

Transaction Cost Analysis (TCA) Framework for American Equity Options

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1. Introduction:

Transaction Cost Analysis (TCA) is crucial for evaluating the efficiency and performance of trading strategies in financial markets. This report presents a comprehensive TCA framework specifically tailored for American equity options. The framework incorporates methodologies to account for various complexities such as different expiries, implied volatilities, and liquidity factors.

2. Literature Review and Analysis

The foundation of this framework draws from seminal research on option pricing models with transaction costs and stochastic volatility. Specifically, the study by Chong Cao applies the Finite Element Method to solve the nonlinear Heston partial differential equation (PDE) under transaction costs. This method is noted for its accuracy in pricing options and calculating Greeks in the presence of stochastic volatility and transaction costs.

3. Framework Development

3.1 Methodologies and Assumptions

- Option Pricing Model: The framework uses the Heston stochastic volatility model modified to include transaction costs, based on the Finite Element Method for numerical solutions.
- Liquidity Considerations: Incorporates bid-ask spreads and trading volumes to estimate liquidity costs associated with different securities.

3.2 Relative Pricing and Volatility Surface Forecasting

- Relative Pricing: Relative pricing is implemented to compare less frequently traded equity options with more liquidly traded instruments. This approach helps in assessing fair value and optimizing trading strategies.

- Volatility Surface Forecasting: A volatility surface is forecasted using historical data and implied volatilities to model the relationship between option prices and volatility across different expiries.

4. Incorporation of Liquidity Factors

- Data Sources: Utilizes market data from Yahoo Finance for option prices, bid-ask spreads, and trading volumes. Specifically, historical and real-time data is extracted for AAPL equity options.

- Data Extraction Methods: Python scripts leverage the Yahoo Finance package for data retrieval. This includes extracting option chain data, historical prices, and volume metrics.

- Associated Costs: Data extraction is cost-effective as Yahoo Finance provides free access to historical and real-time market data. No additional costs are incurred beyond standard internet connectivity.

5. Models and Algorithms

- Implementation: Python programming is utilized for model implementation. Libraries such as pandas, numpy, matplotlib and scipy are used for data manipulation, numerical methods, and statistical analysis.

- Algorithm: The Finite Element Method is coded to solve the modified Heston PDE with transaction costs, enabling accurate pricing of equity options under varying market conditions.

6. Conclusion

This TCA framework integrates advanced methodologies from option pricing models to liquidity considerations, ensuring comprehensive analysis and evaluation of trading strategies for American equity options. By incorporating relative pricing and volatility forecasting, the framework enhances decision-making processes in optimizing trade executions and achieving best execution standards.