Note: The followings are some midterm exam questions extracted from 2017. I am 99.9% confident that you won't be seeing them in this year's midterm exam! The purpose of this document is to give you an idea on how the questions in this year's midterm exam is structured.

MCQs

ADVICE: Spend around two minutes per question

1. The fair price of a 2-month forward contract written on gold, *excluding* storage cost, is $1200. All else being equal, the fair price of the 2-month forward contract written on the same underlying asset (i.e., gold), *including* storage cost, is likely to be _____

    a) Less than $1200
    b) Equal to $1200
    c) Greater than $1200

2. Your stock portfolio has a beta of 1.30 and is currently worth $20m. The S&P/ASX200 index is currently priced at 3540. The December-2009 maturity SPI200 futures contract is quoted at 3560. How many SPI200 futures contracts are required to fully hedge your stock portfolio? *Round your answer to the nearest whole number.*

    a) 292 contracts
    b) 225 contracts
    c) 7344 contracts
    d) 294 contracts
    e) 7303 contracts

3. A stock is currently priced at $40. The risk-free rate of interest is 8% p.a. compounded continuously and an 18-month maturity forward contract is currently traded in the market at $43. You suspect an arbitrage opportunity exists. Which one of the following transactions do you need to undertake at time $t = 0$ to arbitrage based on the given information?

    a) Long the forward, borrow money and buy the share
    b) Short the forward, short-sell the share and invest at risk-free rate
    c) Long the forward, short-sell the share and invest at risk-free rate
    d) Short the forward, borrow money and buy the share

4. When a European put is priced higher than its upper bound, you can arbitrage by devising a trading strategy that consists of _____

    a) Writing the European put
    b) Writing the corresponding European call and investing the proceeds at a risk-free interest rate
    c) Writing the European put and investing the proceeds at a risk-free interest rate
    d) Holding the European put and borrowing at a risk-free interest rate

5. Elizabeth intends to use the Hang Seng Index (HSI) futures to hedge her portfolio. Which of the followings is her **least** concern with respect to using the HSI futures contract?

    a) Expiry of the futures contract
    b) Current level of Hang Seng Index
    c) Systematic risk of her portfolio
    d) Volatility of the stock market
    e) Risk-free rate

6. We can use stocks and/or zero coupon bonds to replicate the payoff of _____ (choose the best answer from the list below).

    a) A call option
    b) A put option
    c) A forward contract
    d) Options, forward and a wide range of derivatives.

7. The current spot exchange rate is AUD 1.00 = USD 0.80. The Australian risk-free rate is 3.0% p.a. compounded continuously, whereas the US risk-free rate is 0.8% p.a. compounded continuously. The no-arbitrage price on a 9-month forward contract written on the exchange rate is likely to be _____

    a) USD 0.813 / AUD
    b) AUD 0.787 / USD
    c) AUD 1.271 / USD
    d) AUD 1.230 / USD

8. A portfolio manager intends to buy some stocks next month and wishes to hedge against share price risk. Which of the followings provides the best hedge against this risk?

    a) Short futures on the stocks
    b) Long futures on the stocks
    c) Buy put options on the stocks
    d) Sell call options on the stocks

9. You believe that the *yield* for 90-day bank bills is about to *fall*, and you plan to *speculate* on your prediction using interest rate *options* on 90-day bank bills. Which of the following option positions will you enter?

    a) Long a call option on 90-day bank bills
    b) Long a put option on 90-day bank bills
    c) Short a call option on 90-day bank bills
    d) Short a put option on 90-day bank bills

10. The fair price of a forward contract is GBP 0.46 for 1 SGD (Singapore dollar), whereas the traded forward price for the contract is GBP 0.40 for 1 SGD. With this in mind, which one of the followings will *most likely* yield an arbitrage profit?

    a) Invest in a U.K. bank and borrow from a Singaporean bank
    b) Invest in a Singaporean bank and borrow from a U.K. bank
    c) Invest in both Singaporean and UK banks
    d) Borrow from both Singaporean and UK banks

Problem-solving question

Consider the following information for an exchange rate:

- Current spot exchange rate is AUD1.80/GBP
- AUD risk-free rate is 6% pa compounded continuously
- UK risk-free rate is 8% pa compounded continuously
- Volatility of the currency (σ) is 20% pa
- Strike price is specified at AUD1.60/GBP
- Time to maturity of the option is 9 mths
- All options are European in nature.

a. What is the price of a call option on 1 AUD? Use the Garman-Kohlhagen model to estimate your answer.
b. What is the price of a put option on 1 AUD? Can you use the put-call parity and solution to (i) to answer this question? Why or why not?
c. What is the price of a call option on 1 GBP? Use the Garman-Kohlhagen model to answer this question.
d. Can you use the put-call parity and solution to (b) to answer (c)? Why or why not? If not, how can you use the solution to (b) to answer (c)?
e. What is the price of a forward contract on 1 AUD?
f. Use the answer in e) to price the call and put options on 1 AUD. Your answers must be the same as in parts (a) and (b).
g. Draw the terminal payoff for a call option on 1 AUD.
h. Draw the terminal payoff for a put option on 1 AUD.
i. Draw the terminal payoff for a call option on 1 GBP.
j. Draw the terminal payoff for a put option on 1 GBP.

a)

The question asks to price the call option on 1 AUD. Before we begin, we know the final answer (i.e., the call price) must be in GBP. Hence:

T = 9/12

X = **GBP** 1/1.60 for 1 AUD

S_0 = **GBP** 1/1.80 for 1 AUD

Domestic rate = 8% (GBP)

Foreign rate = 6% (AUD)

σ = 0.20

Using the Garman-Kohlhagen (GK) model, the AUD-call price is GBP 0.0165 (your answer might be slightly different from mine, since I used the spreadsheet to calculate the option price)

b)

The question asks to price the put option on 1 AUD. You can either use the GK model or the put-call parity, with the call-AUD price is estimated from part (a).

The final answer is GBP 0.0740.

c)

The question asks to price the call option on 1 GBP. Before we begin, we know the final answer (i.e., the call price) must be in AUD. Hence:

T = 9/12

X = **AUD** 1.60

S_0 = **AUD** 1.80

Domestic rate = 6% (AUD)

Foreign rate = 8% (GBP)

σ = 0.20

Using the Garman-Kohlhagen (GK) model, the GBP-call price is AUD 0.213

d)

The put-AUD price is GBP 0.0740 (part b). The call-GBP price is AUD 0.213 (part c). These two are not related via the put-call parity because of different underlying assets. Instead, from part b, we can estimate the answer to part c as follow:

$$put\ \ price^{\frac{\text{GBP}}{\text{AUD}}} \times X^{\frac{\text{AUD}}{\text{GBP}}} \times S^{\frac{\text{AUD}}{\text{GBP}}}$$
$$= 0.0740 \times 1.6 \times 1.80$$
$$= 0.213\ AUD$$

e)

F = So exp[(r – f)*T]

We want to price the forward on 1 AUD. Thus, AUD = underlying asset and the forward price must be in GBP.

T = 9/12

S_0 = **GBP** 1/1.80

Domestic rate = 8% (GBP)

Foreign rate = 6% (AUD)

Thus, forward price = GBP 0.5640

f)

From these formulae:

$$d_1 = \frac{\ln(F/X) + \frac{1}{2}\sigma^2 T}{\sigma\sqrt{T}},\ d_2 = d_1 - \sigma\sqrt{T}$$

$$C = Fe^{-rT}\mathrm{N}(d_1) - Xe^{-rT}\mathrm{N}(d_2)$$

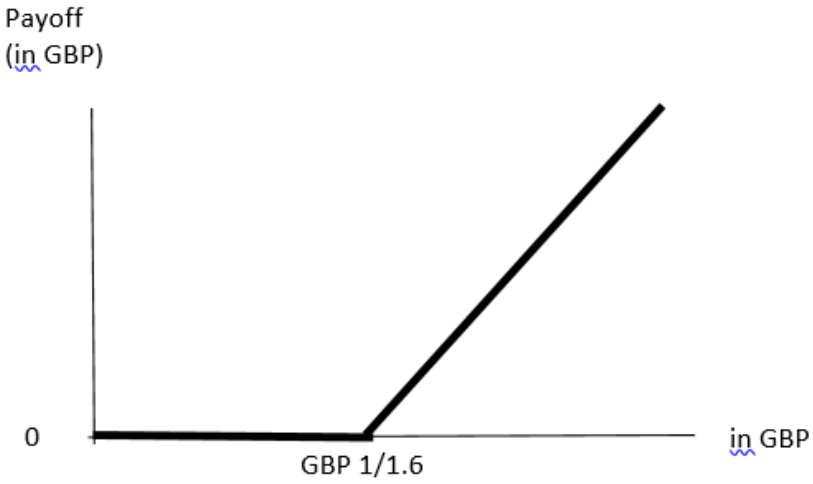
$$P = Xe^{-rT}\mathrm{N}(-d_2) - Fe^{-rT}\mathrm{N}(-d_1)$$

$$P = C - (F - X)e^{-rT}$$

The call-AUD price and the put-AUD price will be the same as those estimated in parts (a) and (b).

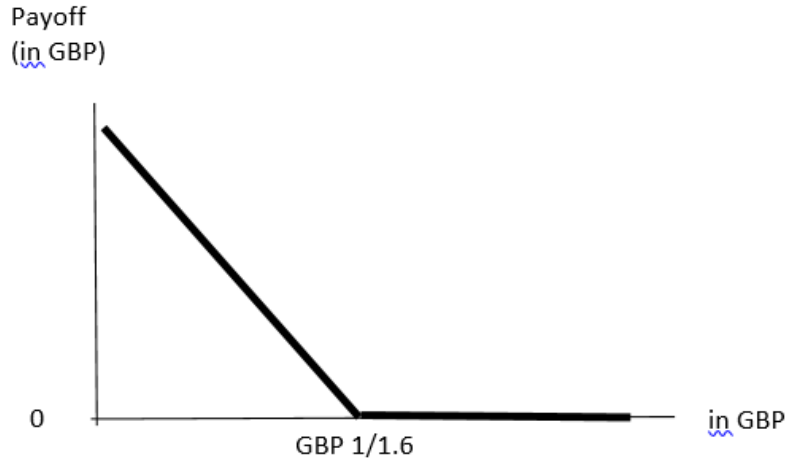
g)

We want to draw the terminal payoff of the call-AUD. Hence, the payoff must be in GBP:



h)

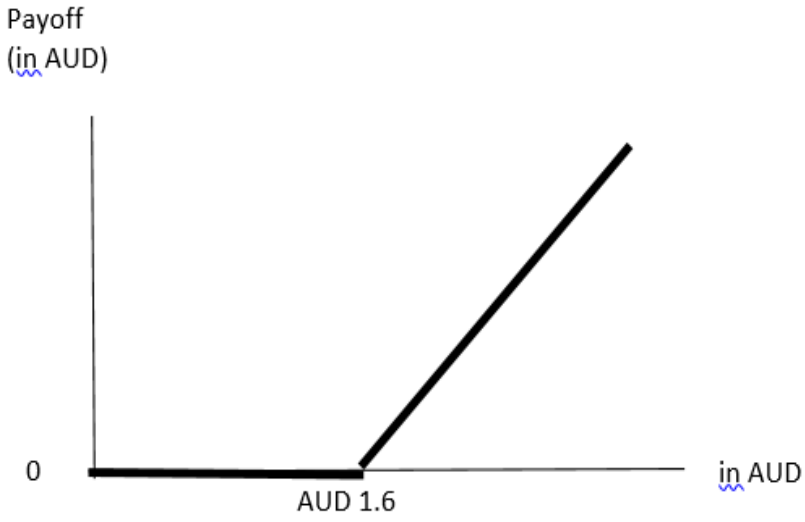
We want to draw the terminal payoff of the put-AUD. Hence, the payoff must be in GBP:



i)

Note: The use of the word "counterparty" below refers to the equivalent position in the other currency, not the short position.

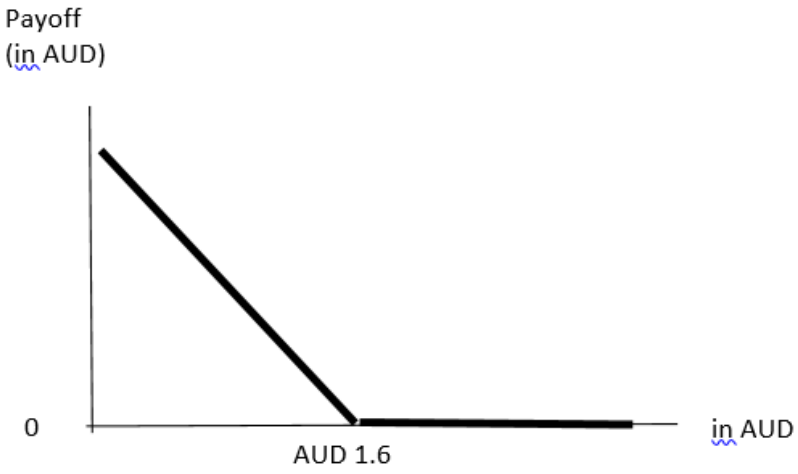
We want to draw the terminal payoff of the call-GBP. Hence, the payoff must be in AUD:



Instantly, you notice that (h) is the "counterparty" of (i).

j)

We want to draw the terminal payoff of the put-GBP. Hence, the payoff must be in AUD:



Instantly, you notice that (g) is the "counterparty" of (j).

Question 2.

a) The 8-month forward contract on the coupon-bearing bond can be priced using the same technique as pricing the dividend-paying share i.e. use the following equation: $F=(S-I)e^{rT}$ where *I* refers to the sum of the present values of all coupon payments, and *S* is the current spot price of the coupon bond.

The present value of the coupon (received in 2 months time) is

$$I_1 = 20e^{-r*2/12} = 20 \times .9934 = \$19.87$$

The present value of the coupon (received in 6 months time) is

$$I_1 = 20e^{-r*6/12} = 20 \times .9802 = \$19.60$$

The fair value of the 8-month forward contract is

$$F = (900 - 19.87 - 19.60)\, e^{r*8/12} = 860.53/.9737 = \$883.77$$

Thus the fair price of the forward contract = $883.77