MT Exam: Practice Set & Solutions

To help students with the material, four practice sets with solutions will be handed out. They will not 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 or his command of the material is whether s/he can handle the questions of the relevant practice sets.

What should you do with this set?

To help students prepare for the Final exam, four practice sets with solutions have been handed out. This practice set provides you with additional preparation material. It contains the questions that I gave out the last time I taught this course (Spring 2001). Solutions to all the questions are included. Students are strongly encouraged to try hard to solve the problems and to use the office hours and the review session to discuss any problems they may encounter in doing so.

Under what conditions did the exam take place?

Students had 75 minutes to answer questions 1 to 5 (max. number of points: 55). There was one bonus question (15 points).

Students were not allowed to collaborate for the midterm with any other person. This exam was closed book, but each student could bring in a calculator and one 8.5"x11" sheet. One side of the sheet could contain anything the student wished, but had to be handwritten by him/her (no photocopying). These conditions will be repeated this Spring.

When asked to "argue briefly", answer in no more than 10 lines but in no fewer than 3. In the multiple-choice questions, just circle the letter of your choice: no consideration is given to explanations.
Question 1. (10 points)

Suppose that, at the open of the IMM on 03-09-00 (today), you went long one March FF futures contract. The agreed upon price was 0.15$/1FF for a FF 250,000 contract. At the trading close today, the futures price has risen to 0.155$/1FF, and you decide to keep your long position open.

a. (3 points) Under marking to market, what happens to you at the end of the day? Choose one of the following:

1. you hold a futures contract that has risen in value by $1,250
2. you hold a futures contract that has fallen in value by $625
3. you receive $1,250 and a new futures contract priced at $.155 (in replacement of the original futures contract with a price of $.15)
4. you must pay over $1,250 to the seller of the futures contract
5. none of the above

b. (7 points) Detail all the cash-flows that you paid or received today. Explain briefly, assuming that there are no brokerage fees to buy or sell the contract. Suppose the initial margin is $2,000 and the maintenance margin is $1,600.

Question 2. (10 points)

On 02-15-00, at the open of the CBOT, you went long one March 2001 gold futures contract. Here were the prices for gold futures contracts traded Chicago Board of Trade on 02-15-00:

<table>
<thead>
<tr>
<th>Futures Contract</th>
<th>open</th>
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The initial margin per gold futures contract was $1,225 and the maintenance margin was $1,000. Each gold futures calls for delivery of 100 troy ounces of gold.

a. (4 points) Assume it cost you $17.50 in brokerage fees to buy the contract, and $17.50 to close your position. If you closed out your position at the market close on 02-15-00, how much did you gain or lose between on 02-15-00? Explain.

b. (6 points) Detail all the cash-flows that you paid or received on that day. Explain briefly.

Question 3. (10 points)

Suppose that you are an analyst for a bank and are asked on December 18, 1996 to predict the spot rate of the DM against the $ on March 20, 1997. Your boss needs the information in 5 minutes.
a. Suppose your bank is lousy, and the only thing you have at hand within the next 5 minutes is the WSJ. However, the page of the Journal with the interest rates data is missing, and somebody dropped coffee on the page with the spot rates: you can only read the spot rate for the DM, not the 90-day forward rate. Fortunately, you find the page that contains the quote for the March DM futures: can you save the day? Argue briefly.

(Hint: the third Wednesday of March in 1997 is 03-20)

b. Suppose you had all the interest rates data you could possibly want. Would you still need the futures data? Explain.

**Question 4. (15 points)**

Suppose the spot rate of exchange between the $ and the £ is 1£=1.5$. The US affiliate of Global Industries Plc., G.I. Inc., is contemplating raising $12m by issuing bonds denominated either in $ or in £. The $ bonds would be priced to yield 10%; the £ bonds would be priced to yield 13%. In either case, the bonds are zero-coupon instruments that mature in 5 years.

a. (7.5 points) Suppose G.I. Inc. is interested only in minimizing its expected financing costs. In the absence of taxes, what annual rate of £ devaluation (or revaluation) would leave G.I. Inc. indifferent between borrowing either £ or $? What would be the expected exchange rate at the end of year 5, given these currency changes?

b. (2.5 points) Suppose that G.I. Inc. decides it would prefer a US$ bond issue, but would agree to go with a pound bond issue instead -- provided (given it is a US-based affiliate) the resulting FX exposure can be hedged in a cost-efficient manner. If the best 5-year forward FX rate is $1.35/1£, should G.I. Ltd go with the $ or the £ issue? Explain intuitively and formally.

**Question 5. (10 points)**

Suppose swap rates for annual fixed rate payments against 6-month dollar LIBOR are currently quoted by Citibank as follows.

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<td></td>
<td>bid</td>
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</tr>
<tr>
<td>3-year</td>
<td>7.71%</td>
<td>7.91%</td>
</tr>
<tr>
<td>4-year</td>
<td>7.73%</td>
<td>7.93%</td>
</tr>
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Philip Morris, Inc., wants to obtain 3-year Yen financing in the amount ¥10bn. The current exchange rate is 100¥/$. After a week of negotiations, it has narrowed its choice to one of the following two options:
1. borrow ¥10bn at an all-in cost of 3.27% (fixed annualized rate).

2. borrow an equivalent amount of dollars, $100m, at an all-in cost of 7.61% (fixed annualized rate), and swap it for Yen.

a. (7.5 points) Simply "eyeballing" the above numbers, can you decide which alternative Philip Morris, Inc., should choose? Explain why -- or why not.

b. (2.5 points) How would you formally reach a conclusion as to which alternative Philip Morris should choose? Explain thoroughly.

**Bonus Question. (15 points)**

You are given the following spot exchange rates:

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<tbody>
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<td>FF in Paris</td>
<td>5.1382-435 FF / $1</td>
</tr>
<tr>
<td>¥ in NY</td>
<td>0.010207-46 $ / 1¥</td>
</tr>
</tbody>
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The annualized 3-month interest rates on the interbank market are:

- for FF deposits or loans: 5.0% - 5.125%
- for $ deposits or loans: 4.5% - 4.75%
- for ¥ deposits or loans: 2.5% - 2.625%

At the same time, a banker in Tokyo quotes the following 90-day forward cross rate:

18.9700-19.0150 ¥/ 1FF.

You are a financial adviser to Toyota Motor Company. Toyota *must* purchase 10,000,000 FF with Yen for delivery in 90 days. Would you recommend that Toyota trade with the Japanese banker? Explain, both intuitively and formally.

(Hint 1: What is the alternative to trading with the banker? Can Toyota "construct a forward" by borrowing and lending?)

(Hint 2: You need some, but not all, of the above information)
MT Exam Practice Set -- Solutions

Question 1. (10 points)

Suppose that, at the open of the IMM on 03-09-00 (today), you went long one March FF futures contract. The agreed upon price was 0.15$/1FF for a FF 250,000 contract. At the close of trading today, the futures price has risen to 0.155$/1FF, and you decide to keep your long position open.

a. (3 points) Under marking to market, what happens to you at the end of the day? Choose one of the following:

1. you hold a futures contract that has risen in value by $1,250
2. you hold a futures contract that has fallen in value by $625
3. you receive $1,250 and a new futures contract priced at $0.155 (in replacement of the original futures contract with a price of $0.15)
4. you must pay over $1,250 to the seller of the futures contract
5. none of the above

Solution.

c. is the answer. Since you have a long position, you receive $1,250 from the seller of the futures contract, your “old” long position is canceled and you get a new long position in a futures contract priced at $0.155/1FF.

b. (7 points) Detail all the cash-flows that you paid or received today. Explain briefly, assuming that there are no brokerage fees to buy or sell the contract. Suppose the initial margin is $2,000 and the maintenance margin is $1,600.

a. and b.: Solution.

When you went long one March FF futures at the open, you had to provide your broker with (a minimum of) $2,000 as margin. Since there was no brokerage fee, you did not experience any additional cash flow at that point.

At the close of the day, your contract was marked to market. Since the futures price increased from 0.15 $/FF at the open of trading to 0.155$/1FF at the close, and since you went long (i.e., you purchased an asset whose price increased, hence you made a profit), you made a gain and were paid that amount. More precisely, you pocketed:

\[(0.155$/1FF - 0.15$/1FF) \times 250,000 \text{ FF} = 1,250.00\]

Since you did not close your position, there was no further cash flow today.
Question 2. (10 points)

On 02-15-00, at the open of the CBOT, you went long one March 2001 gold futures contract. Here were the prices for gold futures contracts traded Chicago Board of Trade on 02-15-00:

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The initial margin per gold futures contract was $1,225 and the maintenance margin was $1,000. Each gold futures calls for delivery of 100 troy ounces of gold.

a. (4 points) Assume it cost you $17.50 in brokerage fees to buy the contract, and $17.50 to close your position. If you closed out your position at the market close on 02-15-00, how much did you gain or lose between on 02-15-00? Explain.

Solution.

Since you went long a futures, and the price of each gold ounce went up, you made a gain. Formally, given that each contract is for 100 troy ounces of gold, you gained:

\[
(357.80 - 356.02) \times 100 - 17.50 \text{ (open position)} - 17.50 \text{ (close position)} = 143.00
\]

Note that, to calculate the exact profit, one should subtract the opportunity cost of money on your $1,225 deposit.

b. (6 points) Detail all the cash-flows that you paid or received on that day. Explain briefly.

Solution.

When you “bought” the contract at the CBOT open, you had to provide your broker with (a minimum of) $1,225 as margin. Furthermore, you paid $17.50 to your broker.

At the close of the day, your contract was marked to market. Since the futures price increased from 356.02$/1oz at the open of trading to 357.80$/1oz at the close, and since you went long (i.e., you purchased an asset whose price increased, hence you made a profit), you made a gain and were paid that amount. As computed in part a., your account was credited with your gain:

\[
(357.80 - 356.02) \times 100 = 178.00
\]

When you then closed your position, the broker gave back your $1,225 margin, and levied an additional $17.50 brokerage fee.
Question 3. (10 points)

Suppose that you are an analyst for a bank and are asked on December 18, 1996 to predict the spot rate of the DM against the $ on March 20, 1997. Your boss needs the information in 5 minutes.

a. Suppose your bank is lousy, and the only thing you have at hand within the next 5 minutes is the WSJ. However, the page of the Journal with the interest rates data is missing, and somebody dropped coffee on the page with the spot rates: you can only read the spot rate for the DM, not the 90-day forward rate. Fortunately, you find the page that contains the quote for the March DM futures: can you save the day? Argue briefly.

(Hint: the third Wednesday of March in 1997 is 03-20)

Answer

The obvious solution is to get your broker on the phone, and get quotes for the 3-month forward rate. Under the assumption that markets are efficient, this forward rate is an unbiased predictor of the future spot rate. Just use the 3-month forward as your best predictor of the spot.

Suppose, however, that you don't have a phone. Remember that futures prices are roughly equal to forward prices for the same delivery date. In this case, the last day of trading for 1997 March futures is 03-20, which is about 3 months from now. The respective prices of comparable forward and futures contracts should be almost the same. But then, you are done: just use the futures as your estimate!

b. Suppose you had all the interest rates data you could possibly want. Would you still need the futures data? Explain.

Solution

Nope: by using interest rates parity you could calculate the forward rate from the current spot and the interest rates differential between Germany and the U.S. The 90-day DM forward rate is your best guess of the DM spot 3 months from now.

Question 4. (15 points)

Suppose the spot rate of exchange between the $ and the £ is 1£=1.5$. The US affiliate of Global Industries Plc., G.I. Inc., is contemplating raising $12m by issuing bonds denominated either in $ or in £. The $ bonds would be priced to yield 10%; the £ bonds would be priced to yield 13%. In either case, the bonds are zero-coupon instruments that mature in 5 years.

a. (7.5 points) Suppose G.I. Inc. is interested only in minimizing its expected financing costs. In the absence of taxes, what annual rate of £ devaluation (or revaluation) would leave G.I. Inc. indifferent between borrowing either £ or $? What would be the expected exchange rate at the end of year 5, given these currency changes?
Solution

The first step required to find a solution to G.I.’s problem, is to determine the cash-flows that the company faces.

<table>
<thead>
<tr>
<th></th>
<th>Pound bond</th>
<th>Dollar bond</th>
</tr>
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<tr>
<td>$t = 0$ (cash-in now)</td>
<td>+ £8m</td>
<td>+ $12m</td>
</tr>
<tr>
<td>$t = 5$ (cash-out in 5 years)</td>
<td>- £8m (1.13)$^5$</td>
<td>- £12m (1.10)$^5$</td>
</tr>
<tr>
<td></td>
<td>= - £14,739,481</td>
<td>= $19,326,120</td>
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Next, notice that the FX rate that makes G.I. indifferent between the two bond issues is the one that equates the PV of $19,326,120 @ 10\%$ discount rate, and the PV of the year-5 US$ equivalent £14,739,481 @ 10\% discount rate. Thus, we must have:

$$
\frac{\text{£14,739,481}}{(1+10\%)^5} s_0(1+d)^5 = \frac{\text{£8m} (1.13)^5}{(1+10\%)^5} - s_0(1+d)^5 = \text{£12m}
$$

where $s_0 = 1.5\$/1\£$. Solving for $d$ yields: $d = -2.65\%$. In other words, the cutoff expected spot rate is $1.31/\£1$, as $14,739,481 * 1.31 = 19,326,120$.

b. (2.5 points) Suppose that G.I. Inc. decides it would prefer a US$ bond issue, but would agree to go with a pound bond issue instead -- provided the resulting FX exposure can be hedged in a cost-efficient manner. If the best 5-year forward FX rate is $1.35/1\£$, should G.I. Ltd go with the $ or the £ issue? Explain intuitively and formally.

Solution

Applying the above depreciation rate to the initial FX rate of $1.5/1\£$, we get that the year-5 spot rate that would make G.I. indifferent between the £ issue and the $ issue is $1.31/1\£$. Locking in a rate of $1.35/1\£$ makes the £ loan unattractive.
**Question 5.** (10 points)

Suppose swap rates for annual fixed rate payments against 6-month dollar LIBOR are currently quoted by Citibank as follows.

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Philip Morris, Inc., wants to obtain 3-year Yen financing in the amount ¥10bn. The current exchange rate is 100¥/1$. After a week of negotiations, it has narrowed its choice to one of the following two options:

1. borrow ¥10bn at an all-in cost of 3.27% (fixed annualized rate).

2. borrow an equivalent amount of dollars, $100m, at an all-in cost of 7.61% (fixed annualized rate), and swap it for Yen.

**a. (7.5 points)** Simply "eyeballing" the above numbers, can you decide which alternative Philip Morris, Inc., should choose? Explain why -- or why not.

**Solution**

P.M. should directly borrow ¥10bn at an all-in cost of 3.27%.

To see why, notice that, in a $/¥ swap, PM would receive 10 b.p. in $ above its all-in cost of 7.61% p.a. BUT would have to pay 20 b.p. more (3.47% vs. 3.27%) on the ¥ side. Since the ¥ discount rate is lower than the $ discount rate, it should be clear that borrowing dollars and swapping for yen is a bad idea for P.M., Inc.

**b. (2.5 points)** How would you formally reach a conclusion as to which alternative Philip Morris should choose? Explain thoroughly.

**Solution**

If P.M. borrows dollars and swaps for Yen, it will pay 7.61% all-in on its dollar loan, receive 7.71% in $ from the swap dealer (Citibank) and pay 3.47% in ¥ to the same swap dealer. Converting the 10 dollar b.p. into their Yen b.p. equivalents, we get:

\[
\text{PV of 10 b.p. in } \$ \text{ for 3 years at 7.71% IRR} = 0.2487\%
\]

\[
\text{PV of } x \text{ b.p. in } ¥ \text{ for 3 years at 3.47% IRR} = 0.2487\% \text{ if } x = 8.87 \text{ b.p.}
\]
We can now do a quick comparison of the all-in costs of financing:

1. borrow ¥ \( \Rightarrow \) all-in-cost = 3.27% p.a.
2. borrow $ and swap \( \Rightarrow \) all-in-cost = 3.47% - 0.0887% = 3.38%

Thus, PM should directly borrow in Yen -- borrowing dollars and swapping for yen is a bad idea for P.M., Inc.

**Bonus Question.** (15 points)

You are given the following spot exchange rates:

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¥ in NY : 0.010207-46 $ / 1¥

The annualized 3-month interest rates on the interbank market are:

- for FF deposits or loans : 5% - 5.125%
- for $ deposits or loans : 4.5%-4.75%
- for ¥ deposits or loans : 2.5% - 2.625%

At the same time, a banker in Tokyo quotes the following 90-day forward cross rate:

18.9700-19.0150 ¥/ 1FF.

You are a financial adviser to Toyota Motor Company. Toyota *must* purchase 10,000,000 FF with Yen for delivery in 90 days. Would you recommend that Toyota trade with the Japanese banker? Explain, both intuitively and formally.

(Hint 1: What is the alternative to trading with the banker? Can Toyota "construct a forward" by borrowing and lending?)

(Hint 2: You need some, but not all, of the above information)

**Solution.**

Since Toyota must purchase the FF with ¥, we are again dealing with a cost-minimization problem. That is, we must find out whether Toyota can buy the 10m FF more cheaply from the banker, or on the interbank market -- by (a) borrowing ¥ at 2.625%, (b) exchanging ¥ spot for $, (c) exchanging $ spot for FF and (d) investing the FF at 5.25%.

The easy way out in this case is to look at the interest rate differential between France and Japan and to notice that, even though the FF should be quoted at an approximate (5%-2.5%)/4 = 0.625% 3-month forward discount against the ¥, the Tokyo banker is quoting 90-day forward quoting ¥ at the same price as spot ¥. Put differently, the Tokyo banker is seriously
underpricing the ¥ forward, i.e., overpricing the FF forward. To see this, notice that his 90-day forward quote can be rewritten in indirect terms as:

$$0.052590-715 \text{ FF /1¥}$$

which is the same as the banker's spot quote given in question 5, and very close to the spot interbank quote computed in the answer to the same question: $0.052446-700 \text{ FF / 1¥}$.

Formally, one can compute the resulting total cost to Toyota as follows:

(d) in 3 months, Toyota will need 10m FF, and hence it must today deposit the PV of these 10m FF, using the 5% deposit rate at which the FF will be invested. This number is:

$$\frac{10m \text{ FF}}{1 + 0.05 \frac{90}{360}} = 9,876,543 \text{ FF}$$

(b-c) in order to purchase these 9,876,543 FF on the interbank spot market (using the $ as the vehicle currency), Toyota will need:

$$\frac{9,876,543}{5.1382 \times 0.010207} \text{ ¥} = 188,319,741 \text{ ¥}$$

(a) Toyota must therefore borrow 188,319,741 ¥ today, and will in 3 months have to repay:

$$188,319,741 \times (1 + 0.02625 \frac{90}{360}) = 189,555,589 \text{ ¥}$$

In plain English, 10m FF will cost Toyota ¥ 189,555,589 in 90 days (no net cash-flow takes place today) if Toyota uses strategy (a)-(b)-(c)-(d). The alternative cost with the banker in Tokyo would have been ¥ (10m*19.0150) = ¥ 190,150,000 -- a clearly more onerous proposition.