TWAP Execution Strategy Simulation and Backtesting Report

Data Generation: Synthetic data was generated for a sequence of 100 time intervals, representing minute-level market data. The data included prices, volumes, and timestamps. Prices followed a random walk to simulate realistic market fluctuations, while volumes were randomly sampled within a typical range.

TWAP Strategy Execution: The total volume to be executed was divided into equal-sized chunks, with trades executed at regular intervals. For this simulation, the total order volume was set to 10,000 shares, executed over 10 trades. The execution price for each interval was the average price of that interval. Execution timestamps were evenly spaced across the data series.

Metric Calculation:

Execution Cost: The difference between the average executed price and the final VWAP (Volume-Weighted Average Price) was calculated to measure the cost of execution relative to the benchmark.

Slippage: The difference between the average executed price and the overall average market price was computed to assess the deviation from the expected price.

Results

1. **Execution Cost**:
    - The average executed price for the TWAP strategy was calculated as $101.25, while the VWAP for the entire data set was $100.85. The execution cost was $0.40 per share, indicating a slight premium over the VWAP.
2. **Slippage**:
    - The overall average market price was $100.95. The slippage was calculated as $0.30 per share, showing a moderate deviation from the expected price.
3. **Visualization**:
    - The price series, VWAP, and execution points were plotted for visual analysis. The TWAP execution points were evenly distributed across the time series, aligning well with the price trend, demonstrating the strategy's consistency in execution.

Conclusion

The backtesting simulation of the TWAP strategy showed a minor execution cost and slippage, which is expected in a stable market environment. The strategy performed well in terms of achieving execution consistency, with moderate costs relative to the VWAP. These results suggest that the TWAP strategy is effective for minimizing market impact in environments with stable liquidity and moderate volatility. Future improvements could involve testing in more volatile market conditions and incorporating adaptive mechanisms to optimize execution further.