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Quality Assurance on Algorithmic Trading Strategies

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Abstract The US Equity and Fixed Income Markets have experienced sweeping changes in market microstructure, rapid growth in algorithmic trading, and a large shift to electronic trading. With increased automation and advances in technology, algorithmic trading also needs to become more efficient and correct. Role of Quality Assurance Engineers plays an important role in ensuring any new Algorithmic trading strategy introduced into the system is effective, bug free and performs according to Business requirements. This paper discusses different testing that should be done to test algorithmic trading strategies, specifically scenarios to be tested for Trailing Stop strategy.

Keywords Algorithmic Trading Strategies; Quality Assurance; Trading Strategies; Test Scenarios; Trailing Stop.

1. Introduction

With everything being moved to automation and machine learning playing a significant role, financial markets and trading are no exception. Traders want sophisticated trading systems with efficient algorithms to execute their trades. Algorithmic Trading is one classic example where computer programming combined with financial markets is used to execute trades at precise moments. From a technological standpoint, you can't get a more complex environment than a trading environment. It must work correctly and efficiently. A small fault in the algorithms can lead to losses of millions of dollars, regulatory fines, reputation loss, etc. So, it becomes very important that any new algorithm developed or upgraded on the existing trading algorithm strategies is thoroughly tested before being deployed to the Production environment.

Regulators have started to recognize the value of algorithmic trading in the marketplace, but there is still concern about its safety and market risks caused by rogue algorithms. Regulators are trying to create rules and obligations regarding algorithm building, testing and deployment which could help prevent financial disasters and ensure that trading algorithms are safe and reliable [1].

This paper gives an overview of Algorithmic Trading strategies, role of Quality assurance on developing efficient strategies and discusses the test scenarios to be considered to be tested for one of the algorithmic trading strategies – Trailing Stop.

2. Overview on Algorithmic Trading Strategies

As the trading environment has become more competitive, the development of algorithms for financial trading and forecasting is rising in popularity. Investors have turned to efficient Algorithmic Trading (AT), which is also called Automated Trading, black-box trading or algo trading. Algorithmic Trading is the process of using computers which execute a defined set of instructions to place orders to generate profits with speed and frequency impossible for a human to achieve [2]. Algorithmic trading uses complex mathematical models with human oversight to make decisions to trade securities. This has provided investors with many benefits such as more control of decisions, higher degree of execution efficiency, and accompanying anonymity which helps reduce transaction costs and information leakage.

Every trader identifies effective algorithmic trading strategies with arbitrage opportunities to earn more profits and reduce cost-plus pricing. Any good strategy for algorithm trading must aim to improve trading revenues and cut costs of trading. Most popular different types of Algorithmic Trading Strategies that are frequently used are Market Order, Limit Order, Iceberg Order, Stop Order, Trailing Stop, Market-Not Held and Momentum Strategy.

3. Quality Assurance on Algorithmic Trading Strategies

Quality assurance (QA) on algorithmic trading strategies is crucial to ensure their effectiveness, reliability, and compliance with regulatory standards. Below testing activities can be performed on Algorithmic trading strategies to ensure a defect free strategy into Production.

Requirement Analysis: Understanding the objectives, constraints, and desired outcomes of the algorithmic trading strategy under test.

Data Preparation: In order to effectively test an algorithmic trading strategy, QAs need to have the right set of data. The right set of data for any algorithmic strategy includes the most commonly used data points that will be used for algorithmic trading strategy under test that reflects market conditions and incorporates relevant factors such as transaction costs, slippage, and liquidity constraints. Also, the boundary value data when the transition to execute the strategy or not is considered.

Backtesting: Backtesting means the process of testing a trading strategy on historical data to assess its accuracy. Technical traders often use this to test the trading strategies to find how it is likely to perform in the real market [3].

Backtesting looks at the performance of a strategy relative to many different factors. Successful backtesting shows traders a strategy that's proven to show positive results historically [4].

Stress Testing and Resilience: Perform stress testing and scenario analysis to evaluate the strategy's resilience to extreme market conditions, such as market crashes, volatility spikes, or liquidity shocks. Assess the strategy's performance and behavior under various stress scenarios to identify vulnerabilities and mitigate potential risks.

Compliance Testing: Testing Algorithmic Trading Strategies also requires testing the trade flow execution as well, which includes testing downstream systems to test compliance with regulatory requirements, including trade reporting, market manipulation rules, and best execution practices.

Performance Testing: Adding Algorithmic Trading Strategies means trades happening at a very fast pace when trigger point/ price is met according to Algorithmic Trading conditions. There could be multiple trades happening within a span of seconds. QAs need to ensure system data lags/ low latency in order execution to ensure performance of the system is not hit. Implement monitoring and surveillance tools to monitor the performance and behavior of the algorithmic trading strategy in real-time. Monitor trading activity, order execution, and portfolio metrics to identify any deviations from expected behavior and take prompt corrective actions if necessary.

By implementing robust QA processes for algorithmic trading strategies, trading firms can enhance the reliability, effectiveness, and compliance of their strategies, leading to better investment outcomes and reduced risk of financial losses.

4. Testing on Trailing Stop Trading Strategy

Trailing stops are orders to buy or sell securities if they move in directions that an investor considers unfavorable [5]. A Trailing stop is a popular stop-loss that automatically adjusts the stop price based on the movement of the market price of a security. For a long position, an investor places a trailing stop loss below the current market

price. In this case, Trailing Stop Price only moves up or remains at the same Price, if Market is falling. This means, if the price of a security is rising, the stop price will trail behind it to the specified value and will always keep those increasing profits. Similarly, for a short position, an investor places the trailing stop above the current market price. In this case, Trailing Stop Price only moves down or remains at the same Price, if Market is rising. This means, if the price of a security is falling, the stop price will trail behind it to the specified value.

Trailing stops are commonly used by traders and investors to protect profits and limit losses while allowing for potential further gains. They are particularly useful in trending markets, where prices can continue to move in the same direction for an extended period. Trailing-stop strategies are commonly used for stock trading, and many investors believe it is a good strategy to balance return and risk [6].

Testing a trailing stop trading strategy involves verifying its functionality, effectiveness, and performance across various market conditions.

Example: Mr ABC bought Stock Shares of Apple Inc. at $160 per share and has put a Trailing Stop Order with Trailing Stop distance at $5.

Some of the testing scenarios to be considered in this scenario:

Functionality Testing: Verify that the trailing stop strategy correctly monitors the price movements of the asset being traded. Test the implementation of the trailing stop mechanism to ensure that it adjusts the stop price dynamically as the market price moves in the desired direction. Below are some of the common scenarios to be tested for testing trailing stop strategy functionality.

- Verify If Apple Inc. Price rises to $180, then Trailing Stop Price adjusts to &175 per share ($180 - $5).
- If the stock price continues to rise, verify trailing stop price continue to adjust accordingly, maintaining a $5 distance from the highest price reached. Similarly, if the stock price falls, ensure trailing stop follows the market price at the specified distance or percentage.
- Test the algorithm's ability to adjust the trailing stop dynamically in response to changes in market conditions and market volatility. Evaluate how the strategy performs under different volatility regimes, including periods of high volatility and low volatility, and adjust parameters accordingly.
- Test scenarios where the trailing stop is adjusted based on predefined risk limits, such as maximum loss thresholds or portfolio exposure constraints.
- Verify that the trailing stop is recalculated and updated as new price highs (for long positions) or lows (for short positions) are reached.
- Test different exit scenarios, including scenarios where the trailing stop is triggered and the trade is closed. If the stock price, then declines and hits $175 per share, then trailing stop order is triggered, and Apple Inc. stock shares are sold.
- Verify transaction Costs and Broker Fees are correctly adjusted on the Stock Price traded. Eg: For Selling Apple Stock at $175, effective Selling Price available to the Trader should be less than $175, considering Transaction fees and Discounts. Similarly, If Trader would have bought the Apple Inc. Stock at $175, then Buy Price should be more than $175.

- Test the management of multiple positions simultaneously using the trailing stop strategy. Validate how the strategy handles multiple open positions across different assets or trading instruments and adjusts trailing stops accordingly.

Backtesting: Conduct rigorous backtesting of the algorithmic trading strategy using historical market data to assess its performance over different time periods and market conditions. Verify that the strategy achieves desired objectives in simulated trading environments.

Integration Testing: In order for Trailing Stop Orders Trades to be executed, Trading system needs to interact with external systems as well for Market Data, Pricing, Transaction fees and even with downstream systems to report the Trades. Verify Integration Testing of trading system application and algorithmic trading strategy under test with external systems.

Performance Testing: Algorithmic trading relies on fast execution speeds and low latency, which is the delay in the execution of a trade. If a trade is not executed quickly enough, it may result in missed opportunities or losses. Verify performance analysis to evaluate the effectiveness of the trailing stop strategy over historical data. Conduct live trading tests in QA trading environments to validate the strategy's performance and behavior in real-time. Monitor trading activity, order execution, and portfolio metrics to identify any discrepancies or issues during live trading.

Regression Testing: Regression Testing of other Algorithmic Trading Strategies supported by the system should be done to ensure changes/ updates in Trailing Stop Strategy has not impacted other Algorithmic Trading Strategies supported by the trading application. Also, Regression testing of other functionalities supported by the trading system should also be done.

By systematically testing across these scenarios, traders can ensure that their trailing stop trading strategy performs as intended, manages risk effectively, and achieves desired trading objectives.

5. Conclusion

Algorithmic trading brings together computer software and financial markets to effectively execute trades under specified market conditions. If Algorithmic Trading Strategies are executed with precision and without delays, it can bring in profits/ minimize losses to the trades, but a small glitch in the execution or delay in the system can have its repercussions. To ensure stability and reliability of algorithmic trading strategies, it is imperative to have thorough testing done on the strategies before they are introduced into the trading systems.

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