Homework #2

FE-570

October 2, 2023

Problem 2.1.

For this problem load the dataset `sampleTQdata.RData` provided in Canvas. This is a generic data set in TAQ format for one trading day 09:30am - 4:00pm. Load the dataset using the R file provided.

We will use these data sets to get some practice working with tick level data.

1. Load the TAQ dataset. Explore the data, and answer the following questions:

i) how many trades are in the dataset?

ii) plot the trade prices p_t and the best-bid b_t and best-ask prices a_t for the entire dataset.

iii) same as in ii) but only for trades with counts 100:200 (this means the 100-th trade to the 200-th trade).

2. Count how many trades take place within the spread ($p_t \in (b_t, a_t)$), and how many at the touch ($p_t = b_t$ or $p_t = a_t$). Give separately the three numbers, and test if their sum reproduces the total trade count from 1.i).

3. Determine the "trade direction" d_t of each trade, which shows if it is a buy ($d_t = +1$) or a sell ($d_t = -1$).

There are two ways to do this, as described below. Implement each of them in R.

i) **Tick test.** This test uses only the trade prices p_t, but not the quotes

a_t, b_t. Under this test the trade is classified as buy/sell according to:

$d_t = +1$ (buy) if $p_t > p_{t-1}$ (uptick) or if $p_t = p_{t-1} > p_{t-2}$ (zero-uptick)
$d_t = -1$ (buy) if $p_t < p_{t-1}$ (downtick) or if $p_t = p_{t-1} < p_{t-2}$ (zero-downtick)

Note that zero-uptick/downtick results apply also if there are multiple (more than 2) trades with the same price. For example if the trade prices are $p_t = (19.9, 20.0, 20.0, 20.0)$ (increasing t order), then the trade signs are $(?, +, +, +)$.

ii) **Lee-Ready rule.** This test uses both trade prices p_t and quotes a_t, b_t. The Lee-Ready rule decides if a trade is a buy or sell by comparing the trade price p_t with the mid-price $m_t = \frac{1}{2}(a_t + b_t)$ (the half-point between best-bid b_t and best-ask a_t). If the trade price is exactly equal to the mid-price $p_t = m_t$ then use the tick rule in point (i) above.

$$d_t = \begin{cases} +1 \text{ (buy)} & \text{if } p_t > m_t \\ -1 & \text{if } p_t < m_t \\ \text{tick rule} & \text{if } p_t = m_t \end{cases} \tag{1}$$

The Lee-Ready rule is implemented as the function `getTradeDirection` in *highfrequency*. You have to implement it independently.

Test that your implementation gives the same result as the `getTradeDirection` implementation.

Compare the results of the two methods (tick rule and Lee-Ready rule) for determining the trade direction. Compute the number of trades which are classified the same way under the two tests.