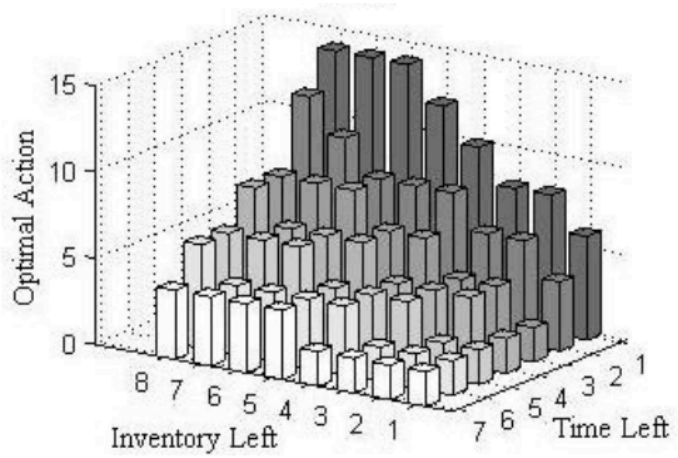
Trade Execution Optimization

Theoretical computer science:
One-way trading problem



Nevmyvaka, Yuriy, Yi Feng, and Michael Kearns.
"Reinforcement learning for optimized trade execution."
Proceedings of the 23rd international conference on Machine learning. ACM, 2006.

"How can we buy (respectively sell) *V* shares within a time horizon *T*, in a manner that minimizes the capital spent (respectively, maximizes the revenue received)?".

Private Variables:
- Remaining Inventory *i*
- Remaining time left *t*
- (Maker/taker fees)

Market Variables:
- Drawn from order book that evolves over time
- E.g. market volume, liquidity, volatility
- More advanced features: technical analysis
- Examination of their performance impact

Order book

Sell Orders

Buy Orders

5734.00	5.378	18.488
5733.20	0.023	13.110
5731.50	0.003	13.087
5731.00	1.000	13.084
5730.10	0.088	12.084
5730.00	8.117	11.996
5729.00	0.873	3.879
5728.30	0.002	3.006
5728.00	2.308	3.004
5726.80	0.255	0.696
5726.20	0.008	0.441
5725.90	0.009	0.433
5725.00	0.424	0.424
5721.20 EUR		
5721.00	10.790	10.790
5720.10	14.420	25.210
5720.00	7.447	32.657
5718.90	3.210	35.867
5716.80	3.090	38.957
5715.60	1.448	40.405
5715.20	6.890	47.295
5714.30	0.050	47.345
5711.10	0.438	47.783
5711.00	0.013	47.796
5706.00	2.175	49.971
5697.40	0.260	50.231
5686.70	0.050	50.281

State at: *t*

5738.00	1.037	16.308
5737.70	0.070	15.271
5737.00	1.000	15.201
5736.00	0.009	14.201
5735.00	0.382	14.192
5734.20	0.018	13.810
5734.00	5.378	13.792
5733.40	0.100	8.414
5733.20	0.296	8.314
5731.50	0.003	8.018
5731.00	1.000	8.015
5730.10	0.088	7.015
5730.00	6.927	6.927
5730.00 EUR		
5729.70	0.014	0.014
5728.60	0.015	0.029
5726.80	2.063	2.092
5725.00	0.066	2.158
5721.50	0.093	2.251
5721.40	0.710	2.961
5721.10	6.740	9.701
5721.00	0.484	10.185
5720.20	2.550	12.735
5720.00	105.047	117.782
5715.60	1.448	119.230
5714.30	0.050	119.280
5711.10	0.438	119.718

State at: *t+1*

Reinforcement Learning

Action *a*: placing a limit order at price *ask*
= 0 → ask price
> 0 → buyer side of book
< 0 → sell side of book

Other approaches:

Online Learning
Neural Nets
Genetic algorithm

Detecting market specific patterns
Detecting buy/sell walls

Evaluation

Commonly compared against mid-spread price: *(ask+bid) / 2*

Outlook: evolve into *market maker*, seeking to profit from the difference between the buy and sell price of an asset