

Set 1 Questions

1. Algorithmic trading *most likely* refers to:
 - A. regular observation of the market followed by manual placement of trades.
 - B. carefully processing each trade decision and executing orders individually.
 - C. using a computer to automate a trading strategy.
2. Which of the following is *least likely* a goal of execution algorithms?
 - A. Minimize market impact.
 - B. Automate “how to trade”.
 - C. Make trading decisions based on data patterns.
3. Which of the following is *most likely* an objective of high-frequency algorithmic trading?
 - A. Minimize market impact.
 - B. Ensure a benchmarked price.
 - C. Automate “when to trade”.
4. Which of the following is *least likely* a goal of high-frequency algorithmic trading?
 - A. Slice large orders into smaller trades.
 - B. Maximize profit.
 - C. Automate “what to trade”.
5. Low latency is *most likely* critical for:
 - A. execution algorithms.
 - B. high-frequency trading algorithms.
 - C. neither execution algorithms nor high-frequency trading algorithms.
6. Which of the following is *least likely* an execution algorithm?
 - A. Market participation.
 - B. Implementation shortfall.
 - C. Pairs trading.
7. Which of the following trading strategies is *best* executed using high-frequency trading algorithms?
 - A. Spread trading
 - B. Implementation shortfall.
 - C. Volume-weighted average price.
8. Which of the following *best* describes spread trading?
 - A. Break down orders based on historical trading volumes of a security.
 - B. Dynamic adjustment of trades as per market conditions.
 - C. Take long/short positions in the futures market based on profitability motives.
9. Which of the following *least likely* employs high-frequency algorithmic techniques?
 - A. Liquidity aggregation and smart order routing.
 - B. Calculation of the volume-weighted average price of a security.

- C. Calculation of the real-time price of a security.
10. Market fragmentation is *best* described as a situation where:
- A. trading is split across multiple venues.
 - B. different types of securities trade on the same platform.
 - C. liquidity aggregation on the largest exchange.
11. Which of the following techniques has *least likely* evolved in response to the trend that trading in certain securities is split across multiple venues?
- A. Liquidity aggregation.
 - B. Smart order routing.
 - C. Genetic tuning.
12. Which of the following is *least likely* an approach to mitigate trading risk?
- A. Real-time pre-trade firewall.
 - B. Back testing and market simulation.
 - C. Detecting anomalous market movements.
13. Which of the following is *least likely* a goal of real-time monitoring/market surveillance?
- A. Detect potential market abuse while it is happening.
 - B. Detect anomalous market movements.
 - C. Detect irregularities in trading costs.
14. Which of the following is *least likely* a concern associated with algorithmic trading?
- A. Fear of an unfair advantage.
 - B. Accentuation of market movements.
 - C. Higher cost of execution.

Set 1 Solutions

1. C is correct. Following an algorithm means taking a series of steps to attain a goal. Algorithmic trading means “using a computer to automate a trading strategy.” Algorithms can take and execute several trading decisions, hence do not trade orders individually. Section 2. LO.a.
2. C is correct. Execution algorithmic trading breaks down large orders and executes them over a certain time, thereby minimizing market impact and automating the placement of orders. Making trading decisions based on data patterns is achieved with HFT algorithms. Section 2.1. LO.b.
3. C is correct. HFT algorithms automate “when to trade” as opposed to execution algorithms which automate “how to trade.” A & B are goals of execution algorithms. Section 2.2. LO.b.
4. A is correct. HFT algorithms do not slice large orders into smaller trades but try to maximize profit. At times these algorithms help determine “what to trade.” Section 2.2. LO.b.
5. B is correct. Latency is defined as “the time difference between stimulus and response.” In HFT algorithms low latency is important to act upon an opportunity ahead of others in the market. Section 2.2. LO.b.
6. C is correct. Pairs trading is a strategy associated with HFT algorithms or stat arb trading. It monitors breaks in correlated relationships between different pairs of instruments. A & B are examples of execution algorithms. Section 2.2. LO.c.
7. A is correct. Spread trading is executed with the HFT algorithms. This trading mechanism involves typically taking long and short positions in the futures market based on the spread between the two. B & C are examples of strategies used in execution algorithms. Section 2.2. LO.c.
8. C is correct. Spread trading is executed with the HFT algorithms. This trading mechanism involves typically taking long and short positions in the futures market based on the spread between the two. A describes VWAP, and B describes implementation shortfall strategy. Section 2.2. LO.c.
9. B is correct. An instance is a program based on execution algorithm which takes inputs from the relevant parameters of the parent order. A & C are areas which use high-frequency algorithmic techniques. Section 2.2. LO.c.
10. A is correct. Market fragmentation is when an instrument trades on multiple avenues resulting in fragmented liquidity in that instrument. Hence B & C are incorrect. Section 3. LO.d.
11. C is correct. Genetic tuning is a high-frequency algorithmic technique in which several (thousands) permutations of algorithms are run parallel with real market data input but may

not trade live in the market. A & B are effects caused by market fragmentation. Section 3. LO.d.

12. C is correct. A & B are the common trading risk mitigation approaches used. Detecting anomalous market movements is associated with real-time monitoring which is performed by regulatory authorities. Section 5.1. LO.e.
13. C is correct. The detection of cost irregularities is not an objective of real-time monitoring and surveillance. A & B are goals of real-time monitoring/ market surveillance. Section 5.2. LO.e.
14. C is correct. The use of algorithms results in **lower** execution costs. A & B are concerns surrounding the use of algorithmic trading. Section 6. LO.f.

Set 2 Questions

The following information relates to questions 1 - 3.

Sam Hunt, chief investment officer at SWL Securities is meeting with two recently hired traders, Andy Stowe and Sonia Shirazi to assess their knowledge of algorithmic trading. Hunt starts the meeting by saying that there are two types of trading algorithms - algorithms for execution and algorithms for high-frequency trading (HFT), and asks Stowe to differentiate between them.

Stowe replies as follows:

- I. “Execution algorithms break down large orders into smaller trades and execute them over time, whereas high-frequency trading or HFT tracks high-frequency data, makes decisions based on this data, and automatically places and manages orders.
- II. Execution algorithms are about automating “how to trade” and “when to trade” whereas high-frequency trading besides handling “how and when” also deals with “what to trade.”
- III. The objective of execution algorithms is to minimize market impact whereas HFT algorithms focus on profit.”

Hunt then inquires about the types of execution algorithms and HFT algorithms. Shirazi explains, “The examples of execution algorithms are volume-weighted average price (VWAP), implementation shortfall, and market participation algorithms. Some types of HFT algorithms are pairs trading, index arbitrage, spread trading, mean reversion and delta neutral strategies.”

Hunt adds, “HFT algorithmic techniques are also used in liquidity aggregation and smart order routing, what do you understand by these strategies?” Shirazi remarks, “Because of market fragmentation, liquidity disparity exists across various venues trading the same instruments. Algorithmic techniques have been used to aggregate liquidity across markets and use smart order routing to send orders to the venues with liquidity so that trades are completed without delay.”

1. Does Stowe *correctly* differentiate between execution algorithms and HFT algorithms?
 - A. Yes.
 - B. No, incorrect regarding minimizing market impact.
 - C. No, incorrect about execution algorithms automating “how” and “when” to trade.
2. The types of execution algorithms and HFT algorithms mentioned by Shirazi are *most likely*:
 - A. correct.
 - B. incorrect, because VWAP is a HFT algorithmic strategy.
 - C. incorrect, because pairs trading is an execution algorithmic strategy.
3. Does Shirazi *correctly* describe the liquidity aggregation and smart order routing used by HFT algorithms?
 - A. Yes.
 - B. No, incorrect regarding liquidity disparities.
 - C. No, incorrect because price disparities also exist.

The following information relates to questions 4 – 7.

Dya Mirza, head of trading at SLZ Investment Bank is conducting a training session of her team on algorithmic trading. Mirza starts the session by making the following comment:

“In all forms of algorithmic trading particularly in high-frequency trading strategies, minimizing latency is an important factor for success. “What are the key components necessary to achieve low latency?”

Junaid Bari, a junior trader, responds:

“Generally, traders are concerned with end-to-end latency. Hence market data, algorithmic and high frequency trading engine, order execution and managing orders over FIX are the main components of minimizing latency.”

Next, Mirza asks the participants, “What are the factors that have led to the development of algorithmic trading and HFT?” Satish Balani, a recently hired trader comments:

“Market fragmentation, opportunities in new asset classes, opportunities in cross-asset class trading, prospects in new geographies and cross-border trading opportunities are some of the drivers of algorithmic trading and HFT.”

Finally, Mirza observes, “Algorithmic and high-frequency trading have caused both positive and negative impact on the markets as a whole. Some of the positive influences are:

- I. Algorithmic trading provides an automated way to break down large orders into smaller trades that minimize impact on the market while achieving a benchmarked price.
 - II. Using algorithms, rather than expensive traders, and the competition between brokers has helped to lower margins resulting in significant cost reduction.
 - III. The use of algorithms in trading has promoted more open and competitive trading amongst large firms across different geographies through technologies such as CEP, widely available low latency market connectivity, and hosting environments.”
4. What does minimizing latency *most likely* mean in algorithmic trading? Low latency means minimizing the:
 - A. trading expense of the firm and client.
 - B. time taken for receiving market data, identifying a pattern or opportunity, making a decision, and executing trades.
 - C. reducing the distance for data to travel to and from the venue.
 5. Does Bari *correctly* state the components of the low latency value chain?
 - A. Yes.
 - B. No, incorrect regarding managing orders over FIX.
 - C. No, incorrect regarding market data.
 6. In algorithmic trading and HFT stat arb strategies, opportunities in cross-asset class trading are capitalized. A *most likely* example of opportunities in cross-asset class trading is:

- A. A US Treasury government bond has a correlation relationship with the US future contract of the same maturity.
 - B. An energy stock trading below its fair value on BOVESPA is identified by a trader in New York.
 - C. A stock with multiple listings on London Stock Exchange (LSE) and NASDAQ is trading at a significant discount on LSE.
7. Does Mirza *correctly* state the positive influences of algorithmic and high-frequency trading on securities markets?
- A. Yes.
 - B. Incorrect with respect to cost reduction.
 - C. Incorrect with respect to open and competitive trading only amongst large firms.

The following information relates to question 8.

Hans Dieter, senior risk manager at Deutsche Investments, in a meeting with Kathlene Swift, head of trading desk, informs her that in view of the increase in risk due to HFT trading, he has implemented two broad measures: real-time pre-trade risk firewall and back testing and market simulation. To a query from Swift about real-time pre-trade firewall, Dieter explains:

“Real-time pre-trade risk firewall involves: (1) Continuously recalculating risk exposures on trade positions while monitoring trades so that the pre-defined risk limits are not exceeded. In case a pre-determined risk threshold is breached, trades are blocked. (2) Monitoring erroneous trades, and blocking them.” Dieter further adds, “Since we are using latest technologies such as CEP, pre-trade checks will be performed at relatively higher latency.”

8. Is Dieter’s explanation *most likely* correct?
- A. Yes.
 - B. No, regarding blocking of fat finger trades.
 - C. No regarding pre-trade checks with higher latency.

Set 2 Solutions

1. C is correct. Execution algorithms automate “how to trade” which means how to place orders in the market whereas high-frequency trading algorithms add “when to trade” and even sometimes “what to trade.” A & B are correct statements. Section 2.2. LO.b.
2. A is correct. Shirazi correctly states the types of execution algorithms and HFT algorithms. Sections 2.1.- 2.2. LO.c.
3. C is correct. Because of market fragmentation there is potential for price and liquidity disparities across venues. Algorithmic techniques can be used to aggregate liquidity across markets and use smart order routing to send orders to the venues with the best price and liquidity thus trading more effectively in a fragmented environment. Section 2.2. LO. c, d.
4. B is correct. In a trading algorithm context, latency is the amount of time taken for market data to be received, a pattern to be identified, a decision to be made, and trades to be executed. Therefore, minimizing the time between these steps will lead to a competitive advantage. Latency needs to be considered end to end (i.e., an HFT algorithm should use low latency market data streaming from a trading venue as quickly as possible, low latency analysis and decision making, and a low latency trade placement channel connected directly to the trading venue. Ensuring low latency adds to the cost of the trading firm and **co-locating** (one of the components of achieving low latency) their algorithms with the trading venue will reduce the distance that data must travel to and from the venue. Section 2.2. LO.b.
5. B is correct. Typically users of an execution algorithm involves a buy-side participant, such as a mutual fund, pension fund, or hedge fund, which sends a broker an order to be executed algorithmically. The order can be transmitted either by phone or in an automatic way from a buy-side **execution management system (EMS)** as a **FIX** (financial information exchange) order. In HFT strategies low latency is important. Therefore, the components of the low latency value chain are: market data, algorithmic and high frequency trading engine, order execution, physical connection and co-location. Section 2.2. LO.b.
6. A is correct. An example of cross-asset opportunities is: A US Treasury 10-year government bond listed on ICAP/Brokertec is determined to have a correlation relationship with the US 10-year future listed on the CBOT. B is an example of opportunities in new geographies, and C is an example of opportunities in cross-border trading. Section 3.
7. C is correct. One of the positive impacts of algorithmic and HFT trading is more open and competitive trading markets. Though the large, top-tier firms are perceived to dominate the market, technologies such as CEP, widely available low latency market connectivity, and hosting environments have allowed **small firms** to run trading operation based on advanced technologies. Section 6. LO.f.
8. C is correct. Dieter is incorrect when he states that pre-trade checks will be done at higher latency. Although risk management has known to increase latency, but using the latest

technology, such as CEP, allows pre-trade checks to be performed with minimal latency.
Section 5.1. LO.e.