SRG Market microstructure

Report on my research

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Our methodology to fit parameters ρ, κ, q

We chose regression to find parameters:

$$\frac{\Delta A_{k+2}}{\Delta t_{k+2}} - \frac{\Delta A_{k+1}}{\Delta t_{k+1}} = -\rho \Delta A_{k+1} + \rho\lambda x_{k+1} + (\kappa + \lambda)\left(\frac{x_{k+2}}{\Delta t_{k+2}} - \frac{x_{k+1}}{\Delta t_{k+1}}\right).$$

Where all the information needed can be extracted from the l3 data:

- ΔA_k is an ask change after execution of the limit order with the depth x_k. So, $\Delta A_k = \mathrm{AskAfter}(k) - \mathrm{AskBefore}(k)$ and $x_k = \mathrm{Volume}(k)$.
- Δt_k is a time between k and $k+1$ orders of dataset. So, $\Delta t_k = \mathrm{Time}(k+1) - \mathrm{Time}(k)$

Backtest methodology

According the OW model, ask dynamics should follow the equation:

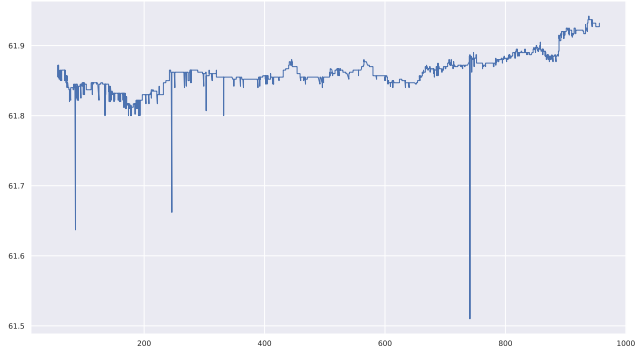
$$A_t = \overline{p}_t + \frac{s}{2} + x_1 \kappa e^{-\rho t},$$

where A_t – ask price after execution, $\overline{p}_t + \frac{s}{2}$ defines steady state level (here $\overline{p}_t$ is a price and s is a spread), κ and ρ are hyperparameters.
Important details:

- According the paper, $\kappa > 0$, $\rho > 0$.
- From numerical properties of the function:
  - A_t can be $1 - 2$ more then V_t not 100, so $|\kappa| << 1$.
  - ρ should not be too big (about 10000, for example), because in this case, resiliency should be so huge, so all execution strategies are useless: you can just sell as many stocks as you want.

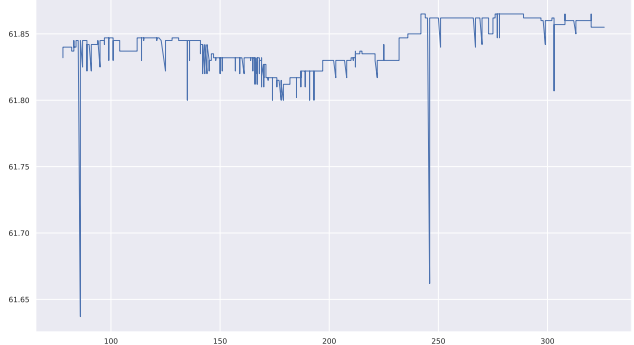
Problems

- In all the tests $\rho > 1000$ and $\kappa < 0$, so we get useless parameters.
- One can say that problem can be fixed by considering t in ms instead of seconds, but it had not work.
- I don't emperically observe such dynamics:



Reason?

Top ask gaps looks like that (like someone creates very strange off-market order and someone buy it immediately). Numericaly: top 30 ask gaps and top 30 volumes has the empty intersection. It is important fact about the data, I took it into account but it did not help.



Another approach to fit the parametrs.

According the OW model, ask dynamics should follow the equation:

$$A_t = \overline{p}_t + \frac{s}{2} + x_1 \kappa e^{-\rho t},$$

so lets try to use OLS to fit the parameters according the ask dynamics. As a steady state level we will consider ask before the execution, so we get:

$$\text{AskAfter}(k) = \text{AskBefore}(k) + \text{Volume}(k)\kappa e^{-\rho \text{Time}(k)}.$$