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MATHEMATICAL ALGORITHMS AND MODELS AT TRADING AS AN EXTENSIVE PART OF DIGITALIZATION IN THE INDUSTRY

The process of trading has many steps in between buying and selling. Nowadays it is two main positions on how to do it. The first, manually by experts as it was done before. The second is to make it automatically based on Machin Learning (ML) technologies. Both methods have some pros and cons. For example, some of the main sets for trading can be done in both ways. Here will be shown the difference between those methods, analysis of both of them and shown that ML method can be the same effective or even more.

A manual trader makes their own buy and sell decisions and enters trades into a trading system by hand without the use of computerized algorithms. It makes a difference with traders who use trading software or develop their own for the same result.

Consider the basic settings for trading and ways to implement them.

Backtesting has to be performed constantly. It helps to eliminate unequivocally losing strategies. Moreover, backtesting can be done manually or automatically. It is often much faster to enter data manually in Excel than to apply a software implementation, especially if using algorithms is not provided. Although, exist a great choice of different tools. Almost all terminals have their own tools for it. For instance, Tradingview has Pinescript, Python has special libraries, etc.

Let us review frequently used Python backtesting libraries. They are examined in terms of flexibility, it means, if it is possible to use for backtesting, paper-trading as well as live-trading, good documentation, and structure, scalability (speed, simplicity, and compatibility with other libraries).

Zipline: This is an event-driven backtesting framework used by Quantopian. It has a great community, good documentation, great support for Interactive Broker (IB), and Pandas integration. The syntax is clear and easy to learn. It has many examples. If the main goal is trading of US equity, then this framework might be the best candidate. Quantopian allows one to backtest, share, and discuss trading strategies in its community. However, Zipline is extremely slow. This is the biggest disadvantage of this library. Quantopian has some workaround such as running the Zipline library in parallel in the cloud. Zipline also seems to work poorly with local files and non-US data. [2]

PyAlgoTrade: This is an event-driven library, which is active and supports backtesting, paper-trading, and live-trading. It is well-documented and also supports TA-Lib integration (Technical Analysis library). It outperforms Zipline in terms of speed and flexibility. However, one big drawback of this library is that it does not support Pandas-object and Pandas modules. [2]

Pybacktest: Vectorized backtesting framework in Python that is very simple and light-weight.

TradingWithPython: Jev Kuznetsov extended the pybacktest library and build his own backtester. The documentation and course for this library are not free.

Stop-loss is a fundamental set. Without that, it is impossible to calculate risk-reward and volume of work for the entry price. Besides, risk-reward and win-rate are main for setting trading performance. Stop-loss sets according to trader`s strategy with using of either averages or local low, or some needed level (or zone), or main trend, etc. Ta-lib can be used for recognizing some patterns. The difference between it and the trailing stop is that the last one is not constant; it can change with increasing or decreasing price. So improving the margin of stop-loss will increase the win-rate of the trader`s strategy, it will reduce the size of its position. Smaller positions sizes mean smaller profit in the long term. Obviously, long-term profit is the main point of algorithmic-trading. [3]

Advantage algorithmic trades. It is mainly used by institutional investors and big brokerage houses to cut down on costs associated with trading. According to research, algorithmic trading is especially beneficial for large order sizes that may comprise as much as 10% of the overall trading volume. [4] Typically market makers use algorithmic trades to create liquidity.

Algorithmic trading also allows for faster and easier execution of orders, making it attractive for exchanges. In turn, this means that traders and investors can quickly book profits off small changes in price. The scalping trading strategy commonly employs algorithms because it involves rapid buying and selling of securities at small price increments.

Disadvantage algorithmic trades. The speed of order execution, an advantage in ordinary circumstances, can become a problem when several orders are executed simultaneously without human intervention. Liquidity is created through rapid buy and sell orders can disappear in a moment, eliminating the change for traders to profit off-price changes. It can also lead to instant loss of liquidity. Research has uncovered that algorithmic trading was a major factor in causing a loss of liquidity in currency markets after the Swiss franc discontinued its Euro peg in 2015. [5]

In conclusion, ML is a tool that allows predicting futures stock prices given past prices. According to efficient market hypothesis, the stock market is random and unpredictable. However, major financial firms like JPMorgan and Goldman Sachs at trading using predictive models on past market data. Features we can incorporate into financial models: sentiment analysis on company opinions, past stock prices, sales growth, dividends. Changes in stock prices are not completely random but very close to it. Therefore, it is a good idea to use predictive models as a tool when deciding where to invest.

Literature:

1. https://www.investopedia.com/terms/t/trade.asp
2. https://robusttechhouse.com/python-backtesting-libraries-for-quant-trading-strategies/
3. https://jesse.trade/blog/tutorials/4-practical-methods-to-set-your-stop-loss-when-algo-trading-bitcoin
4. Ian Domowitz and Henry Yegerman. "The Cost of Algorithmic Trading: A First Look at Comparative Performance," Pages 1-2. Accessed Oct. 26, 2020. https://www.researchgate.net/publication/237547529_The_Cost_of_Algorithmic_Trading_A_First_Look_at_Comparative_Performance
5. Bank of England. "Judgement Day: Algorithmic Trading Around the Swiss Franc Cap Removal," Pages 24-25. Accessed Oct. 26, 2020. https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2018/judgement-day-algorithmic-trading-around-the-swiss-franc-cap-removal