FINM 37300: Homework 4

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21.

I have written my solution in R. All comments are commented in the code:

```
[commandchars=\\\{\}]
# set parameters for Garman Kolhagen formula
days = as.numeric(difftime(strptime("11.10.2016", format = "%d.%m.%Y"),
               strptime("11.04.2016", format = "%d.%m.%Y"),units="days")) # trade date to expiry
tau = days/365
r_AUD = 0.0215 # aud deposit rate
r_USD = 0.0038 # usd deposit rate
AUD_ACT = 365 # day count convention
USD_ACT = 360 # day count convention
sig = 0.128 # implied volatility
K = 0.7400 # strike
S = 0.7540 # spot
notional = 5*10^7 # notional amount

# implement GK formula
Pd = 1/(1+r_USD*days/USD_ACT) # present value of usd
Fwd = S*((1+r_USD*days/USD_ACT)/(1+r_AUD*days/AUD_ACT)) # forward
d1 = (log(Fwd/K) + 0.5*sig^2*tau)/(sig*sqrt(tau))
d2 = (log(Fwd/K) - 0.5*sig^2*tau)/(sig*sqrt(tau))
w = -1 # call or put toggle
p = Pd*w*(Fwd*pnorm(w*d1)-K*pnorm(w*d2)) # price
pnumccy = p

# USD premium
cat('USD premium: ', notional*pnumccy)
```

```
*****************************
USD premium:  1164897
*****************************

# USD pips
cat('USD pips:', 1*10^4*pnumccy)

*****************************
USD pips: 232.9794
*****************************

# USD %
cat('USD %:', 100*pnumccy/K)

*****************************
USD %: 3.14837
*****************************

# AUD premium
cat('AUD premium: ', notional*pnumccy/S)

*****************************
AUD premium:  1544956
*****************************

# AUD pips
cat('AUD pips:', 1*10^4*pnumccy/K/S)

*****************************
AUD pips: 417.5557
*****************************

# AUD %
cat('AUD %:', 100*pnumccy/S)

*****************************
AUD %: 3.089912
*****************************
```

22.

The call delta is $N(d_1)$ and the put delta is $-N(-d_1)$. We also know that $N(x) + N(-x) = 1$. Hence:

$$\text{call} + \text{put} = N(d_1) - N(-d_1) = 2N(d_1) - 1$$

If we set this to 0,

$$\begin{aligned} 2N(d_1) &= 1 \\ N(d_1) &= \frac{1}{2} \\ d_1 &= 0 \end{aligned}$$

This implies that:

$$\begin{aligned} \log(F/K) + \frac{1}{2}\sigma^2\tau &= 0 \\ \therefore F/K &= e^{-\frac{\sigma^2\tau}{2}} \\ K &= Fe^{-\frac{\sigma^2\tau}{2}} \end{aligned}$$

Therefore, plugging in our parameters we get: $K \approx 0.7505$.

23.

My answer is **b)**. For a call,

$$\text{abs}(N(d_1)) = N(d_1)$$

For a put,

$$\text{abs}(-N(-d_1)) = \text{abs}(N(d_1) - 1) = 1 - N(d_1)$$

σ and τ do not vary. Therefore the delta is determined by $log(F/K)$. Hence, the absolute value of the call is directly positively proportional to $log(F/K)$ and the absolute value of the put is directly negatively proportional to $log(F/K)$.

Therefore, in terms of absolute values of the calls and puts, we want to find the option that is deepest in the money. a) is at the money and c) is out of the the money. b) and d) are in the money, however b) is deeper in the money.

24.

My answer is **b)**. The option is deep in-the-money and expiry is very close, hence the option value curve would have approached the payoff curve. So its delta is approximately equal to 1. Therefore the delta hedge would be to sell US$100million.

25.

My answer is **a)**. The option sensitivity increases as time to expiration increases. Also, the closer the option is to the strike, the higher the chance of it flipping between in-the-money and out-the-money.