which in turn will increase the value of the dollar in comparison to other currencies. Now fundamental analysis includes studying all these political and economic events that are likely to impact the country's economy, currency value which will help traders to understand all the circumstances that are building up around the world so that they can predict how it will impact the economy, which country's economy will be stable, which one will collapse, which one will stay up from this they can conclude the currency value of the respective country, can predict investing in which currency will be profitable in near future.

**7. Random Forest**

Random Forest is the algorithm that can be profoundly used in fundamental analysis as we discussed, it includes the different aspect in the analysis and prediction like the economy, political affairs, crisis, strategies, and plans of the nation to make their economy stronger, the validity of their plan, market conditions and many more. When we have so many factors to be considered while performing the analysis it is best to have an algorithm that predicts an outcome based on ensemble learning. The ensemble can be explained in simple words as a methodology where we are generating multiple models on multiple samples of a large dataset and strategically forming the prediction by combining the solution of all the models. The random forest is, in fact, an ensemble learning algorithm, in which we form multiple decision tree models which are unrelated they are individual models which predict the individual outcome, then the outcome with the maximum votes is selected. in respect to the fundamental analysis, we cannot only rely on any one factor such as only on the economy of the nation or only on their currency value we need the best prediction in all those areas individually then after combining all these predictions we can form a strong and more reliable prediction. so, we don't have to worry about the varying conditions throughout the globe we can use the random forest to make this complicated analysis simple by including all the factors in calculating individual prediction for each factor, through multiple decision tree models. And then combining them to form one random forest model which will lead us to the best of the best prediction. In the regression random forest model, all predictions of multiple decision tree models are being average out to form a final prediction. And in classification, random forest model predictions are classified in different classes and the class with the majority becomes the final prediction.

**8. Neural Networks in forex trading**

To understand how a neural network works in forex let us understand what is the neural network and how it works? for better understanding let's divide this topic into three parts 1) a basic understanding of neurons 2) neural network(deep learning) 3)Application in forex trading.

1) a neuron is the basic component of a neural network its working is inspired by the working of neurons in the human brain. this neuron takes multiple inputs and multiplies each input with respective weights this will magnify or reduce the certain input in accordance with the task for which we are training the model then pass it to a special type of function (activation function) which aggregates the sum value [6].

Such as y=f (x1*w1 + x2*w2....).

2) Now the neural network is nothing but the combination of multiple such neurons working together. In addition to the input and output layer, one or more layers are included known as the hidden layers.

we pair each input with adjustable weights, these weights are adjusted according to the performance of the model in classification or clustering. the output of each layer works as the input to other increasing the precision at each layer, it can be put in a simple term as learning from the mistakes of previous layers rectifying and improving the output as we go through the network. In technical terms, this happens by calculating the loss function which calculates the difference between true output and the predicted output. according to this, we make certain adjustments in training the model to make more accurate predictions. When we have multiple layers of input, output, and hidden layers we collectively call it deep learning [7].

each layer in the network gets to train on the output of its previous layer as they sum up and aggregate input at each layer, the deeper you go into the network the more complex features get introduced, training the model up to this precision of complexity not only increase the probability of precise prediction but also increase the ability of the model to deal with complex data.

3) In the forex market while making predictions on any trade it is important to consider many factors. it is more than just time series analysis of historical data or analyzing the sentiment of the market, it takes multiple such analysis to predict more accurately. Making predictions while trading is in itself a complex decision as it depends on the number of factors affecting the situation in the market simultaneously.

Therefore, there is a need for a model which can handle complex and large data with various attributes to make the prediction. Neural network in forex prediction can deal with pattern recognition, analyses of historical data, sentiments, and many such complex data to make the collective sense of all the features to help traders make more accurate predictions.

**Conclusions**

In this paper, I have tried to elaborate machine learning algorithms and techniques which are currently in action in the forex market with simple terms and examples avoiding complex math and equations.

In the conclusion to this paper, I would like to mention some of the key points which I learned during the research on the subject first one is when you are dealing with large sets of data for analysis machine learning is your friend, the more the data you feed to the model the more accurate results it predicts but these models never come with 100

percent accuracy as there is no such thing while training the model we can train it for that particular dataset and get 100 percent accuracy out of it but then the model will be good enough only to that dataset not for any different data sets, so we have to take in that error factor while training the model in a nutshell instead of creating the model which gives 100 percent accuracy for one particular dataset and fails to perform when introduced with new data sets we must train the model to give let say at least 80 percent accuracy for all the datasets, we should train it for generalized data. as these models don't predict results with 100 percent accuracy traders, analysts cannot rely on them blindly they have to be very vigilant while forming the decisions based on the predictions of any ML model, they must always verify it by using their expertise, knowledge, and then proceed.

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