

- The duration of the exam is 1 hour 20 minutes.
- The exam consists of 10 problems and it is worth 100 points.
- Please write in the space provided. If necessary, write on the back of the page.
- Please ask me if you have any questions.
- To receive full credit you have to carefully explain all your answers and show all your work.

General advice: *If you get stuck in the early parts of a problem, do not stop there. You can receive substantial partial credit by explaining how you would solve the rest of problem if you had the necessary answers from its previous parts.*

1. (20 points) Determine whether each of the statements below is True or False:

The price of the futures contract at its expiration is equal to the price of the underlying asset because of arbitrage.

True.

Option buyer would never exercise a call option which is out of the money.

True.

A *call option* is said to be *in the money* if the price of the underlying asset is lower than the strike price.

False. The opposite is true.

An investor with the long position in the bond futures market is hoping for higher interest rates in the future.

False. High interest rates → Low bond prices → Buyer (long position) will have to pay more than (low) market price.

Bond market is less important than stock market in most developed countries.

False. The opposite is true.

Price of an interest rate futures contract can't fluctuate significantly from the price of the underlying bond before the futures expiration date.

True. Arbitrage would prevent that.

Option premiums rise with the volatility of the price of the underlying asset. **True. Option holders care about potential gains only (losses are eliminated because option is a right to buy/sell, not an obligation). The higher is the volatility – the higher are potential gains – the higher is the value of having the option to buy/sell – the higher is the option premium.**

According to the rational expectations theory, investors use all available information to be able to predict future stock prices with certainty. **False. Nobody can predict stock prices with certainty. Investors can only form expectations.**

2. (5 points) Explain how margin accounts allow traders in the futures markets to have very high rates of return.

Typically clearing corporations require only a small proportion of the sum of the futures contracts bought/sold to be kept on the margin account. This required amount that has to be placed on the margin account is the only investment necessary to be able to participate in the trade. The gains/losses, however, depend on the whole sum of the futures bought/sold. Minor changes in price of the underlying asset (they are minor as a percentage of the value of the contract) may lead to quite significant gains/losses in dollar terms. These gains/losses can be large when compared to the value stored at the margin account (which itself is a small proportion of the value of the futures contracts traded). As usual, potential for high rates of return brings high risk along with it.

3. (5 points) Compute the profits of an investor who bought for a \$200 premium a *put* option on 100 stocks with a strike price of \$1100, if at the expiration date the price is \$1000.

This option will be exercised because market price is below option strike price (option gives you the right to sell 100 shares at a price above market price).

Profit = -\$200 (premium) + \$110,000 (sell stocks at the strike price to the option writer) - \$100,000 (buy stocks at the current market price) = \$9,800.

4. (5 points) An investor bought a contract in the corn futures market. What is the position of this investor? What risk does this transaction allow to hedge against?

Buyer has the long position (has to buy corn at the specified future date). This transaction would allow the buyer to hedge against the risk of higher prices of corn in the future. This may be relevant to businesses that use corn as one of their production inputs (there are literally thousands of products that utilize corn – ethanol, for example).

5. (10 points) What are the two main elements of the price of an option and explain what each of them means?

Option price has two components: (1) intrinsic value and (2) option premium. The intrinsic value is the value of the option if it is exercised immediately (it cannot be negative, only in-the-money options have any intrinsic value, at-the-money and out-of-the-money options have zero intrinsic value). For call options the intrinsic value is the difference between market price of the underlying asset and the strike price. For put options it is the difference between the strike price and the market price of the underlying asset. Option premium reflects the potential for gains in the future. If the market price will move in the favorable (for option holder) direction, there will be some gains to be made by exercising the option. Option holders only care about gains because losses are limited by the ability not to exercise the option.

6. (5 points) Suppose that company A paid a \$2 dividend on each of its stocks. Assume that the growth rate of dividends is 4% a year. The risk-free interest rate is 2% and the risk premium is 4%. What is the current price of one stock of the company A?

The formula that was given in the lecture notes is:

$P_{\text{today}} = D_{\text{today}} / (i - g)$, where P_{today} is the price today, D_{today} is the dividend today, i is the interest rate (equal to the sum of risk free rate and risk premium), and g is the dividend growth rate. Plugging in the numbers, we get:

$P_{\text{today}} = D_{\text{today}} / (i - g) = \$2 / (0.02 + 0.04 - 0.04) = \$100.$

The text-book gives a slightly different formula:

$P_{\text{today}} = D_{\text{in one year}} / (i - g) = \$(0.5 * 1.04) / (0.02 + 0.04 - 0.04) = \$104.$

Either is fine for this problem.

7. (10 points) Show on a T-account the following transactions:
 a. A customer withdraws \$1000 from a checking account.

A		L
Reserves (cash items) -\$1000		Deposits -\$1000

- b. Bank sells \$1000 worth of T-Bills to increase the amount of reserves.

A		L
Reserves +\$1000		
Securities -\$1000		

- c. Bank gives \$1000 worth of loans using its excess reserves.

A	L
Reserves (excess reserves) -\$1000	
Loans +\$1000	

8. (10 points) Many banks choose to hold excess reserves. Explain the benefits and costs of holding excess reserves.

The benefit of holding excess reserves is that they provide a buffer against potential liquidity problems (a sort of insurance against the liquidity risk – risk of not being able to provide cash to customer making withdrawals on their demand deposit accounts). The cost of holding excess reserves is that they earn exactly zero rate of return (as opposed to other types of assets, which earn income).

9. (10 points) Describe the asymmetric information problems that a bank faces when considering a loan application from a firm? How can a bank attempt to solve these problems?

There are two main asymmetric information problems – adverse selection and moral hazard. Adverse selection happens if bank doesn't know the true quality (ability to repay) of the potential borrowers. For any given interest rate, the quality of the pool of loan applications will be below average because really good (safe) firms know that they are safe and demand low rates on the loan (because of low risk premium). There are many ways banks can deal with this problem – collect information (analyze loan applications), ask for collateral (safe firms wouldn't mind providing it), include covenants in the loan contract.

Moral hazard happens if the borrower has “wrong” (from the bank's point of view) incentives. One example of wrong incentives is to take on “too much” risk. There are multiple ways to deal with moral hazard problem – the bank can perform monitoring, use collateral and include restrictive covenants.

10. (20 points) Suppose that a bank has \$50 million in assets the interest rate on which is equal to the current rate on 1-year Treasury Bills plus 4%. The interest rate on the remaining \$80 million in assets is fixed and is equal to 8%. The bank pays the interest rate equal to the rate on 1-year T-Bill rate plus 1% on \$100 million of its liabilities. It pays a fixed rate of 5% on the remaining \$30 million of its liabilities. The current T-Bill interest rate is 4%.
- a. Carefully describe the nature of the risk this bank faces because of the mismatch of the interest rate sensitive assets and liabilities?

This bank faces interest rate risk. If interest rate changes (T-Bill interest rate) bank's profits will change. The reason it will happen is the mismatch between rate-sensitive assets and liabilities. If the interest rate goes up, the interest-rate-sensitive assets will be earning more income and rate-sensitive liabilities will cost more at the

same time. If there is more rate sensitive liabilities than assets (which is the case for this bank), the income rise will be smaller than cost rise.

b. Define and calculate the gap?

Gap=interest-rate-sensitive assets - interest-rate-sensitive liabilities = \$50 - \$100 = - \$50 mil.

c. Suppose that the interest rate on assets falls to 7% and the interest rate on liabilities falls to 4%, what is the change in profits of this bank?

Change in profits = gap * change in the interest rate = -\$50mil*-0.01=\$0.5mil.

Alternatively, you can calculate the total profits before and after the change in the interest rates and then take the difference.

d. Imagine that there is a finance company that has \$60 million in rate sensitive assets and \$10 million in rate sensitive liabilities. Describe a swap contract that would allow both bank and finance company to get rid of the risk associated with the mismatch of the interest-rate sensitive assets and liabilities?

Swap:

Notional principal: \$50 mil.

Payments exchanged: The finance company pays the bank a *variable interest rate* on \$50mil, the bank pays the finance company a *fixed interest rate* on \$50mil.

Time period: whatever period both parties are comfortable with.