

Scoring is 2 points for each question. Question 21 will be scored at 4 points.

- 19) The price of an EUR call/USD put struck at 1.0800 is 0.0243. If the spot rate is 1.0630 and the forward rate is 1.0760, then what is the price of an EUR put/USD call struck at 1.0800?

Assume 0.53 years to maturity (for both options and for the forward rate) and assume the relevant USD interest rate for discounting is 4.65% (this rate is a continuously compounded zero coupon rate).

- 20) Why does the derivation of the Garman-Kohlhagen PDE for a foreign exchange spot rate differ from the derivation of the Black-Scholes PDE for a non-dividend-paying stock?

- a) Foreign interest rates and spot FX rates are correlated, so adjustment terms must be introduced
- b) The FX spot rate is not a traded asset, so we cannot construct a risk-free hedged portfolio
- c) Foreign exchange positions must be present valued using the foreign interest rate
- d) A foreign currency position must be carried using a foreign risk-free bond

**\*\* Please write an explanation of why you think the answer is correct.**

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- 21) (This problem counts for 4 points.) Question regarding risk-neutral valuation. It's often said that any derivative of the FX spot rate can be valued using the risk-neutral valuation theory (as in the section "Valuing FX options" of the week #3 lecture notes).

Assume the FX spot rate,  $S$ , follows a geometric Brownian motion,  $dS = \mu S dt + \sigma S dW$ . Let  $V$  be a very simple derivative contract based on  $S$ , where  $V(S_t, t) = S_t$  at any time,  $t$ . In other words, at any time  $t$  the derivative  $V$  has value equal to the spot rate at that time.

Does the argument in the section "Valuing FX options" of the week #3 lecture notes (specifically slides 16-20) apply to the function  $V$  described above? Explain why, or why the theory does not apply in this case.

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- 22) For an GBP put / USD call with a strike of 1.1700, calculate the option price in the four ways discussed in Lecture #3. Also, assuming the notional is 85 million GBP, list the actual premium in GBP and USD amounts. Use the market information listed below:

Spot rate	1.2140
Trade date	23-Feb-2023
Expiry date	23-Aug-2023
Spot date	27-Feb-2023
Delivery date	25-Aug-2023
USD deposit rate	4.75%
GBP deposit rate	3.75%
Implied volatility	11.35%

**NOTE: Use ACT/360 when working with USD and ACT/365 when working with GBP interest rates. Also note that when working with "tau", the trade date to expiry date period, money market conventions do not apply. For that period use ACT/365.**

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23) Assume that a USD-based bank buys the following option (from a client): USD call / JPY put struck at 120.00 with a notional of USD 100 million. If the current trading day is one day before the option's maturity and the current spot rate is 131.87, then what size of spot transaction should the bank execute in order to hedge the value of the purchased option against movements in the exchange rate.

- a) Sell USD 91 million
- b) Sell USD 100 million
- c) Sell USD 105 million
- d) Sell USD 110 million

Please write an explanation of why you think the answer you chose is correct.