
Question 1: Derivatives valuation and analysis**(41 points)**

You are a portfolio advisor of wealthy clients based in Switzerland. Some of your clients are interested in derivatives for hedging purposes while others use derivatives to speculate in the markets.

- a) As of 31st December 2024, one of your clients was invested in US equities for USD 10 million. He recently told you he was concerned about the potential depreciation of the USD over the next 12 months. You observed that the Swiss Franc (CHF) trades at CHF 0.90 for USD 1 and that 1-year interest rates are respectively 0.75% in CHF and 5.00% in USD.
- a1) Explain how you can hedge the currency risk of the client's portfolio in the forward market. Using the information given above, calculate the expected 1-year forward rate for the hedge. (4 points)
- a2) Explain 3 differences between forward and futures contracts. (3 points)
- a3) Even if the current customer's position is hedged based on question a1), there may be cases in which the hedge would not be perfect. Explain why. (2 points)
- a4) Assuming the forward rate quoted in the market is equal to CHF 0.85 for USD 1, describe what should be done to implement an arbitrage opportunity, detailing the operations you do today and in 1 year. Also, calculate the profit in USD, assuming you operate on a notional amount of USD 10 million today. (9 points)
- b) At the beginning of July 2024, the S&P 500 was trading around 5,500. At this time, you met a client who informed you that he found the 3-month volatility of US equities implied from 3-month options particularly low. He was convinced that volatility would increase going forward but did not know if the next move of the stock market would be up or down in the next 3-months. He did not believe that there would be a stock market crash or a big jump in the market. In the search of an option strategy that would best suit your client's needs, you gathered the information provided in Table 1 below.

**Table 1: 3-month Call and Put options on S&P 500,
Quoted premiums at the beginning of July 2024**

Strike Price	Call price (in USD)	Put price (in USD)
3,100		0.85
5,500	168.25	78.50
7,100	0.20	

Multiplier is 100 (1 trading unit is 100 times the index).

b1) Assuming the client had instructed you he was not comfortable with selling an option, which strategy could you have suggested to your client? (3 points)

b2) Assume your client decided to buy 2 put options with a strike of 5,500 and 1 call option with a strike of 5,500 (a strip). Describe the different possible payoffs (the values at the maturity T , V_T) of this strategy at maturity of the options as a function of the value of the underlying at maturity (S_T). In your answer, use the generic expressions below:

$$V_T(S_T) = \text{"Formula of Payoff"} \quad \text{if } S_T \leq \text{Strike Price}$$

$$V_T(S_T) = \text{"Formula of Payoff"} \quad \text{if } S_T > \text{Strike Price}$$

(6 points)

b3) Explain the concept of break-even point and calculate it for the strategy in question b2). Show your calculation. (4 points)

b4) When asked more precisely about what he had in mind, the client told you that a move of plus or minus 20% in 3 months was not likely in his view. If the client had agreed to short options, which strategy could you have suggested to him? In your answer, look for a long butterfly strategy by using 4 different options. Calculate the maximum net profit in USD of this strategy at maturity of the options. (6 points)

c) Also back in July 2024, you met another client holding a well-diversified portfolio of US large caps. This client asked your advice about replacing the direct equity exposure of his portfolio with a call option as he was convinced the stock market would go up in the next 3 months.

Mention 2 key differences between adopting the call strategy and direct equity exposure. (4 points)