Modeling Temporary Market Impact Function g□(x)

Introduction:

In financial markets, large market orders can result in execution at inferior prices because there is finite liquidity at each price level. This added expense is referred to as slippage. The objective of this assignment is to model the temporary market impact function g□(x), that reflects the slippage suffered at time t for purchasing x shares.

Method:

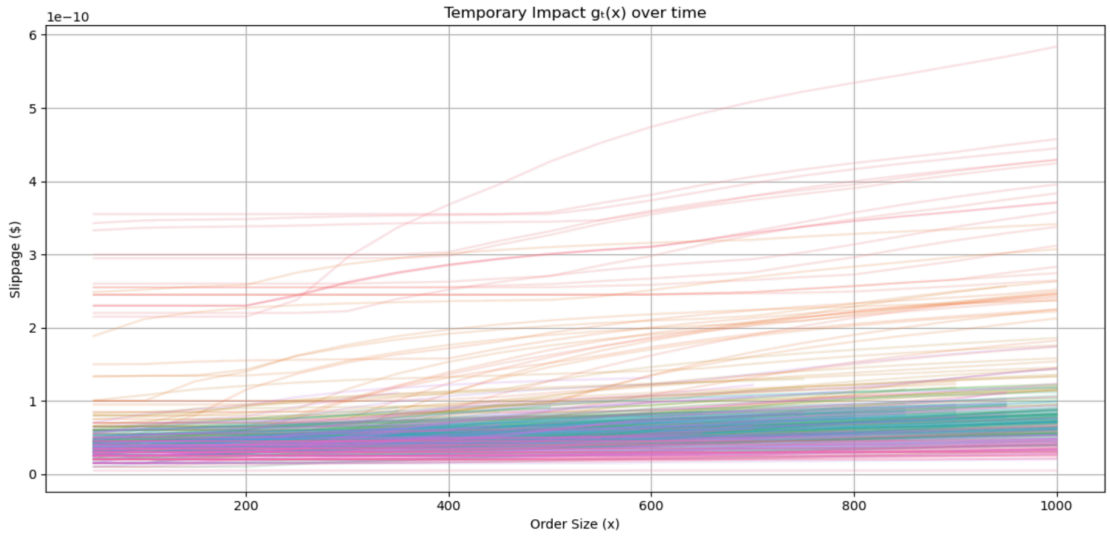
We employed MBP-10 (Market by Price) order book data for one trading day. We took the top 10 ask levels (sizes and prices) and computed the average execution price for market orders of different sizes (ranging from 50 to 1000 shares) for every minute.

The slippage is given as:
g□(x) = \frac{\text{Total Cost}}{x} - \text{Mid Price} where total cost is the weighted average price paid for x shares, and mid price is the average of best bid and best ask.

Results:

The resulting slippage plots indicate that:

- For small order quantities, slippage is near zero and is stable.
- As order size increases, slippage grows sharply — especially once top-of-book liquidity is consumed.
- The connection between g□(x) and x is obviously nonlinear and convex, i.e., larger orders cost disproportionately more.



Conclusion:

The evidence shows that the linear model (e.g., $g_i(x) = \beta_i x$) is a bad approximation, as it underestimates cost for large order sizes. A nonlinear piecewise model, based on real order book levels, better describes market behavior and forms the basis for trade execution optimization.