**Practice Set #3: FRAs, IRFs & Swaps.**

**What to do with this practice set?**

To help students with the material, eight practice sets with solutions shall be handed out. These sets contain mostly problems of my own design as well as a few carefully chosen, worked-out end-of-chapter problems from Hull. None of these Practice Sets will be graded: the number of "points" for a question solely indicates its difficulty in terms of the number of minutes needed to provide an answer.

Students are strongly encouraged to try hard to solve the practice sets and to use office hours to discuss any problems they may have doing so. The best self-test for a student of her/his command of the material is whether s/he can handle the questions of the relevant practice sets.

The questions on the mid-term and final exams will cover the material covered in class. Their format, in particular, shall in large part reflect questions such as the numerical exercises solved in class and/or the questions in the practice sets.
Question 1 (7.5 points)

J.P. Morgan sells a "3 against 12" FRA for $1m at an annualized rate of 4.75%. Three months after the sale, interest rates have the following term structure:

<table>
<thead>
<tr>
<th>maturity (# months)</th>
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<tbody>
<tr>
<td>3</td>
<td>4</td>
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<td>6</td>
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<td>12</td>
<td>5.5</td>
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</tbody>
</table>

a. How much cash does the bank pay to, or receive from, the FRA buyer?

b. What is J.P. Morgan's effective lending rate for the 270-day lending period?

Question 2 (5 points)

1. Four months prior to the delivery date, a Eurodollar futures is equivalent to a _____ FRA.
2. Twelve months prior to delivery, a Eurodollar futures is equivalent to a _____ FRA.
   a. 4 by 7 and 12 by 15
   b. 1 by 4 and 9 by 12
   c. 7 by 10 and 15 by 18

Question 3 (5 points)

(i) Someone wishing to profit from rising stock prices is likely to go _____ S&P 500 futures contracts.
   a. long
   b. short

(ii) A 1% increase in short-term (ST) interest rates should cause 3-month T-bill and Eurodollar futures contracts to decrease in value by:
   a. less than 1%
   b. approximately 1%
   c. more than 1%

(iii) A savings & loan with the traditional “borrow short/lend long” asset-liability structure could lower its profit volatility and its interest rate risk exposure by_______ debt-based futures contracts.
   a. shorting
   b. going long
**Question 4 (10 points)**

(i) You observe that the spot market rates on 3- and 6-month T-bills are 6% & 7% respectively. The implied forward rate on 3-month T-bills three months from now is approximately ____%.

  a. < 6  
  b. 6  
  c. 6.5  
  d. 7  
  e. 8  
  f. 10  

(ii) Suppose that T-bill futures based on 3-month spot market T-bills are priced for delivery in 3 months at 9%. Using the data from question 2 (i), we would expect that someone wishing to invest today $1 million in a 6-month T-bill would prefer to:

  a. buy a 6-month spot market T-bill  
  b. buy a 3-month spot market T-bill & go long a T-bill futures contract for delivery in 3 months.

(iii) You observe that the spot market rates on 3-month & 6-month T-bills are both at 6%. If the T-bill futures contract for delivery in three months is at 5%, the more profitable of the following three month investments would be to:

  a. buy a three-month T-bill  
  b. buy a 6-month T-bill, simultaneously short a T-bill futures contract for delivery in 3 months, then deliver the spot market T-bill into the futures contract position in 3 months (when the original 6-month T-bill will then have 3 months remaining).

(iv) The price of a $1 million face value, 90 day T-bill with a BDR (Bank Discount Rate) of 6% is

  a. $1 million  
  b. $985,000  
  c. between $985,000 & $980,000  
  d. $940,000

(v) The price of a $1 million Face value, 90 day T-bill with a BDR of 5% is $____________.

**Question 5 (5 points)**

(i) The purchaser of a call option on a T-bond is hoping that interest rates will ____

  a. rise  
  b. fall.  
  c. stay constant  

(Hint: similar to the T-bill futures, a T-bond option locks in the price of a bond – in this case, the price of a US government bond with at least 10 years to maturity.)

(ii) If the Treasury yield curve is downward sloping, you would expect that the farthest T-bill futures contracts would be at rates ______________ than the nearby contract months.

  a. higher  
  b. lower  
  c. no different


**Question 6 (10 points)**

Alcoa has just made a $10 million issue (face value) of floating rate bonds on which it pays an interest rate 1% over the LIBOR rate. The bonds are selling at par value. Alcoa is worried that rates are about to rise, and it would like to lock in a fixed interest rate on its borrowings. Alcoa sees that dealers in the swap market are offering swaps of LIBOR for 7%.

(a) What interest rate swap will convert the firm’s interest obligation into one resembling a synthetic fixed-rate loan?
(b) What interest rate will the firm pay on that synthetic fixed-rate loan?
Practice Set #3: Solutions

Question 1 (7.5 points)

J.P. Morgan sells a "3 against 12" FRA for $1m at an annualized rate of 4.75%. Three months after the sale, interest rates have the following term structure:

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</table>

a. How much cash does the bank pay to, or receive from, the FRA buyer?

b. What is J.P. Morgan's effective lending rate for the 270-day lending period?

Answer.

a. By selling the FRA at 4.75%, J.P. Morgan wanted to make sure that it would obtain a 4.75% annualized rate on a $1m 9-month loan it would make 3 months later. Since, 3 months after the FRA sale, the 9-month rate has become 5%, J.P. Morgan in fact can lend at 5%.

Since this is more than 4.75%, J.P. Morgan will pay the interest rate differential to the FRA buyer on the nominal amount of the contract. The exact cash settlement, 3 months after the FRA sale, is:

\[
\text{amount paid by the FRA seller} = \text{nominal amount of contract} \times \frac{(S-A) \times \left( \frac{\# \text{ days the FRA runs}}{\# \text{ days in the year}} \right)}{1 + S \times \left( \frac{\# \text{ days the FRA runs}}{\# \text{ days in the year}} \right)}
\]

\[
= (\$ \text{ 1m}) \times \frac{(.05 - .0475) \times \frac{270}{360}}{1 + .05 \times \frac{270}{360}}
\]

\[
= \$ 1,807.23
\]
b. 4.75%.

By entering into the FRA agreement, JP Morgan has ensured that, regardless of the actual 9-month rate that will prevail 3 months after the FRA sale, it would receive 4.75% on money that it would lend for 270 days: if the cash rate 3 months after the FRA sale were higher than 4.75%, then JP Morgan would pay the interest difference to the FRA buyer; and if the cash rate were lower, then it would receive the interest difference from the FRA buyer.

**Question 2 (5 points)**

1. Four months prior to the delivery date, a Eurodollar futures is equivalent to a _____ FRA.
2. Twelve months prior to delivery, a Eurodollar futures is equivalent to a _____ FRA.
   a. 4 by 7 and 12 by 15: is the answer. On the delivery day (i.e., two business days after the last day of trading of the IRF), the cash-settlement is meant to replicate the payoffs of a 3-month Eurodollar deposit starting that day. A 4 x 7 (12 x 15) FRA does the same thing as a 4-month (1-year) Eurodollar futures.
   b. 1 by 4 and 9 by 12
   c. 7 by 10 and 15 by 18

**Question 3 (5 points)**

(i) Someone wishing to profit from rising stock prices is likely to go _____ S&P 500 futures contracts.
   a. long: is the answer -- the long party wins, as the price of the underlying asset rises.
   b. short

(ii) A 1% increase in short-term interest rates should cause 3-month T-bill futures contracts to decrease in value by:
   a. less than 1%: is the answer – ST bond prices have low duration (low sensitivity to interest rate changes). An annualized 1% increase in ST interest rates corresponds to a 0.25% increase in the 3-month rate and to a roughly equivalent drop in T-bill spot and futures prices.
   b. approximately 1%
   c. more than 1%

(iii) A savings & loan with the traditional “borrow short/lend long” asset-liability structure could lower its profit volatility and its interest rate risk exposure by _____ debt-based futures contracts.
   a. shorting: is the answer – see the class discussion on “keep shorts on.” In essence, S&L’s make LT fixed-rate loans that they in turn finance with short-term deposits. Thus, these institutions make less (or even lose) money when short-term rates go up. Thus, they want to protect themselves by taking futures position that gain value when interest rates go up. Since debt-based futures lose value when interest rates go up, and the short gains when the futures prices fall, S&L’s should take short positions in debt-based futures contracts.
   b. going long
**Question 4 (10 points)**

(i) You observe that the spot market rates on 3- and 6-month T-bills are 6% & 7% respectively. The implied forward rate on 3-month T-bills three months from now is approximately ____%.

   a.  < 6%
   b.  6%
   c.  6.5%
   d.  7%
   e.  8%: is the answer – the 7% 6-month cash (or spot) rate is an average of the 6% 3-month cash rate and the 8% (implied) forward rate.
   f.  >10%

(ii) Suppose that T-bill futures based on 3-month spot market T-bills are priced for delivery in 3 months at 9%. Using the data from question 2 (i), we would expect that someone wishing to invest today $1 million in a 6-month T-bill would prefer to

   a. buy a 6-month spot market T-bill.
   b. buy a 3-month spot market T-bill & go long a T-bill futures contract for delivery in 3 months

      **is the answer** – 9% is higher than the 8% implied forward rate. See also the discussion in class about FRA’s, especially the example about IBM in the FRA handout: a similar logic applies to selling an FRA and to going long T-bill and Eurodollar futures. In both cases, you are locking in a deposit rate.

(iii) You observe that the spot market rates on 3-month & 6-month T-bills are both at 6%. If the T-bill futures contract for delivery in three months is at 5%, the more profitable of the following 3-month investments would be to:

   a. buy a three-month T-bill
   b. buy a 6-month T-bill, simultaneously short a T-bill futures contract for delivery in 3 months, then deliver the spot market T-bill into the futures contract position in 3 months (when the original 6-month T-bill will then have 3 months remaining) – **is the answer**

(iv) The price of a $1 million face value, 90 day T-bill with a BDR (Bank Discount Rate) of 6% is

   a. $1 million
   b. $985,000: is the answer -- the quarterly discount is 1/4th of 6%, or 1.5%, or $15,000.
   c. between $985,000 & $980,000
   d. $940,000

(v) The price of a $1 million Face value, 90 day T-bill with a BDR of 5% is $ _987,500_.


**Question 5 (5 points)**

(i) The purchaser of a call option on a T-bond is hoping that interest rates will
   a. rise
   b. fall: is the answer – as interest rates fall, bond prices rise so the option to buy at a fixed price becomes more valuable
   c. stay constant

(ii) If the Treasury yield curve is downward sloping, you would expect that the farthest T-bill futures contracts would be at rates ____________ than the nearby contract months.
   a. higher
   b. lower: is the answer – when the term structure is inverted, LT rates are lower and, hence, so are the further-out implied forward rates.
   c. no different

**Question 6 (10 points)**

Alcoa has just made a $10 million issue (face value) of floating rate bonds on which it pays an interest rate 1% over the LIBOR rate. The bonds are selling at par value. Alcoa is worried that rates are about to rise, and it would like to lock in a fixed interest rate on its borrowings. Alcoa sees that dealers in the swap market are offering swaps of LIBOR for 7%.

(a) What interest rate swap will convert the firm’s interest obligation into one resembling a synthetic fixed-rate loan?
(b) What interest rate will the firm pay on that synthetic fixed-rate loan?

**Solution:**

(a) The firm should enter a swap in which it pays a 7% fixed rate and receives LIBOR on $10 million of notional principal. Its total payment will be as follows:

<table>
<thead>
<tr>
<th>Interest payments on bond</th>
<th>(LIBOR + 0.01) x $10 million par value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net cash flow from swap</td>
<td>(0.07 – LIBOR) x $10 million notional principal</td>
</tr>
</tbody>
</table>

TOTAL 0.08 x $10 million

(b) The interest rate on the synthetic fixed-rate loan is 8%.