

Advanced Assignment Equities:

1. Assume that Trader "A" places an order and the order book changes as given in the image below. What is the side, quantity and nature of the order (limit/ market, aggressive/passive).

Before

Price (£)	Quantities		
8.50	20		
8.35	150	100	
8.30	100	200	50
8.25			
8.20			
8.15	80	160	
8.1	150		
8.05	70	350	



After

Price (£)	Quantities		
8.40	20		
8.35	150	100	
8.30	150		
8.25			
8.20			
8.15	80	160	
8.10	150		
8.05	70	350	

2. Assume that Trader "B" places an order and the order book changes as given in the image below. What is the side, quantity and nature of the order (limit/ market, aggressive/passive).

Before

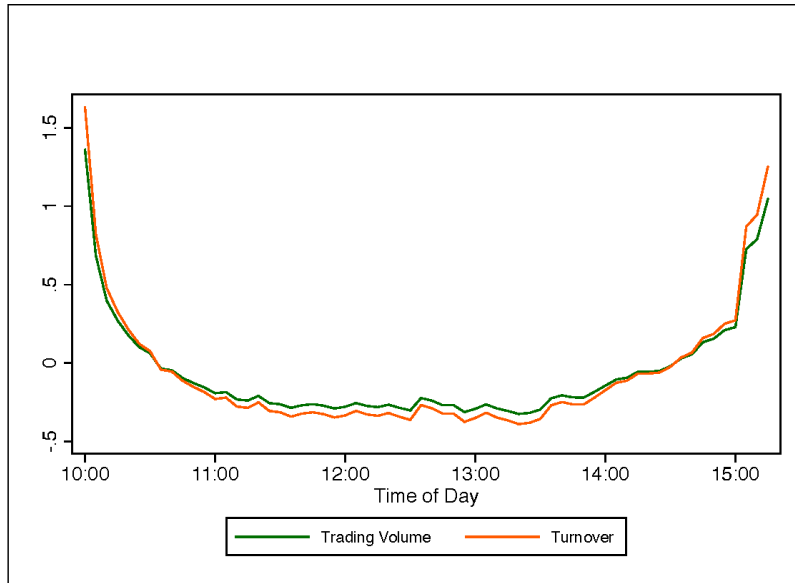
Price (£)	Quantities		
8.40	20		
8.35	150	100	
8.30	100	200	50
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8.20			
8.15	80	160	
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After

Price (£)	Quantities		
8.40	20		
8.35		20	
8.30			
8.25			
8.20			
8.15	80	160	
8.1	150		
8.05	70	350	

3. Everything else being equal, which of the following algo orders will have more market impact. Please explain with sufficient reasoning. POV = Percentage of volume
  - i. POV 5
  - ii. POV 15
4. Say a trader wants to buy 100,000 shares of Google. He decided to do so by using the TWAP algo and spreading his order over the entire day. In which of the following two timeframes is he likely to have more market impact. Assume a regular U shaped intraday volume profile as shown below :



(Market Open : 10:00 | Market Close : 16:00 )

- a. 10:15 to 10:30
  - b. 13:00 to 13:15
5. Briefly mention a scenario when the trading trajectory of a VWAP algo order will be similar to that of a POV algo order

# ANSWERS

## Answer 1 -

The sell side of the order book changed and the buy side remained the same. So trader A has placed a buy order. **So side is buy.**

The order is an **Aggressive limit buy order submitted at 8.30.**

- Trader A placed an order that first matched with existing sell offers at the price level 8.30.

- This can be seen as the **sell order disappeared** from the book — it was executed immediately.
- Since 150 units of **new buy orders** are shown at **8.30** in the updated book, it implies that remaining 150 units were not filled and are now resting as a passive limit buy order at 8.30.
- Hence the **total quantity of the order is  $350 + 150 = 500$** .

It acted aggressively because it crossed the spread and this means the order is **Aggressive Limit Order**. The order took existing liquidity (rather than waiting to be filled), it is considered **aggressive**.

Conclusion-

Parameter	Value
Side	Buy
Quantity	500 units
Order Type	Aggressive Limit Order
Nature	Aggressive

**Answer 2-** The sell side of the order book changed and the buy side remained the same. So trader B has placed a buy order. So **side is buy**.

At an ask price of 8.30 quantity reduced from  $(100 + 200 + 50)$  350 to 0 that means 350 units were bought. At an ask price of 8.35 , quantity reduced from  $(150 + 100)$  250 to 20 that means 230 units were bought. So the total quantity bought is  $350 + 230 = \mathbf{580 \text{ units}}$ .

Conclusion-

Attribute	Value
Side	Buy
Quantity	$350 \text{ (at 8.30)} + 230 \text{ (from 8.35)} = \mathbf{580}$
Nature	<b>Market Order</b> (because it executed immediately)
Aggressive or Passive	<b>Aggressive</b> (because it removed liquidity from the book)

### Answer 3 -

POV algo main points are-

- Instead of sending a large block order at once, target a defined fraction of the actual volume for each interval
- Intention is to keep trading activity in line with total volume. The aim is to be unseen in the natural flow of market trading, thereby reducing the likelihood of moving the market too much.
- Trade at a constant percentage (Participation rate)

POV 5 –

Participation rate = 5%

POV 15 –

Participation rate = 15%

More volume traded at once compared to POV 5

- Now, executing a larger share of the volume makes trading activity more noticeable to other market participants => POV 15 will be more noticeable, this visibility can cause other traders to adjust their pricing or withdraw liquidity, increasing market impact.
- Higher participation requires more frequent and possibly larger trades, putting more pressure on the order book and potentially moving prices => increasing market impact
- POV 15 will generally cause more market impact than POV 5 because it demands more liquidity from the market in a shorter time span

**Hence, everything else being equal POV 15 will have more market impact.**

### Answer 4 -

TWAP algo main points-

- Equal Amount of shares contracts in each interval
- But the trading volume exhibits  
U-shape pattern from opening to closing

Although the TWAP strategy keeps the execution rate constant, the actual market impact varies depending on the prevailing trading volume. When executing during higher volume periods, the same number of shares would have less impact on price because the market can absorb them more easily. Conversely, during low volume periods, executing the same number of shares can push the price up or down more, since there are fewer counter-orders available.

In a typical U-shaped intraday volume pattern, volume is relatively high near the open, tapers off around midday, and then picks up again toward the close. Consequently:

- From 10:15–10:30, overall market volume is still relatively high (shortly after the open).

- From 13:00–13:15, volume tends to be lower (midday lull).

Because market impact is generally related to how large your order is relative to available liquidity, **trading between 13:00 and 13:15** will likely lead to a **greater market impact** (the same 100,000 shares make up a bigger slice of lower midday volume).

#### Answer 5 -

Both VWAP and POV algorithms aim to execute trades based on market volume, though their methodologies differ slightly.

#### VWAP (Volume Weighted Average Price) algo order-

- VWAP executes trades based on historical volume patterns, executing amounts proportional to the predicted volume in that interval.
- It allocates more trades during periods of historically high volume and fewer trades during historically low volume.

#### POV (Percentage of Volume) algo order-

- It dynamically adjusts its trading intensity based on real-time market activity, executing a fixed percentage of the live market volume.
- Trades as a constant percentage equal to the participation rate.

#### Scenario when the trading trajectory of a VWAP algo order will be similar to that of a POV algo order

- When the **current day's trading volume distribution closely matches/ mirrors historical trading volume patterns**, the VWAP and POV algorithms may behave similarly, resulting in overlapping trajectories.
- Scenarios where the **market volume is stable and predictable**.
- Trading session with uniform market volume distribution throughout the day. In such a case, both algorithms would execute trades at a relatively constant pace, leading to similar execution patterns.

Example :- Suppose a trader wants to execute 10000 shares using both algorithms during a trading session:

- VWAP: The algo predicts and executes a trade at 10% of total hourly market volume based on historical patterns.
- POV: The algo dynamically executes 10% of real-time market volume.

In this case, both algorithms would execute approximately 1000 shares, leading to similar execution trajectories.

#### When VWAP and POV Differ:

If there are volume spikes (e.g., during news events or at market open/close), VWAP and POV would diverge.

- VWAP would continue to follow its predetermined schedule based on historical patterns.
- POV would adjust dynamically to capture its percentage of increased real-time volume.