Derivative Probelm Set 1

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January 2024

Problem 1(a) FX Analysis

We will start from the foreign exchange category and then move to the agriculture category. We have that both the high volume and high open interest indicate high liquidity. The higher volume implies more market participants and demand for the future, which increases liquidity.

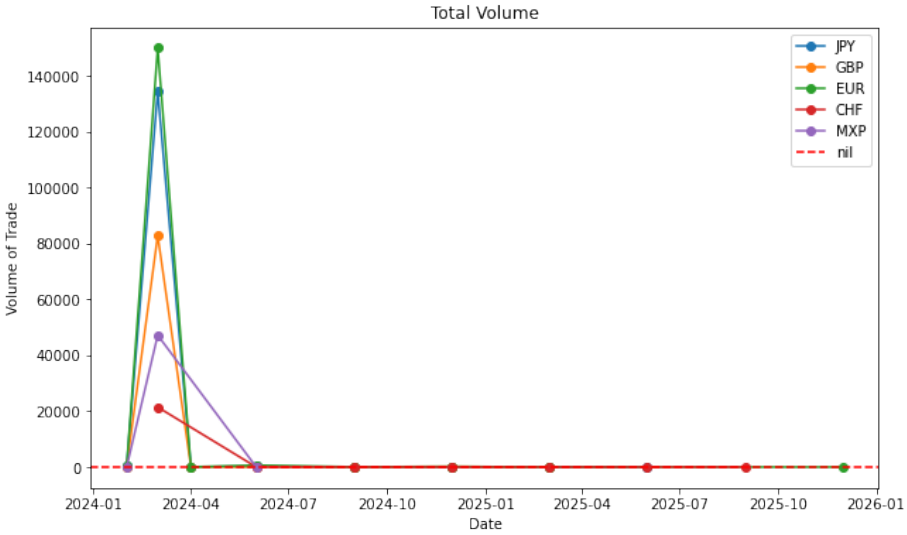

Figure 1: FX Volume

Similarly, the higher open interest rate implies more demand, which increases liquidity. When examining the data from January 19th, 2024, we see that the Mexican Peso futures volume is equal to 47,200 and the open interest is equal to 251,535. For the Japanese Yen, the volume is equal to 135,204 and the open interest is equal to 232,876. For the Euro, the volume is equal to 151,206 and the open interest is equal to 725,529. For the British Pound, the volume is equal to 83,433 and the open interest is equal to 180,879. Lastly for the Swiss

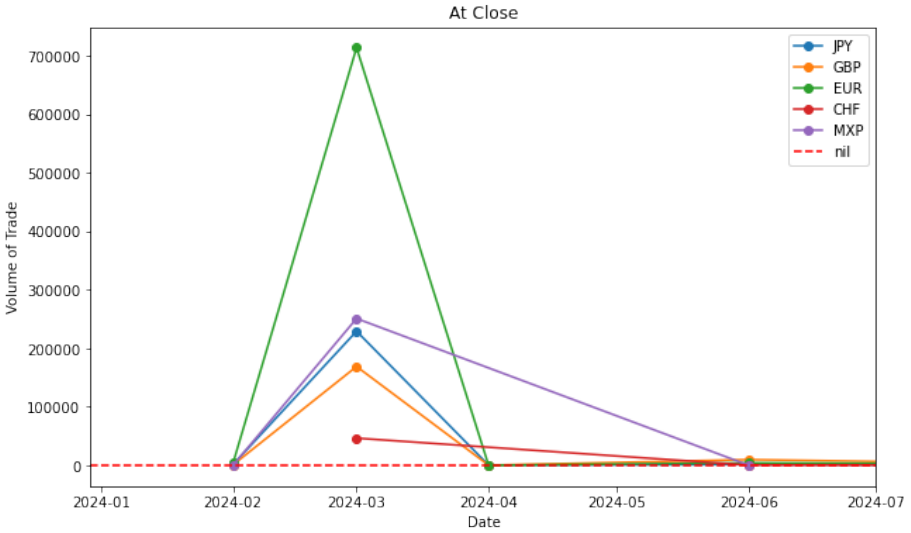

Figure 2: FX At Close

Franc, the volume is equal to 21,454 and the open interest is equal to 47,265. We believe that the maturities that liquidity is concentrated in is for the Swiss Franc as both the volume and open interest are quite low for this foreign exchange category. Both the Mexican Peso and the British Pound have lower volumes compared to the Japanese Yen and the Euro, but their open interests are quite high. For the Japanese Yen, after April 2024, there is very little activity for both the volume and the open interest. For the Euro, there is less activity after June 2024 for both the volume and open interest. For the British Pound, activity is lower after April 2024, and for the Swiss Franc, activity is almost nil after June 2024. We would say that the trend for lower activity is pretty stable for both the volume and the open interest in the sense that after a certain point in time, both the volume and open interest show a very little change in activity.

This shows that there is reliability of the settlement values shown. The contract with maturity at 2024-03 appears to be favored for trading with a much higher peak liquidity compared to contracts with maturity at other dates . This may be because in March, there is a global activity or trend that stimulates currency exchange.

Problem 1(a) Agriculture Analysis

Now, let's move onto the agriculture category. Both the high volume and high open interest indicate high liquidity. The higher volume implies more market participants and demand for the future, which increases liquidity. Similarly, the higher open interest implies more demand, which increases liquidity.

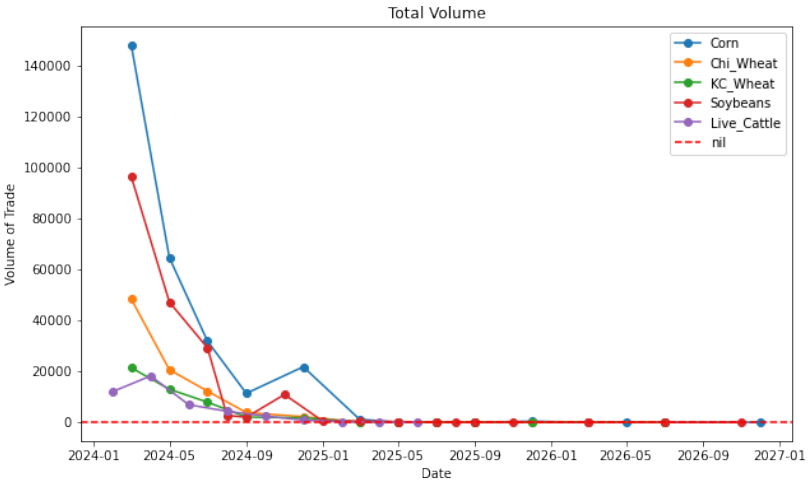

Figure 3: Agriculture Volume

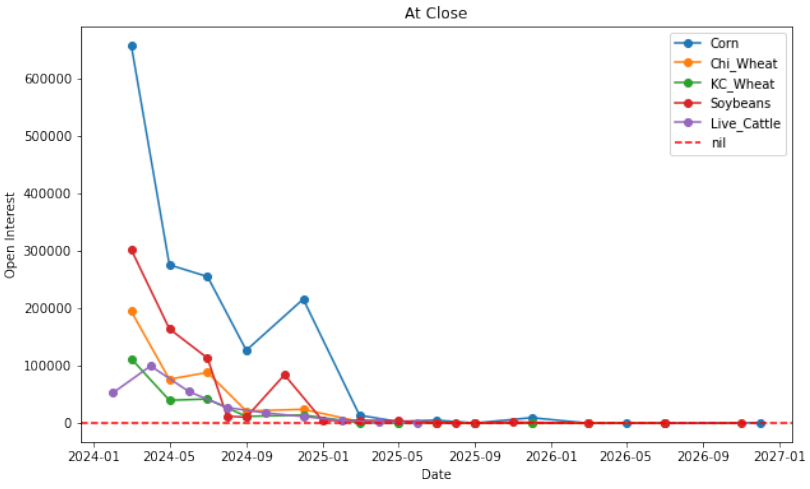

Figure 4: Agriculture At Close

When examining the data from January 19th, 2024, we see that the Corn futures volume is equal to 279,584 and the open interest is equal to 1,565,508. The Soybean futures volume is equal to 190,039 and the open interest is equal to 703,990. For the Live Cattle futures, the volume equals 45,323 and the open interest equals 272,065. For the Chicago SRW Wheat Futures, the volume equals 87,622 and the open interest is equal to 409,549. For the KC HRW Wheat Futures, the volume equals 46,346 and the open interest is equal to 221,469. In this case, the Corn futures and the Soybean futures have both high volume and high open interest rate. We believe that the maturities that liquidity is concentrated in are for the Live Cattle, Chicago SRW Wheat Futures, and for the KC HRW Wheat Futures as the volume for all three is quite low. However, the open interest for all three is quite high. For the Corn futures, there is virtually no activity after March 2025 and for the Soybean futures, there is very little activity after January 2025. In regards to the Live Cattle Futures there is little activity after December 2024. For the Chicago SRW Wheat Futures, there is basically no activity after March 2025. Lastly, for the KC HRW Wheat Futures, there is again nil activity after March 2025. We would say that the trend for lower activity is in general pretty similar for both the volume and the open interest in the sense that after a certain point in time, both the volume and open interest show a little change in activity. However, there is more of a difference between the volume and the open interest rate when it comes to agriculture. There are some cases in which there is virtually no activity when it comes to the volume, but there is still a little bit of activity in regards to the open interest rate. This shows that there is reliability of the settlement values shown, but these values might not be as reliable as the foreign exchange category.

The contract with maturity range from 2024-09 to 2024-12 appears to be favored for trading with a reversal trending during this range in the plot. People may want to end the position in contract at the end of the purchasing year. Maybe they have a prediction about weather that affects agriculture.

Problem 1(b) LEAN HOG FUTURES

We choose the Lean Hog futures as reference:

ESTI ESTIMATED VOLUME TOTALS IS 34,103

PRIOR DAY OPEN INTEREST TOTALS IS 196,713

The curve in contango before maturity 2024-08, starts to become backwardation from maturity range from 2024-08 to 2024-12 and then goes to contango again at maturity 2024-12. There is a seasonality effect in the curve, where the curve of spot rate goes contango with maturity before summer, and becomes backwardation starting in the summer until the end of year, then goes contango again at the beginning of the year. As the underlying asset is lean log, this curve behavior may be caused by some diet habits that vary seasonally. For example, some dishes that people only have during warm weather, Thai food that have a lot of dishes made from pork, which people are more likely to have

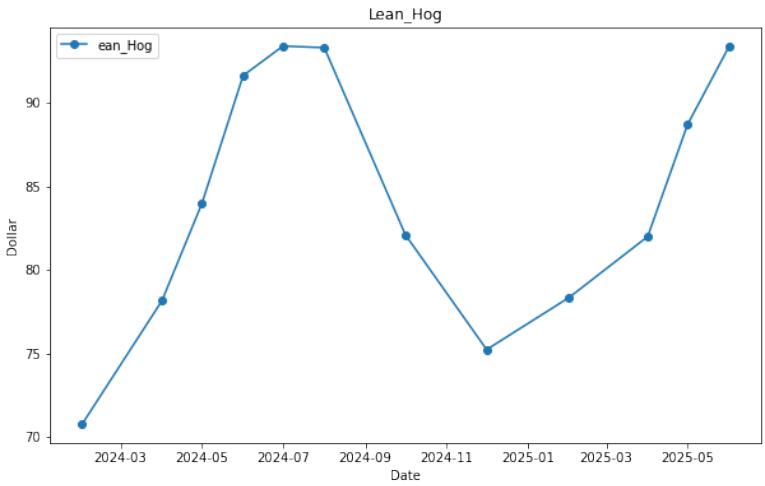

Figure 5: LEAN HOG FUTURE PRICE

during summer.

Problem 1(b) AUSTRALIAN DOLLAR FUTURES

We choose the Australian dollar futures as reference:

ESTIMATED VOLUME TOTALS 82,059

PRIOR DAY OPEN INTEREST TOTALS 165,254

The curve in contango before maturity 2024-12, starts to become backwardation at maturity range from 2024-12 to the end of the record. The curve's behavior can be attributed to the change of people's view on the Australian economy before and after the maturity 2024-12. They may believe that Australia will have a worse economy after 2024-12, so they predict that before 2024-12, they will have a higher demand on the AUD.

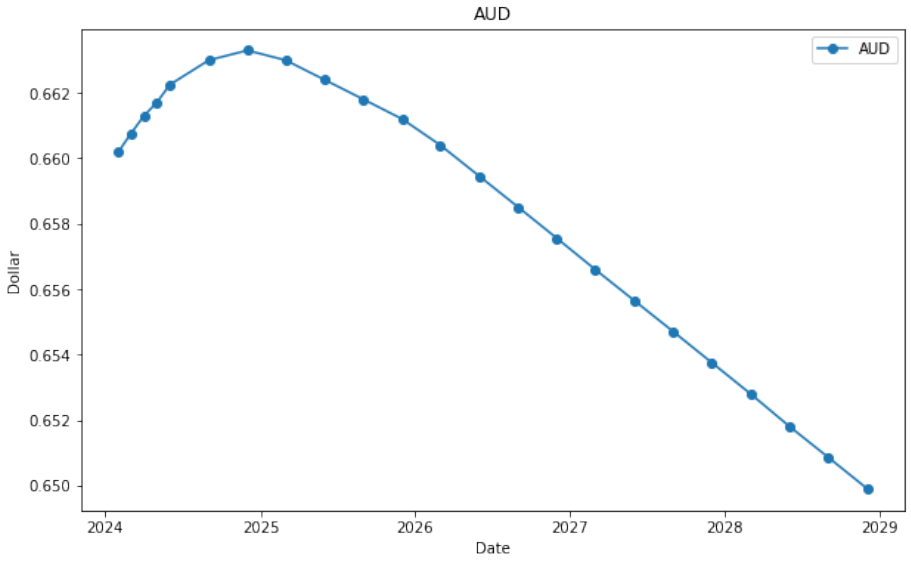

Figure 6: AUSTRALIAN DOLLAR FUTURES Price

Problem 2 Option Analysis

(a) Call Option

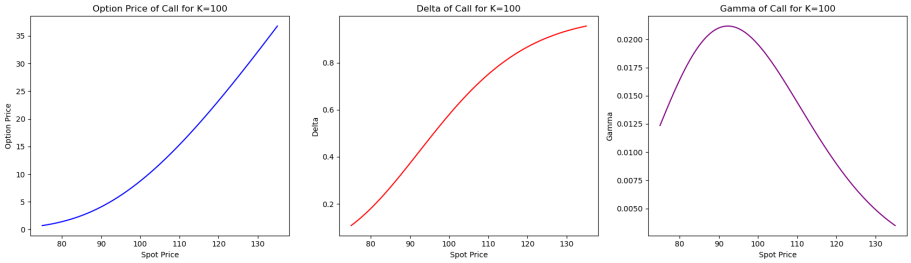

Figure 7: Call Option for K=100

The value is positive and monotonically increasing as spot increase. The delta is positive monotonically increasing,indicating increasing sensitivity of the option price to changes in the underlying price as the spot price approaches and surpasses the strike price. The gamma is initially increasing and then decreasing as spot increase, the maximum gamma 0.021181 is at spot=92.32881, indicating highest sensitivity of delta near the strike price, which diminishes as the spot price moves away from the strike price.

(b) Put Option

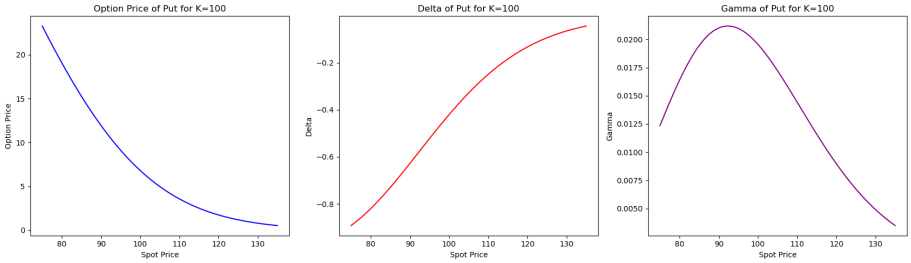

Figure 8: Put Option for K=100

The value is positive and monotonically decreasing as spot increase The delta is positive monotonically decreasing as spot increase.The gamma is the same as a call option with same strike price.

(c) Straddle

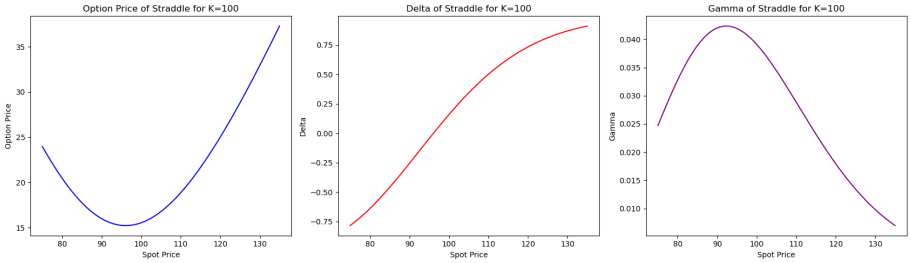

Figure 9: Straddle for K=100

The value initially decreasing and then increasing as spot increase,The minimum value of the straddle is at the strike price, where both the call and put have the lowest intrinsic value. As the spot price moves away from the strike price in either direction, the value of the straddle increases because one of the options (call or put) will be 'in-the-money' and increase in value, more than offsetting the loss in value of the other option. The delta is constantly 1.the gamma is initially increasing and then decreasing as spot increase, the maximum gamma 0.042361 is at spot=92.32881.

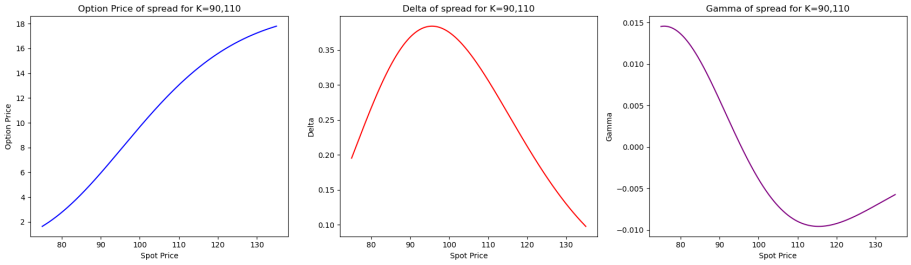

Figure 10: Call Spread for k=90,110

(d) Spread

The value is positive and monotonically increasing as spot increase. The delta is initially increasing and then decreasing as spot increase, the maximum delta 0.384104 is at spot=95.634391.The peak delta is likely around the at-the-money point. As the underlying price continues to increase, the delta of the spread decreases, reflecting that the max profit potential of the spread is capped. The gamma is initially decreasing and then increasing as spot increase, the minimum gamma -0.00959 is at spot=115.367279, and the maximum gamma 0.014571 is at spot=75.801336.(Graph above)

(e) Combo

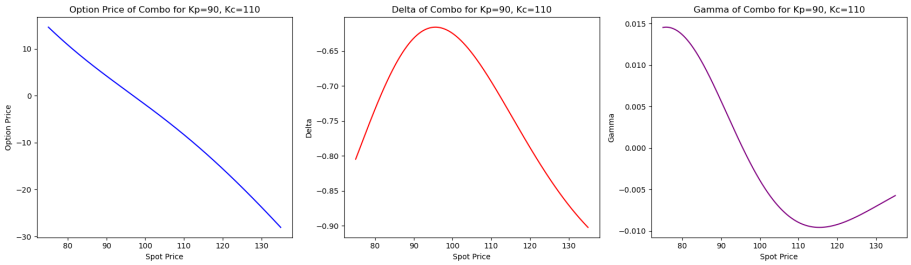

Figure 11: Combo with $k_p = 90, k_c = 110$

The value is positive and monotonically decreasing as spot increase. The delta is initially increasing and then decreasing as spot increase, the maximum delta -0.615896 is at spot=95.634391 -the gamma is initially decreasing and then increasing as spot increase, the minimum gamma -0.00959 is at spot=115.367279

(f) Butterfly

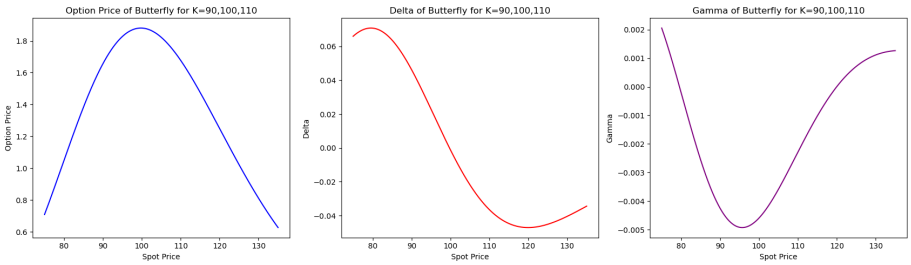

Figure 12: Butterfly for K=90,100,110
The value is initially increasing and then decreasing as spot increase, the maximum value 1.88045 is at spot=99.741235 The delta is negative and monotonically decreasing as spot increase The delta is close to zero around the middle strike price, indicating that the strategy has a minimal directional bias at this point and is most sensitive to movements away from this price. The gamma is negative and monotonically decreasing as spot increase.