Deep Dive: Trading Strategies

Step-by-Step Numerical Examples

Module 17 (Extended)

Objective

In an interview, do not just define the strategy. Walk the interviewer through a trade lifecycle:

1. Entry Signal (Why do we trade?)
2. Execution (What do we buy/sell?)
3. PnL Mechanics (Where does the money come from?)
4. Exit (When do we leave?)

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Chapter 1

Volatility Trading: Gamma Scalping

Many candidates know what a Straddle is. Few can explain how to monetize it via **Gamma Scalping**.

1.1 The Concept

You buy an option (Long Gamma). You hedge it initially to be Delta Neutral.

- If the stock goes UP, your Delta increases (becomes positive). To stay neutral, you must SELL shares.
- If the stock goes DOWN, your Delta decreases (becomes negative). To stay neutral, you must BUY shares.

Result: You are mechanically "Selling High" and "Buying Low". This trading profit offsets the cost of the option (Theta).

1.2 Numerical Example

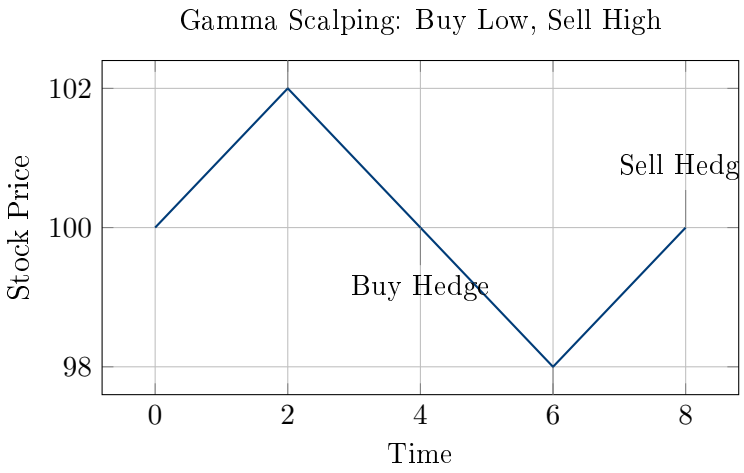
Scenario: The Oscillating Stock

Initial Setup ($t = 0$):
- Stock Price $S_0 = \$100$.
- We buy 1 ATM Straddle (Call + Put). Total Premium paid = \$4.
- Delta is 0. No shares needed initially.
- Gamma is 0.10 (For every \$1 move, Delta changes by 0.10).

Step 1 ($t = 1$): Stock rises to \$102.
- New Delta $\approx 0 + (2 \times 0.10) = +0.20$.
- We are now "Long 20 shares" equivalent.
- **Action:** Sell 20 shares at \$102 to return to neutral.
- *Cash In: \$2,040.*

Step 2 ($t = 2$): Stock crashes back to \$100.
- New Delta returns to 0.
- We are currently "Short 20 shares" (from Step 1).
- **Action:** Buy back 20 shares at \$100.
- *Cash Out: \$2,000.*

PnL Result: We sold at \$102 and bought at \$100. Profit $= 20 \times (\$102 - \$100) = +\$\mathbf{40}$.


Gamma Scalping: Buy Low, Sell High
Stock Price
102
100
98
0
2
4
6
8
Time
Buy Hedge
Sell Hedg

Chapter 2

Stat Arb: Pairs Trading

2.1 The Concept

We find two stocks, Coke (KO) and Pepsi (PEP), that historically move together. We model the **Spread**:

$$S_t = \ln(P_{KO}) - \beta \ln(P_{PEP})$$

We assume S_t is mean-reverting (Ornstein-Uhlenbeck).

2.2 Numerical Example

Scenario: The Divergence

Parameters:

- Historical Mean of Spread = 0.
- Standard Deviation of Spread (σ) = \$1.00.
- Beta $\beta = 1$ (for simplicity).

Day 1: Market Normal

- KO = \$50, PEP = \$50. Spread = 0. (Z-score = 0).
- **Action:** Do nothing.

Day 2: The Shock (Bad news for PEP)

- KO = \$50, PEP drops to \$47.
- Spread = $50 - 47 = +3$.
- Z-score = $(3 - 0)/1 = +3$ (3 Sigma Event!).
- **Signal:** The spread is too high. It must fall.
- **Action:** Sell the expensive one (KO), Buy the cheap one (PEP).
- *Trade:* Short 1 share KO @ \$50, Long 1 share PEP @ \$47.

Day 3: Convergence (Mean Reversion)

- Market stabilizes. KO drops to \$49, PEP recovers to \$49.
- Spread = $49 - 49 = 0$. Target reached.
- **Action:** Close positions.
- Buy back KO @ \$49 (Gain \$1). Sell PEP @ \$49 (Gain \$2).

Total Profit: +**\$3.00**. (Risk-free profit if correlation holds).

Chapter 3

Momentum Strategies

3.1 The Concept

"The trend is your friend." We use **Moving Average Crossovers** to identify trends early. This captures huge moves (like Bitcoin 2017/2020 or Oil shocks) but loses money in choppy sideways markets ("Whipsaw").

3.2 Numerical Example

Scenario: The Golden Cross

Indicators:
- Fast Moving Average (MA-10).
- Slow Moving Average (MA-50).

Week 1-3: Choppy Market
- Asset trades between \$100 and \$105.
- MA-10 oscillates around MA-50.
- **PnL:** Small losses due to false signals (buying at \$105, selling at \$104).

Week 4: The Breakout
- Price jumps to \$110.
- MA-10 crosses **above** MA-50.
- **Action:** BUY at \$110.

Week 5-10: The Trend
- Price rallies to \$150. We hold.
- We do not sell even if price drops to \$145, as long as MA-10 $>$ MA-50.

Week 11: The Reversal
- Price drops to \$135.
- MA-10 crosses **below** MA-50.
- **Action:** SELL at \$135.

Result: Profit = \$135 - \$110 = \$25. We missed the top (\$150) and the bottom (\$100), but we captured the "meat" of the move.

Chapter 4

Market Making: Inventory Skewing

4.1 The Concept

A Market Maker (MM) wants to earn the Bid-Ask spread. The danger is **Inventory Risk**: accumulating a position that loses value. To manage this, the MM **skews** their quotes to force the market to balance their inventory.

4.2 Numerical Example (Avellaneda Logic)

Scenario: Managing Risk

State 0: Neutral Inventory

- Fair Price (Mid): $100.00.
- Standard Spread: $0.10.
- **MM Quote:** Bid $99.95 | Ask $100.05.

Event: A large seller hits our Bid.

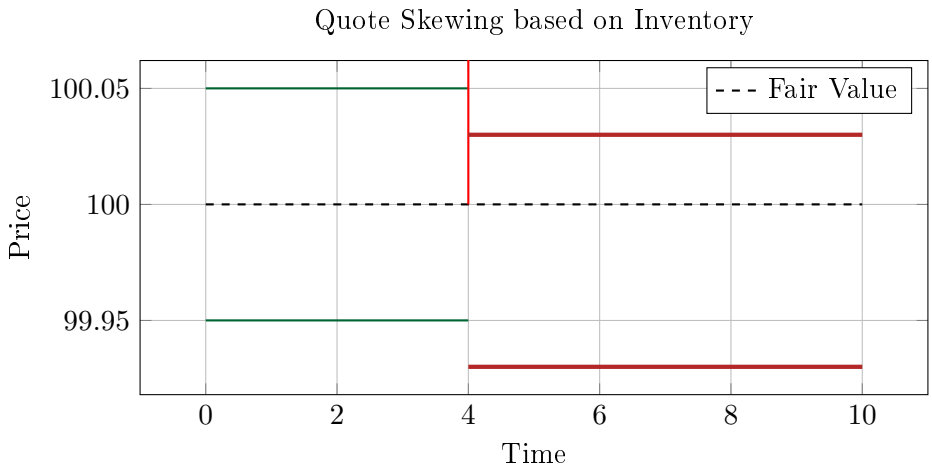
- We buy 1,000 shares at $99.95.
- **Inventory:** Long +1,000 shares.
- **Risk:** If price drops to $99.00, we lose $1,000. We need to sell ASAP.

Action: Skew the Quotes Downward We lower our prices to attract buyers (to sell to them) and discourage sellers.

- New Mid assumption: $99.98.
- **New MM Quote:** Bid $99.93 | Ask $100.03.

Consequence:

- Because our Ask ($100.03) is cheaper than the market average ($100.05), buyers flock to us.
- We sell our 1,000 shares at $100.03.
- **PnL:** Bought at $99.95, Sold at $100.03. Profit = $0.08/share.
- Inventory is back to 0. Risk is neutralized.


Quote Skewing based on Inventory
Fair Value
100.05
100
99.95
Price
0
2
4
6
8
10
Time