**Bid Price Threshold**

For a security with externally forced bid-ask spread , the following **Bid Price Amount Inequality** must be held for a long or short position of bid price with amount to be respectively opened or closed instantly in full amount for sure in theory:

Where is the ith currently unmatched bid price greater than or equal to with amount , and is the jth currently unmatched asked price less than or equal to with amount .

Without changing the value of , as decreases, the number of currently unmatched bid prices greater than or equal to increases while the number of currently unmatched ask prices less than or equal to decreases, causing the inequality to be harder to hold.

So for a given , the minimum value of holding the inequality will be the theoretical **Bid Price Threshold** for both instantly opening a long position and closing a short position in full amount.

The **Bid Price Function** based on over time can be represented as follows:

If , then will instantly be the fully matched bid price in theory, otherwise no such guarantee can be given.

**Ask Price Threshold**

Similarly, the following **Ask Price Amount Inequality** must be held for a short or long position of ask price with amount to be respectively opened or closed instantly in full amount for sure in theory:

Where is the jth currently unmatched asked price less than or equal to with amount , and is the ith currently unmatched bid price greater than or equal to with amount .

Without changing the value of , as increases, the number of currently unmatched ask prices less than or equal to increases while the number of currently unmatched bid prices greater than or equal to decreases, causing the inequality to be harder to hold.

So for a given , the minimum value of satisfying the inequality will be the theoretical **Ask Price Threshold** for both opening a short position and closing a long position in full amount.

The **Ask Price Function** based on over time can be represented as follows:

If , then will instantly be the fully matched ask price in theory, otherwise no such guarantee can be given.

**Demonstrations**

Let’s say the current price of a security is 95 with 1 as the base unit, and it applies the following fees:

1. The actual price of a bid paid by the bidder will be increased by 1 after submission but the matched ask will still only get the submitted bid price
2. The actual price of an ask received by the asker will be decreased by 1 after submission but the matched bid will still pay the submitted ask price

With the following unmatched bid-ask table, the **Bid Price Thresholds** and **Ask Price Thresholds** can be calculated:

|  |  |  |
| --- | --- | --- |
| **Submitted Price** | **Actual Price** | **Amount** |
| 93 Ask | 92 Ask | 870 |
| 94 Ask | 93 Ask | 900 |
| 95 Ask | 94 Ask | 860 |
| 95 Bid | 96 Bid | 850 |
| 96 Bid | 97 Bid | 910 |
| 97 Bid | 98 Bid | 890 |
| 98 Bid | 99 Bid | 880 |

First, the total amount of ask is 870+900+860=2630 while that of bid is 850+910+890+880=3530, meaning that the 900 amount of bid having the lowest price and then the latest submission time won’t be instantly matched in theory(at least not in full amount), while the remaining 2630 amount of bid having the highest price and then the earliest submission time will theoretically be instantly matched in full.

Then, all bids with submitted price 97 and 98 should be instantly matched in full, while the earliest submitted 860 amount of bids with submitted price 96 should also be instantly matched, leaving the remaining 50 latest submitted ones, along with all bids with submitted price 95 to be matched later if possible.

Assuming that a new bid can be submitted right after these submissions but right before the actual matching, then the **Bid Price Thresholds** for the following amounts are:

860 or smaller amounts – 97 submitted bid price

861 to 860+890=1750 – 98 submitted bid price

1751 to 860+890+880=2630 – 99 submitted bid price

Note that it’s impossible to fully match amounts larger than 2630 instantly no matter how high the bid price is, as there are just 2630 amount of asks.

Similarly, the **Ask Price Thresholds** for the following amounts are:

900 or smaller amounts – 97 submitted ask price

901 to 900+860=1760 – 94 submitted ask price

1761 to 900+860+900=2660 – 93 submitted ask price

2661 to 900+860+900+870=3530 – 92 submitted ask price

Note that it’s impossible to fully match amounts larger than 3530 instantly no matter how low the ask price is, as there are just 3530 amount of bids.