Commerce 374
Winter 2007

Homework 8 - Solutions

Problem 1.

1) In futures trading, the minimum level to which an equity position may fall before requiring additional margin is *most accurately* termed the _____
   A) initial margin
   B) variation margin
   C) cash flow margin
   D) maintenance margin
2) A person with a long position in a commodity futures contract want the price of the commodity to _____
   A) decrease substantially
   B) increase substantially
   C) remain unchanged
   D) increase or decrease substantially
3) Futures and options are similar in all of the following ways except _____
   A) expiration dates are standardized
   B) deliverable quantities are standardized
   C) the owner is not obligated to proceed with the transaction
   D) All of the above are similarities between futures and options
4) _____ is a true statement.
   A) A margin deposit can only be met by cash
   B) All futures contracts require the same margin deposit
   C) The maintenance margin is the amount of money you post with your broker when you buy or sell a futures contract
   D) The maintenance margin is the value of the margin account below which the holder of a futures contract receives a margin call
5) An investor would want to _____ to exploit an expected fall in interest rates.
   A) buy S&P 500 index futures
   B) take a short position in treasury bond futures
   C) take a long position in treasury bond futures
   D) take a long position in wheat futures
6) If the S&P 500 index futures is overpriced relative to the spot S&P 500 index, you should _____
   A) buy all the stocks in the S&P 500 and write put options on the S&P 500 index
   B) sell the stocks in the S&P 500 and buy call options on S&P 500 index
   C) sell S&P 500 index futures and buy all the stocks in the S&P 500
   D) sell short all the stocks in the S&P 500 and buy S&P 500 index futures
7) In the context of a futures contract, the *basis* is defined as _____
   A) the futures price minus the spot price
   B) the spot price minus the futures price
   C) the futures price minus the initial margin
   D) None of the above

In all the calculation questions, I used the test bank question and they use the discrete discounting. For your exam, I want you to use continuous compounding.

8) The current level of the S&P 500 is 550. The dividend yield on the S&P 500 is 3%. The risk-free interest rate is 6%. The futures price for a contract on the S&P 500 due to expire 6 months from now should be _____.
   A) $541.69
   B) $558.19 ($F = S*(1 + r_f - d)^{0.5} = \$558.19$)
   C) $566.50
   D) $583.00
9) The futures price for a contract on gold due to expire a year from now is $430. The dividend yield on the S&P 500 is 4%. The risk-free interest rate is 8%. The spot price of gold should be _____.
   A) $398.15
   B) $413.46
   C) $447.20
   D) $464.40
10) Which of the following constitute acceptable means of making delivery on stock index futures contract?
   A) cash
   B) treasury bills
   C) Both of the above answers are correct
   D) None of the above answers are correct
11) Consider an investor who enters a long position in July wheat futures contract for 5,000 bushels at $4 per bushel. Suppose that the initial margin is equal to 5%. How much money will she have in her futures account at the end of the second day if the closing price at first day was $4.10 and the price at the end of the second day was $3.95 per bushel? Assume that the maintenance margin is equal to 100% of initial margin and she does not withdraw any money from her account in period 1. Besides, assume that all the futures positions are cleared at the end of the day.
   A) $250
   B) $750
   C) $1000
   D) $1500
12) For the same problem as before, consider another investor who wants to take an opposite position in the same wheat futures contract. How much money will he have in his account at the end of period two? This time, assume that the maintenance margin is equal to 65% of initial margin and, similarly to investor in Q.11, he does not withdraw any money from his account in period 1. Again, assume that all futures positions are cleared at the end of the day.
   A) $1000
   B) $1250
   C) $1400
   D) $1750

Problem 2.
The 2-month interest rates in Switzerland and the United States are 3% and 8% per annum, respectively. The spot price of the Swiss franc is $0.6500. The futures price for a contract deliverable in 2 months is $0.6600. What arbitrage opportunities does this create?

In order to answer this question we need to use the interest rate parity equation.

$F = E*e^{(r-rf)(T-t)}$

If there are no arbitrage opportunities then $F = 0.65* e^{(8\%-3\%)2/12} = \$0.6554$. This means that since F=0.66 it is overpriced. To take advantage of this mispricing, we can borrow 0.65 USD which is the spot rate for 1 CHF. Then, we can lend 1 CHF and finally take a short position in the futures contract.

The payoff table is as follows:

Strategy	time = 0	time = T
Buy Franc	$-E_0$	$+ E_T*e^{(0.03)2/12}$
Sell US dollar	$+E_0$	$- E_0*e^{(0.08)2/12}$
Short forward	0	$(F-E_T)* e^{(0.03)2/12}$
Total	0	$- E_0*e^{(0.08)2/12} + F* e^{(0.03)2/12} = \$0.0046$

So, you can see that with no money down you can create positive payoff in the future independent of the exchange rate in the future.

Problem 3.
Consider a stock that will pay a dividend of D dollars in one year, which is when a futures contract matures. Consider the following strategy: buy the stock, short a futures contract on the stock, and borrow S_0 dollars, where S_0 is the current price of the stock.

a) What are the cash flows now and in one year?
b) Show that the equilibrium futures price must be $F_0 = S_0(1+r) - D$ to avoid arbitrage
c) Call the dividend yield $d = D/S_0$, and conclude that $F_0 = S_0(1+r-d)$.

a.

Action	Initial CF	Final CF
Buy shares	$-S_0$	$S_T + D$
Short futures	0	$F_0 - S_T$
Borrow	S_0	$-S_0(1 + r)$
TOTAL	0	$F_0 + D - S_0(1 + r)$

b. The net initial investment is zero, whereas the cash flow is not zero. Therefore, to avoid arbitrage opportunities the equilibrium futures price will be the final cash flow equated to zero. Accordingly, $F_0 = S_0(1 + r) - D$.

c. Noting that $D = d \times S_0$ we substitute and rearrange to find that $F_0 = S_0(1 + r - d)$.

Problem 4.
Southwest Air intends to hedge their complete exposure to fuel prices with heating oil futures and options, since jet fuel futures and options are not available. They expect to consume 90 millions of gallons of jet fuel per month over the next year. Assume that heating oil and jet fuel prices are perfectly correlated.

a. *How should they hedge their jet fuel prices with futures contracts?*

They should buy heating oil fuel futures for 90 million gallons of heating oil for each month during the next year. Note that the expiration dates of the futures contract should be one month after the corresponding consumption needs to avoid the delivery of the heating oil.

b. *How should Southwest hedge their exposure with heating oil options?*

They should buy European call options for 90 million gallons of heating oil for each month during the next year. They should close out their option positions the month before the options expire.

c. *What are the main differences of using options compared to futures contracts? Please make sure to give three differences.*

- Futures contracts do not require any upfront investment. Options need an upfront investment (payment of the premium).
- Futures contracts hedge the risk completely (you eliminate price risk completely), while the call options only eliminate the possibility of losses.
- The most you can lose with the call options is the premium you paid upfront. For futures you can lose considerably more.

Problem 5.
Suppose that you are the manager and sole owner of a highly leveraged company. All the debt will mature in one year. If at that time the value of the company is greater than the face value of the debt, you will pay off the debt. If the value of the company is less than the face value of the debt, you will declare bankruptcy and the debt holders will take over all the assets of the company.

a. *Express your position as an option on the value of the company.*

Suppose that V is the value of the company (i.e., the value of all the assets of your company) and D is the face value of the debt in one year. The company will go into bankruptcy if the total assets V are less than the face value of the debt D. In this case, the debt holders will take over the assets from the equity holder. If the

company does not go broke (i.e., V>D), then the equity holder needs to pay back the face value of the debt D to the debt holders and the equity holder can keep the remaining assets of V-D. The values of the two positions are as follows:

Figure 1: Value of Debt

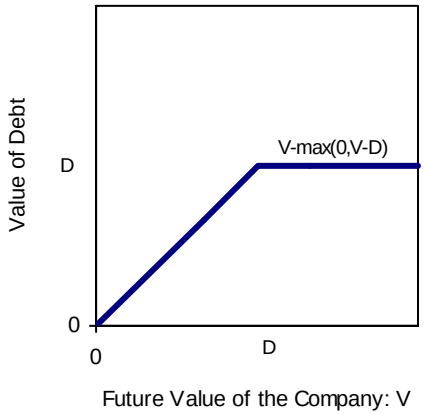
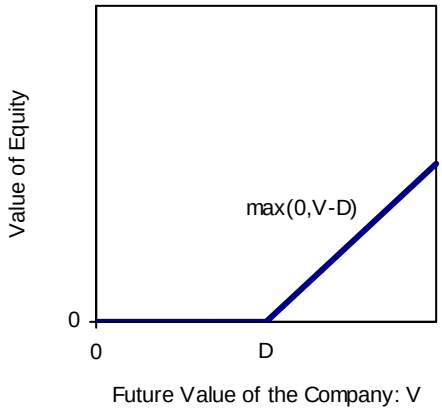


Figure 2: Value of Equity



Figures 1 and 2 show the value of the debt and the value of the equity position in the company. If the company goes broke (V<D), then the bond holders take over the company and the value of the debt equals to the value of the company (D=V) and the value of the equity position of the manager is zero. If the company does not go broke (V>D), then the bond holder will receive the face value of the debt D and the equity holder will receive the remaining assets of the company (i.e., V-D). Note that debt is risky in this case. The debt holders will not always receive the whole face value of the debt D. Note also that the sum of the value of the debt and the value of the equity equals the value of the total assets of the company.

The value of the manager's position is therefore:

$$\max(0, V-D).$$

This is the payoff of a call option on the company with a strike price of D.

b. *Express the position of the debt holders in terms of options on the value of the company.*

The debt holders receive after one year:

$$\min(V,D) = V - \max(0, V-D).$$

The debt holders hold a long position in the assets of the company combined with a short position in a call option on the assets with an exercise price of D.

The position of the debt holders can also be characterized as:

$$\min(V,D) = D - \max(0, D-V)$$

Since max(0, D-V) is the payoff from a put option on the company with a strike price of D, the debt holders have in effect made a risk-free loan (worth D at maturity with certainty) and written a put option on the value of the company with strike price D. The equivalence of the two characterizations is an application of the put-call parity.

c. *What can you do to increase the value of your position?*

The manager can increase the value of her position by increasing the value of the call option in a. It follows that the manager should attempt to increase both V and the volatility of V. Increasing the volatility of V is beneficial because the value of a call option increases if the volatility of the asset returns increases. If V increases, the manager benefits to the full extent of the change. If V decreases, much of the downside is absorbed by the company's lenders.

Problem 6.
Please list and briefly discuss <u>three</u> most important/useful concepts you have learned in this class during the entire semester.

I leave this question to your discretion. Obviously, I have learned a lot from you in this class and hope you did as well, but I do not want to impose on you my personal opinion ☺