Algorithmic Trading and High Frequency Finance
FRE-GY- 7251 I – Prof. Pierre Yves Guillo

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Market Making Simulation

Main Idea:

Main idea of this project is to take the role of Market Maker and adjust/quote the price of the instrument by dictating the price inside, outside or at the Market Bid-Offers. Therefore, we, as the market maker continuously adjust the prices and find the PNL by keeping rules and constraints into consideration.

Order Data

	A	B	C
1	Side	Time	
2	B	1/7/2018 22:04	
3	S	1/7/2018 22:04	
4	B	1/7/2018 22:04	
5	S	1/7/2018 22:04	
6	B	1/7/2018 22:04	
7	B	1/7/2018 22:04	
8	B	1/7/2018 22:04	
9	S	1/7/2018 22:04	
10	S	1/7/2018 22:04	
11	S	1/7/2018 22:04	

Tick Data

	A	B	C	D
1	DateTime	Bid	Ask	
2	02:03.8	1.3556	1.35616	
3	02:03.8	1.3556	1.35617	
4	02:03.9	1.35554	1.35617	
5	02:03.9	1.35554	1.35618	
6	02:04.1	1.35554	1.35619	
7	02:06.4	1.35546	1.35619	
8	02:08.8	1.35546	1.35618	

Two sets of Prices - Time Series of Bid-Offer ticks :

1. **Market Ticks:** Given time-order set of bid/ask tick prices.
2. **Market Maker Ticks:** We quote our Bid Offer Prices which can be inside, outside or at Market.

Main Constraints:

1. **Reaction Time :** We find our Market Maker prices by considering two market events: Arrival of Tick Data or Execution of an Order. We adjust or update our MM price only after a particular time period (called Reaction time-10msec) of arrival of a market event.
2. **Open Position Limit:** Net Open Position Limit of 10mm of GBPUSD. At no point of time, we are allowed to breach +/- 10mm open position limit. For example: if we approach the limit -10mm, we refrain from executing more sell orders and skip them until we have a buy order and improve on our Open Position(from perspective of

Market Maker).

3. **Execution Probability and Follow-up Probability :** Execution of order is subject certain probabilities- MM is better than M than 100% chance of execution, MM == M than50% chances of execution and M is better than MM 0% chance of execution. Similar constraints are applied to execution immediate successive order with some probability(0.25 probability).

Approaches to Execution:

Approach 1 : Passive Approach

This is the basic market taking approach. The market maker simply takes the prices available in the market for Bid and Ask. The constraints on PNL and Open Inventory limits are not applicable here. The graphs and the statistics for this approach are shown below.

Approach 2 : Dynamic Approach

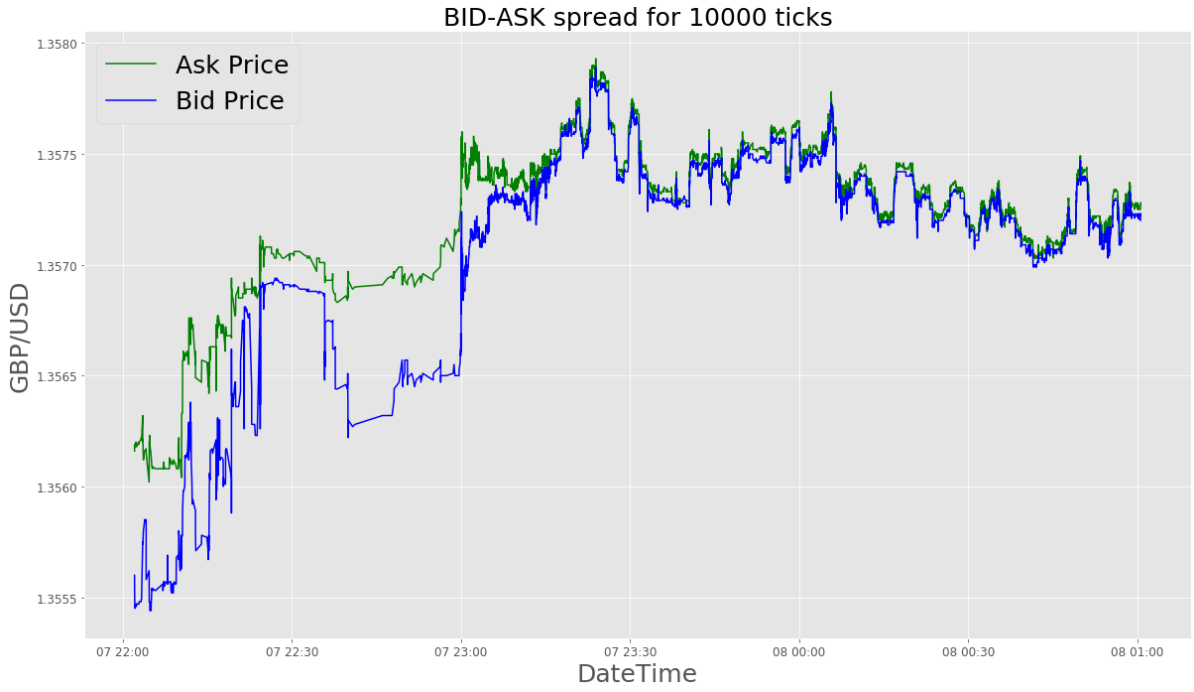
This strategy of Market Maker involves implementation of Open Limit and PNL constraints.

Implementation Flow:

1. Given the Market ticks, we find Market Maker ticks by adding a time delta of 10msec to Market tick or on occurrence of an order.
   Upon arrival of Order, if the order is executed, it will be considered as a market event and our Market Maker ticks will be update according to order execution price.
2. After generation of Market Maker tick, we now assume the role of Market Maker and traverse through the tick data and execute the order by offering a price, which can be inside, outside or at the market price.
3. The execution of the orders is subject to the constrains mentioned above.
4. This gives us our(MM) Bid-Offer Spread and plot it. (Deliverable 1)
5. For every executed order, we calculated Market Maker PNL and calculate our inventory or open position.
6. Plot PNL and Open inventory Position. (Deliverable 2 and 3).
7. Calculating Statistics.(for PNL)
   Mean, 25%tile, Median, 75%tile,Cummulative PNL ,Volatility, Information Ratio, Winners, Losers, Win/Loss Ratio.

Analysis and Results:

Market Bid Ask Spread:

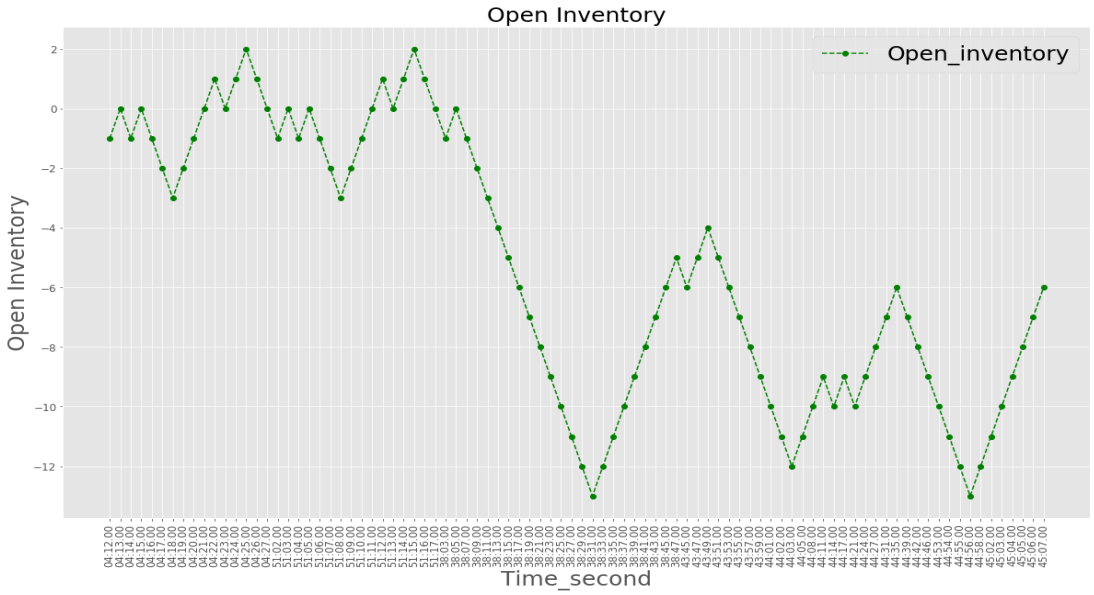


Approach 1:

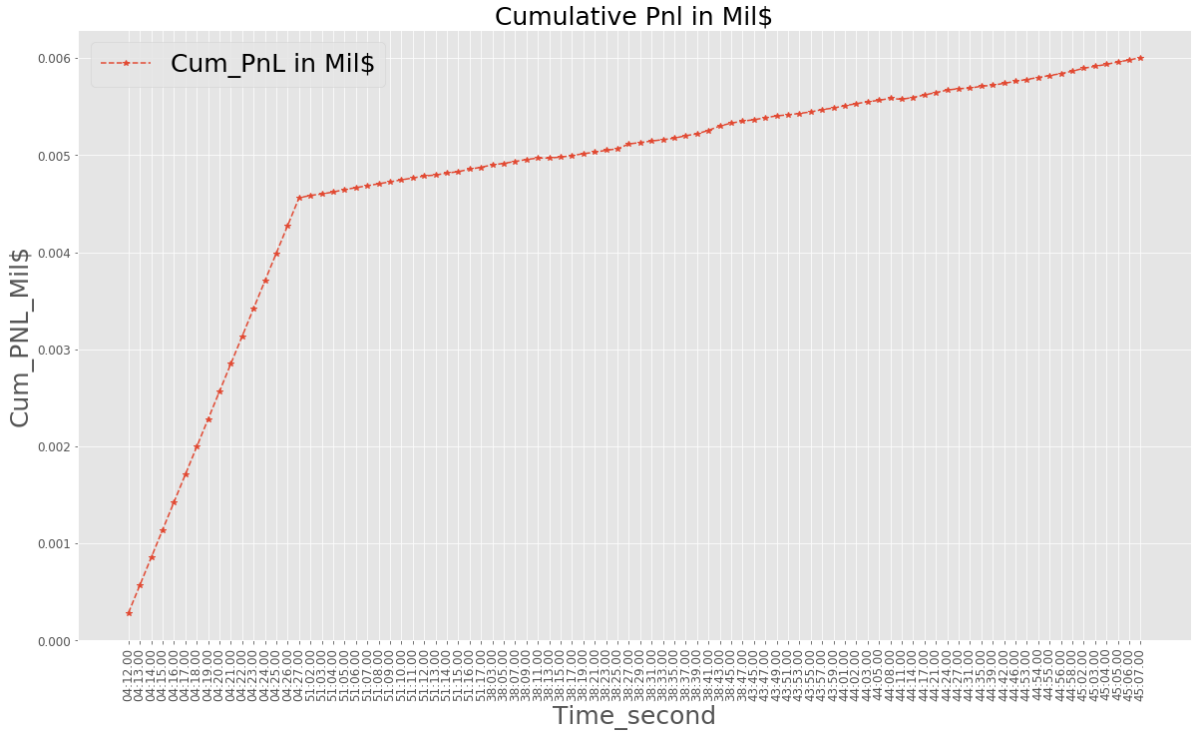
Market Maker Bid Ask Spread:

This will be same as Market Bid Ask Graph. Shown above

Open Inventory:



Cumulative PNL:



Statistics:

Approach 1 – Passive Approach Statistics

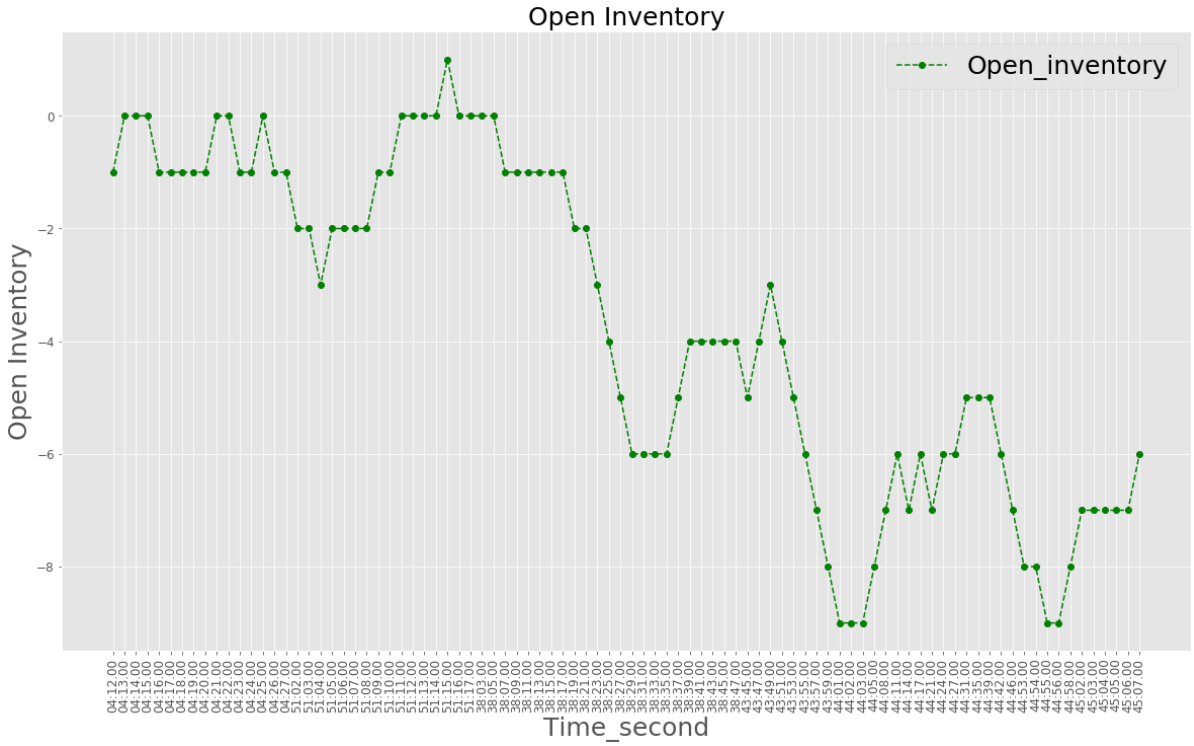
Statistics	Values
Mean PNL	66.72
Median PNL	20
Volatility	0.08
25%tile	15
75%tile	25

Approach 2

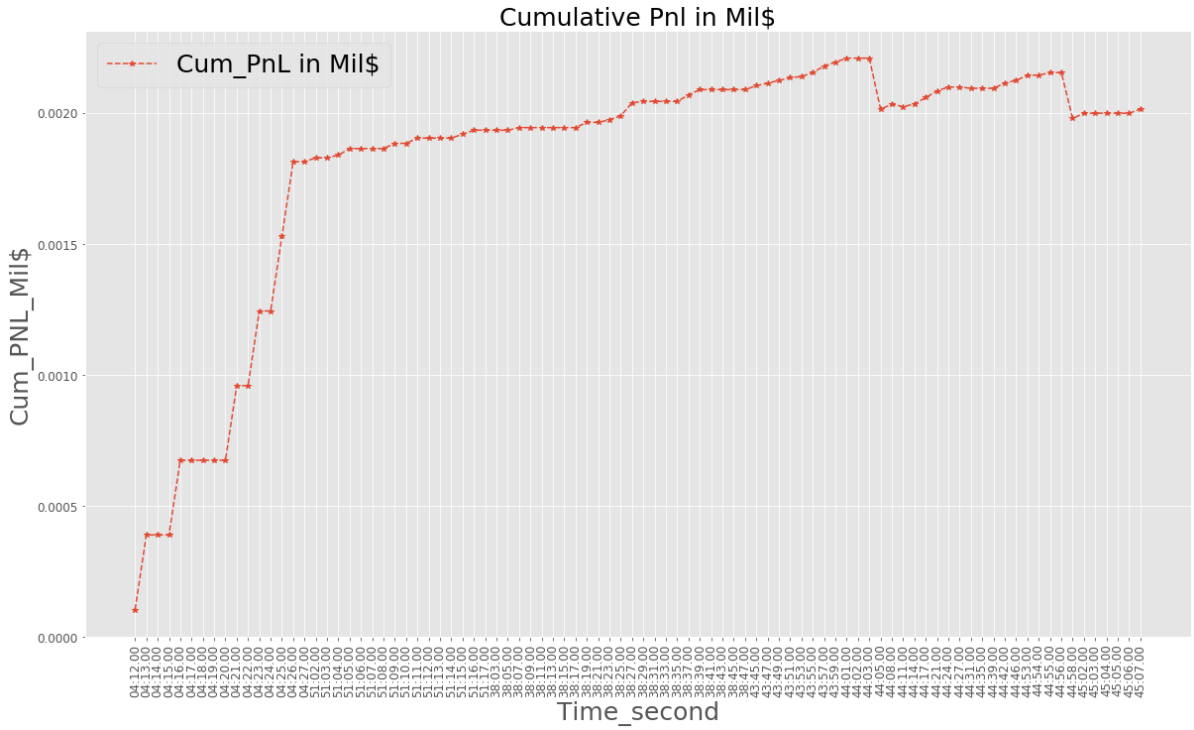
Dynamic Approach

Market Maker Bid Ask Spread:

Open Inventory:



Cumulative PNL:



Approach 2 – Dynamic Approach Statistics

Statistics	Values
Mean PNL	43.8
Median PNL	3
Volatility	0.08
25%tile	10
75%tile	25
Information Ratio	2.43
Execution %	51.0%
Win-Loss Ratio	10.5