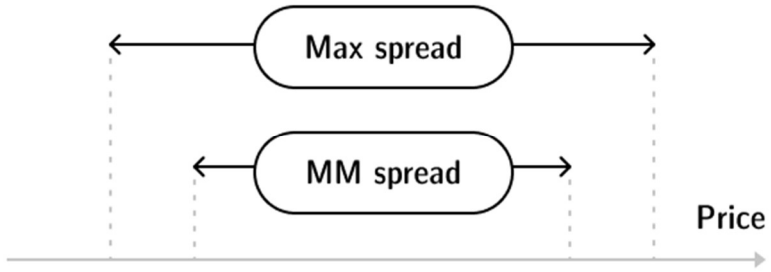
Market-making algorithms

Providing liquidity is of paramount importance for further development of the trading industry. Liquidity provision mechanisms are widely spread in the largest stock markets: NYSE, NASDAQ and CME.

A market maker must support two-way quotations in the orderbook and comply with the following requirements:
— Support of the two-way quotations spread: maximum difference between best bid price and best offer price for the given market maker's orders in relation to a particular instrument.
— Minimum volume of orders: total volume of all buy and sell orders according to the market maker's data in relation to a particular instrument within the two-way quotations spread.
— Minimum quotation period: Market maker must support two-way quotations with the established spread and volume of orders placed during the given time period.



Picture 2. Market-making spread

Execution of market-making algorithms leads to a boost of liquidity of trading instruments while the spread is being reduced. It also results in a lower volatility of the trading instruments.

One of the market-making strategies involves the simultaneous placement of buy and sell orders. This strategy carries a risk of failure of one of the two orders if the price goes in the opposite direction of the working order direction. In order to reduce the risk, one should use a neutral average price that will depend on the quantity of the market maker's open position.

Neutral average price is calculated as follows:

$$P_n = P_{last} - Q \cdot \gamma \cdot \sigma^2 (T - t)$$

where P_{last} is the last trade price,
Q is the quantity of the open position,
γ is the constant index (chosen during the algorithm testing),
σ is the standard divergence of the asset price,
T is the trading period, and
t is the current time (in T fractions).

Buy and sell orders are placed at distances Δb *and* Δa from the price P_n. The given quantities will depend on the intensity of order execution λ, which, in its turn, depends on distance δ to the average price.
The average price equals (best bid price + best offer price)/2. Therefore,

$$\lambda(\delta) = A \cdot e^{(-k\delta)}$$

where $A = \frac{\Lambda}{\alpha}$, Λ is the frequency of buy and sell market orders, $\alpha = 1{,}5$

$$\Delta b + \Delta a = \gamma \cdot \sigma^2 (T - t) + \frac{2}{\gamma} ln(1 + \frac{\gamma}{k})$$