AP/ADMS 4540 Financial Management
Winter 2019

Mid-term Exam Solution

Question 1 on Duration and Interest Rates

a) Based on this the implied going market rate is 7% annually. Therefore the semiannual rate is 3.5%.

Period	Payment	PV (using 3.5%)	RV = PV/ Price	WV = RV x time
1	30	30	0.030243107	0.030243107
2	30	28.98550725	0.029220393	0.058440787
3	30	28.00532101	0.028232264	0.084696792
4	30	27.05828117	0.02727755	0.1091102
5	30	26.14326683	0.026355121	0.131775603
6	30	25.25919501	0.025463885	0.152783308
7	30	24.40501933	0.024602787	0.17221951
8	30	23.57972882	0.023770809	0.190166471
9	30	22.78234669	0.022966965	0.206702686
10	1030	755.7429014	0.761867119	7.618671188
Total		**991.9615675**	**1**	**8.754809653**

(8 marks)

Semi-annual duration is 8.74548

Annualized duration is 8.7548/2 = 4.3774 **(2 marks)**

b) Modified duration = negative volatility = -4.3774/ (1 + 7%) = -4.091% **(3 marks)**

The change in price for a 50 basis points increase in yield will be volatility x 0.50 = -4.091% x 0.50 = -2.0455 **(2 marks)**

c) If the bond liquidity of the bond increases then the demand of bonds will increase and this will drive up the price of the bonds. This increase in price will result in a decrease in yield as investors are paying initially more for the bond. **Thus, higher liquidity will determine an increased demand of the bond and the yield will drop. (2.5 marks)**

The government will be forced to finance the increased deficit and therefore will have to issue more bonds. As there will be a higher supply of bonds the price of the bonds will fall and the government will have to offer higher and higher returns on these bonds. **Thus there will be a higher supply and higher yield. (2.5 marks)**

Question 2 on Refunding

Step 1: Find the appropriate after tax discount rate

r = (1 – t) x coupon on new issue

r= 4.9% (2 marks)

Step 2: The costs of refunding

1. Call premium costs:

8.5% Call premium x Par value $100,000,000 = 8,500,000 **(2 marks)**

2. Flotation Costs:

For tax purposes Flotation Costs are amortized over the life of the issue, or five years, whichever is less:

Yearly Flotation Expense:

$1,100,000 Flotation Costs / 5yrs = 220,000

Flotation costs annual tax shield:

$220,000 Flotation Costs Expense x 30% Tax rate = 66,000

PV tax savings on the flotation costs:

$66,000 x PVIFA (4.9%, 5 yrs) = 286,537

Net flotation costs = Flotation Costs – PV of tax savings

Net flotation costs = 813,463 (2 marks)

3. Find the additional interest:

Extra interest paid on old issue:

Par value $100,000,000 x 8.5% coupon rate x (3/12) = 2,125,000

After tax extra interest paid on old issue :

$2,125,000 x (1- 30%) = 1,487,500

Interest on short term investment:

Par value new bond $110,000,000 x 4.0% rate x (3/12) = 1,100,000

After-tax interest on short term investment:

$1,100,000 x (1- 30%) = 770,000

The total additional interest is

$1,487,500 - $770,000 = 717,500 **(2 marks)**

Total after-tax investment cost is

Call premium 8,500,000

Flotation costs 813,463

Additional interest 717,500

Total investment 10,030,963 (2 marks)

Step 3: Interest savings on new issue

Interest on old bond

Par value old bond $100,000,000 x 8.5% Coupon rate= 8,500,000

Interest on new bond

Par value new bond $110,000,000 x 7.0% Coupon rate= 7,700,000

Annual savings = 800,000

After-tax savings: $800,000 x (1- 30%) = 560,000

PV of annual after tax savings:

$560,000 x PVIFA (4.9%,15 yrs) = 5,852,098 (2 Marks)

Step 4: NPV for the refunding operation

Interest savings 5,852,098

NPV of the extra $10m from the new issue 2,500,000

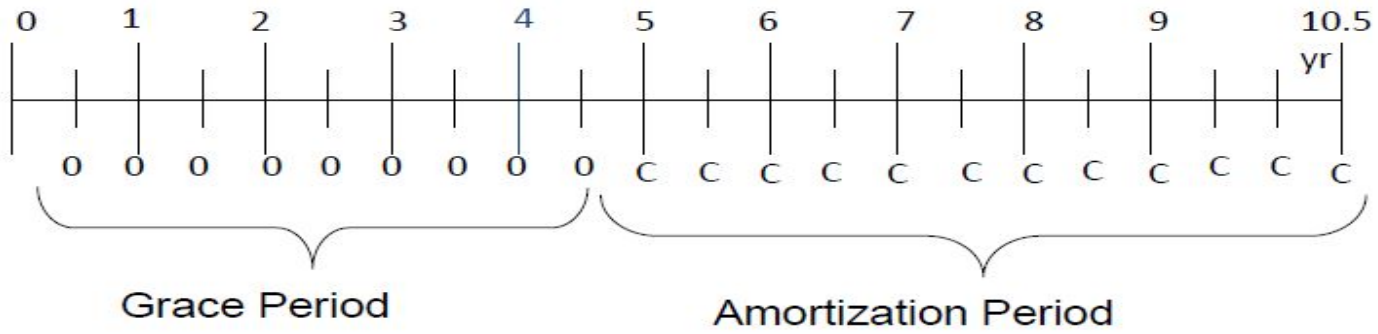
Investment costs (10,030,963)

Net Present Value (NPV) (1,678,865) (2 Marks)

Since Net Present Value is negative and less than zero (NPV < 0), NIDC should not proceed with the refunding. **(1 mark)**

<u>Question 3 on ODA (15 marks)</u>

As drawn on chalkboard during midterm exam:



Find the payments at subsidized interest rate of 6% (3% semi-annually)

Semi-annual payments "C" for the amortization period (the final 6 years) = 1,000,000,000/ PVIFA (3%, 12)

C =$100,462,085.50 **(1 mark)**

(Note that this is just C as shown in lecture3.ppt multiplied by 10 as the loan is $1 billion, which is 10x $100 million.)

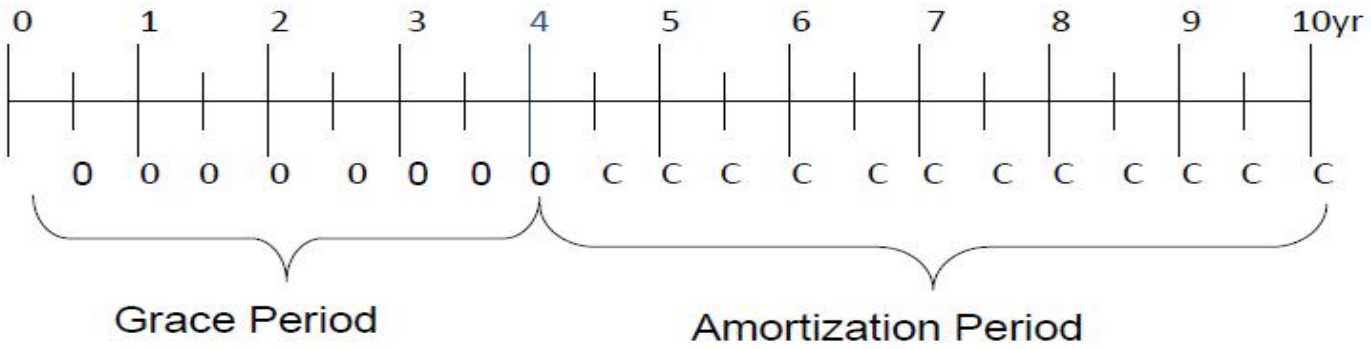
Find the PV of all the payments at the market rate of 100% (50% semi-annually)
PV of the "C" flows, i.e., PV of payments:
At middle of year 5, PV of "C" flows= 100,462,085.50 * PVIFA (50%, 12) = $199,375,578.80 **(1 mark)**
At beginning of year 0, PV of "C" flows= 199,375,578.80 * PVIF (50%, 9) = $5,186,216.35 **(1 mark)**

Find the grant element
The implicit grant = $1,000,000,000 - $5,186,216.35 = $994,813,783.70 **(1 mark)**
The grant element = $994,813,783.70 / 1,000,000,000.00
= 99.4814% **(1 mark)**
Since the grant element is greater than 25%, this loan would qualify as ODA, which is obvious for OSAP loans as discussed in class (when we mentioned the grant element for OSAP or student loans would be well over 90%).

Find the PV cost when no repayment is needed
Calculated earlier, the PV cost = $5,186,216.35 in time zero (0) dollars, which is 0.5186% of the value of the loan at time zero (0). **(1 mark)** Given how miniscule the repayment amount (compared to the $1 billion loan and $994,813,783.70 implicit cost) and percentage of loan are, it is a no-brainer to convert the OSAP loan into a grant and make it ***tuition-free*** for STUDENTS. So ***yes***, and this is what state governments of MA, NY etc., have already done for student. **(1 mark)**

Find the PV savings with 4-year grace period (instead of 4.5 years)

As drawn on chalkboard during midterm exam:



Note that C is the same as above because the amortization period of 6 years does not change.
PV of the "C" flows, i.e., PV of payments:
At beginning of year 5, PV of "C" flows= 100,462,085.50 * PVIFA (50%, 12) = $199,375,578.80
At beginning of year 0, PV of "C" flows= 199,375,578.80 * PVIF (50%, 8) = $7,779,324.52 **(1 mark)**
Savings, in PV dollars ($ at time zero) = $7,779,324.52 - $5,186,216.35 = $2,593,108.17, or 0.2593% of the value of the loan at time zero (0). $2,593,108.17 is a miniscule amount compared to the $1 billion loan and $994,813,783.70 implicit cost. **(1 mark)**

Discuss the impact on STUDENTS
While the savings are miniscule to the ON government (as shown above), the impact on STUDENTS is significant. Reducing the grace period to 4 years would increase the PV of repayments by $2,593,108.17/$5,186,216.35 = 49.9999%, or almost 50%. In addition, converting the grant back to a loan would saddle STUDENTS with student debt the rest of their lives, which many would not be able to repay, resulting in a bad credit report and higher rates for STUDENTS in the future. **(3 marks)**

Discuss the impact on ON's capital stock
From the Jaganathan and Wang (*Journal of Financ*e, 1996) paper, the largest capital asset is human capital. Statistics Canada reports that the returns on human capital (i.e., wage levels) increase significantly with higher education. Together with the stylized facts on economic growth you learnt in first year macroeconomics, it is evident that the only way to increase this largest capital asset which then increases economic growth is more education. With significant numbers of

STUDENTS unable to afford higher education now with the PC government's policies (as we discussed the significant impact on STUDENTS above), the growth in this largest capital asset would decline or become negative, which would result in a lower capital stock, lower productivity and lower economic growth. In short, ON would be poorer. **(3 marks)**
(We will examine Statistics Canada data on human capital returns and higher education in Assignment 2.☺)
Aside: Spending more than USD $103 million to save CAD $6 million is representative of PC economic policy (proof: Hydro One!)
Final Note: It is extremely disappointing that students are not able to find C (same as in-class example * 10) and worse, not able to find the PV of cash flows when the time line of cash flows was drawn on the chalkboard. ☹

Question 4 on Risk and Return (30 marks)

4a. From William Sharpe's own experience, "B" students would be preferred over "A" students by employers for non-academic jobs. Sharpe attributed it to the perception that "A" students were too nerdy and lack practical "smarts". In the earlier seasons of "The Big Bang Theory", Leonard, Raj and Howard (reflecting the lives of your professors who were "A" students in college and grad school) not only struggled outside academic, but because they lacked basic social skills, were also unable but desperately wanted to find dates ☺ **(2 marks)** William Sharpe thought that academic finance was "moronic" because, before the 1960s, it was based on accounting (financial statements and ratios). It did not model rational behavior, and was (i) not testable and (ii) impossible to do sensitivity analysis, that is, what would happen if one variable changed. In the 1960s, finance became an axiomatic science, that is, the models were based on assumptions (e.g., rationality). These models generated testable hypotheses, and also allowed the user to see what would happen when one variable changed. **(2 marks)**

4b. Since P is a tangency portfolio, the relation between S's expected return $E(r_s)$ and its covariance with P (σ_{SP}) is given by a capital-asset pricing relationship:

$$E(r_s) = r_f + [E(r_p) - r_f]\,\beta_{SP}$$

where $\beta_{SP} = \sigma_{SP} / \sigma_P^2$. **(1 mark)**
The covariance, $\sigma_{SP} = cov(r_s,r_p) = cov(r_s,0.5r_s+0.5r_b) = 0.5var(r_s) + 0.5cov(r_s,r_b) = 0.022$ **(1 mark)**
The variance of P, $\sigma_P^2 = var(r_p) = 0.5^2 var(r_s) + 0.5^2 var(r_b) + 2(0.5)(0.5)cov(r_s,r_b)$
$= 0.5^2\,(0.04) + 0.5^2\,(0.01) + 2(0.5)(0.5)(0.2)(0.1)(0.2) = 0.0145$ **(1 mark)**
The beta $\beta_{SP} = cov(r_s,r_p)/ var(r_p) = 0.022/0.0145 = 1.52$ **(1 mark)**

4c. The "equity premium puzzle" was discovered by Mehra and Prescott in their seminal 1985 article in the *Journal of Monetary Economics*. The puzzle was due to the high equity premiums found in U.S. stock markets and the much lower bond risk premiums which could not be explained by any rational economic model with reasonable assumptions on investor risk tolerance. In Canada, the "equity premium puzzle" was evident from historical risk premiums from 1948-2000. The risk premium for Canadian large stocks was 6.89% which was more than 4 times (more than 300% higher than) the risk premium for Canadian bonds at 1.58%. This was a puzzle because the standard deviation of Canadian large stocks was 16.48% which was only 60% higher than the standard deviation of Canadian bonds of 10.49% from the lecture 3 slides. However, we know that in the long-run, efficient markets would resolve such puzzles. Indeed, when we examine Canadian data from 1957-2008, we see that the risk premium for Canadian large stocks (or the equity premium) fell to 3.79% while the risk premium for Canadian bonds increased to 2.13%. The higher equity premiums (approximately 80% higher risk premiums for stocks than for bonds) could be better explained by the approximately 70% higher risk of Canadian stocks (16.86% standard deviation) than Canadian bonds (9.93% standard deviation) from the lecture 3 slides. In the 9ce of the RWJR textbook, we see that the risk premium for Canadian large stocks (or the equity premium) rose to 4.42% while the risk premium for Canadian bonds increased to 2.69%. From 2008 to 2014, the higher equity premiums (about 70% higher) could be even better explained by the about 70% higher risk of Canadian stocks (16.5% standard deviation) than Canadian bonds (9.78% standard deviation). In short, the equilibrium of Canadian equity and bond risk premiums (relative to risk) appears to have returned. **(4 marks)**

4d. Each dividend $D = EBT\,(1 - T_c) = 1\,(1 - 0.35) = 0.65$. $P_0 = D / R_E = 0.65/0.1 = \$6.50$. **(1 mark)** Now $D = EBT\,(1 - T'_c) = 1\,(1 - 0.21) = 0.79$. $P'_0 = D / R_E = 0.79/0.1 = \$7.90$. **(1 mark)** Share price increased (7.90-6.50)/6.50 = 0.2154 or 21.54%. **(1 mark)** There is ***no growth*** in earnings (g = 0) yet the share price increased. This is simply due to the lower corporate tax rate of 21%. This example demonstrates ***the pure tax effect on the share price,*** i.e., ***the share price increases simply due to a cut in the corporate tax rate***. **(1 mark)**

4e. The 1-year return on the S&P 500 after the Trump inauguration was (2,823.81–2,278.87)/2,287.87 = 23.9127%. The 1-year return on the S&P/TSX after the Trump inauguration was (15,951.7-15,386/15,386) = 3.6767%. The difference or spread (23.9127%-3.6767% = 20.236%) ***can be mostly explained by the TCJA***, which caused share prices in the U.S. to increase by 21.54% simply due to the lower corporate tax rate of 21% alone. Without TCJA's 21.54% share price increase, Canadian shares actually performed ***better*** than U.S. shares. This is because ***oil performed better in 2017 with a positive annual return of 21.33%.*** We know that the S&P/TSX is significantly positively correlated with oil price, unlike the S&P 500 index. Finally, this corporate tax cut is ***one-time***, meaning that its effect would not linger on into 2018. **(4 marks)**

4f. When the federal debt increases, i.e., the supply of U.S. government bonds increases, the demand-supply framework tells us that when the supply curve moves to the right (holding demand constant), **(1 mark)** the price of U.S. government bonds *will decrease* **(1 mark)** and thus the yield of U.S. government bonds *will increase*. **(1 mark)** The current bondholders of U.S. government bonds (e.g., sovereign wealth funds from China) suffer a fall in their U.S. bond portfolio values (with the fall in U.S bond prices) and pay for the increase in the U.S. federal debt now. It is a transfer of wealth to pre-TCJA U.S. stockholders (e.g., Trump cabinet members) from existing U.S. government bondholders who suffer capital losses and working-class borrowers who pay higher interest rates **(2 marks).**

4g. From Assignment 1, the 2017 return on the S&P 500 was (2,673.61–2,238.83)/2,238.83 = 19.42%. The increase ***can be mostly explained by the TCJA***, which should cause share prices in the U.S. to increase by 21.54% simply due to the lower corporate tax rate of 21% alone. Also from Assignment 1, the 2018 return on the S&P 500 was (2,506.85-2,673.61)/2,673.61 = - 6.24% (***negative return***). As Professor Robert Reich and Nobel-laureate Professor Paul Krugman point out, more than 80% of U.S. stocks are held by the world's billionaires (and 33% of shareholders of U.S. companies live outside the U.S.). Therefore, their wealth increase and decrease are directly related to the increase and decrease of the value of U.S. stocks. As calculated in Assignment 1, U.S. stock prices increased by 19.42% in 2017 (as measured by the S&P 500 index), and this increase can be mostly explained by the TCJA. That the effect of the TCJA is one-time is evident by the decrease in U.S. stock prices in 2018 (-6.24% as measured by the S&P 500 index). Professor Reich therefore referred to the TCJA as a drug which only provides a temporary high (one-time increase of 21.54%). Unfortunately, while the benefits of higher stock prices go mostly (80%) to billionaires, as both Professor Krugman and Professor Reich point out, the costs are mostly borne by others like bondholders and the working class who now pay higher interest rates (see **4f.**). **(5 marks)**

<u>Question 5 on Risk and Return (CAPM/APT/Canadian Tradition) (15 marks)</u>

5a. We solve for the factor premia λ_0. λ_1 and λ_2 from the following three equations:

$0.332 = \lambda_0 + 1.6\,\lambda_1 + 0.8\,\lambda_2$ (1)

$0.448 = \lambda_0 + 2.0\,\lambda_1 + 1.2\,\lambda_2$ (2)

$0.545 = \lambda_0 + 2.4\,\lambda_1 + 1.5\,\lambda_2$ (3)

Subtracting (1) from (2) yields (4) and subtracting (1) from (3) yields (5)

$0.116 = 0.4\,\lambda_1 + 0.4\,\lambda_2$ (4)

$0.213 = 0.8\,\lambda_1 + 0.7\,\lambda_2$ (5)

Multiplying (4) by 2 yields:

$0.232 = 0.8\,\lambda_1 + 0.8\,\lambda_2$ (6)

Subtracting (5) from (6) yields:

$0.019 = 0.1\,\lambda_2$ which implies that $\lambda_2 = 0.19$

Substituting $\lambda_2 = 0.19$ into (4) yields:

$0.116 = 0.4\,\lambda_1 + 0.4\,(0.19)$ or $\lambda_1 = 0.10$

Substituting $\lambda_1 = 0.10$ and $\lambda_2 = 0.19$ into (1) yields:

$0.332 = \lambda_0 + 1.6\,(0.10) + 0.8\,(0.19)$ which implies that $\lambda_0 = 0.02$.

Thus the equation for APT is:

$r_i = 0.02 + 0.10\,\beta_{i1} + 0.19\,\beta_{i2}$ **(9 marks)**

5b. No arbitrage requires that the expected return for portfolio D be on the straight line between A and B. We can solve for the portfolio weights to show that $w_A = w_B = 0.5$.

Equilibrium return = 0.5 * 0.332 + 0.5 * 0.448 = 0.39 or 39%. **(1 marks)**

Sensitivity = 0.5 * 0.8 + 0.5 * 1.2 = 1 **(1 marks)**

Portfolio D has the same systematic risk as factor 2. **(2 marks)**

5c. $E(r_E) = 0.02 + 0.10\ (2) + 0.19\ (1.5) = 0.505$ or 50.5 % **(1 mark)**

But actual return is 52.5%. Therefore E has overperformed, E is underpriced, and investment in portfolio E is recommended because the actual return is higher than the expected. **(1 mark)**

5d.

- The APT can handle multiple factors that the CAPM ignores

Critique: Both the APT and CAPM can handle multiple factors, and many versions of the CAPM include multiple factors, e.g., the CAPM version used by Jaganathan and Wang (*Journal of Financ*e, 1996) which we discussed in class. The CAPM does not ignore multiple factors

- A multifactor model like the APT is probably more reflective of reality

Critique: While the Chen, Roll and Ross studies suggest multiple significant factors affecting U.S. stock returns, in Canada, Otuteye (*CIR*, 1991, as discussed in class) shows that the ***only*** significant factor is the market (TSE at that time) return. Therefore, the multifactor APT is ***not*** more reflective of reality in Canada.