Assignment 2 Report

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Introduction

The purpose of this assignment is to find out if and when an order should be immediately executed by paying (half) the Bid/Offer spread or if it would be economically better to rest this order within the Bid/Offer spread for a period time to achieve possibly a better execution.

Three approaches

Market Taking (MT) ---for each order, you will aggress the market immediately and therefore incur the (half) Bid/Offer spread
Opportunistic Market Making (OMM) -- for each order, you will rest it within the Bid/Offer spread, for a given amount of time, waiting for its (possible) opportunistic execution
OMMSide --- by joining "your side" of the market (i.e. the Bid price if you are buying, the Offer if selling)
OMMMid --- by resting your order at mid-market

Assumptions

1. there is enough liquidity to 100% fill you upon the execution of your order
2. upon execution of your order you are done at your expected price (no slippage upon your order's execution)
3. The size of the trade is $1
4. The PnL are measured by basis points
5. The PnL are calculated relative to the mid-market price at the time the order was placed
6. SL: A maximum stop loss in case the market run away from you
7. TTE: maximum execution time, Upon reaching this time limit, you will aggress the market to fill your order

Analysis

When SL = 0.0002 and TTE = 10 seconds, some statistics are calculated below:

	Total PnL (bp)	**Avg PnL (bp)**	**Median PnL (bp)**	**Avg execution time**	**Median execution time**	**# of SL triggered**	**# of TTE triggered**
MT	-60.050	-0.667	-0.200	0	0	N/A	N/A
OMMSide	-88.049	-0.978	-0.575	4.622	3	27	23
OMMMid	-94.499	-1.050	-0.275	4.166	3	27	19

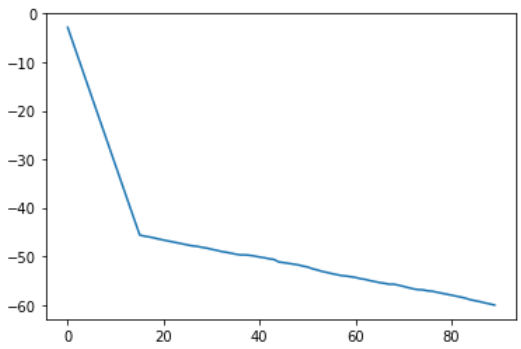


Figure 1 MT Cumulative PnL

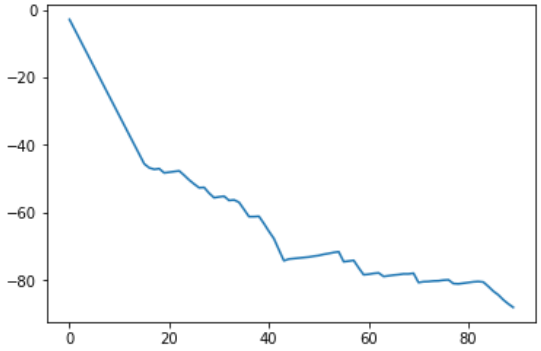


Figure 2 OMMSide Cumulative PnL

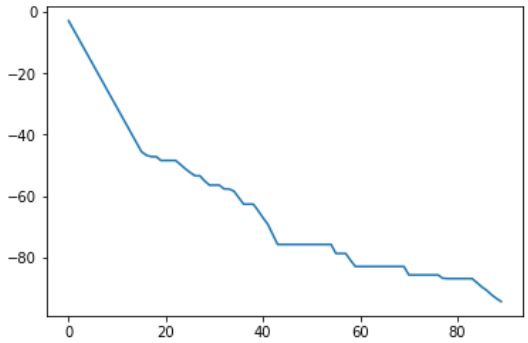


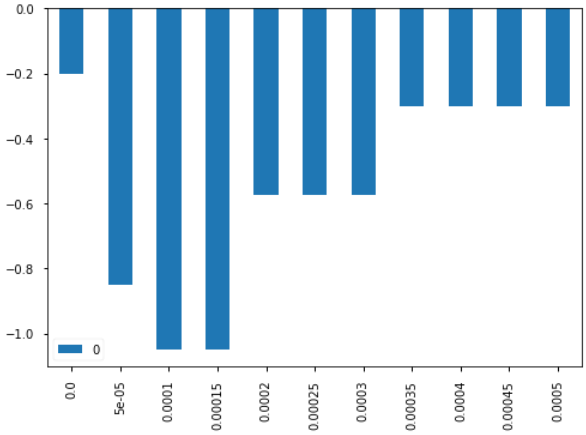
Figure 3 OMMMid Cumulative PnL

When SL = 0.0002 and TTE = 10 seconds, we can see that MT, which aggress the market immediately, has the best performance in terms of total, median and average PnL. It also does not need to wait, which is more time efficient. However, by changing ST and TTE, we might able to get better execution PnL using OMMSide and OMMMid. In the following section, I am going to explore the influence of SL and TTE.

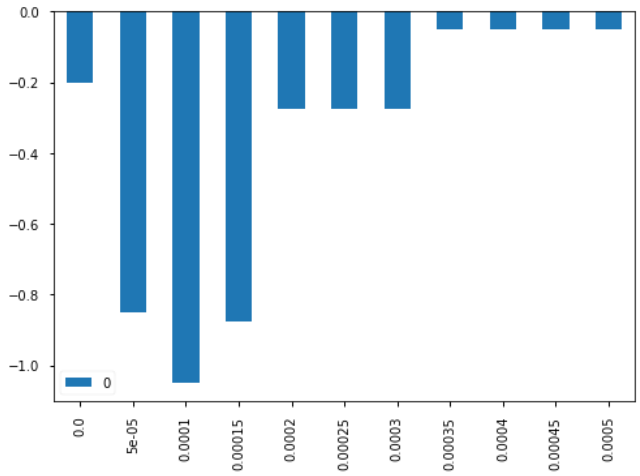
Further Analysis

- **Show the influence of the length of SL on the median execution PnL**
  Test SL in range $0-0.0005, TTE = 10

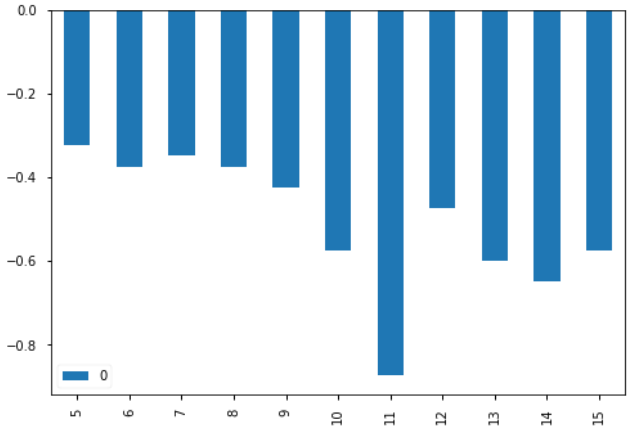
  When TTE = 10 seconds, OMMSide approach's median PnL in different SL level from 0 to 0.0005 is shown on the right. When stop loss level is at 0, OMMSide has the best performance with median PnL equal to -0.2bps.



When TTE = 10, OMMMid approach's total PnL is shown on the right. It performs better when SL in the range of 0.00035-0.0005.

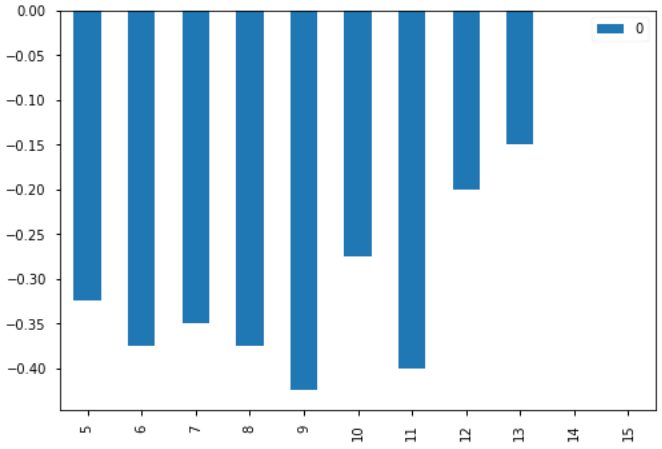


- **Show the influence of the length of TTE on the median execution PnL**
  Test TTE in range 5-15 seconds, ST = 0.0002



For OMMSide, when TTE = 5, the strategy generates the best median execution PnL.

For OMMMid, when TTE = 14 and 15, the median PnL goes down to 0, which is a very good result.



The table below shows the median of the PnL of OMMSide, with SL in range 0 to 10 and TTE in range 5 to 15.

	5	6	7	8	9	10	11	12	13	14	15
0	-0.200	-0.200	-0.200	-0.200	-0.200	-0.200	-0.200	-0.200	-0.200	-0.200	-0.200
1	-0.600	-0.600	-0.800	-0.825	-0.850	-0.850	-0.850	-0.850	-0.850	-0.850	-0.850
2	-0.425	-0.475	-0.675	-1.000	-1.050	-1.050	-1.050	-1.050	-1.050	-1.050	-1.050
3	-0.325	-0.375	-0.500	-0.500	-0.750	-1.050	-1.075	-1.075	-1.050	-1.050	-1.075
4	-0.325	-0.375	-0.350	-0.375	-0.425	-0.575	-0.875	-0.475	-0.600	-0.650	-0.575
5	-0.325	-0.375	-0.350	-0.375	-0.425	-0.575	-0.875	-0.475	-0.600	-0.650	-0.575
6	-0.325	-0.375	-0.350	-0.375	-0.425	-0.575	-0.875	-0.475	-0.600	-0.650	-0.575
7	-0.325	-0.375	-0.275	-0.375	-0.300	-0.300	-0.125	-0.275	-0.325	-0.175	-0.125
8	-0.325	-0.375	-0.275	-0.375	-0.300	-0.300	-0.125	-0.275	-0.325	-0.175	-0.125
9	-0.325	-0.375	-0.275	-0.375	-0.300	-0.300	-0.125	-0.275	-0.325	-0.175	-0.125
10	-0.325	-0.375	-0.275	-0.375	-0.300	-0.300	-0.125	-0.275	-0.325	-0.175	-0.125

Annex

- **OMMSide Order statistics** (SL = 0.0002, TTE = 10 seconds)

Order Time	PnL	Execution time	SL	TTE
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/8/18 7:51	-1.15	10	/n	TTE
1/8/18 7:51	-0.45	10	/n	TTE

1/8/18 7:51	0.2	9	/n	/n
1/8/18 7:51	-1.25	10	/n	TTE
1/8/18 7:51	0.2	7	/n	/n
1/8/18 7:51	0.2	6	/n	/n
1/8/18 7:51	0.2	5	/n	/n
1/8/18 7:51	-1.3	10	/n	TTE
1/8/18 7:51	-1.4	10	/n	TTE
1/8/18 7:51	-1.2	10	/n	TTE
1/8/18 7:51	-1.1	10	/n	TTE
1/8/18 7:51	0.1	1	/n	/n
1/8/18 7:51	-1.7	10	/n	TTE
1/8/18 7:51	-1.35	10	/n	TTE
1/8/18 7:51	0.25	7	/n	/n
1/8/18 7:51	0.2	6	/n	/n
1/10/18 10:38	-1.25	10	/n	TTE
1/10/18 10:38	0.15	3	/n	/n
1/10/18 10:38	-0.7	10	/n	TTE
1/10/18 10:38	-2.1	9	SL	/n
1/10/18 10:38	-2.15	7	SL	/n
1/10/18 10:38	0	0	/n	/n
1/10/18 10:38	0.1	1	/n	/n
1/10/18 10:38	-2.15	2	SL	/n
1/10/18 10:38	-2.3	2	SL	/n
1/10/18 10:38	-2.15	1	SL	/n
1/10/18 10:38	-3.3	3	SL	/n
1/10/18 10:38	-3.25	1	SL	/n
1/10/18 10:38	0.5	2	/n	/n
1/10/18 10:38	0.15	3	/n	/n
1/10/18 10:38	0.15	1	/n	/n
1/10/18 10:38	0.15	4	/n	/n
1/10/18 10:38	0.15	2	/n	/n
1/10/18 10:38	0.25	1	/n	/n
1/10/18 10:38	0.2	9	/n	/n
1/10/18 10:38	0.35	9	/n	/n
1/10/18 10:38	0.25	3	/n	/n
1/10/18 10:38	0.3	1	/n	/n
1/10/18 10:38	0.2	3	/n	/n
1/12/18 8:43	-2.95	10	SL	TTE
1/12/18 8:43	0.2	6	/n	/n
1/12/18 8:43	0.2	2	/n	/n

1/12/18 8:43	-2.2	4	SL	/n
1/12/18 8:43	-2.05	3	SL	/n
1/12/18 8:43	0.15	3	/n	/n
1/12/18 8:43	0.25	1	/n	/n
1/12/18 8:43	0.15	2	/n	/n
1/12/18 8:44	-1.05	10	/n	TTE
1/12/18 8:44	0.2	6	/n	/n
1/12/18 8:44	0.2	6	/n	/n
1/12/18 8:44	0.15	6	/n	/n
1/12/18 8:44	0.2	3	/n	/n
1/12/18 8:44	0	0	/n	/n
1/12/18 8:44	0.2	4	/n	/n
1/12/18 8:44	-2.75	3	SL	/n
1/12/18 8:44	0.25	2	/n	/n
1/12/18 8:44	0.05	10	/n	TTE
1/12/18 8:44	0.15	3	/n	/n
1/12/18 8:44	0.05	4	/n	/n
1/12/18 8:44	0.2	4	/n	/n
1/12/18 8:44	0.1	1	/n	/n
1/12/18 8:44	-1.1	10	/n	TTE
1/12/18 8:44	-0.1	10	/n	TTE
1/12/18 8:44	0.2	1	/n	/n
1/12/18 8:44	0.2	2	/n	/n
1/12/18 8:44	0.2	2	/n	/n
1/12/18 8:44	0.1	10	/n	TTE
1/12/18 8:44	-0.15	10	/n	TTE
1/12/18 8:45	-1.3	10	/n	TTE
1/12/18 8:45	-1.4	10	/n	TTE
1/12/18 8:45	-1.1	10	/n	TTE
1/12/18 8:45	-1.45	10	/n	TTE
1/12/18 8:45	-1.2	10	/n	TTE
1/12/18 8:45	-1.05	10	/n	TTE

- **OMMMid Order statistics** (SL = 0.0002, TTE = 10 seconds)

Order Time	PnL	Execution time	SL	TTE
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n

1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/7/18 22:04	-2.85	0	SL	/n
1/8/18 7:51	-1.15	10	/n	TTE
1/8/18 7:51	-0.45	10	/n	TTE
1/8/18 7:51	0	8	/n	/n
1/8/18 7:51	-1.25	10	/n	TTE
1/8/18 7:51	0	6	/n	/n
1/8/18 7:51	0	5	/n	/n
1/8/18 7:51	0	4	/n	/n
1/8/18 7:51	-1.3	10	/n	TTE
1/8/18 7:51	-1.4	10	/n	TTE
1/8/18 7:51	-1.2	10	/n	TTE
1/8/18 7:51	-1.1	10	/n	TTE
1/8/18 7:51	0	1	/n	/n
1/8/18 7:51	-1.7	10	/n	TTE
1/8/18 7:51	-1.35	10	/n	TTE
1/8/18 7:51	0	7	/n	/n
1/8/18 7:51	0	6	/n	/n
1/10/18 10:38	-1.25	10	/n	TTE
1/10/18 10:38	0	3	/n	/n
1/10/18 10:38	-0.7	10	/n	TTE
1/10/18 10:38	-2.1	9	SL	/n
1/10/18 10:38	-2.15	7	SL	/n
1/10/18 10:38	0	0	/n	/n
1/10/18 10:38	0	1	/n	/n
1/10/18 10:38	-2.15	2	SL	/n
1/10/18 10:38	-2.3	2	SL	/n
1/10/18 10:38	-2.15	1	SL	/n
1/10/18 10:38	-3.3	3	SL	/n

1/10/18 10:38	-3.25	1	SL	/n
1/10/18 10:38	0	1	/n	/n
1/10/18 10:38	0	3	/n	/n
1/10/18 10:38	0	1	/n	/n
1/10/18 10:38	0	2	/n	/n
1/10/18 10:38	0	2	/n	/n
1/10/18 10:38	0	1	/n	/n
1/10/18 10:38	0	9	/n	/n
1/10/18 10:38	0	9	/n	/n
1/10/18 10:38	0	1	/n	/n
1/10/18 10:38	0	1	/n	/n
1/10/18 10:38	0	1	/n	/n
1/12/18 8:43	-2.95	10	SL	TTE
1/12/18 8:43	0	4	/n	/n
1/12/18 8:43	0	2	/n	/n
1/12/18 8:43	-2.2	4	SL	/n
1/12/18 8:43	-2.05	3	SL	/n
1/12/18 8:43	0	3	/n	/n
1/12/18 8:43	0	1	/n	/n
1/12/18 8:43	0	1	/n	/n
1/12/18 8:44	0	8	/n	/n
1/12/18 8:44	0	1	/n	/n
1/12/18 8:44	0	5	/n	/n
1/12/18 8:44	0	6	/n	/n
1/12/18 8:44	0	3	/n	/n
1/12/18 8:44	0	0	/n	/n
1/12/18 8:44	0	4	/n	/n
1/12/18 8:44	-2.75	3	SL	/n
1/12/18 8:44	0	2	/n	/n
1/12/18 8:44	0	7	/n	/n
1/12/18 8:44	0	3	/n	/n
1/12/18 8:44	0	4	/n	/n
1/12/18 8:44	0	4	/n	/n
1/12/18 8:44	0	1	/n	/n
1/12/18 8:44	-1.1	10	/n	TTE
1/12/18 8:44	-0.1	10	/n	TTE
1/12/18 8:44	0	1	/n	/n
1/12/18 8:44	0	2	/n	/n
1/12/18 8:44	0	1	/n	/n
1/12/18 8:44	0	2	/n	/n

1/12/18 8:44	0	3	/n	/n
1/12/18 8:45	-1.3	10	/n	TTE
1/12/18 8:45	-1.4	10	/n	TTE
1/12/18 8:45	-1.1	10	/n	TTE
1/12/18 8:45	-1.45	10	/n	TTE
1/12/18 8:45	-1.2	10	/n	TTE
1/12/18 8:45	-1.05	10	/n	TTE