Trading algorithms, markets and the cost of a trade

Portfolio Management

1 A story: the tanker in the harbour

- A huge order is unloaded in slices, like a tanker
- An algorithm is a rule for slicing the order
- Four classes, each built for a different order
- Skill: match the class to the order

IN THE LESSON

- Imagine a harbour with a small dock.
- A tanker arrives with a huge load of oil.
- If the crew pumps it all out in one minute, the dock floods and prices nearby jump.
- So they unload in slices, at a pace the harbour can take.
- Trading a large order of shares works the same way.
- If Imani Voss sent the whole order to the market at once, her own buying would push the price up against her.
- So the order is cut into small pieces and fed to the market by a trading algorithm, which is simply a rule that decides when, where and how much to trade.
- There are four main classes of rule, and the skill lies in matching the class to the order.

2 Four classes of trading algorithm

What each class is built to do

Class of algorithm	Core idea
Schedule: VWAP, TWAP, volume share	Follow plan
Arrival price	Trade early
Liquidity-seeking	Hunt for size
Close-targeting	Match close

IN THE LESSON

- Here are the four classes.
- The first is schedule based.
- It follows a plan laid down in advance.
- Volume weighted average price, which people say as V W A P, trades in step with the market's usual pattern of volume through the day, so the average price paid stays close to the day's average.
- Time weighted, said T W A P, trades the same amount in each slice of time.
- Percentage of volume trades a fixed share of whatever the market actually trades.
- The second class is arrival price, also called implementation shortfall.
- It trades more at the start, to stay close to the price when the order arrived.
- The third is liquidity seeking.
- It searches visible exchanges and dark venues, where orders are hidden, for chances to trade a big block.
- The fourth targets the close.

3 What decides the choice

- Order size against normal daily volume
- Urgency: how soon the idea is priced in
- Liquidity and the gap between buy and sell prices
- Volatility: how wild the usual swings are
- Benchmark: the yardstick for judging the trade

IN THE LESSON

- So what decides the choice?
- Five things, and Imani checks them in turn.
- First, the size of the order compared with the stock's normal daily volume.
- A small order hardly disturbs anyone, so the choice matters little.
- A big one demands care.
- Second, urgency.
- If Tomas thinks the market will price in his idea within a day or two, she cannot dawdle.
- Third, how liquid the stock is, meaning how easily it trades, and how wide the gap is between the buying and selling price.
- Fourth, volatility, the size of the usual price swings, because a wild stock punishes slow trading.
- Fifth, the benchmark, the yardstick the trade will be judged against.
- If that yardstick is the day's average price, a schedule that tracks it is the natural fit.

4 Steady pace or front loaded

Chart: Order done (%) vs Trading day, open to close

- Arrival: 44% at quarter day
- Schedule: 25% at quarter day

IN THE LESSON

- Here is the difference in picture form.
- The horizontal axis is the trading day, from the open to the close.
- The vertical axis is how much of the order is done, as a percentage.
- The grey line is a schedule based algorithm.
- It trades at an even pace, so after a quarter of the day exactly twenty five per cent is done.
- The red line is an arrival price algorithm.
- It rushes at the start.
- After the same quarter of the day it has done forty four per cent, and it finishes sooner.
- Why accept this?
- Because if the price is likely to drift away, each hour of waiting is a cost.
- What do you pay for the speed?
- More impact, because your own trading is squeezed into a shorter time.
- Patient orders choose the grey line, and urgent orders the red.

5 Example 1: percentage of volume

Thornbury buys 600,000 shares; normal daily volume 5,000,000

Order against daily volume	600,000 ÷ 5,000,000	**12%**
Volume needed at a 10% rate	600,000 ÷ 0.10	**6,000,000**
Days at normal volume	6,000,000 ÷ 5,000,000	**1.2 days**
Quiet day, volume 4,000,000	10% × 4,000,000	**400,000 filled**
Left unfilled	600,000 − 400,000	**200,000**

IN THE LESSON

- Now an example of the trap.
- Tomas wants six hundred thousand shares of a stock that normally trades five million shares a day.
- The order is twelve per cent of a normal day, which is large but manageable.
- Imani picks a percentage of volume algorithm set to ten per cent.
- To trade six hundred thousand at ten per cent of volume, the market must trade six million shares while she works.
- At five million a day, that takes one point two days.
- So the finish time is not fixed, it depends on the market.
- Now suppose the day is quiet and only four million shares trade.
- Ten per cent of four million is four hundred thousand, so two hundred thousand shares are still waiting.
- Worse, volume often surges when the price is moving against the order, so the algorithm buys most when buying is dearest.

6 Which order, which class

Imani's quick decision guide

The order	Class chosen
Large, patient, liquid, VWAP yardstick	Schedule
Urgent, price may run away	Arrival price
Large order in a thin stock	Seek liquidity
Index fund, valued at the close	Close target

IN THE LESSON

- Putting it together, here is a quick decision guide.
- A large, patient order in a liquid stock, benchmarked to the day's average price, suits a schedule based algorithm.
- An urgent order, where the price may run away, suits arrival price, which front loads the trading.
- A large order in a thin stock suits liquidity seeking, which takes size whenever it appears, over hours or even days, because a schedule is hard to keep when little trades.
- An index fund whose value is struck at the closing price should target the close, so its trades match the yardstick it is measured against.
- Notice the pattern.
- Nobody picks the cleverest algorithm.
- They pick the one that fits the order's size, urgency and yardstick.

7 A story: price tags and haggling

- Exchange markets: visible prices, like price tags
- Dealer markets: ask for a quote, like a stall
- Different structure needs different tools
- Do not use equity tools in dealer markets

IN THE LESSON

- Think of two ways to buy something.
- In a supermarket every item has a price tag, everyone sees the same price, and you simply pick it up.
- At a street stall in a foreign town there are no tags.
- You ask the seller, perhaps ask a second seller, and agree a price.
- Markets work the same way.
- Shares, futures and listed options trade on exchanges and similar venues where orders and prices are visible.
- Bonds, swaps and spot currency mostly trade with dealers, firms that quote you a price at which they will buy or sell.
- Imani has been asked to write a note for traders joining a new multi asset fund at Thornbury.
- Her first line is simple: do not use the supermarket's tools at the stall.

8 Exchange markets and dealer markets

Exchange style: visible prices

Equities → Futures → Listed options

Dealer style: ask for quotes

Bonds → Swaps → Spot currency

IN THE LESSON

- Here is the picture.
- The top row is exchange style trading.
- Equities trade on exchanges and alternative venues, with visible order books, dark pools and algorithms.
- Futures are standardised contracts, cleared centrally and margined, which means a small deposit is held daily against losses.
- Listed options are standardised too.
- The bottom row is dealer trading.
- Bonds trade over the counter, which means directly between firms, mostly through dealers.
- Swaps are custom contracts, negotiated with one dealer.
- Spot currency, the swap of one money for another for immediate delivery, trades in a deep dealer market that is increasingly electronic.
- The top row is a crowd of visible prices.
- The bottom row is a conversation with a few dealers, and that changes what a trader can do.

9 Exchange markets: what to expect

Visible books, central clearing

Market and its feature	Effect
Equities: order books, dark pools	Algorithms
Futures: standard, cleared, margined	Front month
Listed options: standard, cleared	Near the money

IN THE LESSON

- Start with the exchange markets.
- Equities have the deepest liquidity in large companies, where thousands of orders sit in the book, and patchy liquidity in small ones.
- Because the book is visible, algorithms can slice orders and work them across venues, including dark pools, which hide orders until they trade.
- Futures and listed options are standardised, so every contract is the same, which pools liquidity.
- They are centrally cleared and margined, so a clearing house stands behind each trade and collects daily payments from losers, which cuts counterparty risk.
- But liquidity gathers in a few places: the nearest expiry of a future, called the front month, and options whose strike price is close to the current price, called near the money.
- Far dated futures and distant options can be thin.

10 Dealer markets: what to expect

Negotiated trades, dealer quotes

Dealer market and its feature	Effect
Bonds: many issues rarely traded	Wide spreads
Swaps: custom, negotiated	Costly to exit
Swaps: clearing and collateral	Less risk
Spot currency: deep dealers	Electronic

IN THE LESSON

- Now the dealer markets.
- Most bond issues trade rarely.
- A company may have dozens of bonds, and on many days some do not trade at all.
- So there is no reliable volume curve and little price transparency, and the gap between the dealer's buying and selling prices is wide.
- Spreads and impact costs are higher than for shares, and a trader typically asks several dealers for quotes.
- Swaps are customised and negotiated with one dealer.
- They carry counterparty risk, the chance the other side fails to pay, which is reduced by clearing and by collateral, assets posted as security.
- And because they are tailor made, they can be costly to unwind, since only the dealer who knows the trade may offer a fair price.
- Spot currency is the friendly one: a deep dealer market, increasingly traded on electronic platforms.

11 Example 2: half the spread

Buy 5m each. Share 49.995-50.005; bond 99.75-100.25

Share half spread	0.005 ÷ 50.00	**1 bp**
Bond half spread	0.25 ÷ 100.00	**25 bp**
Cost of 5m in the share	5m × 0.0001	**500**
Cost of 5m in the bond	5m × 0.0025	**12,500**
Bond against share	12,500 ÷ 500	**25 times**

IN THE LESSON

- Let us put a cost on the difference.
- Kofi, the junior trader, wants to buy five million of a large company's shares and five million of a corporate bond, using the same tools.
- Half the quoted spread is roughly what you give up by crossing it.
- The share is quoted at forty nine point nine nine five to fifty point zero zero five, a gap of one cent.
- Half of that, divided by fifty, is one basis point, which is one hundredth of one per cent.
- The bond is quoted at ninety nine point seven five to one hundred point two five, so half the gap is point two five on a price of one hundred, which is twenty five basis points.
- On five million, the share costs five hundred and the bond costs twelve thousand five hundred.
- The bond costs twenty five times as much, and it has no visible volume curve for a V W A P algorithm to follow, so Imani tells Kofi to ask dealers for quotes.

12 A story: the paper portfolio

- Paper portfolio: traded instantly at the decision price
- Real portfolio: slow, partly filled, charged fees
- Implementation shortfall = the gap between them
- Four pieces: delay, execution, opportunity, fees

IN THE LESSON

- When Tomas decides to buy, he has an imaginary version of the trade in his head.
- In it, the whole order is bought instantly, at the price on his screen at that moment, with no fees.
- Call that the paper portfolio.
- The real portfolio is messier.
- The order takes time to reach the desk, the price moves, only part is filled, and commission is charged.
- The difference in profit between paper and real is the implementation shortfall, the standard measure of what a trade really cost.
- It is a valuable measure because it blames nothing and misses nothing.
- It splits into four pieces: delay, execution, opportunity and fees.
- Each piece answers a different question about the journey from idea to fill.

13 Four prices along one trade

Chart: Share price vs Time, decision to cancellation

- Decision 40.00
- Arrival 40.08
- Average fill 40.20
- Cancelled 40.60

IN THE LESSON

- Here is one buy order drawn as a price path.
- The horizontal axis is time, from the decision on the left to the cancellation on the right.
- The vertical axis is the share price.
- At the first point Tomas decides, and the price is forty.
- That is the decision price.
- A little later the order reaches the trading desk and the price has risen to forty point zero eight, the arrival price.
- The desk then buys most of the shares at an average of forty point two zero.
- The price keeps rising, and Tomas cancels the unfilled shares when the price is forty point six zero.
- Notice the gaps.
- Decision to arrival is the delay.
- Arrival to the average fill is the execution.
- And decision to the final price is what the unfilled shares missed.

14 Implementation shortfall

Shortfall = delay + execution + opportunity + fees
bp = shortfall ÷ (shares ordered × decision price) × 10,000

Delay cost	Arrival − decision, traded shares
Execution cost	Fill − arrival, traded shares
Opportunity cost	Final − decision, unfilled shares
Fees	Commission and other charges

IN THE LESSON

- Now the four pieces.
- Delay cost is the arrival price minus the decision price, times the shares that were actually traded.
- It is the price of waiting before the order reached the market.
- Execution cost is the average execution price minus the arrival price, again times the shares traded.
- It is the price of trading itself, including your own impact.
- Opportunity cost is the final price, or the price when the order was cancelled, minus the decision price, times the shares never traded.
- It is the gain you missed.
- Fees are commissions and other explicit charges.
- Add the four to get the shortfall.
- To express it in basis points, divide by the paper investment, shares ordered times the decision price, and multiply by ten thousand.
- For a sale, reverse the signs, so a lower price is the cost.

15 Example 3: Thornbury's shortfall

Order 50,000 at 40.00; arrival 40.08; fill 40,000 at 40.20

Delay cost	40,000 × (40.08 − 40.00)	**3,200**
Execution cost	40,000 × (40.20 − 40.08)	**4,800**
Opportunity cost	10,000 × (40.60 − 40.00)	**6,000**
Fees at 0.02 a share	40,000 × 0.02	**800**
Shortfall on 2,000,000	14,800 ÷ 2,000,000	**74 bp**

IN THE LESSON

- Now the numbers.
- Tomas ordered fifty thousand shares at a decision price of forty.
- The arrival price was forty point zero eight.
- Forty thousand shares were bought at an average of forty point two zero.
- Ten thousand were cancelled at forty point six zero.
- Commission is two cents a share on shares traded.
- Delay: forty thousand times eight cents is three thousand two hundred.
- Execution: forty thousand times twelve cents is four thousand eight hundred.
- Opportunity: ten thousand times sixty cents is six thousand.
- Fees: forty thousand times two cents is eight hundred.
- The total is fourteen thousand eight hundred.
- The paper portfolio is fifty thousand times forty, which is two million, so the shortfall is seventy four basis points.
- Notice that the opportunity cost is the biggest piece, and it never appears on a broker's statement.

16 The four pieces in dollars

Cost (dollars)

Delay	**3,200**
Execution	**4,800**
Opportunity	**6,000**
Fees	**800**

Fees are 5% of the 14,800 total

IN THE LESSON

- Here are the four pieces as bars.
- The vertical axis is cost in dollars.
- Delay is three thousand two hundred.
- Execution is four thousand eight hundred.
- Opportunity, the tallest, is six thousand.
- Fees, the shortest, are only eight hundred.
- Fees are the only bar a broker's statement shows.
- So a manager who looks only at commissions sees about five per cent of the true cost, eight hundred out of fourteen thousand eight hundred.
- The tall bar is a lesson about the order itself.
- Tomas cancelled the unfilled part, and the price kept rising, so a large share of the cost was shares he never bought.
- Whether that was a mistake depends on his view, but measuring the shortfall makes the cost of hesitating visible instead of hiding it.

17 Example 4: the trap in numbers

Same order: what a report that skips unfilled shares shows

Traded shares only	3,200 + 4,800 + 800	**8,800**
In basis points	8,800 ÷ 2,000,000	**44 bp**
Missed on unfilled shares	10,000 × 0.60	**6,000**
Missing from the report	6,000 ÷ 2,000,000	**30 bp**
True shortfall	8,800 + 6,000	**14,800 = 74 bp**

IN THE LESSON

- Now the trap, in numbers.
- Suppose a report measured only the shares that were bought.
- Delay, execution and fees add to three thousand two hundred plus four thousand eight hundred plus eight hundred, which is eight thousand eight hundred.
- Over the two million paper investment, that is forty four basis points.
- It sounds respectable.
- But the ten thousand shares never bought missed a rise of sixty cents each, six thousand in all, thirty basis points.
- Add that and the true shortfall is fourteen thousand eight hundred, seventy four basis points.
- The lesson is that an unfilled order is not free.
- If a trader can look good by filling only the easy shares, the report rewards the wrong behaviour.
- Always ask what happened to the shares that were not traded.

18 Three mistakes so far

- Percentage of volume: finish time is not fixed
- Equity tools do not suit dealer markets
- Shortfall must include the unfilled shares

IN THE LESSON

- Time to stop and check three mistakes.
- The first is thinking a percentage of volume algorithm will finish the order on time.
- It trades a share of whatever volume appears, so completion is uncertain, and it can trade more when the market is moving against you.
- The second is applying equity trading tools to dealer markets.
- Bonds and swaps have no visible book and no reliable volume curve, so the answer is to ask for quotes, weigh the spread, and plan for higher costs.
- The third is leaving out the unfilled shares when measuring shortfall.
- Opportunity cost is real, and ignoring it lets slow and partial trading look cheap.
- Keep these three in mind, and we turn to judging the quality of the work.

19 A story: the runner and the wind

- A runner's time depends on the wind and the course
- Pick the yardstick that fits the race
- Strip out what the trader cannot control
- Then compare with the plan and with peers

IN THE LESSON

- A runner finishes a race.
- Is her time good?
- It depends.
- Was there a tailwind, or a gale in her face?
- Was the course hilly?
- Was she expected to run faster or slower?
- To judge her fairly you need a yardstick, you need to remove the weather, and you need the plan.
- Judging a trade is the same.
- Tomas will ask Imani whether a trade was good, and she cannot answer from the price alone.
- She chooses a benchmark that fits the purpose of the order, expresses the cost in basis points, removes the movement of the whole market, and compares the answer with what the desk expected beforehand and with similar trades by others.
- That is the process, and each step guards against a different way of being fooled.

20 Cost in basis points

Buy: cost = (average price − benchmark) ÷ benchmark × 10,000
Sale: (benchmark − average price) ÷ benchmark × 10,000

Average price	Price actually paid or received
Benchmark price	Price the order is judged against
Cost in bp	Positive = a cost to the client

IN THE LESSON

- The formula is simple.
- For a buy, the cost in basis points is the average execution price minus the benchmark price, divided by the benchmark price, times ten thousand.
- A positive number means you paid more than the yardstick, which is a cost.
- For a sale, reverse the sign: benchmark minus the average price received, over the benchmark.
- Again positive is a cost, and a negative number means you beat the yardstick.
- The classic slip is to apply the buy formula to a sale, which turns a cost into a gain.
- The real choice is the benchmark.
- Arrival price captures the full impact of trading, and suits an order with a deadline.
- Volume weighted average price shows whether the trader beat the day's average.
- Closing price suits index trades.

21 Which yardstick for which order

Match the yardstick to the order's purpose

Benchmark and what it shows	Best for
Arrival price: full impact of trading	Urgent orders
VWAP: did we beat the day's average	Patient orders
Close: the price that values the fund	Index trades
Pre-trade estimate and peers	Context

IN THE LESSON

- Each benchmark answers a different question.
- Arrival price asks what the whole trade cost compared with the market when the order reached the desk.
- It includes the impact of the trader's own buying, so it suits urgent orders.
- Volume weighted average price asks whether the trader beat the day's average, and it suits patient orders worked across the day.
- The closing price asks how far the fills were from the price that values an index fund, which makes it the fair yardstick for index trades.
- Last, the pre trade cost estimate from the desk's model, and the results of peers, add context.
- A number with nothing to compare it with is only a number.

22 Example 5: a buy, fully judged

Buy 300,000: arrival 60.00, paid 60.48, VWAP 60.36

Cost against arrival	0.48 ÷ 60.00 × 10,000	**80 bp**
Market drift, beta 1.2	1.2 × 40 bp (index +0.40%)	**48 bp**
Market-adjusted cost	80 − 48	**32 bp**
Cost against VWAP	0.12 ÷ 60.36 × 10,000	**19.9 bp**
Desk estimate was 30 bp	32 − 30	**2 bp over**

IN THE LESSON

- Now Imani reviews a buy of three hundred thousand shares of a food company.
- The arrival price was sixty.
- The average price paid was sixty point four eight.
- The day's volume weighted average price was sixty point three six.
- While the order was worked, the market index rose point four per cent, and the stock has a beta of one point two, meaning it normally moves one point two times as much as the market.
- Against the arrival price, the cost is forty eight cents over sixty, which is eighty basis points.
- That looks bad.
- But the market itself rose, and a stock with that beta would be expected to rise forty basis points times one point two, forty eight basis points.
- Take that off and the market adjusted cost is thirty two basis points, the trader's own part.
- Against the volume weighted average price the cost is nineteen point nine basis points.
- The desk had estimated thirty.

23 Taking the market out

Adjusted cost = raw cost − beta × index return over the trading period

Raw cost	Cost against the arrival price
Beta	Sensitivity to the market
Index return	Index move while trading
Adjusted cost	The trader's own part

IN THE LESSON

- The market adjustment deserves its own formula.
- Take the cost against the arrival price, then subtract beta times the index return over the trading period.
- Beta tells you how strongly this stock normally moves with the market.
- If the stock has a beta above one, the market alone is expected to carry the price up by more than the index itself rose.
- What is left is the trader's own contribution.
- The same idea works for a sale.
- If the market falls while you are selling, part of the shortfall is the market's doing, not the trader's.
- Remember the direction: for a buy, a rising market raises cost, and for a sale, a falling market raises cost.
- Subtract only the part the market explains.

24 Four readings of one trade

Cost (basis points)

Arrival price	**80**
Market-adjusted	**32**
Against VWAP	**19.9**
Pre-trade estimate	**30**

Same trade, four readings

IN THE LESSON

- Here are the four readings of the same trade as bars.
- The vertical axis is cost in basis points.
- The tall bar is the arrival price cost, eighty.
- The market adjusted bar, thirty two, is what is left after removing the market's push.
- The volume weighted bar, nineteen point nine, is lower still, because the day's average was itself pushed up by the same rising market.
- And the last bar is the pre trade estimate, thirty.
- Read together, the raw eighty alarmed us, but the trader's own part was close to plan, only a little above the estimate.
- A fair verdict is acceptable execution in a rising market, worth a look at whether the first hour could have been quicker.
- One number alone would have told the wrong story, in either direction.

25 Example 6: the VWAP trap

Sell 150,000: arrival 80.00, sold at 79.60, VWAP 79.50

Cost against arrival	(80.00 − 79.60) ÷ 80.00	**50 bp**
Cost against VWAP	(79.50 − 79.60) ÷ 79.50	**−12.6 bp**
Order share of day's volume	order ÷ whole market	**40%**
Is the VWAP beat real?	order moved the benchmark	**Not much**

IN THE LESSON

- Now the classic trap.
- Another trader sold a hundred and fifty thousand shares of a mining company.
- The arrival price was eighty.
- The average sale price was seventy nine point six zero.
- The day's volume weighted average price was seventy nine point five zero.
- She says she beat the benchmark, so the execution was excellent.
- Check, using the sale formula.
- Against arrival, eighty minus seventy nine point six zero is forty cents, fifty basis points of cost.
- Against the volume weighted price, seventy nine point five zero minus seventy nine point six zero is minus ten cents, minus twelve point six basis points, a gain.
- But her order was forty per cent of the day's volume.
- A seller that large drags the day's average down, so the benchmark was partly made by her own selling.
- Beating it proves little, and fifty basis points is the honest number.

26 The whole judging routine

Measure

Pick the benchmark → Cost in basis points → Remove market drift

Interpret

Pre-trade estimate → Peer orders → Fair verdict

IN THE LESSON

- Here is the whole judging routine as a flow.
- The top row is the measurement.
- First, pick the benchmark that fits the order's purpose.
- Second, compute the cost in basis points, with the right sign for a buy or a sale.
- Third, remove the market drift using beta and the index return.
- The bottom row is the interpretation.
- Compare with the pre trade estimate, to see whether the result matched the plan.
- Compare with peers, similar orders by similar traders, to see whether the plan itself was reasonable.
- Then judge, and ask one more question: how much of the day's volume did the order take?
- A large order can flatter its own benchmark.
- Tomas gets a short, honest answer: the result, the reason and the lesson.

27 Recap: the lesson in five lines

- Algorithm: size, urgency, liquidity, benchmark
- Exchanges allow algorithms; dealers need quotes
- Shortfall = delay + execution + opportunity + fees
- Cost in bp against the benchmark that fits
- Remove market drift; beware a big order's own VWAP

IN THE LESSON

- Let us pull the lesson together.
- First, the choice of trading algorithm follows the order: its size against normal volume, its urgency, the liquidity and volatility of the stock, and the benchmark.
- Second, exchange markets allow algorithms, while bonds, swaps and spot currency are dealer markets that need quotes and bring higher costs.
- Third, implementation shortfall is delay plus execution plus opportunity plus fees, and it must count the shares never traded.
- Fourth, execution is judged in basis points against the benchmark that fits the order.
- Fifth, remove the market's drift with beta, compare with the estimate and with peers, and beware a big order that flatters its own average price.

28 Try three quick questions

1. Buy 20,000: decision 10.00, arrival 10.10, 15,000 filled at 10.20, rest cancelled at 10.50, no fees. Shortfall?
   Answer: 1,500 + 1,500 + 2,500 = 5,500, which is 275 bp.
2. Raw cost 60 bp; beta 0.8; index up 0.50%. Market-adjusted cost?
   Answer: 0.8 × 50 = 40, so 60 − 40 = 20 bp.
3. Why not run an equity VWAP algorithm on a rarely traded bond?
   Answer: No reliable volume curve: ask dealers for quotes.

IN THE LESSON

- Now try three quick questions yourself.
- Pause after each one.
- Question one.
- A buy of twenty thousand shares has a decision price of ten and an arrival price of ten point one zero.
- Fifteen thousand shares are filled at an average of ten point two zero, and the rest are cancelled at ten point five zero.
- There are no fees.
- What is the shortfall?
- Delay is fifteen hundred, execution is fifteen hundred, and opportunity is twenty five hundred.
- The total is fifty five hundred, which is two hundred and seventy five basis points.
- Question two.
- A buy costs sixty basis points against the arrival price.
- The stock has a beta of point eight, and the index rose half a per cent.
- What is the market adjusted cost?
- Point eight times fifty is forty, and sixty minus forty leaves twenty basis points.
- Question three.
- Why not run an equity volume weighted algorithm on a rarely traded bond?
- Because bonds trade with dealers and have no reliable volume curve, so the trader should ask dealers for quotes.