Financial Economics 4378 Midterm 3 Review

Question 1 (Duration Gap)

Consider a bank with the following balance sheet:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Value</th>
<th>Duration of the Asset</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 year loan @5%</td>
<td>$10,000</td>
<td>2</td>
</tr>
<tr>
<td>5yr loan @5%</td>
<td>$5,000</td>
<td>4</td>
</tr>
<tr>
<td>4yr loan @6%</td>
<td>$5,000</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Value</th>
<th>Duration of the Liability</th>
</tr>
</thead>
<tbody>
<tr>
<td>4yr loan @ Libor</td>
<td>$5,000</td>
<td>1</td>
</tr>
<tr>
<td>3 yr loan @5%</td>
<td>$5,000</td>
<td>2</td>
</tr>
<tr>
<td>6 yr loan @6%</td>
<td>$10,000</td>
<td>5</td>
</tr>
</tbody>
</table>

a) Find the duration gap. When does the net worth suffer a loss, if interest rate goes up or if it goes down?

b) Suppose the portfolio manager wants to make Duration Gap equal to -0.25 (minus 0.25). What should be the new duration on the liability side to achieve this purpose?

Question 2 (Position Delta)

If the following two portfolios contain the same delta points, what should be the number of call options contracts N in portfolio B?

**Portfolio A:** 1000 shares of IBM and long positions in 20 put option contracts on IBM (each contract contains 100 put options) with put delta -0.20.

**Portfolio B:** 500 shares of IBM and N long call option contracts on IBM (each contract contains 100 call options) with call delta +0.50.

Question 3 (Position Delta)

If the following portfolio has 4900 delta points, what should be the number of put options contracts N in the portfolio?

- 1500 shares of BAC stock.
- 10 LONG call option contracts on BAC (each call contract contains 100 call options) with call delta 0.60.
- N SHORT put option contracts on BAC (each put contract contains 100 put options) with put delta -0.40.
Question 4 (Arbitrage)

Consider two put options on the same stock with the same expiration date.

Put option #1 has a strike price of $X_1=180$ and its price is given by $p_1=25$.
Put option #2 has a strike price of $X_2=170$ and its price is given by $p_2=10$.
The gross risk free rate of return from today until the expiration date is $r=0\%$

a) Given that we must have (as shown in class),

$$p_1 - p_2 \leq X_1 - X_2$$

state whether arbitrage is possible. Precisely specify the arbitrage position.

b) Find the arbitrage profit for all possible values of $S_T$ the stock price at the expiration date. Specify the minimum and maximum arbitrage profits possible.

Question 5 State and explain whether TRUE OR FALSE:

- If the duration gap is positive, the portfolio manager who wants to set it to zero must increase the duration of the liability side.

- A bond portfolio manager currently expects the interest rates to go down in the near future. This manager might be better off by reducing the duration of its liability side.

- If the duration gap is negative, the portfolio manager who wants to set it to zero must reduce the duration of the liability side.

- If the duration gap is positive, increasing the duration of the asset side will further increase the duration gap and will expose the balance sheet to more losses if interest rates go up.

- If a trader sells put options on a stock, this trader has a position with a negative delta and hence must buy shares of the underlying stock to offset his/her exposure to underlying stock price risk.

- If an investor buys call options on a stock and also sells put options on the same stock, then this investor can offset his/her risk with respect to the underlying stock price by buying shares of the underlying stock.