Econ435 – Financial Markets and the Macroeconomy
Solutions to Problem Set 1

Question 1 (*2 points*)

This is an open-ended question, so any answer that had a decent argument is "correct".

My own take of the issue is that holding CEOs responsible for the financial statements of the company should significantly reduce their incentives to "cook the books". It does not directly help solving the principal-agent problem and it only works to reduce the negative effects created by one of the solutions to dealing with the principal-agent problem (basically, stock options or any other means of making the CEO care about the short-term profits of the company). From this point of view, it is probably not the best solution, but in combination with a means of increasing the incentives of CEOs to obtain large profits, this might actually work.

The response to the criticism that "good managers" would be scared away by this measure is that if managers are good, then they should not fear this measure in the first place. If they can help the company obtain high profits, without needing to cheat, then they would do so and earn their reward, without fear of financial responsibility (of course, this abstracts from corporate politics and the possibility that the CEO was framed). Therefore, the measure would actually help screen bad CEOs from good CEOs.

Question 2 (*4 points*)

(i) (*3 points*) The value of the price-weighted index in year 0 is simply the average of the prices of the three stocks:

$$I_0^p = \frac{75 + 15 + 105}{3} = 65.$$

Since there is a stock split, we need to calculate the new value of the divisor before calculating the index for year 1. If nothing happened but the stock split, the price of stocks Y and Z would be as in year 0 (i.e., \$15 and \$105), and the price of stock X would be \$75/3 = \$25. Then, the value of the divisor is

$$d = \frac{25 + 15 + 105}{I_0^p} = \frac{145}{65} = 2.231.$$

Now we can calculate the value of the index in year 1:

$$I_1^p = \frac{28 + 14 + 102}{d} = 64.55.$$

(ii) (*1 point*) The value of the value-weighted index in year 1 is

$$I_1^v = \frac{28 \cdot 90 + 14 \cdot 130 + 102 \cdot 15}{75 \cdot 30 + 15 \cdot 130 + 105 \cdot 15} \cdot 10,000 = \frac{5,870}{5,775} = 10,164.50.$$

Question 3 (*4 points*)

(i) (*1.5 points*) The tax rate that would make the investor indifferent between the muni and the corporate bond is

$$t^* = 1 - \frac{r_m}{r_b} = 1 - \frac{0.10}{0.12} = 0.1667 = 16.67\%.$$

(ii) (*1.5 points*) The equivalent taxable yield is

$$r = \frac{r_m}{1-t} = \frac{0.10}{1-0.20} = 0.125 = 12.5\%.$$

(iii) (*1 point*) Since $r > r_b$ (or, equivalently, $t^* < t$), the investor would strictly prefer the muni. Note that even if the difference in "equivalent returns" is small ($0.5), the investor would *always* choose the asset that gives her the highest yield.

Question 4 (*7 + 3 points*)

(i) (*1 point*) The total value of the stock bought is $1,000 \cdot \$30 = \$30,000$. As Bob covers 60% of this, he borrows 40% from the broker, that is, $\$30,000 \cdot 40\% = \$12,000$. So Bob contributes $\$30,000 - \$12,000 = \$18,000$ and his account with the broker looks like this:

Assets		**Liabilities and Equity**	
Value of stock	$30,000	Loan from broker	$12,000
		Equity	$18,000
Total	$30,000	Total	$30,000

(ii) (*1 point*) The highest price that would trigger a margin call is the price that would make the margin equal the maintenance margin. The total value of the stock when the price is p is $1,000 \cdot p$, and the value of equity is $1,000p - 12,000$. Hence,

$$\frac{1,000p - 12,000}{1,000p} = 0.4 \quad \Rightarrow \quad 1,000p - 12,000 = 400p \quad \Rightarrow \quad 600p = 12,000,$$

which gives $p = 20$. So the highest price that would trigger a margin call is $20. (Note: the *lowest* price that would trigger a margin call is $0, since this is the lower limit of stock prices!)

(iii) (*2 points*) If Bob decides to sell after one year, the revenue from the sale is $\$35 \cdot 10,000 = \$35,000$. However, Bob needs to repay the loan, both the principal ($\$12,000$) and the interest ($\$12,000 \cdot 5\% = \$600$). Thus, his net return is $\$35,000 - \$12,600 = \$22,400$. His net profit will be just how much he made from the transaction: $\$22,400 - \$18,000 = \$4,400$, which gives a rate of return of $\$4,400/\$18,000 = 24.44\%$.

(iv) (*3 points*) If the broker issues a margin call, then Bob has 3 options:

1. inject cash into the account – Bob could add some money to his account, which would be the equivalent of him repaying part of the loan from the broker. This causes the margin to increase since the amount in the loan would be reduced, and hence the value of equity would go up.

2. inject stock into the account – Bob could also buy some stock and add it to the account. The margin would go up, in this case, because equity would increase directly (the stock brought would contribute 100% to equity).

3. sell stock – if Bob ran out of cash, he could always instruct his broker to sell some of the stock. In this case, all (or the largest part) of the proceeds from the sale would go toward repaying the loan from the broker. The margin increases because the value of the loan falls relative to the value of equity (100% of the sale of stock goes to repaying the loan).

(v) (*extra 3 points*) When the margin call is issued, Bob's account with the broker looks like in the table below.

Assets			**Liabilities and Equity**
Value of stock	$\$15,000$	Loan from broker	$\$12,000$
		Equity	$\$3,000$
Total	$\$15,000$	Total	$\$15,000$

Bob wants to inject a number x of shares such that the margin returns to its initial value of 60%. After injecting the shares, the account with the broker is shown in the table below.

Assets			**Liabilities and Equity**
Value of stock	$\$15,000 + 15x$	Loan from broker	$\$12,000$
		Equity	$\$3,000 + 15x$
Total	$\$15,000 + 15x$	Total	$\$15,000 + 15x$

The margin now is:

$$\frac{3,000+15x}{15,000+15x}=0.6 \quad\Rightarrow\quad 3,000+15x=9,000+9x \quad\Rightarrow\quad 6x=6,000,$$

meaning that Bob has to inject $x = 1,000$ more shares (worth $\$15 \cdot \$1,000 = \$15,000$) into the account. After doing so, the value of stock rises to $\$15,000 + \$15,000 = \$30,000$, equity rises to $\$3,000 + \$15,000 = \$18,000$, and the account with the broker becomes

Assets		**Liabilities and Equity**	
Value of stock	\$30,000	Loan from broker	\$12,000
		Equity	\$18,000
Total	\$30,000	Total	\$30,000

When calculating the rate of return, two answers were possible:

1. the rate of return ignoring the margin call – in this case, the rate of return is just the one from part (iii): 24.44%.
2. the rate of return taken into account the margin call – the difference is that now Bob has 2,000 shares, but his (initial) investment is $\$18,000 + \$15,000 = \$33,000$. The proceeds from the sale are $\$35 \cdot 2,000 = \$70,000$, out of which he still needs to pay the debt to the broker of \$12,600. Hence, Bob is left with $\$70,000 - \$12,600 = \$57,400$, which gives a net profit of $\$57,400 - \$33,000 = \$24,400$. The rate of return is now $24,400/33,000 = 73.94\%$.

Note that Bob was amazingly lucky: the price of the stock more than doubled by the end of the year! The reason his rate of return is so much higher than in part (iii) is that he bought 1,000 shares for half price (\$15 rather than \$30). Still, the price might have stayed low and then Bob would have incurred a loss rather than gained this much.

Question 5 (*3 points*)

The formula used to calculate the value of the investment in Class-A shares after n years is

$$V_A(n) = I \cdot (1-f) \cdot (1+r)^n = \$1,000 \cdot (1-0.05) \cdot (1+0.12)^n = \$950 \cdot 1.12^n,$$

since the operating expenses are already taken into account in the rate of return, and there are no 12b-1 charges or back-end loads.

For Class-B shares, the formula is

$$V_B(n) = I \cdot (1+r-b)^n(1-s) = \$1,000 \cdot (1+0.12-0.0075)^n \cdot (1-s) = \$1,000 \cdot 1.1125^n \cdot (1-s),$$

since there is no front-end load, and where s depends on n, the number of years. Thus, if $n = 1$, $s = 4\%$; if $n = 4$, $s = 1\%$, and if $n = 10$, $s = 0$. (Note: s is equal to $(0.05 - n)$, if that is positive, otherwise it is 0, so that s is not negative even as $n > 5$.)

The results are:

Year	Class A	Class B
1	$\$1,064.00$	$\$1,068.00$
4	$\$1,494.84$	$\$1,516.48$
10	$\$2,950.56$	$\$2,904.02$

From the table above you can see Class-B shares are better for shorter-term investments, while Class-A shares catch up in the long run. The explanation for this is that the starting point is lower for Class-A shares, but the net rate of return is lower for Class-B shares (because of the 12b-1 charges). In the long run, the higher rate of return of the Class-A shares will dominate and their return will eventually surpass the return on Class-B shares.