

Evaluation of algorithmic strategies for trading on foreign exchange market

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Abstract - The Foreign Exchange market (Forex or FX) is the largest financial market. A trading strategy represents a set of instructions which advise or perform opening (entry) or closing (exit) trading positions based on the results of technical analysis. A trading strategy allows to exclude randomness in the trading process, it granites strict following defined rule out the emotional factor in the trade. Simulations on historical data can provide preliminary information about expected performance of trading strategy on live market. Simulation helps to determine does strategy is doing what it was intended to do, also it provides preliminary estimations of possible profit and risk levels before using it on live market. All trading strategies are going to have losing trades. Optimizations are performed to help to select parameter values that correspond to optimal strategy performance based on historical data. During optimization, a trading strategy is run several times with different sets of parameters trying to maximize obtained profit, minimize of losses, reduce risk of trading (drowdowns), find optimal number of trades, increase expected payoff factors, etc.

I. INTRODUCTION

The Foreign Exchange market (Forex or FX) is the largest financial market. Unlike other financial markets, the Forex market has no physical location or central exchange location. It is an market where buyers and sellers including banks, corporations, and private investors conduct business. The Foreign Exchange market is available 24-hour, trading begins each day in Sydney, and moves around to Tokyo, London, and New York. That allows investors to respond to currency fluctuation caused by economic, social and political events at the moment they occur. Traders obtain gains on basis these fluctuations according with a known principle “buy cheaper, sell higher”. The major currencies on foreign exchange market are US dollar (USD), euro (EUR), Japanese yen (JPY), British pound (GBP), Australian dollar (AUD), Canadian dollar (CAD), and the Swiss franc (CHF). The major currencies pairs are: EURUSD, USDJPY, GBPUSD, AUDUSD, USDCHF and USDCAD^[1].

II. ANALYSIS OF FINANCIAL MARKET

There are two basic approaches for analyzing the currency market: fundamental analysis and technical analysis. The fundamental analysis is focused on the causes of price movements (economic, social and political news and information), while the technical analyses studies the price movements themselves^[6]. If fundamental and technical analyses are used parallel one another conclusions could be opposite. Technical analysis is based on the following three axioms:

- market movement considers everything;
- the prices move with the trend;
- the history repeats itself.

Technical analysis is based on assumption that any factor influences the price, whether economic, political, or psychological, has already been taken into account and reflected in the price chart. Every price change is caused by a change in external factors. Second assumption is that the price movement is a result of a trend. The implies that the current trend will most likely continue, excluding disorderly chaotic movement of the market, price on market will follow current trend until the opposite trend are established. Third assumption is that models that worked in the past, will probably work in the future. That is based on human psychology which remains almost unchanged over years^[1].

Technical analysis is research of market dynamics with the purpose of forecasting future price development, which is done by charts and technical indicators. Technical indicator is a result of mathematical calculations based on current price, previous prices and/or volumes, figure 1. The values of technical indicators are used to forecast probable price changes. Technical indicators could be classified on oscillators, indicators of trends and volumes.

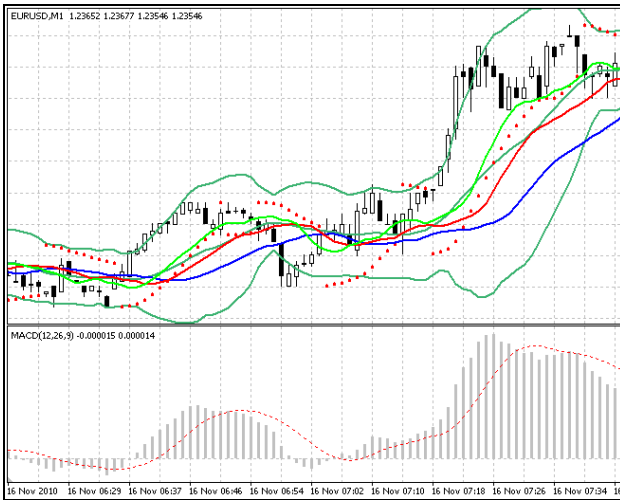


Figure 1 – Chart with technical indicators

Oscillators are: Average True Range, DeMarker, Envelopes, Force Index, Ichimoku Kinko Hyo, Momentum, Moving Average Convergence/Divergence (MACD), Moving Average of Oscillator, Price Rate of Change (ROC), Relative Strength Index (RSI), Relative Vigor Index (RVI), Stochastic Oscillator, Ultimate Oscillator, Williams' Percent Range.

Trends indicators are: Average Directional Movement Index (ADX), Accumulation Swing Index, Bollinger Bands, Commodity Channel Index (CCI), Mass Index, Moving Average (MA), Pivot Points Support and Resistance Lines, Parabolic SAR, Standard Deviation, ZigZag, Williams' Accumulation/Distribution.

Technical indicators for tracking changes in Volumes are: Accumulation/Distribution (AD), Money Flow Index (MFI), On Balance Volume, Price and Volume Trend, Volume Rate of Change).

Trading on Foreign Exchange market is conducted through the client terminal such as MetaTrader, VT Trader, etc. Terminal provides the necessary tools for trading, analyzing price dynamics. The terminal represents the all-in-one concept and combines necessary tools for trade in the financial markets. Client terminal sending orders to a broker server's to execute a deal with specified parameters. Broker server checking orders (correctness of prices, availability of funds on the account, etc.), figure 2.

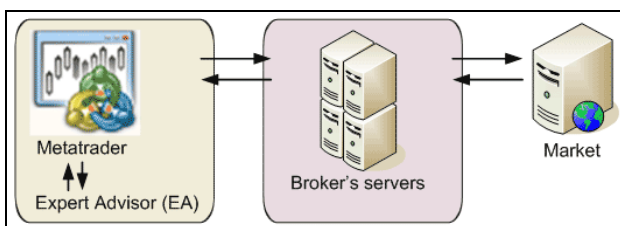


Figure 2 - Client terminal, Broker's server, financial market

III. ALGORITHM STRATEGIES FOR AUTOMATED TRADING

A trading strategy represents a set of instructions which advise or perform opening (entry) or closing (exit) trading positions based on the results of technical analysis. A trading strategy allows to exclude randomness in the trading process, it granites strict following defined rule out the emotional factor in the trade. All trading strategies have three major components: entry and exit, risk management, position sizing. Condition for activate entries and exits of trade can be very simple or in same cases very complex. It can be filtered by one or many different elements. An entry can be at a specific price level or it can be triggered at the specific combination on values of technical indicators. A trading strategy can have more than one entry or exit, also parameters used for define condition for enter a trade could be entirely unrelated with parameters used for define condition for exit. Rules that open position in buy or sell directions are usually opposite of each other^[2,3].

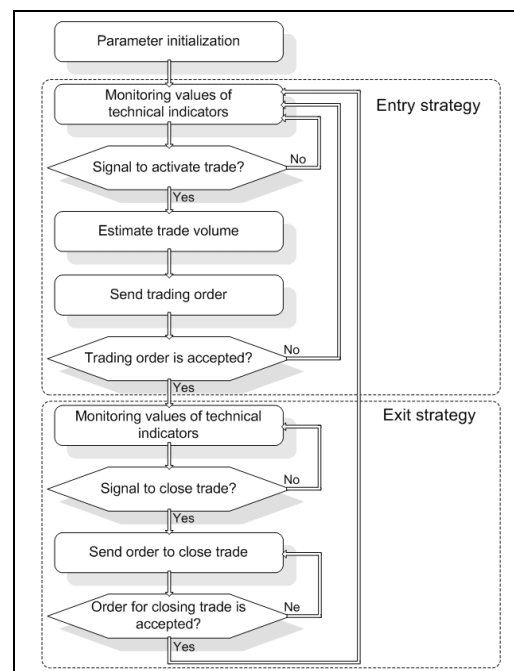


Figure 3 – Structure of Expert Advisor

Client terminal MetaTrader5 enables automated trading. It contains MQL5 built in object-oriented programming language. Syntax of MQL5 is similar of C++, it contains a large number of functions and procedures necessary for access to broker servers, analyzing quotes, monitoring technical indicators and for managing positions. Expert Advisors (EA) are programs developed in MQL5 programming language; they are used for market analysis and automatic trading. Expert advisor manage trading activities on basis of received signals, figure 3. Expert Advisors releases traders from the routine market watching and manually execution of trade operations. A trading strategy can open positions with a fixed size for each position, or size of invested amount could be estimated for each position according to some rule. Performance of trading strategies without algorithm for position sizing strategy could be suboptimal^[5].

IV. THE DEVELOPEMET OF THE TRADING STRATEGIES

For development a trading strategy is recommended to follow next steps^[6]:

1. formulation,
2. specification trading rules, development software model,
3. preliminary testing (simulations on historical data),
4. parameter optimization (selection optimal trading strategies, most robust and highest profit, lowest level of risk, etc),
5. evaluation of performance and robustness (walk-forward analysis),
6. running trading of the strategy in real market,
7. monitoring of trading performance (compare real results with results of simulations),
8. evaluation and improvement.

Development trading strategy begins with ideas and observations about behavior of historical market, and implementing them into a trading system. All trading strategies are going to have losing trades. Losses can occur one at a time or in series. All trading strategies have different forms of risk. Risk management can not eliminate losses. Main purpose of risk management is to limit losses and keep it under anticipated and affordable boundaries. Risk management is to limit losses so that strategy can continue with trading even after series of trade that ended with losses or after large drawdown. The maximum drawdown is the largest drop in equity measured from account. Maximum drawdown is widely considered to be one of the best measures of the overall risk of a trading strategy. It is recommended that trading strategies contain methods for managing risks.

V. EVALUATION OF PERFORMANCE TRADING STRATEGIES

Simulations on historical data can provide preliminary information about expected performance of trading strategy on live market. This simulation helps to determine does strategy is doing what it was intended to do, also it provides preliminary estimations of possible profit and risk levels before using it on live market^[4]. A strategy tester is one of components of the client terminal MetaTrader. It is a multi-currency tool, which allows performing simulations and optimizations of trading strategies (Expert Advisors) before using them in live trading. During simulations, an Expert Advisor runs on historical data. Performances of Expert Advisor can be evaluated by following parameters:

- amounts of money: withdrawal, gross profit, gross loss, total net profit, profit factor, expected payoff, recovery factor, sharpe ratio;
- risk factors such as: balance drawdowns (absolute, relative and maximal), equity drawdowns (absolute, relative & maximal);

- trades during simulation: total trades, short trades (won %), long trades (won %), trades with profit (% of total), trades with loss (% of total), largest profit trade, largest loss trade, average profit trade, average loss trade, maximum consecutive wins(\$), maximum consecutive losses(\$), maximal consecutive profit(count), maximal consecutive loss(count), average consecutive wins and average consecutive losses.

VI. OPTIMIZATION OF THE TRADING STRATEGIES

Strategy optimization represents process of searching for optimal parameters for predefined criteria. During optimization, a trading strategy is run several times with different sets of parameters which allow selecting their best combination. Goals of optimization can be: maximize obtained profit, minimize of losses, reduce risk of trading (drawdowns), find optimal number of trades, increase expected payoff factors, etc.

Optimizations are performed to help to select parameter values that correspond to optimal strategy performance based on historical data. Optimization systematically goes through all potential combinations as it searches for the solution with the highest results on selected criteria. For optimization trading strategies could be used Strategy tester (one of MetaTrader's modules), also for analysis of financial data and searching optimal trading parameters could be used neural networks, data mining and evolutionary methods^[7,8,9,10,11,12,13].

Strategy tester enables visually presentation of results of optimization as^[14]:

- A Graph with Results, figure 4;
- A Line Graph (1D), figure 5;
- A Planar Graph (2D), figure 6;
- A Three-Dimensional Graph (3D) , figure7;

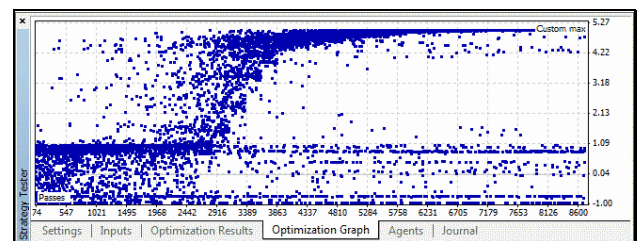


Figure 4 – optimization results shown as a graph with results

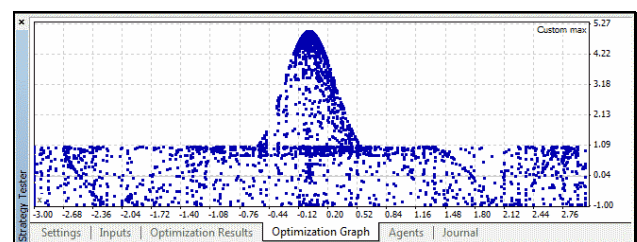


Figure 5 - optimization results shown as a line graph (1D)

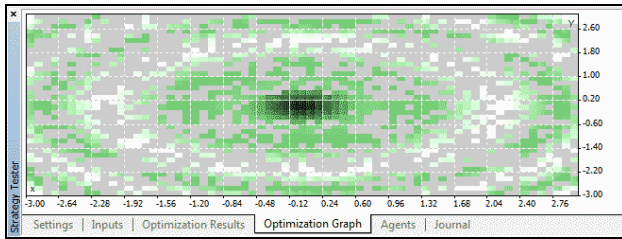


Figure 6 - optimization results shown as a planar graph (2D)

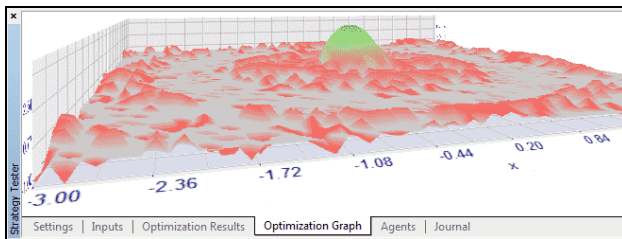


Figure 7 - optimization results shown as a three-dimensional graph (3D)

VII. CONCLUSION

Automatic trading software speeds up the process of trading on foreign exchange market, it allows monitoring a large number of parameters and make decisions in real time. Software trading methods reduce the impact of human emotions in decision making process and allow to overcome problems that may arise due to lack of concentration. Modern technology, software, and real-time information does not guaranty successful trading results. Technology provides more information and a faster process of trading, however, for successful trading results is still necessary to find an appropriate approach how to use of available information and how to make correct decisions.

REFERENCES

- [1] Ilić V. (2011) "Automatic trading on foreign exchange market – development software for automatic trading and analysis of financial data", 318 pages, ISBN 978-86-914311-0-5, http://SOLAIR.EUnet.rs/~ilicv/automatsko_trgovanje.html
- [2] Aldridge I., (2010) "High-Frequency Trading - A Practical Guide to Algorithmic Strategies and Trading Systems", John Wiley & Sons, Inc., Hoboken, New Jersey, ISBN 978-0-470-56376-2
- [3] Miner R. C., (2009), "High Probability Trading Strategies - Entry to Exit Tactics for the Forex, Futures, and Stock Markets", John Wiley & Sons, Inc
- [4] Pardo R., (2008), "Evaluation and Optimization of Trading Strategies", John Wiley & Sons, Inc.
- [5] Ilić V., (2010) "The structure of software for automated trading on foreign exchange market", eTrade - X International Conference on electronic commerce and electronic business, Palić, <http://www.etrgovina.org/novosti/2010-prvi-dan-program-konferencije/>
- [6] Ilić V., (2010) "Methods for analysis of financial data and development of algorithmic strategies for automated trading", InfoM no 34 – Journal of Information Technology and Multimedia Systems, pp. 30-34, Belgrade, <http://scindeks.nb.rs/article.aspx?artid=1451-439710340301>
- [7] Brabazon A., O'Neill M. (2006), "Biologically Inspired Algorithms for Financial Modeling", New York: Springer-Verlag
- [8] Zhang P., (2004) "Neural Networks in Business Forecasting", Idea Group Publishing, ISBN:1591402158
- [9] Ilić V., (2000): "NeuroVCL components for Delphi", Seminar on Neural Network Applications in Electrical Engineering "NEUREL 2000", Belgrade, Sponsored by IEEE Signal Processing Society, pp 130-134, IEEE Catalog Number 00EX278, ISBN 0-7803-5512-1 (Softbounded Edition), ISBN 0-7803-5512-X (Microfishe Edition), Library of Congress: 99-60930, http://solair.EUnet.rs/~ilicv/NeuroVCL_eng.html
- [10] Ilić, V. (2000): "Force learn algorithm – training neural networks with patterns which have highest errors", Seminar on Neural Network Applications in Electrical Engineering "NEUREL 2000", Belgrade, Sponsored by IEEE Signal Processing Society, IEEE Catalog Number 00EX278, pp 46-48, ISBN 0-7803-5512-1 (Softbounded Edition), ISBN 0-7803-5512-X (Microfishe Edition), Library of Congress: 99-60930, http://solair.EUnet.rs/~ilicv/FLAlg_eng.html
- [11] Hand P., Mannila H., Padhraic S., (2001) "Principles of Data Mining", The MIT Press, ISBN: 026208290x
- [12] Ilić V., (2009) "Integration of Agents and Data Mining in Interactive Web Environment for Psychometric Diagnostics", Chapter 17 in edited book: Data Mining and Multiagent Integration, Longbing Cao (Ed.), Springer, ISBN: 978-1-4419-0521-5, 15 p., <http://www.springer.com/computer/database+management+&+information+retrieval/book/978-1-4419-0521-5>
- [13] Ilić V., (2002): "Evolutionary Neuro Autonomous Agents", Neurel 6th - Seminar on Neural Network in Electrical Engineering, pp 37-40, IEEE Catalog Number 02EX609, ISBN 0-7803-7593-9, Library of Congress: 2002108419
- [14] Unknown, (2011) "MetaTrader 5 user guide", MetaQuotes Software Corp.