
Question 1: Derivatives valuation and analysis**(33 points)**

As a manager in an investment banking advisory department, you provide investment advisory services to Company Falkon, a company that is primarily engaged in the processing and production of soybean meal and needs to sell 100,000 tonnes of soybean meal by the end of October 2024. The company asks you for investment and risk management advice based on the following information.

The Dalian Commodity Exchange offers trading in soybean meal futures and American-style options on these futures. Each option represents 1 soybean meal futures contract, and each futures contract covers 10 tonnes of soybean meal. As of August 2024, with three months until the November futures/options expiry, the spot price of soybean meal is CNY 2,940 per tonne (CNY = Chinese Yuan). The November 2024 futures (M2411) are priced at CNY 2,965 per tonne, and the December 2024 futures (M2412) are priced at CNY 2,980 per tonne. The market's continuously compounded risk-free interest rate is 2%.

In October 2024, there are two possible scenarios for the soybean meal spot and futures markets.

Scenario 1: the spot price of Soybean meal is CNY 2,570, and the futures price of soybean meal expiring in November 2024 is CNY 2,590.

Scenario 2: the spot price of Soybean meal is CNY 3,340, and the futures price for soybean meal expiring in November 2024 is CNY 3,330.

a) Soybean meal price changes show a clear seasonal pattern, in other words, soybean meal prices are likely to rise in August, while soybean meal prices are likely to fall between September to November. Further with the impact of the weather in 2024, the decline of soybean meal prices between September and November is expected to be steeper. Assuming that the spot price of soybean meal and futures prices are changing simultaneously, to hedge the risk of a decline in the price of soybean meal, you first suggest using futures contracts to hedge the risk.

a1) In order to fully hedge against the risk of a fall in the price of soybean meal:

- i) What is the futures position that Company Falkon should choose in August 2024 (type of transaction, maturity of contract, and size of the position)?
(2 points)
- ii) Calculate the net sales income (in CNY terms) generated by Company Falkon in October 2024 using the hedged position chosen at i), under Scenario 1 (combination of spot market, and hedge profit/loss).
(3 points)
- iii) Calculate the net sales income generated by Company Falkon using the hedged position under Scenario 2.
(3 points)
- iv) Did Company Falkon lock in the price of soya meal completely? Explain.
(3 points)

- a2) Company Falkon does not think that using futures contracts to hedge risk is a good option. Analyse the reason why Company Falkon may question this recommendation according to the characteristics of futures hedging. (2 points)
- b) Consider that Company Falkon has taken a short position in December futures. However, Company Falkon is not satisfied with the futures hedging strategy and is concerned about the fact that the futures position will not allow to profit from a rise of Soybean prices at maturity. You propose to buy an option contract to hedge the position based on the futures hedging strategy. Which option in Table 1 should Company Falkon choose? What is the option position (direction of trade and number of options)? (3 points)

The information of soybean meal futures options traded in Dalian Commodity Exchange is as shown in Table 1 below.

Table 1: Soybean meal options quotes for August 2024

Product name	Underlying asset	Expiry date	Strike price (CNY/Ton)	Option premium (CNY/Ton)
Call option1	M2411	NOV 2024	2,900	114.0
Call option2	M2412	DEC 2024	2,900	143.5
Put option 1	M2411	NOV 2024	2,900	37.5
Put option 2	M2412	DEC 2024	2,900	87.0

- c) Based on the American call and put option parity relationship, you analyse the option market quotations in Table 1 and find that an arbitrage opportunity exists. [Note: The options' underlying asset is the futures contract and NOT the spot, and they are American Style.]

c1) Identify and analyse step by step, the arbitrage opportunity. Round your calculations to 2 decimal places.

Hint: Use the following Put Call Parity for American options on futures without dividends.

$$F \cdot e^{(-r \cdot T)} - K \leq C_{US} - P_{US} \leq F - K e^{(-r \cdot T)}$$

where:

F :future price of the underlying

K : strike or exercise price of the option

e :euler's number

r : continuously compounded risk-free rate of interest

T : time until expiry of the option

C_{US} : value of American call option on futures

P_{US} : value of American put option on futures

(8 points)

- c2) Suggest a strategy using 1 option unit as an example to take advantage of the arbitrage. Show the initial and final payoffs generated by this strategy. For simplicity, assume both the options are held till maturity and not exercised before maturity. (9 points)