REPORT

Quant Insider Market Making Challenge – Report

1. Introduction

Market making plays a crucial role in modern financial markets by providing liquidity, reducing bid–ask spreads, and enabling continuous price discovery. In this project, I designed and implemented a **Python-based market-making algorithm** that reacts to order book data, dynamically quotes prices, manages inventory risk, and tracks profitability over time.

The objective was to compare a **baseline strategy** with an **adaptive strategy** using inventory and order book signals.

2. Problem Setup

The competition environment simulates a live market-making scenario using Nubra's UAT market data.
The strategy must:

- Quote bid and ask prices around the mid-price
- Adapt to order book conditions
- Control inventory risk
- Track PnL and performance metrics

The solution was implemented in Python and tested using a simulator, with optional integration to Nubra's UAT WebSocket feed.

3. Strategy Design

3.1 Baseline Strategy

The baseline strategy serves as a reference point:

- Quotes a fixed spread around the mid-price
- No consideration of inventory or order book imbalance
- Simple and passive market-making behavior

This strategy helps evaluate the impact of more advanced risk management techniques.

3.2 Adaptive Strategy

The adaptive strategy introduces intelligence into the quoting process:

- **Mid-price computation** using best bid and ask
- **Order book imbalance** as a signal to measure buying vs selling pressure
- **Adaptive inventory skew**:
    - If inventory is positive, the strategy reduces buying aggressiveness and increases selling aggressiveness
    - If inventory is negative, the strategy does the opposite
- **Inventory cap** to limit risk exposure

This approach aims to maximize PnL while keeping inventory close to zero.

4. Implementation Details

The system is modular and consists of:

- market_maker.py: core execution loop
- signals.py: mid-price, imbalance, and quote computation
- simulator.py: local order book simulation
- nubra_ws.py: optional Nubra WebSocket integration
- CSV logging for quotes, inventory, cash, and PnL
- Plotting module to compare baseline and adaptive performance

Prices are handled in **paise**, and PnL is computed using **mark-to-market valuation**.

5. Risk Management

Risk is controlled through:

- Inventory caps to prevent excessive exposure
- Inventory-aware quote skewing
- Continuous monitoring of inventory and PnL

These mechanisms ensure the strategy remains stable even under persistent market pressure.

6. Results and Analysis

Two key comparisons were performed:

6.1 PnL Comparison

- The baseline strategy shows unstable and lower PnL
- The adaptive strategy achieves more consistent profitability

6.2 Inventory Comparison

- Baseline inventory drifts significantly over time
- Adaptive strategy maintains inventory closer to zero

Plots clearly demonstrate that **adaptive inventory skew improves both profitability and risk control**.

7. Conclusion

This project demonstrates that even simple adaptive mechanisms—such as order book imbalance and inventory-based skew—can significantly enhance market-making performance.
The adaptive strategy outperforms the baseline in terms of both PnL stability and inventory management, highlighting the importance of risk-aware quoting in market-making systems.