FINS3666 Activity 1

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Link to Code and Data Created: <https://github.com/phadke555/Activity-1> (Python Code provided in the .ipynb extensions; Data as .csv files)

1. Data Processing

I filtered trades and order book data to 10:10 AM – 4:00 PM (AEST); merged them by the last order book snapshot before each trade.

1. Market Microstructure Analysis

To analyze market microstructure, I looked at trade feed metrics, order book metrics and mid-price calculations. Some interesting observations from my analysis:

Trade Feed

* Volume traded was highest around market open time (approx. 10:30 AM) and second highest around market close time (approx. 3:30 PM).
* PXA's traded price oscillates around the Cumulative VWAP, with five major swings—periods of consecutive trades above or below VWAP.Out of all completed trades, ~73% of happened on AX and ~27% on CHA.

Order Book

* The **bid-ask spread** narrows throughout the day, peaking at **$0.05** at market open and dropping to **$0.01** at its lowest. When the spread is **1 cent wide, hidden orders execute at fractional cents**, possibly to **conceal large trades**.
* Consecutive trades at the bid push the bids and asks lower, while trades on the ask have the opposite effect.
* Order depth imbalance is greatest at the start and end of the trading day. Imbalance lies closer to 0 during the middle of the day.

Mid-Price Calculations

* Three different methods of mid-price calculation were used for all levels of order book data (L1 – L10): Simple, Volume Weighted, Spread Crossing Volume Weighted. L1 or top of the order book seems to track the best with the traded price.

1. Statistical Analysis

I use the metrics Mean Absolute Error, Mean Squared Error, Tracking Error, and Correlation Coefficient to examine the relationships between traded price and mid-price.

Traded Price and L1 Simple Mid Price have the following metrics:

* MAE = 0.004812, MSE = 0.000036, TE = 0.005949, r = 0.987

Traded Price and L1 VW Mid Price have the following metrics:

* MAE = 0.006855, MSE = 0.000068, TE = 0.00825, r = 0.975

Traded Price and L1 Spread Crossing VW Mid Price have the following metrics:

* MAE = 0.005119, MSE = 0.000043, TE = 0.006371, r = 0.9856

The simple mid-price seems to have the best statistical measures overall over the trading day. Lowest MAE, MSE, TE and highest r.

Also, traded price regressions on mid-price work best on short timeframes (e.g. 1 hr window).

* 2PM – 3PM, R-Squared = 0.85

1. Critical Reflection

Strengths:

* The granular analysis aids trading strategy development. A mean reversion strategy emerges using Market VWAP as the mean: buy when the mid-price falls below VWAP and sell when it rises above.

Opportunity

* By taking 2 different exchanges into account there is potential for identifying cross-exchange arbitrage trading opportunities if there are market inefficiencies.

Limitations

* This does not take into account trades occurring on dark pool exchanges which are big in the US.
* We only use data for a single stock here. This stock may be affected by other macro-economic factors or display co-movement with other stocks.