Krunal . Modi
Roll No. 702.

Financial Engineering - 2 - Assignment 1.

Q1.

Ans.] 6m rate . 5%
9m rate : 6%

Rate locked using FRA , 7%

Implied forward rate = $\frac{(6\% \times 75\%) - (5\% \times 50\%)}{25\%}$

= 8%

The agreed FRA is 7%. Therefore, arbitrage profit can be made by borrowing for 6m at 5%, lending for 9m at 6% & entering into the FRA for 7% between 6-9m.

Q2.

Ans.] * Case A : The company is better off using a forward contract. If the company uses futures contract, it will have to settle the loses daily which may cause liquidity crunch.

* Case B ; Using future contract would be a better hedging instrument. This is because the company will realise gains on a daily basis rather than at the end.

* Case C : For this case, the company is better off using a futures contract as they will realise gains initially. Although they are being offset later the initial gain paints a better picture of the hedging strategy.

* Case D : The company should use forward contract as it will help them in avoiding the initial -ve cash flow settlement that would be if future contract was used.

Q3.

Ans.] * The selection of the delivery date will be one that is most preferable & beneficial to the company. This might not be beneficial to the bank & can cause losses to them. Thus, the bank has to consider multiple factors while pricing the product.

* If the bank assumes when the company will take delivery correctly, it will be able to price the products accordingly.

* The bank will also make profit if the company selects a suboptimal delivery date.

Qu.

Ans] To find the hedging strategy, first:

Contract value = 10,000 [100 − 0.25 (100 − 92)]

= 9,80,000.

No. of contracts = $\frac{\text{portfolio forward value}}{\text{future contract price}} - \frac{\text{portfolio du}}{\text{futures du}}$

$= \frac{48,20,000}{9,80,000} \times 2$

= 9.84.

∴ An effective hedge would be to short 10 contracts.

Q.5.

Ans] No. of short futures contract req:

$= \frac{\text{portfolio forward price}}{\text{futures contract price}} \times \frac{\text{portfolio duration}}{\text{futures duration}}$

$\frac{100,000,000}{122,000} \times \frac{4}{9}$

= 364.3

∴ 364 short contracts are required.

(a.) No. of constracts shorted = $\frac{100,000,000}{122,000} \times \frac{4}{7}$

= 468.4

∴ 468 contracts will be required

(b.) In this case, the bond portfolio could probably be more than the profit on shor~~ter~~ futures position.

Q6.

Ans.] Per annum differences:

1.5 % → yen
0.4 % → dollars

Total gain from swap = (1.5 − 0.4) %

= 1.1 % p.a.

Bank profit : 0.5 % per annum

∴ 0.3 % for X & Y.

X borrows dollar at : 9.6 − 0.3 = 9.3 %
Y borrows yen at : 6.5 − 0.3 = 6.2 %

Q7.

Ans.] The swap rate is the fixed rate that a party receives in return for paying a variable rate.

At the same time, the swap rate for a particular maturity is the swap par yield for the maturity.

Q8.

Ans.] The bank must enter into int. rate swaps with other institutions. Here, the bank can pay fixed rate & receive floating rate.

Q.9.

Ans.] Disc. rate:

12% p.a. with quaterly compounding

11.8% p.a. with continuous compounding.

Next floating payment $= 11.8\% \times 100 \times 0.25$

$= 2.95$.

Value of floating-rate bond $= 102.95 \cdot e^{-0.1182 \times 2/12}$

$= 100.94$.

Value of fixed-rate bond $= 2.5e^{-11.8\% \times 1/6} + 2.5e^{-11.8\% \times 5/12} + 2.5e^{-11.8\% \times 8/12} + 2.5e^{-11.8\% \times 11/12} + 2.5e^{-11.8\% \times 14/12}$

$= 98.678$.

Value of swap $= 100.94 - 98.678$

$= \$ 2.262$ million

Q. No.
Ans 1. Forward rate = 8%
Strike rate = 7.6%
TTM = 4 yrs.
r.f. rate = 8%
Volatility = 25%

Pay-off from swaption = max $[0.076 - F, 0]$

Value of annuity at the end of year 5, 6, 7, 8 & 9 $= \sum_{i=5}^{9} e^{-0.078i}$

$= 2.972$

$d_1 = \frac{\ln(0.08/0.076) + 0.25^2 \times 2}{0.25\sqrt{4}} = 0.3526$

$d_2 = -0.1474$

Value of swaption $= 2.914\,[0.076\,\Phi(-d_2) - 0.08\,\Phi(d_1)]$

$= 0.0401$
$= \$\,40{,}100$

C(ii)
(a) $S_0 = 1/1.48 = 0.6757$

$K = 1/1.50 = 0.6667$

$r = 0.08$,

$\sigma = 0.12$

$q = 0.04$

$T = 1$.

Value of derivative $= 10,000\ \Phi(-d_2)e^{-0.08\times1}$

$d_2 = \ln(0.6757/0.6667) + (0.8 - 0.04 - 0.12^2/2)$

$= 0.3852$.

$\Phi(-d_2) = 0.3501$

Value of derivative $= 10,000 \times 0.3501 \times e^{-0.08}$
$= 3231$

In dollars, $3231 \times 1.48 = \$4782$.

Q.10.

Ans.] In an asian optⁿ the payoff becomes more certain as the time passes and the delta always approaches zero as the maturity date is approached. This makes delta hedging easy.

Q.13.

Ans.] Value $= 100\,\Phi(-d_2)\,e^{-0.08\times0.5}$

$$d_2 = \frac{\ln(960/1000) + (0.08 - 0.03 + 0.2^2/2)\times 0.05}{0.2\cdot\sqrt{0.5}}$$

$= 0.1826.$

$\Phi(-d_2) = 0.4276.$

Value $= 100 \times 0.4276 \times e^{-0.08\times0.5}$

$= \$\,41.08.$