

- 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:

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

False. Low interest rates → High bond prices → Seller (short position) will have to sell bonds at a lower price (specified in the contract) than (high) market price.

Option writer always exercises a call option which is in the money.

False. Option writer doesn't have a right to exercise options.

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

True. Put option = right to sell. It is in the money if strike price is above market price.

Most of the options sold in the US are of the so-called European type.

False.

The intrinsic value of an at-the-money call option is zero.

True.

If the Efficient Market Hypothesis is true, it is not possible for anyone to beat the market average.

False. It is unlikely, but still possible. There are always lucky investors.

Indirect finance plays a more significant role in the modern financial system than direct finance.

True.

2. (5 points) Compute the profits of an investor who bought for a \$300 premium a *call* option on 100 shares with a strike price of \$1000 per share, if at the expiration date the market price of this share is \$1200.

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

Profit = -\$300 (premium) + \$120,000 (sell stocks at the market price) - \$100,000 (buy stocks at the strike price from the option writer) = \$19,700.

3. (5 points) Suppose that a corn futures contract specifies the delivery of 1000 bushels of corn in 5 months at the price of \$5 per bushel. Suppose that the price rises from \$5 to \$6 per bushel of corn. Carefully describe the transactions on the margin accounts of a seller and a buyer of one such corn futures contract.

The price of 1000 bushels of corn will go up by \$1,000 (= \$6,000 - \$5,000). Seller of the futures will lose because of this price change – if the price stays at \$6 will the contract expires, seller will have to deliver corn at a price lower than current market price (\$5 < \$6). \$1,000 will be transferred from seller's margin account to buyer's margin account.

An alternative way to think about this is to imagine that seller won't have to deliver any corn to the buyer. Seller can sell his corn on the market for corn and buyer can buy corn on the same market. If they engage in the futures contract, they guarantee the price. It is fixed at \$5,000. If \$1,000 is transferred from seller's account to the buyer's account, buyer will be paying \$5,000 (\$6,000 (price on the market) - \$1,000 (compensation from the seller)) instead of current market price \$6,000. The seller will be able to sell his corn at the current market price \$6,000, but he'll obtain the fixed price of \$5,000 because he pays \$1,000 to the buyer.

4. (10 points) Explain what the moral hazard of debt contracts is and name at least two ways of dealing with this problem?

Moral hazard happens if the borrower has “wrong” (from the lender's point of view) incentives. The borrower has incentives to take on too much risk. The reason it happens is that borrower is not risking its own money but lender's money. There are multiple ways to deal with moral hazard problem:

- a. **High net worth (if borrower has a lot of his/her own capital invested in the firm, he/she will think twice before investing in very risky projects).**
- b. **Monitoring.**
- c. **Enforcement of restrictive covenants.**
- d. **Financial Intermediation.**

5. (5 points) Suppose that company A expects to pay a \$2 dividend on each of its stocks next year. The price of each share of stock is \$200. Assume that the growth rate of dividends is 4% a year. The risk-free interest rate is 3%. What is the implied risk premium?

$P_{\text{today}} = D_{\text{next year}} / (i - g)$, where P_{today} is the price today, $D_{\text{next year}}$ is the dividend next year, 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:

$$P_{\text{today}} = D_{\text{next year}} / (i - g) = \$2 / (rp + 0.03 - 0.04) = \$200.$$

The implied risk premium is: $rp = 0.2$.

6. (5 points) What is the difference between price-weighted and value-weighted stock market indices? Give at least one example of each?

Price weighted stock market index (Dow Jones): price of one share of stock is used as weight. Companies with larger price per share have larger weight.

Value weighted index (S&P 500): the total market value of each company serves as weight. Larger companies have larger weight.

7. (10 points) Show on a T-account the following transactions:
- A customer repays a \$1000 loan to the bank.

<u>A</u>		<u>L</u>
Reserves (cash items) +\$1000		
Loans -\$1000		

- Bank borrows \$100,000 on the federal funds market to meet the required reserve norms.

<u>A</u>		<u>L</u>
Reserves (cash items) +\$100,000		Borrowing +\$100,000

- Bank issues and sells \$100,000 worth of new shares.

A	L
Reserves (cash items) +\$100,000	Capital +\$100,000

8. (10 points) Explain the relationship between return on assets and return on equity. What incentives does this relationship give a bank manager? Is this the desired outcome preferred by regulators? Why?

$$\text{ROE} = \frac{\text{after-tax profit}}{\text{capital}} = \text{ROA} * \text{EM} = \left[\frac{\text{after-tax profit}}{\text{total assets}} \right] * \left[\frac{\text{total assets}}{\text{capital}} \right],$$

So, the return-on-equity (ROE) is the product of the return-on-assets (ROA) and equity multiplier (EM). ROA provides a measure of the profitability of assets. For any given level of ROA the bank manager can increase the profitability of the bank to its equity-holders (ROE) by increasing leverage (EM). Regulators wouldn't want this to happen because high values of EM imply high levels of risk (risk of insolvency). Bank's capital serves as a buffer against potential losses on the bank's loan investments. If bank doesn't have sufficient capital, even minor amount of defaults on its loans (which are written off against capital) can lead to bankruptcy.

9. (15 points) Suppose that a bank has \$350 million in assets the interest rate on which is equal to the current rate on 1-year Treasury Bills plus 3%. The interest rate on the remaining \$800 million in assets is fixed and is equal to 7%. The bank pays the interest rate equal to the rate on 1-year T-Bill rate plus 1% on \$900 million of its liabilities. It pays a fixed rate of 4% on the remaining \$250 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?

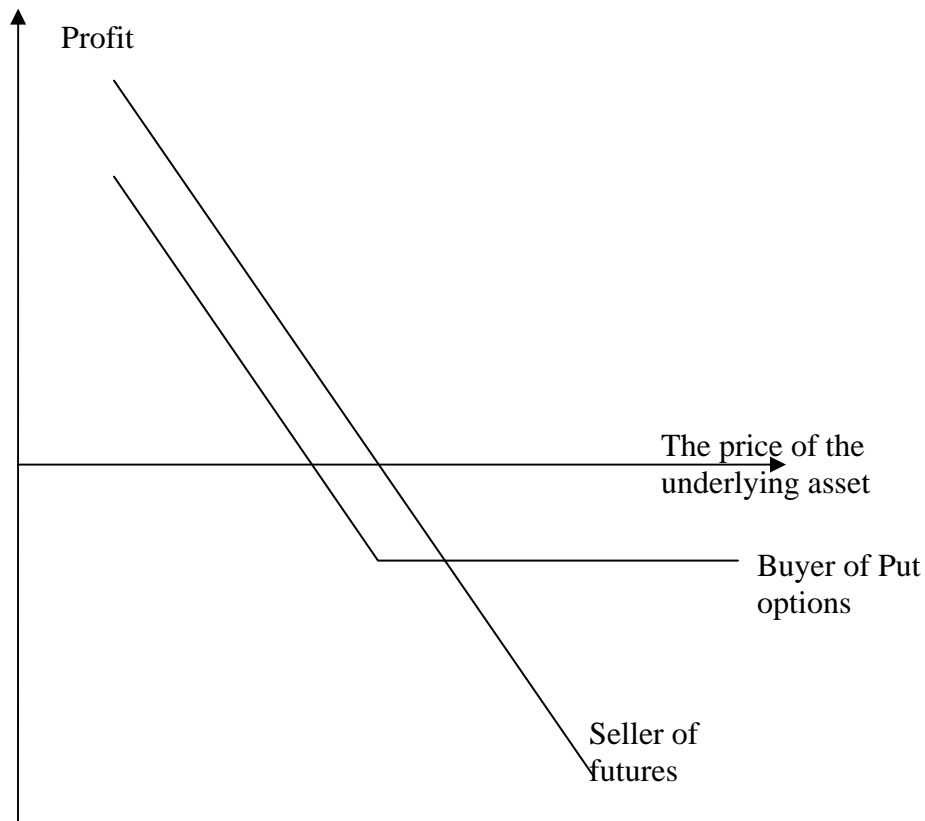
$$\text{Gap} = \text{interest-rate-sensitive assets} - \text{interest-rate-sensitive liabilities} = \$350 - \$900 = -\$550 \text{ mil.}$$

- c. Suppose that the T-Bill interest rate rises to 5%, what is the change in profits of this bank?

Change in profits = gap * change in the interest rate = -\$550mil*0.01= - \$5.5mil.

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

10. (15 points) Show graphically and explain the profits and losses of selling futures relative to buying put options.



The key to understanding this graph is to realize that selling a future gives you *the obligation* to sell (deliver) some asset, while a *put* option gives you *the right* to sell it. If the market conditions are not favorable (the market price of the asset at the expiration date is high), you do not exercise the contract (you can sell the asset at a higher market price instead of exercising the option by selling the asset to the option writer at a lower strike price).

The profit-loss function for futures is linear. Both gains and losses fall linearly for each \$1 change in the underlying asset price at expiration (equal to the price of futures contract at the expiration). The profit curve for options is nonlinear. The loss is limited to the amount of the premium. Profits are a linear function of the asset price at expiration, but profits from options are always less than for futures by the amount of the premium.

For low prices of the underlying asset both the future and out option will be exercised. The profits of holding put option are lower by the amount of the option premium. For high prices of the underlying asset, the future will be exercised (because it must be) and the put option will not be exercised, limiting the losses of the option holder to the amount of the option premium.