SMU
SINGAPORE MANAGEMENT UNIVERSITY

AY 2023-24 Term 2 Final Examinations

Name: _____   **Student ID: _____**

Date / Start Time	19 Feb 2024 / 12:00pm
Course	**QF206 - Quantitative Trading Strategies**
Groups	G1
Instructor	Assistant Professor Liu Peng
Total number of pages (including this instruction sheet)	7

INSTRUCTIONS TO CANDIDATES

1   The time allowed for this examination paper is **30 minutes**.

2   This is a closed-book exam.

3   This examination paper contains a total of **10** questions, including **6 MCQs and 4 written questions**.

4   You are required to answer **all** questions here.

1. What does the bid/ask spread in a limit order book (LOB) signify?

   A. It represents the total number of shares available for buying and selling.

   B. It indicates the highest price a buyer is willing to pay and the lowest price a seller is willing to accept.

   C. It signifies the profit a broker makes on the difference between the selling and buying price.

   D. It is the price difference between the best bid and the best offer for a given financial instrument in the LOB.

   Answer: B
   - Bid: The highest price a buyer is willing to pay for a security.
   - Ask: The lowest price a seller is willing to accept for a security.
   - Spread: The difference between the bid and ask prices.

2. Is stop order subject to slippage?

   A. Yes

   Answer: A (Stop orders are subject to slippage. A stop order, when triggered, converts into a market order, which is then executed at the best available price. This can result in the order being filled at a price different from the original stop price, leading to slippage, especially during volatile market conditions.)

   B. No

   Explanation
   Stop Orders and Market Orders: Stop orders are placed at a specific price level. When the market reaches that price, the order is triggered and automatically converted into a market order. Market orders are executed at the best available price in the market.
   Slippage: Slippage occurs when the actual execution price of an order is different from the expected price, often due to rapid price movements between the time the order is triggered and the time it's executed.
   Volatility: During volatile market conditions, prices can fluctuate rapidly. This means that by the time a stop order is triggered and converted to a market order, the market price may have moved significantly, leading to slippage.
   Example: If a stop-loss order is placed at $50, and the price drops rapidly after hitting the stop level, the order might be filled at $48 instead of $50, resulting in slippage.

3. What is the primary difference between a Market-if-Touched (MIT) order and a limit order?

   A. An MIT order is executed at a specific price, while a limit order is executed at the current market price when activated.

   B. A limit order is used to buy or sell securities at a specified price or better, while an MIT order becomes a market order when the market price touches the MIT price.

   C. An MIT order limits the investor's losses to a certain amount, whereas a limit order is used to guarantee the price, but not the execution of the order.

   D. A limit order is executed immediately at the market price, while an MIT order is held until the market price reaches the trigger price.

   Answer: B
   - Limit order: This type of order allows you to specify a maximum price you are willing to pay for a security (when buying) or a minimum price you are willing to sell for (when selling). The order will only be executed if the market price reaches or better your specified limit price.
   - Market-if-Touched (MIT) order: This order type is triggered when the market price of a security reaches a predetermined "trigger price". Once triggered, the MIT order becomes a market order, meaning it is executed immediately at the current market price, regardless of whether it's higher or lower than the trigger price.

4. An analyst is using the Exponential Moving Average (EMA) to track the price of a stock over time. On a particular day, the stock price is $50, and the EMA from the previous day is $48. If the smoothing factor α is set to 0.1, what will be the EMA for the current day?

   A. $49.80   B. $48.20

   C. $48.80   D. $50.20

   Answer: B
   Here, we use the formula: EMA(today) = (Price(today) * α) + (EMA(yesterday) * (1 — α)). Substituting the given values to this formula yields the final answer B.

5. An investor is looking to execute trades in a volatile market where a particular stock is less frequently traded. The current order book shows a wide bid-ask spread due to the stock's volatility.

   Order Book Just Before Investor's Action:

   Bid Side: 50 shares @ $100, 100 shares @ $98, 150 shares @ $95

   Ask Side: 50 shares @ $105, 100 shares @ $107, 150 shares @ $110

   The investor places a limit order to buy 200 shares with a price limit of $106 per share.

Question: Given the immediate post-order book status, calculate the number of shares bought, the average price paid per share, and the remaining number of shares left in the limit order. Assume the order book does not change except for the investor's order execution.

A. 150 shares bought, average price $104, 50 shares remaining

B. 100 shares bought, average price $105, 100 shares remaining

C. 200 shares bought, average price $105.50, 0 shares remaining

D. 50 shares bought, average price $105, 150 shares remaining

Answer: D
- The investor can buy up to 200 shares at prices ≤ $106.
- 50 shares @ $105 are available, then 100 shares @ $107 (too high, skip).
- Only 50 shares @ $105 are filled.

6. An investor is monitoring a highly volatile stock that currently trades at $150 per share. The investor is considering placing a buy limit order because they want to purchase the stock at a price no higher than their specified limit. They aim to capitalize on price dips while avoiding buying during temporary spikes.

Question: What is the correct statement about the execution of a buy limit order in this scenario?

A. The buy limit order will be executed immediately as the investor has specified a limit price, guaranteeing the purchase of the stock.

B. The buy limit order guarantees execution at the specified limit price or lower, irrespective of market volatility and price movements.

C. The buy limit order will be executed only if the stock's price reaches or falls below the limit price, and it does not guarantee that the order will be filled.

D. The buy limit order ensures the investor can buy the stock at any price fluctuation, as long as the order is active, guaranteeing both the price and the execution.

Answer: C
A buy limit order is a conditional order that instructs the broker to purchase a stock at a specific price or lower. It does not guarantee execution, as the stock's price may not reach or fall below the specified limit. If the market price stays above the limit, the order will not be filled, even if it is active.

Why other options are incorrect:
A is incorrect because a buy limit order does not guarantee immediate execution or purchase of the stock if the price is not at or below the limit.
B is incorrect because a buy limit order is not guaranteed to be executed at the specified limit price or lower, especially in volatile markets.
D is incorrect because a buy limit order does not guarantee execution at any price fluctuation, only at or below the limit price.

7. Assume an investor is considering a portfolio consisting of two assets, S and T. Asset S has an expected annual return of 8% and a standard deviation of 12%, while Asset T has an expected annual return of 14% and a standard deviation of 18%. The correlation coefficient between the returns of S and T is 0.6. The investor decides to allocate 60% of the portfolio to asset S and the remainder to asset T. Calculate the expected annual return and the variance of the portfolio.

Portfolio expected annual return: _____

Portfolio variance: _____

(write short calculation process here)

Expected annual return: $E(R_{p})=w_{S}\cdot E(R_{S})+w_{T}\cdot E(R_{T})$
Variance: $\sigma _{p}^{2}=w_{S}^{2}\cdot \sigma _{S}^{2}+w_{T}^{2}\cdot \sigma _{T}^{2}+2\cdot w_{S}\cdot w_{T}\cdot \rho \cdot \sigma _{S}\cdot \sigma _{T}$

Substituting the values into the formulae above yields the following final answers:
Expected annual return = 10.4%
Variance = 1.66%

8. An investor is analyzing the historical performance of a portfolio to determine its risk characteristics. Over the course of one year, the portfolio provided the following month-end values in sequence: $100,000, $110,000, $105,000, $120,000, $115,000, $130,000, $125,000, $135,000, $130,000, $140,000, $135,000, $145,000, and $140,000. Calculate the maximum drawdown for the portfolio over this period.

Max drawdown: _____

(write short calculation process here)

The maximum peak-to-trough decline occurs between the peak of $110 000 (at the end of month 1) and the trough of $105 000 (at the end of month 2).

Percentage drawdown = \frac{110,000 - 105,000}{110,000} \approx 4.55%.

9. Consider a simplified version of an order book for a particular stock in a financial market. The order book is divided into bid (buy orders) and ask (sell orders) sides, with prices in USD and quantities in shares. For simplicity, assume no additional fees or slippage.

   Details of the order book:

   Bid Side: 100 shares @ $50, 150 shares @ $49, 200 shares @ $48

   Ask Side: 100 shares @ $51, 150 shares @ $52, 200 shares @ $53

   An investor intends to execute transactions using a combination of market and limit orders under the following conditions:

   - The investor places a market order to buy 250 shares.
   - After the market order is fully executed, the investor places a limit order to sell 300 shares at a price of $52.

   Question: Calculate the total cost of the buy order and the total potential revenue from the sell order, and determine the investor's net position if the limit order is fully executed. Assume that the limit order's placement does not immediately fill due to the current ask prices.

Total cost of the buy order: _____

Total potential revenue from the sell order: _____

Net position if the limit order is fully executed: _____

(write short calculation process here)

Buy 100 shares @ $51 = $5100
Buy 150 shares @ $52 = $7800
Total cost = $5100 + $7800 = $12,900
Sell 300 shares @ $52 = $15,600
Net position = $15,600 - $12,900 = $2,700

10. An investor uses a dual moving average crossover strategy to signal buys and sells for a particular stock. This strategy involves a short-term moving average (SMA) and a long-term moving average (LMA). When the SMA crosses above the LMA, it is a buy signal, and when the SMA crosses below the LMA, it is a sell signal. The investor uses a 50-day SMA and a 200-day LMA.

The stock's closing prices for the last 250 days have been collected. On day 250, the 50-day SMA is $20, and the 200-day LMA is $19.50. On day 251, the closing price of the stock is $21, and the closing price 200 days ago was $18.

Assuming no other price changes affect the moving averages more significantly than these two prices, calculate the new 50-day SMA and 200-day LMA for day 251 and indicate whether a buy or sell signal is generated, or if the position is unchanged.

New 50-day SMA: _____

New 200-day LMA: _____

Signal: _____

(write short calculation process here)

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# Previous moving averages and relevant prices
prev_50d_sma = 20.0
prev_200d_lma = 19.5
closing_price_251 = 21.0
closing_price_201 = 18.0  # price that drops out of 200-day LMA

# Calculate new 50-day SMA:
# New 50d SMA = Prev 50d SMA + (New Price - Oldest Price in 50d window) / 50
# But since only the new price is added and the oldest price is not specified,
# assume the oldest price in the 50d window is also $20 (since SMA was $20).
oldest_50d = prev_50d_sma  # $20
new_50d_sma = prev_50d_sma + (closing_price_251 - oldest_50d) / 50

# Calculate new 200-day LMA:
# New 200d LMA = Prev 200d LMA + (New Price - Price 200 days ago) / 200
new_200d_lma = prev_200d_lma + (closing_price_251 - closing_price_201) / 200

# Determine signal
if new_50d_sma > new_200d_lma and prev_50d_sma <= prev_200d_lma:
    signal = "Buy"
elif new_50d_sma < new_200d_lma and prev_50d_sma >= prev_200d_lma:
    signal = "Sell"
else:
    signal = "Unchanged"

Calculation
New 50d SMA = 20 + (21 - 20) / 50 = 20 + 0.02 = 20.02
New 200d LMA = 19.5 + (21 - 18) / 200 = 19.5 + 0.015 = 19.515
Since 20.02 > 19.515 and 20 > 19.5, the position is unchanged.
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