

FOREX meet A.I.^{*}

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Abstract

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1. Introduction

People are involved more and more in trading of currencies these days. Amongst those markets, of the biggest buying and selling platforms are cryptocurrency trading and the FOREX marketplace. Although cryptocurrency promises better returns than foreign exchange, FOREX gives solid, especially secured, and relatively regulated trading in comparison to cryptocurrency trading. As a result, in latest years, the foreign exchange (FOREX) market has attracted pretty a lot of interest from researchers all over the world. Different kinds of studies have been performed to accomplish the task of predicting future FOREX currency prices accurately.

Researchers have been involved primarily in neural networks models, pattern-based approaches, and optimization techniques. The emergence of artificial neural networks performed a massive function in foreign exchange rate prediction. During our evaluation of related works, we discovered that many deep learning algorithms, such as gated recurrent unit (GRU) and long short term memory (LSTM), have been explored and exhibit massive potential in time sequence prediction.

The foreign exchange market, is the world's largest foreign money trade market with over 5.1 trillion of trade exchange per day. It is recognized to be very complicated and volatile. Currency trading occurs 24 h a day, however the buying and selling time is divided into 4 fundamental time zones. Each of these zones has its specific opening hours and closing hours. FOREX is divided into three specific categories: majors, cross-rates, and exotics. Majors are the most traded currencies which are priced in opposition to the USD and occupy the majority of the FOREX market. Our work is primarily based on Majors.

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Each forex pair has its opening price, highest price, lowest price, and closing price based on the trading session. For security reasons, it is now not possible for one person to at once go to, register with, and purchase from the FOREX market, but each individual needs to use third party like brokers, who are humans or corporations that have admission to the FOREX market and are capable to buy or sell currencies. In the FOREX market, solely two alternatives are available, either buying currencies or selling if they have brought any currencies previously.

Recent years have viewed a lot of researches in the FOREX market foreign money rate prediction. Predicting the FOREX market has been a key goal of investigators over the preceding couple of decades. There are two methods to forecast the market: undamental research and technical research. Fundamental research considers many factors, such as the financial system and political state of a country, the popularity of a company, all inner and exterior buying and selling news, etc. Technical research concentrates predicting the FOREX market based totally on historic data, in particular, the highest price, lowest price, opening price, and closing price of a currency and the volume traded on a particular day.

The remainder of the paper is arranged as follows.

2. Related Works

Numerous hybrid techniques have been examined in preceding years. Based totally at the papers we reviewed, according to the principle set of rules the studies prioritised, the papers can be cut up into going in conjunction with the following categories: regression strategies, optimization strategies, neural networks, and others. Those classes had been made in keeping with the popularity of the principle method of the forecasting system in the past years.

2.1. Regression Methods

Raimund et al. [1] proposed a hybrid model for foreign exchange prediction that makes use of wavelet models along with support vector regression (SVR). Before everything, they used a discrete wavelet transform (DWT) technique to interpret facts from their forex dataset. Then the data were used as the input of support vector regression (SVR) for predicting the foreign exchange prices. They analyzed the overall performance of their system with ARIMA and ARFIMA models. The effects confirmed that their system performs higher than ARIMA and ARFIMA models.

Taveeapiradeecharoen et al. [2] proposed a version for time series inspection and prediction; this is based on compressed vector autoregression. At the start, they used random compression method to decrease a big wide variety of foreign exchange data into a smaller form. After that, they used the Bayesian model averaging (BMA) approach to establish the load of each random compressed datum to attain the intersecting parameters. Their approach can provide out of sample forecasting till fourteen days previous to the real time. They rconcluded that their system was not suitable to predict all of the 30 forex currencies. Their proposed study outperformed the existing benchmark of Bayesian autoregression for specific 6 foreign money pairs.

A huge range of forecasting models have been proposed via the authors of the paper [3], by applying linear kernel SVR to hostorical data for EUR/USD, GBP/USD,

and USD/JPY currency pairs received from high-frequency trading. Previous successive timeframes are used as features to predict the movement of rates in future/next time frame. Upon building models, they found a easy rule that supplied high-quality results.

70 After reviewing recent papers, it's evident that support vector regression turned into the most used approach included in our reviewed papers. Compressed vector autoregression, the CRT regression tree, and partial least squares regression had been additionally utilized by researchers. However, there are different algorithms which include lasso regression, logistic regression, and multivariate regression which have been abandoned in
75 later years. The reviewed literature shows that the system primarily based on a regression model performed higher than ARIMA and ARFIMA models [1], and the model performance may additionally growth [4] when a regression model is combined with other techniques. However, when operating with a huge number of foreign money pairs, it is able to become hard with regression techniques, as most of the currency pairs return a
80 higher MSE [2].

2.2. Optimization Techniques

Chandrinou et al. [5] proposed a technical system for FOREX that was stimulated by using the Donchian channel method. the primary reason in their method become to create profitable portfolios for FOREX buying and selling strategy. They first constructed the modified Renko bars (MRBs) via combining their trading guidelines. Their
85 changed MRBs proved to be more correctly responsive than the normal candlesticks used in FOREX. They created an optimization level used by eight currency pairs. To acquire their optimization stage, they used three search-derivative-free global optimization strategies. These algorithms were the swarm optimization algorithm, also referred to as dividing a hyperrectangle (DIRECT), along side multilevel coordinate search (MCS), and pity beetle (PBA). They examined their optimization method and primarily based on the total return they built two kinds of portfolios: an equally weighted portfolio and a Kelly criterion-based portfolio. They evaluated the performance in their approach primarily based at the geometric return, arithmetic mean, and Sharpe ratio. They found
95 out that the proposed version isn't always suitable for three currency pairs, whilst for the others they attain from 29% until over 200% general return.

Pradeepkumar et al. [6] advised a model for foreign exchange prediction that became primarily based on a quantile regression neural network (QRNN) and particle swarm optimization. They used PSO to train the QRNN and named the version PSO-QRNN.
100 They used 8 pairs currencies. They used seven unique algorithms for the overall performance evaluation of their model: group method of data handling (GMDH), multilayer perceptron (MLP), random forest (RF), a quantile regression neural network (QRNN), generalized autoregressive conditional heteroskedasticity (GARCH), quantile regression random forest (QRRF), and a general regression neural network (GRNN). Once they executed the Diebold–Mariano (DM) evaluation check on all of the test results, they found that their proposed PSO-QRNN version completed higher than all models on datasets. For the rest of the datasets, QRRF and QRNN carried out better than other approaches.

Das et al. [7] proposed a hybrid approach that turned into build the use of extreme learning machine's on-line sequential version and krill herd (KH). The krill herd (KH)
110 was devoted to features reduction. They compared their proposed system with a recurrent backpropagation neural network (RBPNN) and extreme learning machine (ELM). They considered 3 elements: (i) without features reduction (ii) with statistical features

reduction, and (iii) with optimized features reduction strategies. For optimized features reduction strategies, they used bacteria foraging optimization (BFO), krill herd, and particle swarm optimization techniques. They used four foreign currency pairs. For RMSE their approach performed first-class. However, in MAE overall performance, their proposed model didn't provide the satisfactory effects.

For foreign exchange buying and selling approach optimization, a genetic set of rules become employed by the authors of the paper [8] to evolve a various set of profitable buying and selling rules based totally on weighted moving average approach. They used a time series with 4147 observations inside a range of sixteen years from 2000 to 2015 and they used the close prices of four foreign money pairs. Developed approach yields acceptably high returns on out-of-sample data. The rules acquired using their genetic algorithm result in appreciably better returns than the ones produced by exhaustive search.

In conclusion, these techniques are not appropriate for all currency pairs and may provide better effects for only a few randomly selected ones, as we can see inside the proposed papers.

2.3. Neural Network

2.4. Rest of the Methods

3. Preliminaries

3.1. Trading System: Meta Trader 5

3.2. Technical indicators

In our trading system, XX technical indicators are used as the basis of trading rules. These technical indicators are: Adaptive Moving Average, Average Directional Moving Index, Bollinger Bands, Double Exponential Moving Average, Envelope Moving Average, Parabolic SAR, Fractal Adaptive Moving Average, Standard Deviation, Triple Exponential Moving Average, Average True Range, Bears Power, Bulls Power, MACD (Moving Average Convergence Divergence), Stochastic oscillator, William' Percentage Range, Momentum, RSI (Relative Strength Index), and Heiken Ashi Candles.

3.3. Genetic Algorithm

The unstable and chaotic structure of exchanges in FX market complicates forecast analysis. This leads to the utilization of optimisation methods. There are many heuristic methods, such as genetic algorithm (GA), simulated annealing (SA), etc. to resolve optimisation problems. GA is one of the most popular heuristic optimisation approach that generates options which evolve in time. GA is based totally on evolution and genetics. Heuristic strategies yield nearly but not necessarily optimal solution with reasonable computational effort and time.

Genetic algorithm refers to the heuristic algorithm, which offers an acceptable answer to the hassle in the majority of virtually practically significant cases, however the correctness of the decisions has no longer been tested mathematically, and is used most frequently for problems, the analytical solution of which is very hard or even impossible.

Heuristic algorithms are extensively used for solving problems of high computational complexity, alternatively of going via all of the options, which takes up a considerable quantity of time.

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4. Trading Strategies

5. Filippo Experiments

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