Smart order execution strategies

Basic principles

As new markets appear, the problems of scaling cryptocurrency and altcoin trade play a crucial role in the fast development of the blockchain industry. Institutional investors need to carry out trade operations with a very heavy volume of assets. If the operation volume is larger than the market can "digest" without affecting the price, then operations can lead to a significant price change and slippage. Therefore, it will be impossible to execute the order at the same price. First, all the trades will be at the desired price, but gradually the price will become less profitable.

In order to reduce costs, institutional clients need to use smart order execution strategies. This class of strategies is based on the work with the order book. HyperQuant software allows users to dynamically create quoting strategies depending on a particular task. Execution of large market orders can be divided into several steps and involve a combination of various strategies, including the following:

1. quotation for placing an order at BBO
2. quotation of the given price level
3. quotation of the desired order volume
4. spread quotation

Quotation types may vary significantly. Depending on the necessary configuration, you can use multiple legs and configure each of them individually.
It is possible to create a model configuration, depending on the following parameters:
— whether the leg will be used for quotation or not
— quote one level or multiple levels in the leg
In case of hedging, grab liquidity from down in the order book or use the current BBO.

HyperQuant platform users will be able to configure different custom fields of quotation strategies. For example:

- Instrument
- Volume
- Minimum volume
- Maximum volume
- Maximum BBO distance
- Internal quotation levels

- Internal quotation levels
- Hedging
    - Hedging type
    - Hedging settings

TWAP algorithmic order

For every specified interval, buy/sell transactions with the given volume are carried out for a defined number of iterations at the weighted average price or with an intended price divergence from BBO. The overall order volume is executed evenly within the given interval. The even volume order execution is ensured by dividing the interval by N iterations.

Here, we explain how the order parameters are calculated. In each *i-th* iteration, the order is placed with the following parameters: order volume and order price.

The order volume is calculated as follows:

$$V_i = \frac{V}{N} + V_{i-1}^{left}$$

where V is the overall order volume, N is the number of iterations, and V_{i-1}^{left} is the unexecuted volume of the previous iteration.

The buy limit order price is calculated as follows:

$$P_i = A \cdot (1 + \frac{Lim}{100})$$

where A is the best bid price and Lim is the the tolerable price divergence from the best bid price in per cent.

The sell limit order price is calculated as follows:

$$P_i = B \cdot (1 - \frac{Lim}{100})$$

where B is the best offer price and Lim is the tolerable price divergence from the best offer price in per cent.

Buy/sell order market price

In this case, the orders are executed at BBO, taking into account the price change as the volume of the *i-th* iteration is fulfilled.

Order placement

If the place order transaction is rejected by the stock exchange's trading system, then the order is withdrawn.

Otherwise, the unexecuted volume is calculated as follows:

$$V_i^{left} = V_i - V_i^{exec}$$

where V_i^{exec} is the executed volume.
If the unexecuted volume equals zero, one should proceed to clause «execution for the *i-th+1* iteration».
If the unexecuted volume does not equal zero, then one should decide whether to transfer the unexecuted volume to the next interval or not.
If the interval (*i-th* iteration) is over, then the unexecuted volume is transferred to the next interval (*i-th+1* iteration).
When the unexecuted volume is transferred to the next iteration, provided that the current iteration is not the last one, the order is withdrawn.

«VWAP» algorithmic order

For a defined number of iterations during a specified interval, a certain volume is bought/sold at the volume weighted average price, not exceeding the intended price divergence. Maximum and minimum price limits are established so that the price stays within that range during each iteration. The order is executed evenly during the given interval.

The overall time interval is limited by t_s and t_E (time of the interval start and time of the interval ending) and is divided by N intervals. The execution order is placed at each interval, and the order volume equals the given percentage $(Perc_v)$ of the executed volume for the previous interval. The order volume is also limited by the upper limit $1/N$. If there is unexecuted volume from the previous iteration, then the current iteration limits the volume with the upper limit $1/\mathrm{N}$ + unexecuted volume from previous iterations.

In each *i-th* iteration, the order is placed with the following parameters: order volume and order price.

The order volume is calculated as follows:

$$V_i = Min((V_{i-1}^{exec} \cdot \frac{Perc_v}{100} + V_{i-1}^{left}), (\frac{V}{N} + V_{lim}^{left}))$$

where V_{i-1}^{exec} is the executed volume from the previous iteration, V_{i-1}^{left} is the unexecuted volume from the previous iteration, V is the total volume, and V_{lim}^{left} – is the total unexecuted volume left until the exceeded limit in the previous iterations. With that,

$$V_{lim}^{left} = \frac{V \cdot i}{N} - V^{exec}$$

where V^{exec} is the total unexecuted volume in all iterations.

The weighted average price is calculated for all trades until t moment:

$$P_t^W = \frac{\sum_j P_j \cdot Q_j}{\sum_j Q_j}$$

where P_j is the price of each trade until t moment, and Q_j is the quantity in each trade.

The weighted average price is calculated for all trades until t moment, taking into account ΔP_{max}^W as the given maximum divergence of the weighted average price of execution.

For a buy order:

$$Plim_t^W = P_t^W \cdot (1 + \frac{\Delta P_{max}^W}{100})$$

For a sell order:

$$Plim_t^W = P_t^W \cdot (1 - \frac{\Delta P_{max}^W}{100})$$

The buy order price is calculated as follows:

$$P_i = MAX(A, Plim_t^W{}_i)$$

The sell order price is calculated as follows:

$$P_i = MIN(B, Plim_t^W{}_i)$$

where A is the best bid price, and B is the best offer price.

Order placement

In case the placing order transaction is rejected by the trading system of the stock exchange, then the order is withdrawn.

Otherwise, the unexecuted volume is calculated as follows:

$$V_{lim}^{left} = V_i - V_i^{exec}$$

If the unexecuted volume equals zero, one should proceed to «execution for the *i-th+1* iteration» clause. If the current iteration is the last one, then the order awaits t_E.

If the unexecuted volume does not equal zero, then one should decide whether to transfer the unexecuted volume to the next interval or not.

If the interval (*i-th* iteration) is over, then the unexecuted volume is transferred to the next interval (*i-th+1* iteration).

When the unexecuted volume is transferred to the next iteration, provided that the current iteration is the last one, the order is cancelled.