INSTITUTE OF ACTUARIAL & QUANTITATIVE STUDIES

Subject: Financial Engineering II

Chapter: Unit-2

Category: Practice Questions

1. An investment manager has a portfolio of options on a single underlying asset. Explain whether a position in this underlying asset could be used to make the portfolio gamma-neutral.

2. The portfolio, on a given day, is delta-neutral at the start of the business day but has a gamma of –3,706.2.

The delta and gamma of a particular traded option on the underlying asset are 0.70 and 1.74 respectively on the given day.

(i) Determine the transactions in the traded option and/or underlying asset which are required to make the portfolio both delta-neutral and gamma-neutral.

(ii) Propose alterations to the original portfolio to make it less gamma negative.

(iii) Recommend another action that the company should take to mitigate the risk of a large negative gamma position occurring in future.
[Total 15]

3. Explain the principle of risk-neutral valuation.

4. Use the Black's model to value a 1-year European put option on a 10-year bond. Assume that the current cash price of the bond is \$125, the strike price is \$110, the 1-year risk-free interest rate is 10% per annum, the bond's forward price volatility is 8% per annum, and the present value of the coupons to be paid during the life of the option is \$10.

5. Explain carefully why Black's approach to evaluating an American call option on a dividend-paying stock may give an approximate answer even when only one dividend is anticipated. Does the answer given by Black's approach understate or overstate the true option value? Explain your answer.

6. Calculate the price of an option that caps the 3-month rate, starting in 15 months' time, at 13% (quoted with quarterly compounding) on a principal amount of \$1,000. The forward interest rate for the period in question is 12% per annum (quoted with quarterly

compounding), the 18-month risk-free interest rate (continuously compounded) is 11.5% per annum, and the volatility of the forward rate is 12% per annum.

7. Consider a two-month call futures option with a strike price of 40 when the risk-free interest rate is 10% per annum. The current futures price is 47. What is a lower bound for the value of the futures option if it is (a) European and (b) American?

8. A corporation knows that in three months it will have $5 million to invest for 90 days at LIBOR minus 50 basis points and wishes to ensure that the rate obtained will be at least 6.5%. What position in exchange-traded options should it take to hedge?

9. What is the value of a 2-year fixed-for-floating compounding swap where the principal is $100 million and payments are made semiannually? Fixed interest is received and floating is paid. The fixed rate is 8% and it is compounded at 8.3% (both semiannually compounded). The floating rate is LIBOR plus 10 basis points and it is compounded at LIBOR plus 20 basis points. The LIBOR zero curve is flat at 8% with semiannual compounding (and is used for discounting).

10. Show that V1 + f =V2, where V1 is the value of a swaption to pay a fixed rate of sK and receive LIBOR between times T1 and T2, f is the value of a forward swap to receive a fixed rate of sK and pay LIBOR between times T1 and T2, and V2 is the value of a swaption to receive a fixed rate of sK between times T1 and T2. Deduce that V1= V2 when sK equals the current forward swap rate.

11. Calculate the price of a cap on the 90-day LIBOR rate in 9 months' time when the principal amount is $1,000. Use Black's model with LIBOR discounting and the following information:

(a) The quoted 9-month Eurodollar futures price =92. (Ignore differences between futures and forward rates.)

(b) The interest rate volatility implied by a 9-month Eurodollar option =15% per annum.

(c) The current 12-month risk-free interest rate with continuous compounding =7.5% per annum.

(d) The cap rate =8% per annum. (Assume an actual/360 day count.)

12. Calculate impact on portfolio on account of change in value of PC1 by 2 and PC2 by 1 for the data given below.

Component Loadings (Correlations between Initial Variables and Principal Components)

Maturities (rates in bps)	PC1	PC2
1M	0.897	-0.426
3M	0.921	-0.382
6M	0.945	-0.323
1Y	0.972	-0.227
2Y	0.993	-0.059
3Y	0.991	0.089
5Y	0.939	0.335
7Y	0.868	0.495
20Y	0.686	0.710

Cumulatively, the first two PCs explain 99.137% of all variance of the Treasury bond yields.

Standard deviation of factor scores

PC1	PC2
9.54	3.23

Change in portfolio value for 1-basis point rate move

1Y	2Y	3Y	5Y	7Y	20Y
+8	+6	+5	-5	-3	-2