



INSTITUTE OF ACTUARIAL
& QUANTITATIVE STUDIES

Subject: Financial
Engineering 2

Chapter:

Category: Assignment
Questions

1. A bank can borrow or lend at LIBOR. Suppose that the six-month rate is 5% and the nine-month rate is 6%. The rate that can be locked in for the period between six months and nine months using an FRA is 7%. What arbitrage opportunities are open to the bank? All rates are continuously compounded.
2. When a known future cash outflow in a foreign currency is hedged by a company using a forward contract, there is no foreign exchange risk. When it is hedged using futures contracts, the daily settlement process does leave the company exposed to some risk. Explain the nature of this risk. In particular, consider whether the company is better off using a futures contract or a forward contract when
 - a) The value of the foreign currency falls rapidly during the life of the contract
 - b) The value of the foreign currency rises rapidly during the life of the contract
 - c) The value of the foreign currency first rises and then falls back to its initial value
 - d) The value of the foreign currency first falls and then rises back to its initial value

Assume that the forward price equals the futures price.

3. Suppose that the Treasury bond futures price is 101.375. Which of the following four bonds is cheapest to deliver?

Bond	Price	Conversion factor
1	125.15625	1.2131
2	142.46875	1.3792
3	115.96875	1.1149
4	144.06250	1.4026

4. A Eurodollar futures price changes from 94.66 to 94.72. What is the gain or loss to an investor who is long two contracts?
5. A portfolio manager plans to use a Treasury bond futures contract to hedge a bond portfolio over the next three months. The portfolio is worth \$100 million and will have a duration of 4.0 years in three months. The futures price is 122, and each futures contract is on \$100,000 of bonds. The bond that is expected to be cheapest to deliver will have a duration of 9.0 years at the maturity of the futures contract. What position in futures contracts is required?
- a) What adjustments to the hedge are necessary if after one month the bond that is expected to be cheapest to deliver changes to one with a duration of seven years?
- b) Suppose that all rates increase over the three months, but long-term rates increase less than short-term and medium-term rates. What is the effect of this on the performance of the hedge?
6. Company X wishes to borrow U.S. dollars at a fixed rate of interest. Company Y wishes to borrow Japanese yen at a fixed rate of interest. The amounts required by the two companies are roughly the same at the current exchange rate. The companies have been quoted the following interest rates, which have been adjusted for the impact of taxes:
- | | <i>Yen</i> | <i>Dollars</i> |
|-----------|------------|----------------|
| Company X | 5.0% | 9.6% |
| Company Y | 6.5% | 10.0% |
- Design a swap that will net a bank, acting as intermediary, 50 basis points per annum. Make the swap equally attractive to the two companies and assume that all foreign exchange risk is assumed by the bank.
7. Explain what a swap rate is. What is the relationship between swap rates and par yields?

8. A fixed interest swap market denominated in Euros has a yield curve defined by the following continuously compounded interest rates:

<i>Term (years)</i>	<i>Zero Coupon Yield</i>
1	4.0%
2	4.4%
3	4.6%
4	4.8%
5	5.0%

A financial institution is committed to a forward agreement whereby it will pay 5.75% per annum interest on a nominal amount of €1million invested for three years from the end of year 2, with the interest being paid annually in arrears at the end of years 3, 4 and 5.

- (i) (a) Calculate the fixed rate of a three-year forward-starting swap commencing in two years' time with annual payments.
 (b) Hence state whether the forward agreement currently has a positive or negative value to the financial institution.

One possible contract being considered is a receiver swaption that would pay, at the end of year 2, the value of the forward agreement if it has a negative value to the financial institution at that time. The volatility of the forward rate is 12% per annum.

- (ii) Specify the terms of this swaption and calculate its fair price.
 (iii) Describe an alternative strategy to that in (iii) which creates the same effect but uses a payer swaption.

9. Under the terms of an interest rate swap, a financial institution has agreed to pay 10% per annum and receive three-month LIBOR in return on a notional principal of \$100 million with payments being exchanged every three months. The swap has a remaining life of 14 months. The average of the bid and offer fixed rates currently being swapped for three-month LIBOR is 12% per annum for all maturities.

The three-month LIBOR rate one month ago was 11.8% per annum. All rates are compounded quarterly. What is the value of the swap?

10. Suppose that the LIBOR yield curve is flat at 8% with annual compounding. A swaption gives the holder the right to receive 7.6% in a five-year swap starting in four years. Payments are made annually. The volatility of the forward swap rate is 25% per annum and the principal is \$1 million. Use Black's model to price the swaption with LIBOR discounting
11. What is the value in dollars of a derivative that pays off \$10,000 in one year provided that the dollar–sterling exchange rate is greater than 1.5000 at that time? The current exchange rate is 1.4800. The dollar and sterling interest rates are 4% and 8% per annum respectively. The volatility of the exchange rate is 12% per annum.
12. Explain why delta hedging is easier for Asian options than for regular options.
13. What is the value of a derivative that pays off \$100 in six months if the bond market price is greater than 1,000 and zero otherwise? Assume that the current market price is 960, the risk-free rate is 8% per annum, the income yield on the bond is 3% per annum, and the volatility of the bond price is 20%. Explain whether income yield is relevant for the valuation of this derivative.
14. 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)	PC 1	PC 2	PC 3
1Y	-0.032838	0.067482	0.001970
2Y	0.031877	0.062923	0.003184
3Y	-0.009330	0.078643	0.002030

5Y	0.219963	0.048486	0.004415
7Y	0.533525	0.126723	0.002907

Cumulatively, the first two PCs explain 97.137% of all variance of the Treasury bond yields.

Standard deviation of factor scores

PC1	PC2
3.54	2.23

Change in portfolio value for 1-basis point rate move

1Y	2Y	3Y	5Y	7Y
+7	+6	+5	-4	-2

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