# CHAPTER 2
# Mechanics of Futures Markets

## Practice Questions

**Problem 2.1.**
*Distinguish between the terms open interest and trading volume.*

The *open interest* of a futures contract at a particular time is the total number of long positions outstanding. (Equivalently, it is the total number of short positions outstanding.) The *trading volume* during a certain period of time is the number of contracts traded during this period**.**

**Problem 2.2.**
*What is the difference between a local and a futures commission merchant?*

A futures *commission merchant* trades on behalf of a client and charges a commission. A *local* trades on his or her own behalf.

**Problem 2.3.**
*Suppose that you enter into a short futures contract to sell July silver for $17.20 per ounce. The size of the contract is 5,000 ounces. The initial margin is $4,000, and the maintenance margin is $3,000. What change in the futures price will lead to a margin call? What happens if you do not meet the margin call?*

There will be a margin call when $1,000 has been lost from the margin account. This will occur when the price of silver increases by 1,000/5,000 = $0.20. The price of silver must therefore rise to $17.40 per ounce for there to be a margin call. If the margin call is not met, your broker closes out your position.

**Problem 2.4.**
*Suppose that in September 2012 a company takes a long position in a contract on May 2013 crude oil futures. It closes out its position in March 2013. The futures price (per barrel) is $68.30 when it enters into the contract, $70.50 when it closes out its position, and $69.10 at the end of December 2012. One contract is for the delivery of 1,000 barrels. What is the company's total profit? When is it realized? How is it taxed if it is (a) a hedger and (b) a speculator? Assume that the company has a December 31 year-end.*

The total profit is ($70.50 − $68.30) × 1,000 = $2,200. Of this $(\$69.10-\$68.30)\times 1{,}000$ or $800 is realized on a day-by-day basis between September 2012 and December 31, 2012. A

further $(\$70.50 - \$69.10) \times 1,000 = \$1,400$ is realized on a day-by-day basis between January 1, 2013, and March 2013. A hedger would be taxed on the whole profit of $2,200 in 2013. A speculator would be taxed on $800 in 2012 and $1,400 in 2013.

**Problem 2.5.**
*What does a stop order to sell at $2 mean? When might it be used? What does a limit order to sell at $2 mean? When might it be used?*

A *stop order* to sell at $2 is an order to sell at the best available price once a price of $2 or less is reached. It could be used to limit the losses from an existing long position. A *limit order* to sell at $2 is an order to sell at a price of $2 or more. It could be used to instruct a broker that a short position should be taken, providing it can be done at a price more favorable than $2.

**Problem 2.6.**
*What is the difference between the operation of the margin accounts administered by a clearing house and those administered by a broker?*

The margin account administered by the clearing house is marked to market daily, and the clearing house member is required to bring the account back up to the prescribed level daily. The margin account administered by the broker is also marked to market daily. However, the account does not have to be brought up to the initial margin level on a daily basis. It has to be brought up to the initial margin level when the balance in the account falls below the maintenance margin level. The maintenance margin is usually about 75% of the initial margin.

**Problem 2.7.**
*What differences exist in the way prices are quoted in the foreign exchange futures market, the foreign exchange spot market, and the foreign exchange forward market?*

In futures markets, prices are quoted as the number of US dollars per unit of foreign currency. Spot and forward rates are quoted in this way for the British pound, euro, Australian dollar, and New Zealand dollar. For other major currencies, spot and forward rates are quoted as the number of units of foreign currency per US dollar.

**Problem 2.8.**
*The party with a short position in a futures contract sometimes has options as to the precise asset that will be delivered, where delivery will take place, when delivery will take place, and so on. Do these options increase or decrease the futures price? Explain your reasoning.*

These options make the contract less attractive to the party with the long position and more attractive to the party with the short position. They therefore tend to reduce the futures price.

**Problem 2.9.**
*What are the most important aspects of the design of a new futures contract?*

The most important aspects of the design of a new futures contract are the specification of the underlying asset, the size of the contract, the delivery arrangements, and the delivery months.

**Problem 2.10.**
*Explain how margins protect investors against the possibility of default.*

A margin is a sum of money deposited by an investor with his or her broker. It acts as a guarantee that the investor can cover any losses on the futures contract. The balance in the margin account is adjusted daily to reflect gains and losses on the futures contract. If losses are above a certain level, the investor is required to deposit a further margin. This system makes it unlikely that the investor will default. A similar system of margins makes it unlikely that the investor's broker will default on the contract it has with the clearing house member and unlikely that the clearing house member will default with the clearing house.

**Problem 2.11.**
*A trader buys two July futures contracts on frozen orange juice. Each contract is for the delivery of 15,000 pounds. The current futures price is 160 cents per pound, the initial margin is $6,000 per contract, and the maintenance margin is $4,500 per contract. What price change would lead to a margin call? Under what circumstances could $2,000 be withdrawn from the margin account?*

There is a margin call if more than $1,500 is lost on one contract. This happens if the futures price of frozen orange juice falls by more than 10 cents to below 150 cents per pound. $2,000 can be withdrawn from the margin account if there is a gain on one contract of $1,000. This will happen if the futures price rises by 6.67 cents to 166.67 cents per pound.

**Problem 2.12.**
*Show that, if the futures price of a commodity is greater than the spot price during the delivery period, then there is an arbitrage opportunity. Does an arbitrage opportunity exist if the futures price is less than the spot price? Explain your answer.*

If the futures price is greater than the spot price during the delivery period, an arbitrageur buys the asset, shorts a futures contract, and makes delivery for an immediate profit. If the futures price is less than the spot price during the delivery period, there is no similar perfect arbitrage strategy. An arbitrageur can take a long futures position but cannot force immediate delivery of the asset. The decision on when delivery will be made is made by the party with the short position. Nevertheless companies interested in acquiring the asset may find it attractive to enter

into a long futures contract and wait for delivery to be made.

**Problem 2.13.**
*Explain the difference between a market-if-touched order and a stop order.*

A market-if-touched order is executed at the best available price after a trade occurs at a specified price or at a price more favorable than the specified price. A stop order is executed at the best available price after there is a bid or offer at the specified price or at a price less favorable than the specified price.

**Problem 2.14.**
*Explain what a stop-limit order to sell at 20.30 with a limit of 20.10 means.*

A stop-limit order to sell at 20.30 with a limit of 20.10 means that as soon as there is a bid at 20.30 the contract should be sold providing this can be done at 20.10 or a higher price.

**Problem 2.15.**
*At the end of one day a clearing house member is long 100 contracts, and the settlement price is $50,000 per contract. The original margin is $2,000 per contract. On the following day the member becomes responsible for clearing an additional 20 long contracts, entered into at a price of $51,000 per contract. The settlement price at the end of this day is $50,200. How much does the member have to add to its margin account with the exchange clearing house?*

The clearing house member is required to provide $20\times\$2,000=\$40,000$ as initial margin for the new contracts. There is a gain of $(50{,}200 - 50{,}000)\times 100 = \$20{,}000$ on the existing contracts. There is also a loss of $(51{,}000-50{,}200)\times 20=\$16{,}000$ on the new contracts. The member must therefore add

$$40{,}000-20{,}000+16{,}000=\$36{,}000$$

to the margin account.

**Problem 2.16.**
*On July 1, 2012, a Japanese company enters into a forward contract to buy $1 million with yen on January 1, 2013. On September 1, 2012, it enters into a forward contract to sell $1 million on January 1, 2013. Describe the profit or loss the company will make in dollars as a function of the forward exchange rates on July 1, 2012 and September 1, 2012.*

Suppose $F_1$ and $F_2$ are the forward exchange rates for the contracts entered into July 1, 2012 and September 1, 2012, and $S$ is the spot rate on January 1, 2013. (All exchange rates are measured as yen per dollar). The payoff from the first contract is $(S-F_1)$ million yen and the payoff from

the second contract is $(F_2 - S)$ million yen. The total payoff is therefore $(S - F_1) + (F_2 - S) = (F_2 - F_1)$ million yen.

**Problem 2.17.**
*The forward price on the Swiss franc for delivery in 45 days is quoted as 1.1000. The futures price for a contract that will be delivered in 45 days is 0.9000. Explain these two quotes. Which is more favorable for an investor wanting to sell Swiss francs?*

The 1.1000 forward quote is the number of Swiss francs per dollar. The 0.9000 futures quote is the number of dollars per Swiss franc. When quoted in the same way as the futures price the forward price is $1/1.1000 = 0.9091$. The Swiss franc is therefore more valuable in the forward market than in the futures market. The forward market is therefore more attractive for an investor wanting to sell Swiss francs.

**Problem 2.18.**
*Suppose you call your broker and issue instructions to sell one July hogs contract. Describe what happens.*

Live hog futures are traded on the Chicago Mercantile Exchange. The broker will request some initial margin. The order will be relayed by telephone to your broker's trading desk on the floor of the exchange (or to the trading desk of another broker). It will then be sent by messenger to a commission broker who will execute the trade according to your instructions. Confirmation of the trade eventually reaches you. If there are adverse movements in the futures price your broker may contact you to request additional margin.

**Problem 2.19.**
*"Speculation in futures markets is pure gambling. It is not in the public interest to allow speculators to trade on a futures exchange." Discuss this viewpoint.*

Speculators are important market participants because they add liquidity to the market. However, contracts must be useful for hedging as well as speculation. This is because regulators generally only approve contracts when they are likely to be of interest to hedgers as well as speculators.

**Problem 2.20.**
*Live cattle futures trade with June, August, October, December, February, and April maturities. Why do you think that the open interest for the June contract is less than that for the August contract in Table 2.2?*

Normally, the shorter the maturity of a contract is, the higher the open interest. However, traders tend to close out their positions in the month immediately before the maturity month. This means

that the open interest for the closest maturity month can be less than that for the next closest maturity month

**Problem 2.21.**
*What do you think would happen if an exchange started trading a contract in which the quality of the underlying asset was incompletely specified?*

The contract would not be a success. Parties with short positions would hold their contracts until delivery and then deliver the cheapest form of the asset. This might well be viewed by the party with the long position as garbage! Once news of the quality problem became widely known no one would be prepared to buy the contract. This shows that futures contracts are feasible only when there are rigorous standards within an industry for defining the quality of the asset. Many futures contracts have in practice failed because of the problem of defining quality.

**Problem 2.22.**
*"When a futures contract is traded on the floor of the exchange, it may be the case that the open interest increases by one, stays the same, or decreases by one." Explain this statement.*

If both sides of the transaction are entering into a new contract, the open interest increases by one. If both sides of the transaction are closing out existing positions, the open interest decreases by one. If one party is entering into a new contract while the other party is closing out an existing position, the open interest stays the same.

**Problem 2.23.**
*Suppose that on October 24, 2012, a company sells one April 2013 live-cattle futures contracts. It closes out its position on January 21, 2013. The futures price (per pound) is 91.20 cents when it enters into the contract, 88.30 cents when it closes out its position, and 88.80 cents at the end of December 2012. One contract is for the delivery of 40,000 pounds of cattle. What is the total profit? How is it taxed if the company is (a) a hedger and (b) a speculator? Assume that the company has a December 31 year end.*

The total profit is

$$40,000 \times (0.9120 - 0.8830) = \$1,160$$

If the company is a hedger this is all taxed in 2013. If it is a speculator

$$40,000 \times (0.9120 - 0.8880) = \$960$$

is taxed in 2012 and

$$40,000 \times (0.8880 - 0.8830) = \$200$$

is taxed in 2013.

**Problem 2.24.**
*A cattle farmer expects to have 120,000 pounds of live cattle to sell in three months. The live-cattle futures contract traded by the CME Group is for the delivery of 40,000 pounds of cattle. How can the farmer use the contract for hedging? From the farmer's viewpoint, what are the pros and cons of hedging?*

The farmer can short 3 contracts that have 3 months to maturity. If the price of cattle falls, the gain on the futures contract will offset the loss on the sale of the cattle. If the price of cattle rises, the gain on the sale of the cattle will be offset by the loss on the futures contract. Using futures contracts to hedge has the advantage that it can at no cost reduce risk to almost zero. Its disadvantage is that the farmer no longer gains from favorable movements in cattle prices.

**Problem 2.25.**
*It is July 2011. A mining company has just discovered a small deposit of gold. It will take six months to construct the mine. The gold will then be extracted on a more or less continuous basis for one year. Futures contracts on gold are available with delivery months every two months from August 2011 to December 2012. Each contract is for the delivery of 100 ounces. Discuss how the mining company might use futures markets for hedging.*

The mining company can estimate its production on a month by month basis. It can then short futures contracts to lock in the price received for the gold. For example, if a total of 3,000 ounces are expected to be produced in September 2011 and October 2011, the price received for this production can be hedged by shorting 30 October 2011 contracts.

## Further Questions

**Problem 2.26**
*Trader A enters into futures contracts to buy 1 million euros for 1.4 million dollars in three months. Trader B enters in a forward contract to do the same thing. The exchange (dollars per euro) declines sharply during the first two months and then increases for the third month to close at 1.4300. Ignoring daily settlement, what is the total profit of each trader? When the impact of daily settlement is taken into account, which trader does better?*

The total profit of each trader in dollars is $0.03 \times 1{,}000{,}000 = 30{,}000$. Trader B's profit is realized at the end of the three months. Trader A's profit is realized day-by-day during the three months. Substantial losses are made during the first two months and profits are made during the final month. It is likely that Trader B has done better because Trader A had to finance its losses during the first two months.

**Problem 2.27**

*Explain what is meant by open interest. Why does the open interest usually decline during the month preceding the delivery month? On a particular day, there were 2,000 trades in a particular futures contract. This means that there were 2000 buyers (going long) and 2000 sellers (going short). Of the 2,000 buyers, 1,400 were closing out positions and 600 were entering into new positions. Of the 2,000 sellers, 1,200 were closing out positions and 800 were entering into new positions. What is the impact of the day's trading on open interest?*

Open interest is the number of contract outstanding. Many traders close out their positions just before the delivery month is reached. This is why the open interest declines during the month preceding the delivery month. The open interest went down by 600. We can see this in two ways. First, 1,400 shorts closed out and there were 800 new shorts. Second, 1,200 longs closed out and there were 600 new longs.

**Problem 2.28**

*One orange juice future contract is on 15,000 pounds of frozen concentrate. Suppose that in September 2011 a company sells a March 2013 orange juice futures contract for 120 cents per pound. In December 2011 the futures price is 140 cents. In December 2012 the futures price is 110 cents. In February 2013 it is closed out at 125 cents. The company has a December year end. What is the company's profit or loss on the contract? How is it realized? What is the accounting and tax treatment of the transaction if the company is classified as a) a hedger and b) a speculator?*

The price goes up during the time the company holds the contract from 120 to 125 cents per pound. Overall the company therefore takes a loss of $15,000 \times 0.05 = \$750$. If the company is classified as a hedger this loss is realized in 2013, If it is classified as a speculator it realizes a loss of $15,000 \times 0.20 = \$3000$ in 2011, a gain of $15,000 \times 0.30 = \$4,500$ in 2012, and a loss of $15,000 \times 0.15 = \$2,250$ in 2013.

**Problem 2.29.**

*A company enters into a short futures contract to sell 5,000 bushels of wheat for 450 cents per bushel. The initial margin is $3,000 and the maintenance margin is $2,000. What price change would lead to a margin call? Under what circumstances could $1,500 be withdrawn from the margin account?*

There is a margin call if $1000 is lost on the contract. This will happen if the price of wheat futures rises by 20 cents from 450 cents to 470 cents per bushel. $1500 can be withdrawn if the futures price falls by 30 cents to 420 cents per bushel.

**Problem 2.30.**
*Suppose that there are no storage costs for crude oil and the interest rate for borrowing or lending is 5% per annum. How could you make money on May 26, 2010 by trading July 2010 and December 2010 contracts on crude oil? Use Table 2.2.*

The July 2010 settlement price for oil is $71.51 per barrel. The December 2010 settlement price for oil is $75.23 per barrel. You could go long one July 2010 oil contract and short one December 2010 contract. In July 2010 you take delivery of the oil borrowing $71.51 per barrel at 5% to meet cash outflows. The interest accumulated in five months is about 71.51×0.05×5/12 or $1.49. In December the oil is sold for $75.23 per barrel which is more than the amount that has to be repaid on the loan. The strategy therefore leads to a profit. Note that this profit is independent of the actual price of oil in June 2010 or December 2010. It will be slightly affected by the daily settlement procedures.

**Problem 2.31.**
*What position is equivalent to a long forward contract to buy an asset at $K$ on a certain date and a put option to sell it for $K$ on that date?*

The long forward contract provides a payoff of $S_T - K$ where $S_T$ is the asset price on the date and $K$ is the delivery price. The put option provides a payoff of max ($K - S_T$, 0). If $S_T > K$ the sum of the two payoffs is $S_T - K$. If $S_T < K$ the sum of the two payoffs is 0. The combined payoff is therefore max ($S_T - K$, 0). This is the payoff from a call option. The equivalent position is therefore a call option.

**Problem 2.32. (Excel file)**
*The author's Web page (www.rotman.utoronto.ca/~hull/data) contains daily closing prices for the crude oil futures contract and gold futures contract. (Both contracts are traded on NYMEX.) You are required to download the data and answer the following:*

a) *How high do the maintenance margin levels for oil and gold have to be set so that there is a 1% chance that an investor with a balance slightly above the maintenance margin level on a particular day has a negative balance two days later? How high do they have to be for a 0.1% chance? Assume daily price changes are normally distributed with mean zero. Explain why the exchange might be interested in this calculation*
b) *Imagine an investor who starts with a long position in the oil contract at the beginning of the period covered by the data and keeps the contract for the whole of the period of time covered by the data. Margin balances in excess of the initial margin are withdrawn. Use the maintenance margin you calculated in part (a) for a 1% risk level and assume that the maintenance margin is 75% of the initial margin. Calculate the number of margin calls and the number of times the investor has a negative margin balance and therefore an incentive to walk away. Assume that all margin calls are met in your calculations. Repeat the calculations for an investor who starts with a short position in the gold*

*contract.*

Note that the data for this problem in the 8th edition is different from that in the 7th edition.

a) For gold, the standard deviation of daily changes is $15.184 per ounce or $1518.4 per contract. For a 1% risk this means that the maintenance margin per contract should be set at $1518.4 \times \sqrt{2} \times 2.3263$ or 4996 when rounded. For a 0.1% risk the maintenance margin per contract should be set at $1518.4 \times \sqrt{2} \times 3.0902$ or 6,636 when rounded. For crude oil, the standard deviation of daily changes is $1.5777 per barrel or $1577.7 per contract. For a 1% risk, this means that the maintenance margin should be set at $1577.7 \times \sqrt{2} \times 2.3263$ or 5,191 when rounded. For a 0.1% chance the maintenance margin should be set at $1577.7 \times \sqrt{2} \times 3.0902$ or 6,895 when rounded. The exchange might be interested in these calculations because they indicate the chance of a trader who is just above the maintenance margin level at the beginning of the period having a negative margin level before funds have to be submitted to the broker.

b) For a 1% risk the initial margin is set at 6,921 for on crude oil. (This is the maintenance margin of 5,191 divided by 0.75.) As the spreadsheet shows, for a long investor in oil there are 157 margin calls and 9 times (out of 1039 days) where the investor is tempted to walk away. For a 1% risk the initial margin is set at 6,661 for gold. (This is 4,996 divided by 0.75.) As the spreadsheet shows, for a short investor in gold there are 81 margin calls and 4 times (out of 459 days) when the investor is tempted to walk away. When the 0.1% risk level is used there is 1 time when the oil investor might walk away and 2 times when the gold investor might do so.