

Market simulation: HYDR case study

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HYDR

RusHydro is the biggest Russian hydro-generating company and the second biggest in the world in terms of installed capacity.

HYDR is referred to be the blue chip. During September, 2010 :

- on average 18100 orders arrived daily,
- 2 billion stocks daily were bought and sold,
- \$2.1 billion turnover for a month.
- Totally 16892 market participants appeared to trade.

Market microstructure : primary analysis

Scatter plot on September, 22, 2010

Activity: V_01092010_HYDR553397265_BA: Result Viewer: V_01092010_HY56248_CL

File Publish Help

Clusters Rules Results Build Settings Task

Leaf Clusters: 5
Cluster Levels: 5
Cases: 2 359

Clusters: Show Leaves Only

Cluster ID	Cases
1	2 359
2	770

Detail

Activity: V_01092010_HYDR553397265_BA: Result Viewer: V_01092010_HY34378_CL

File Publish Help

Clusters Rules Results Build Settings Task

Leaf Clusters: 10
Cluster Levels: 7
Cases: 2 359

Clusters: Show Leaves Only

Cluster ID	Cases
1	2 359
2	763
3	1 596
4	758
14	111
16	57
17	54
15	647
5	838
6	127

Detail

Expand All

Collapse All

Activity: V_01092010_HYDR553397265_BA: Result Viewer: V_01092010_HY31752_CL

File Publish Help

Clusters Rules Results Build Settings Task

Leaf Clusters: 10
Cluster Levels: 7
Cases: 2 359

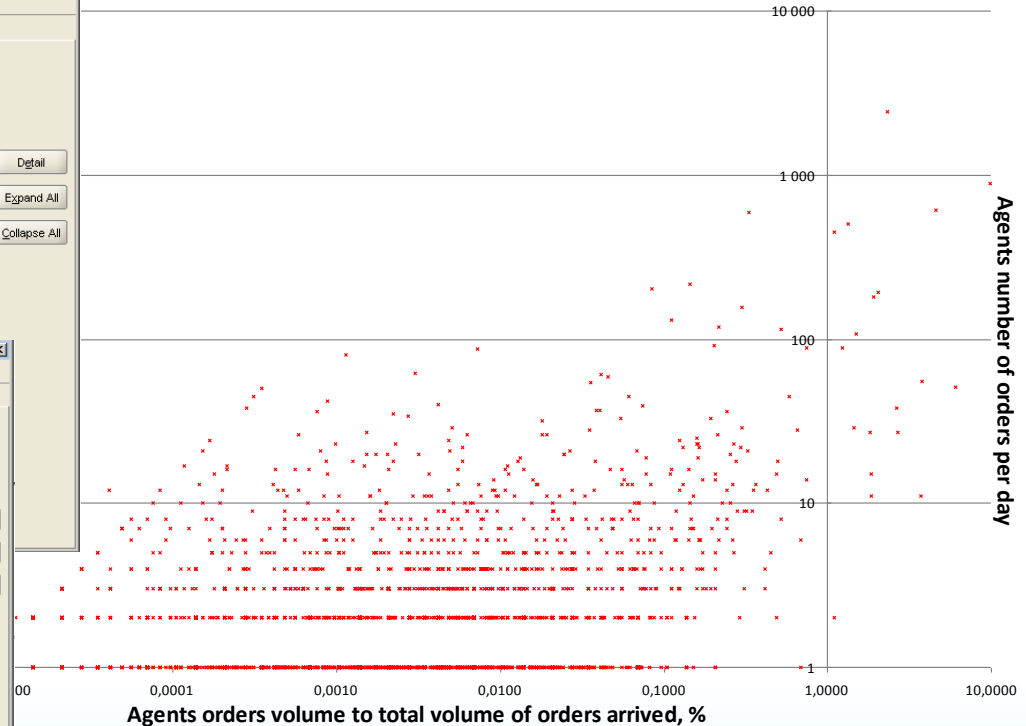
Clusters: Show Leaves Only

Cluster ID	Cases
1	2 359
2	761
3	1 598
4	736
5	862
6	146
8	24
10	11
12	3
13	8
11	13
14	5
15	8
9	122
16	57
18	22
19	35
17	65
7	716

Detail

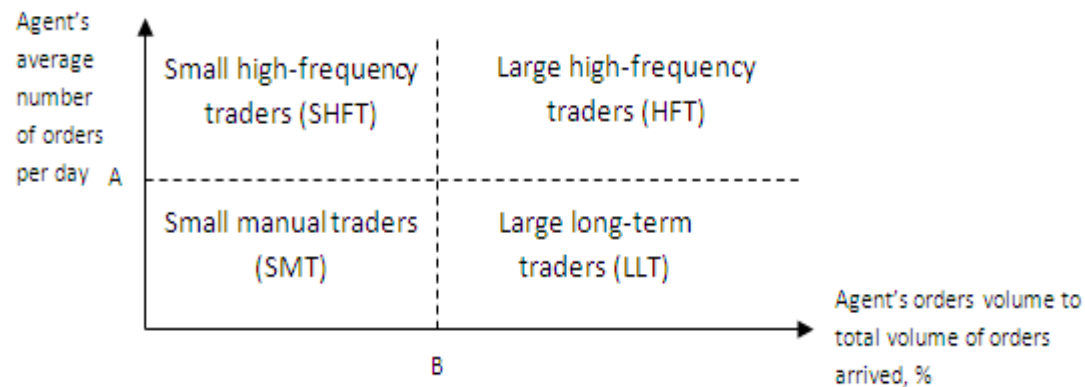
Expand All

Collapse All



Which one is correct?

HYDR: market microstructure map



Agents type	Number of agents (% of total)	Average orders intensity per agent per day	Average share of orders generated per agent per day	Total share of orders generated per cluster
HFT	16 (0,09%)	336,5	2,03%	32,45%
SHFT	69 (0,41%)	59,8	0,11%	7,30%
LLT	4 (0,02%)	9,5	1,52%	6,08%
SMT	16803 (99,48%)	0,5	0,003%	54,16%

Techniques applied

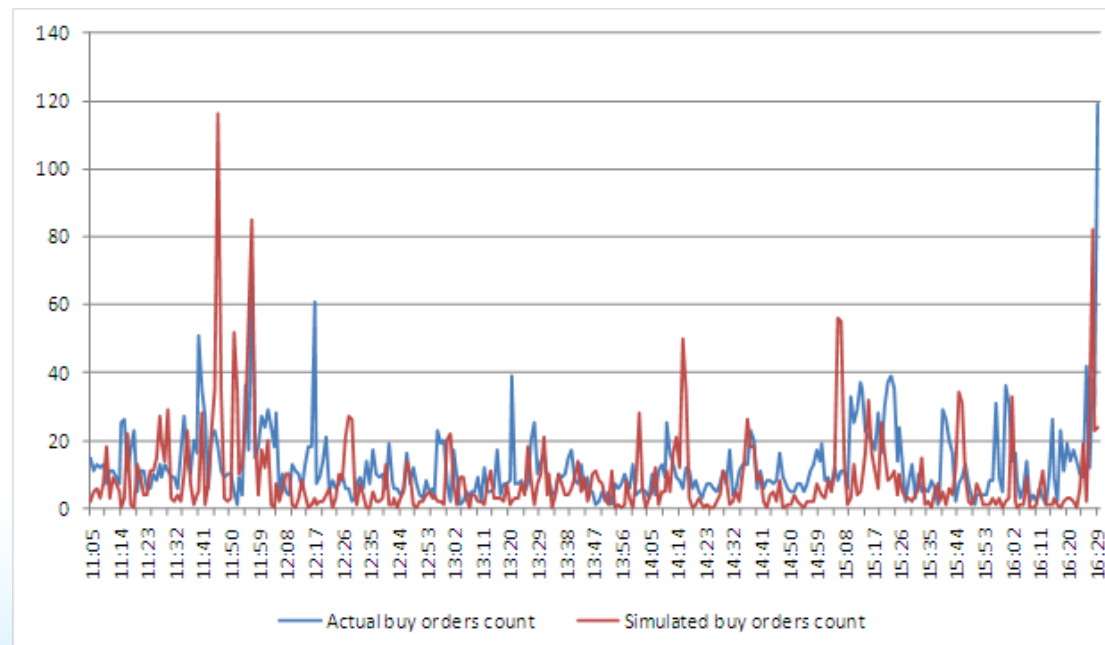
- Agents clusters modeling
- Econometrics for decision making functions
For order placement:
 - Linear regressions for HFTs and SHFTs,
 - Logit regressions for LLTs
- Monte-Carlo simulation
 - Exponential, Cauchy, Log-normal distributions.
 - Gaussian copula

Order parameters : HFTs and SHFTs

- Dividing day session into subsessions;
- Using AR-processes to imitate order placement intensity

$CNT_t = 1.61 + 0.504 \cdot CNT_{t-1} + 0.115 \cdot CNT_{t-5}$, $R^2 = 31\%$, sell side, subsession 11.00 – 16.30

$CNT_t = 1.89 + 0.601 \cdot CNT_{t-1} + 0.119 \cdot CNT_{t-5}$, $R^2 = 42\%$, buy side, subsession 11.00 – 16.30



Order parameters: LLTs

- Logistic regression for decision on order placement,
- Linear regression for price-quantity order parameters

$$L_t = \frac{1}{1 + \exp(-5.58 + 2.71 \text{BUY}_{t-1} \text{SH}_{t-1} + 0,00000013 \text{MVOL}_{t-1})} \quad , R^2 = 16,7\%, \text{ buy side}$$

$$L_t = \frac{1}{1 + \exp(-5.91 + 2.808 \cdot \text{SELL}_{t-1} \text{SH}_{t-1} + 0,00000012 \text{MVOL}_{t-1})} \quad , R^2 = 18\%, \text{ buy side}$$

$$\text{BUYVOL}_t = -3749277 \cdot 0.69 + 7510510 \cdot 0.3 \cdot \text{BUY}_{t-1} \text{SH}_{t-1} + 0.165 \cdot \text{MVOL}_{t-1} \quad , R^2 = 27\%$$

$$\text{SELLVOL}_t = -1672266 \cdot 0.3 + 4997988 \cdot \text{SELL}_{t-1} \text{SH}_{t-1} + 0.2511 \cdot \text{MVOL}_{t-1} \quad , R^2 = 36,7\%$$

$$\text{BUYP}_t = 0.998 \cdot \text{MPRICE}_{t-1} \quad , R^2 = 74,3\%$$

$$\text{SELLP}_t = 0.089 + 0.943 \cdot \text{MPRICE}_{t-1} \quad , R^2 = 70,3\%$$

Simulation Engine

Simulation engine

FFMS_DATA

Time	Type	Price	Quantity	Id
01.09.2010 18:17:11	LS	1,59	10200	1309047769
01.09.2010 18:17:11	cancel	-	0	1309041932
01.09.2010 18:17:12	LS	1,589	600000	1309047902
01.09.2010 18:17:13	LS	1,588	1000	1309047997
01.09.2010 18:17:13	LS	1,588	43000	1309048018
01.09.2010 18:17:14	LS	1,589	2000	1309048275
01.09.2010 18:17:16	LS	1,589	500000	1309048572
01.09.2010 18:17:16	cancel	-	0	1309041655
01.09.2010 18:17:17	LS	1,595	-31000	1309048820
01.09.2010 18:17:18	LS	1,588	100	1309048952
01.09.2010 18:17:18	LS	1,589	100000	1309048956
01.09.2010 18:17:18	cancel	-	0	1309043847
01.09.2010 18:17:19	LS	1,585	2000000	1309049073
01.09.2010 18:17:19	LS	1,588	1000000	1309049118
01.09.2010 18:17:19	LS	1,588	5000	1309049189
01.09.2010 18:17:20	LS	1,59	3000000	1309049250
01.09.2010 18:17:20	LS	1,586	2100	1309049282
01.09.2010 18:17:20	LS	1,589	-10000	1309049305
01.09.2010 18:17:20	LS	1,598	-131100	1309049306
01.09.2010 18:17:20	cancel	-	0	1309043744
01.09.2010 18:17:21	LS	1,586	50000	1309049349
01.09.2010 18:17:21	LS	1,587	8900	1309049430
01.09.2010 18:17:21	cancel	-	0	1309045089
01.09.2010 18:17:23	LS	1,592	10100	1309049708

Import... Send selected orders

Order book

Sell Quantity	Price	Buy Quantity	Code	Time
1,588	20000		1309046332	
1,588	7000		1309046468	
1,588	4600		1309045223	
1,588	1300		1309045088	
1,588	10000		1309043847	
1,588	32000		1309043643	
1,588	193900		1309043638	
30600	1,589		1309044055	
1000	1,59		1309040262	
100000	1,59		1309040772	
1198000	1,59		1309040886	
1000000	1,59		1309041074	
568900	1,591		1308976674	
60000	1,591		1308995791	

Show selected traders Best orders: 20
 Execute orders automatically

Deals

Code	Time	Price	Quantity	Buyer
5664	01.09.2010 18:17:04	1,588	100	14348
5665	01.09.2010 18:17:05	1,59	10200	2174
5666	01.09.2010 18:17:09	1,59	10100	2174
5667	01.09.2010 18:17:11	1,59	10200	2174
5668	01.09.2010 18:17:12	1,589	29100	12844
5669	01.09.2010 18:17:12	1,589	350000	12844
5670	01.09.2010 18:17:12	1,589	220900	12844
5671	01.09.2010 18:17:14	1,589	2000	11324
5672	01.09.2010 18:17:16	1,589	77100	5934
5673	01.09.2010 18:17:16	1,589	13500	5934
5674	01.09.2010 18:17:16	1,589	40000	5934
5675	01.09.2010 18:17:16	1,589	369400	5934
5676	01.09.2010 18:17:18	1,589	100000	12354

Deal Sec Min Hour Count: 150

Traders

Code	Type	Orders	Deals	Sum quantity	Net volume	Net value	Planned orders
2193	TRealTrader	1	1361	30600	28500	-37835,999...	0
573	TRealTrader	4	1262	3885700	-46481600	73846612,0...	0
61	TRealTrader	0	660	0	129300	-216945,00...	0
2674	TRealTrader	1	637	32000	-1915500	2815727	0
2174	TRealTrader	0	423	0	317900	-512828,60...	0
9147	TRealTrader	3	336	9568900	25085100	-39711212	0
3825	TRealTrader	0	188	0	-19567300	31041148,2	0
7088	TRealTrader	4	170	350800	9200	-14071,600...	0
11840	TRealTrader	0	152	0	15000000	-23838000,...	0
593	TRealTrader	3	136	3000000	-14995100	23753730,5	0
11293	TRealTrader	0	129	0	1583200	-2525124,8	0

 SMT LLT HFT SHFT Trade up to time: 10:30:00 11:30 18:30 Trade

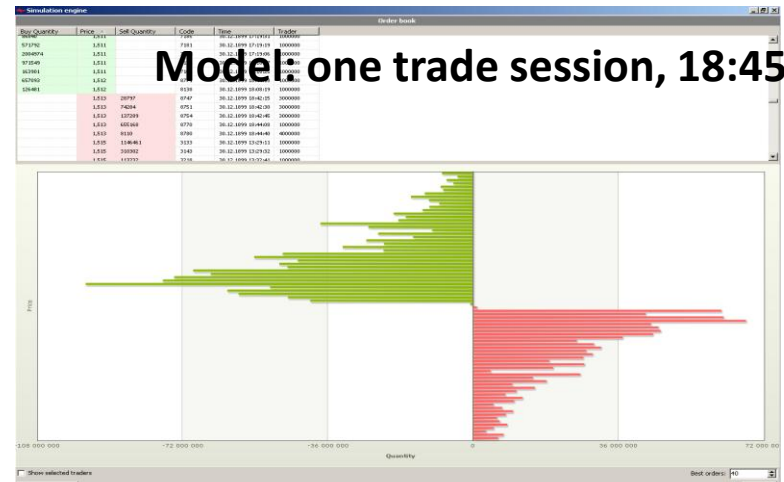
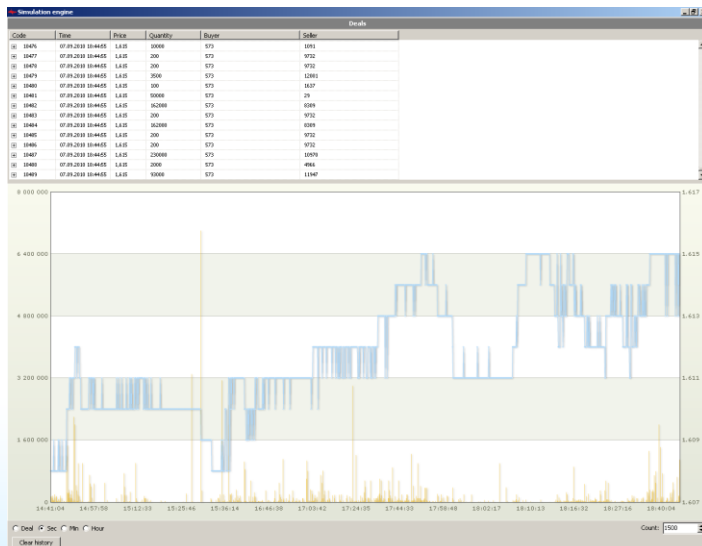
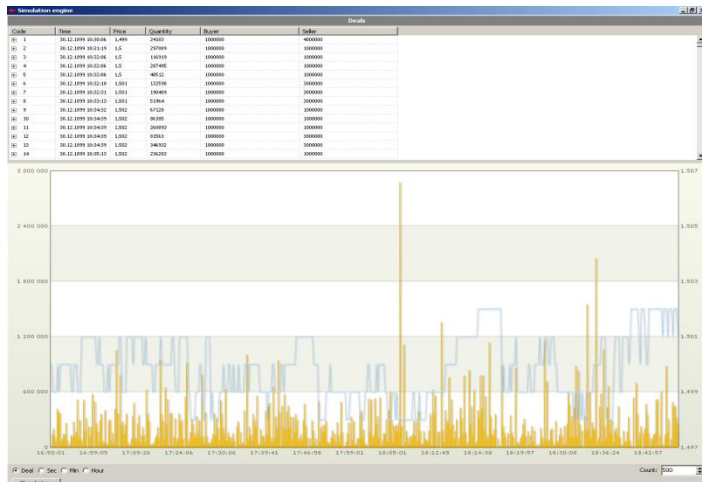
Traders current orders

Time	Price	Current quantity
01.09.2010 18:16:34	1,59	-1000000
01.09.2010 18:16:11	1,586	643200
01.09.2010 18:14:47	1,591	-1242500
01.09.2010 10:32:34	1,593	-1000000

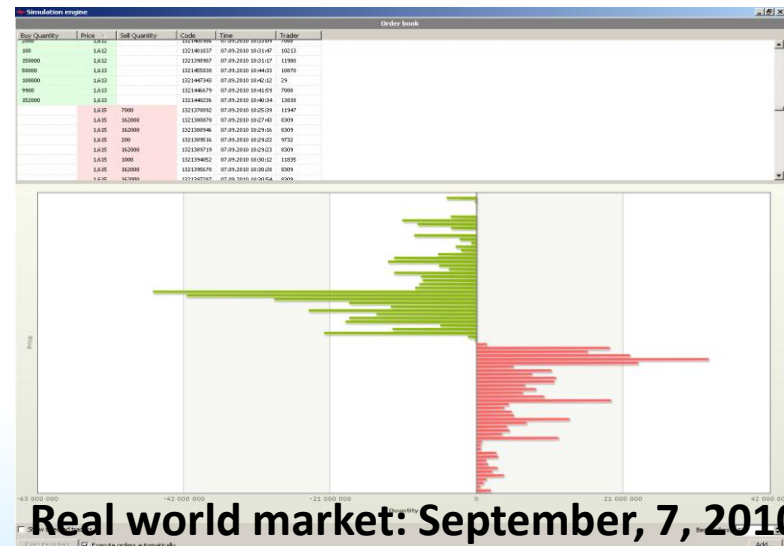
Traders deals

Code	Time	Price	Quant
130	01.09.2010 10:30:14	1,59	-32
131	01.09.2010 10:30:14	1,59	-6C
132	01.09.2010 10:30:14	1,59	-2C
140	01.09.2010 10:30:26	1,59	-2C
141	01.09.2010 10:30:40	1,591	-2C
142	01.09.2010 10:30:42	1,591	-1E
143	01.09.2010 10:30:43	1,591	-4I
144	01.09.2010 10:30:44	1,59	-1E
145	01.09.2010 10:30:45	1,591	-3E

Model results comparing to real world market



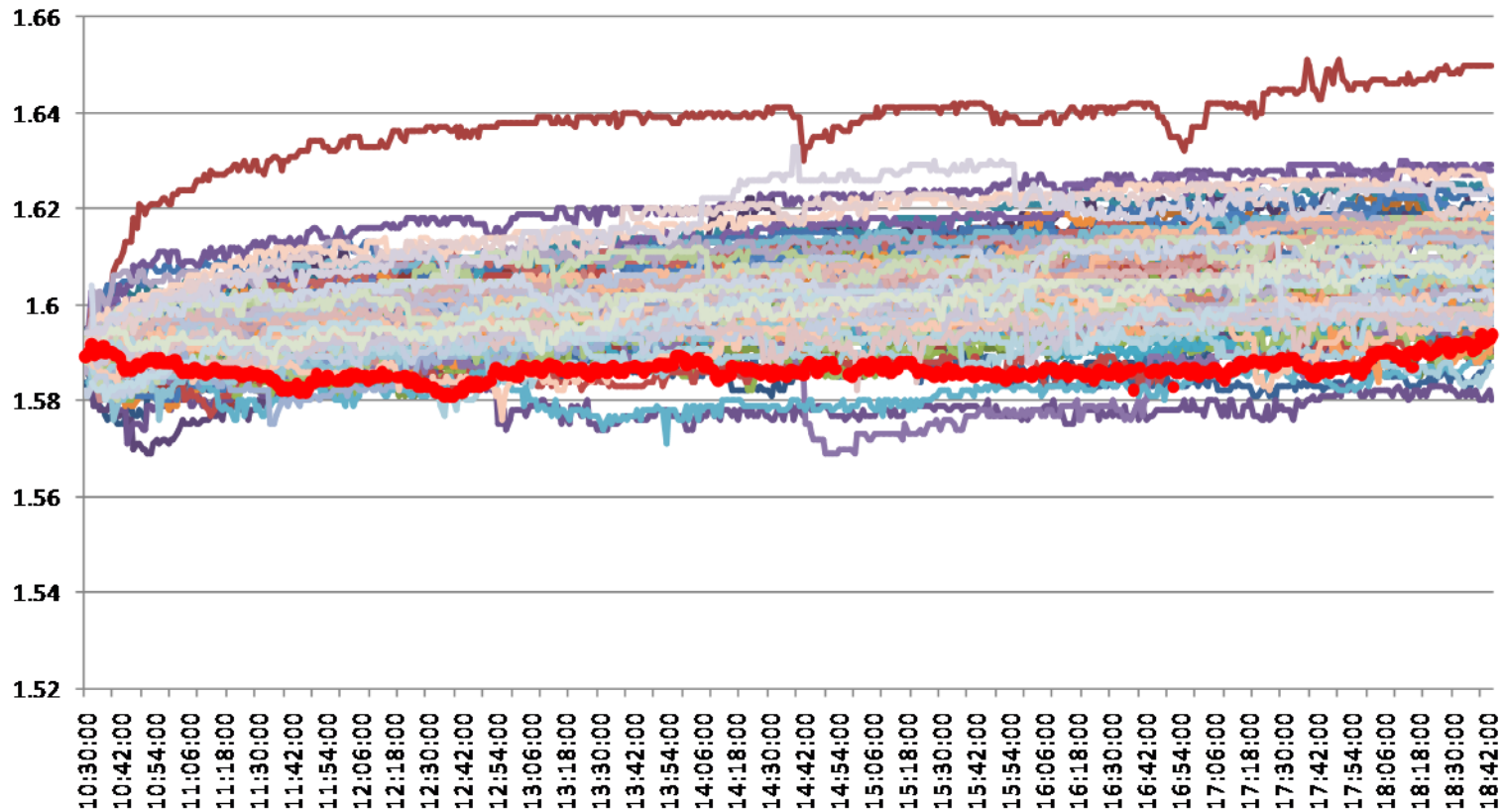
Model: one trade session, 18:45



Real world market: September, 7, 2010 18:45

Model results comparing to real world market

Price dynamics



What's next?

- Detailing clusters,
- Turn from sub clusters to agents level,
- Implementing direct agents interaction,
- Further decision making functions calibration...

Thank you!

Questions?

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