Capital Structure
Solutions

Question 1

List the three assumptions that lie behind the Modigliani–Miller theory in a world without taxes. Are these assumptions reasonable in the real world? Explain.

Assumptions of the Modigliani-Miller theory in a world without taxes:

1) Individuals can borrow at the same interest rate at which the firm borrows. Since investors can purchase securities on margin, an individual's effective interest rate is probably no higher than that for a firm. Therefore, this assumption is reasonable when applying MM's theory to the real world. If a firm were able to borrow at a rate lower than individuals, the firm's value would increase through corporate leverage. As MM Proposition I states, this is not the case in a world with no taxes

2) There are no taxes. In the real world, firms do pay taxes. In the presence of corporate taxes, the value of a firm is positively related to its debt level. Since interest payments are deductible, increasing debt reduces taxes and raises the value of the firm.

3) There are no costs of financial distress. In the real world, costs of financial distress can be substantial. Since stockholders eventually bear these costs, there are incentives for a firm to lower the amount of debt in its capital structure.

Question 2

Bruce & Co. expects its EBIT to be $185,000 every year forever. The firm can borrow at 9 percent. Bruce currently has no debt, and its cost of equity is 16 percent. If the tax rate is 35 percent, what is the value of the firm?

The value of the unlevered firm is:

$$V = \frac{EBIT(1 - T_C)}{R_0} = \frac{\$185{,}000(1 - 0.35)}{0.16} = \mathbf{\$751{,}562.50}$$

What will the value be if Bruce borrows $135,000 and uses the proceeds to repurchase shares?

The value of the levered firm is:

$$V_L = V_U + T_C B$$
$$V_L = \$751{,}562.50 + 0.35 \times \$135{,}000 = \mathbf{\$798{,}812.50}$$

What is the cost of equity after recapitalization?

We can find the cost of equity using M&M Proposition II with taxes. First, we need to find the market value of equity, which is:

$$V = B + S$$
$$\$798{,}812.50 = \$135{,}000 + S$$
$$S = \mathbf{\$663{,}812.50}$$

Now we can find the cost of equity, which is:

$$R_S = R_0 + (R_0 - R_B)(B/S)(1 - T_C)$$
$$R_S = 0.16 + (0.16 - 0.09) \times (\$135{,}000/\$663{,}812.50) \times (1 - 0.35)$$
$$R_S = 0.1692 \; or \; \mathbf{16.93\%}$$

What is the WACC?
Using this cost of equity, the WACC for the firm after recapitalization is:

$$WACC = (S/V)R_S + (B/V)R_B(1 - T_C)$$
$$WACC = (\$663{,}812.50/\$798{,}812.50) \times (0.1693) + (\$135{,}000/\$798{,}812.50) \times 0.09 \times (1 - 0.35)$$
$$WACC = 0.1505 \; or \; \mathbf{15.05\%}$$

What are the implications for the firm's capital structure decision?
When there are corporate taxes, the overall cost of capital for the firm declines the more highly leveraged is the firm's capital structure. This is M&M Proposition I with taxes.

Question 3
Ms. Kraft owns 50,000 shares of the common stock of Copperhead Corporation with a market value of $2 per share, or $100,000 overall. The company is currently financed as follows:

	Book Value
Common stock (8 million shares)	$2 million
Short-term loans	$2 million

Copperhead now announces that it is replacing $1 million of short-term debt with an issue of common stock. What action can Ms. Kraft take to ensure that she is entitled to exactly the same proportion of profit as before?

Note the market value of Copperhead is far in excess of its book value:

	Market Value
Common Stock (8 million Shares at $2)	$ 16 million
Short-term loans	$ 2miliion

Ms. Kraft owns 50,000 shares out of the 8 million shares which equates to 0.625% of the firm.

The company proposes to increase common stock by $1 million to $17 million and cut short-term debt.
Ms. Kraft can offset this by:
a. borrowing $0.00625 \times 1{,}000{,}000 = \$6{,}250$, and
b. buying that much more Copperhead stock so that she does not lose control of her holding of the firm.

Question 4
The common stock and debt of Northern Sludge are valued at $50 million and $30 million, respectively. Investors currently require a 16% return on the common stock and an 8% return on the debt. If Northern Sludge issues an additional $10 million of common stock and uses this money to retire debt, what happens to the expected return on the stock? Assume that the change in capital structure does not affect the risk of the debt and that there are no taxes.

Expected return on assets is:
$R_A = R_D(1-T_C)\frac{D}{V} + R_E\frac{E}{V}$
$D = \$30m, E = \$50m, V = D + E = \$30 + \$50m = \mathbf{\$80m}$
$T_C = 0, R_D = 0.08, R_E = 0.16$

If we ignore taxes, the return on assets will be same for any capital structure mix considered.
$R_A = 0.08 \times (30/80) + 0.16 \times (50/80) = 0.13 \; or \; \mathbf{13\%}$

$R_E = R_A + (R_A - R_D)\frac{D}{E}$
With an additional $10m of common stock, $E = \$60m$ and $D = \$20m$ there's a change in capital structure.
The new return on equity will be $R_E = 0.13 + (20/60)(0.13 - 0.08) = 0.147 \; or \; \mathbf{14.7\%}$

Question 5
Gaucho Services starts life with all-equity financing and a cost of equity of 14%. Suppose it refinances to the following market-value capital structure:

Debt (D)	45% at r_D=9.5%
Equity (E)	55%

Use MM's proposition 2 to calculate the new cost of equity. Gaucho pays taxes at a marginal rate of Tc =40%. Calculate Gaucho's after-tax weighted-average cost of capital.

First, we assume no taxes exist so as to work out the return on equity given that the return on assets does not change with changing debt levels:

Currently $R_A = R_E = 0.14, or \mathbf{14\%}$
From proposition 2 the leverage causes R_E to increase to:
$R_E = R_A + (R_A - R_D) \times (D/E) = 0.14 + (0.14 - 0.095) \times (45/55) = 0.1768 \; or \; \mathbf{17.68\%}$

After-tax WACC formula:
$After - tax \; WACC = 0.095 \times (1 - 0.40) \times 0.45 + 0.1768 \times 0.55 = 0.1229, or \; \mathbf{12.29\%}$

Question 6
Executive Chalk is financed solely by common stock and has outstanding 25 million shares with a market price of $10 a share. It now announces that it intends to issue $160 million of debt and to use the proceeds to buy back common stock.

a. How is the market price of the stock affected by the announcement?
According to MM's first proposition, the share price will not change by a change in capital structure given that the value of the firm is determined by its real assets.

b. How many shares can the company buy back with the $160 million of new debt that it issues?

$$\frac{\$160 \text{ million}}{\$10 \text{ per share}} = \mathbf{\$16 \; millions \; \boldsymbol{shares}} \text{ in shares repurchase}$$

c. What is the market value of the firm (equity plus debt) after the change in capital structure?
After the change in capital structure, the market value of the firm is unchanged as argued by MM's first proposition (in a world of no taxes).

$Equity + Debt = \$250 \; million$

d. What is the debt ratio after the change in structure?

$Debt/(Debt + Equity) = \$160 \; million/\$250 \; million = \mathbf{0.64}$

e. Who (if anyone) gains or loses?
According to Modigliani and Miller's first proposition there's no change in value due to changing the capital structure therefore we do not expect any gains or loses.

Question 7
Hubbard's Pet Foods is financed 80% by common stock and 20% by bonds. The expected return on the common stock is 12% and the rate of interest on the bonds is 6%. Assume that the bonds are default-risk free. Draw a graph that shows the expected return of Hubbard's

common stock (rE) and the expected return on the package of common stock and bonds (rA) for different debt-equity ratios.

The company cost of capital is:

$$R_A = (0.8 \times 0.12) + (0.2 \times 0.06) = 0.108 = \mathbf{10.8\%}$$

Under Proposition I, this is unaffected by capital structure changes. With the bonds remaining at the 6% default-risk free rate, we have:

R_D *and* R_A will remain constant with changing capital structure and therefore is represented by a horizontal line. On the other hand, R_E will change with changing capital structure as follows:

$$R_E = R_A + (R_A - R_D)\frac{D}{E}$$

For $D/E = 0, R_E = 10.8\% + (10.8\% - 6\%) \times 0 = \mathbf{10.8\%}$
For $D/E = 0.5, R_E = 10.8\% + (10.8\% - 6\%) \times 0.5 = \mathbf{13.2\%}$

Question 8

For each of the following statements indicate whether the statement is true or false and explain why.

a. It is obvious that firms should use as much debt as possible. It is cheaper than using equity and interest on debt is also tax deductible.

False. While debt is cheaper than equity this only refers to the explicit cost of debt. There are implicit costs as well.

b. In a no tax world, Modigliani and Miller's two propositions inherently contradict each other.

False. Proposition 1 states that the value of a firm is independent of its capital structure while proposition 2 shows that there is a positive relationship between a firm's debt-to-equity ratio and the expected rate of return on its equity.

c. The costs of financial distress are typically borne by a firm's debt holders.

False. When a firm is liquidated its equity is generally worthless so the liquidation costs incurred will be borne by debtholders. However, debtholders realize this and will require compensation, in the form of a higher interest rate, for these expected costs.

Question 9

Ronald Masulis analysed the stock price impact of exchange offers of debt for equity or vice versa. In an exchange offer, the firm offers to trade freshly issued securities for seasoned securities in the hands of investors. Thus, a firm that wanted to move to a higher debt ratio

could offer to trade new debt for outstanding shares. A firm that wanted to move to a more conservative capital structure could offer to trade new shares for outstanding debt securities. Masulis found that debt for equity exchanges were good news (stock price increased on announcement) and equity for debt exchanges were bad news.

a. Are these results consistent with the trade-off theory of capital structure?
Masulis' results are consistent with the view that debt is always preferable because of its tax advantage, but are not consistent with the 'tradeoff' theory, which holds that management strikes a balance between the tax advantage of debt and the costs of possible financial distress. In the tradeoff theory, exchange offers would be undertaken to move the firm's debt level toward the optimum. That ought to be good news, if anything, regardless of whether leverage is increased or decreased.

b. Are the results consistent with the evidence that investors regard announcements of:
- **i.** stock issues as bad news and
- **ii.** stock repurchases as good news?

The results are consistent with the evidence regarding the announcement effects on security issues and repurchases.

c. How could Masulis's results be explained?
One explanation is that the exchange offers signal management's assessment of the firm's prospects. Management would only be willing to take on more debt if they were quite confident about future cash flow, for example, and would want to decrease debt if they were concerned about the firm's ability to meet debt payments in the future.

Question 10
Here are book and market value balance sheets of the United Frypan Company (UF):

Book			
Net working capital	$20	$40	Debt
Long-term assets	$80	$60	Equity
	$100	$100	

Market			
Net working capital	$20	$40	Debt
Long-term assets	$140	$120	Equity
	$160	$160	

Assume that MM's theory holds with taxes. There is no growth, and the $40 of debt is expected to be permanent. Assume a 40% corporate tax rate.

a. How much of the firm's value is accounted for by the debt-generated tax shield?

$$PV\ Tax\ Shield = T_C D = (0.4) \times (\$40) = \$16$$

b. How much better off will UF's shareholders be if the firm borrows $20 more and uses it to repurchase stock?

$$The\ additional\ PV\ tax\ shield = T_C \Delta D = (0.4) \times (\$20) = \$8$$

Question 11

Compute the present value of interest tax shields generated by these three debt issues. Consider corporate taxes only. The marginal tax rate is T*c* =0.35.

a. A $1000, one-year loan at 8%

a. $PV\ (tax\ Shield) = \frac{T_C(r_D D)}{1+r_D} = \frac{0.35(0.08 \times \$1{,}000)}{1.08} = \$25.93$

b. A five-year loan of $1000 at 8%. Assume no principal is repaid until maturity.

b. $PV\ (tax\ Shield) = \sum_{t=1}^{5} \frac{T_C(r_D D)}{(1+r_D)^t} = \frac{0.35(0.08 \times \$1{,}000)}{(1.08)^t} = \$111.80$

c. A $1000 perpetuity at 7%.

c. $PV\ (tax\ Shield) = T_C D = 0.35 \times \$1{,}000 = \$350$

Question 12

Due to large losses incurred in the past several years, a firm has £2 billion in tax loss carryforwards. This means that the next £2 billion of the firm's income will be free from corporate income taxes. Security analysts estimate that it will take many years for the firm to generate £2 billion in earnings. The firm has a moderate amount of debt in its capital structure. The firm's CEO is deciding whether to issue debt or equity to raise the funds needed to finance an upcoming project. Which method of financing would you recommend? Why?

The firm should issue equity in order to finance the project. The tax-loss carry-forwards make the firm's effective tax rate zero. Therefore, the company will not benefit from the tax shield that debt provides. Moreover, since the firm already has a moderate amount of debt in its capital structure, additional debt will likely increase the probability that the firm will face financial distress or bankruptcy. As long as there are bankruptcy costs, the firm should issue equity in order to finance the project.

Question 13

Janetta Corp. has an EBIT rate of £975,000 per year that is expected to continue in perpetuity. The unlevered cost of equity for the company is 14 percent, and the corporate tax rate is 35 percent. The company also has a perpetual bond issue outstanding with a market value of £1.9 million.

a. What is the value of the company?

Using M&M Proposition I with taxes, the value of a levered firm is:

$$V_L = [EBIT(1 - T_C)/R_0] + T_C B$$
$$V_L = [£975{,}000(1 - 0.35)/0.14] + 0.35 \times £1{,}900{,}000$$
$$V_L = £5{,}191{,}785.71$$

b. The CFO of the company informs the company president that the value of the company is £4.8 million. Is the CFO correct?

The CFO may be correct. The value calculated in part *a* does not include the costs of any non-marketed claims, such as bankruptcy or agency costs.

Question 14

Edwards Construction currently has debt outstanding with a market value of £85,000 and a cost of 9 percent. The company has EBIT of £7,650 that is expected to continue in perpetuity. Assume there are no taxes. What is the value of the company's equity?

The interest payments each year will be:

$$Interest\ Payment = 0.09(£85{,}000) = £7{,}650$$

This is exactly equal to the EBIT, so no cash is available for shareholders. Under this scenario, the value of equity will be zero since shareholders will never receive a payment. Since the market value of the company's debt is £85,000, and there is no probability of default, the total value of the company is the market value of debt. This implies the debt to value ratio is 1 (one).

Question 15

Consider a company with the following balance sheet;

Assets	Liabilities
Total Assets = 200	Equity = 120
	Long Term Debt = 60
	Short Term Debt = 20

Assume that the debt betas are zero. And that the coupons are 9% for long term debt and 8% for short term debt. The risk free rate of interest is 5% and the expected return on the market as a whole is 15%. The beta of the equity of the company is 1.5. The company maintains the ratio of its liabilities in the current form.

The company has an environmentally hazardous project that costs $2 million in capital outlays now, last for 10 years. At the end of each of these 10 years the project generates net operating

cash flows of $450.000. At the end of year 10 the company also has to pay for some clean-up connected with this project of $1 million.

a. Determine the company's required rate of return on equity.

risk free	5%
market return	15%
beta equity	1.5
beta debt	0

a. Use the CAPM to determine the required return on equity as:
$r_E = r_f + beta_E * (r_M - r_f) = 5\% + 1.5 * (15\% - 5\%) = 20.00\%$

b. Determine the company's cost of capital using the method unlevering betas as well as weighted average cost of capital.

b) Determine the cost of debt first from the CAPM
$r_d = r_f + beta_D * (r_M - r_f) = r_f = 5\%$

Then determine the ratio of debt to the value of the company:
Value of the company = equity+ST debt+LT debt = 120+60+20 = 200
Debt/Value = (ST debt+LT debt)/Value = (60+20)/200 = 40%

Then the weighted average cost of capital are:
$WACC = (debt/value) * r_D + (equity/value) * r_E = 0.4 * 5\% + 0.6 * 20\% = 14\%$

Unlevering betas requires that the asset beta satisfies the equation:
$beta_A = (debt/value) * beta_D + (equity/value) * beta_E = 0.4 * 0 + 0.6 * 1.5 = 0.9$

Then the CAPM gives the unlevered cost of capital as:
$r_A = r_f + beta_A * (r_M - r_f) = 5\% + 0.9 * (15\% - 5\%) = 14.00\%$

We find that the cost of capital is 14% for this company

c. What is the NPV of the project? Should the company take it?

Capital outlay: $2,000,000.00
Clean-up: $1,000,000.00
Cash flow: $450,000.00

The NPV is simply the present value of the cash flows over the lifetime of the project:

NPV = -2,000,000 + (450,000/0.14)*(1-1.14^{-10}) - 1,000,000/1.14^{10} = $77,508.23

Hence, the company should take the project since the NPV is positive.

d. Suppose the company could lease rather than buy the equipment connected with this project. This would reduce capital expenditure on outlay to $500.000 today, but the company would still be responsible for the clean-up costs. The lease payments are certain to be $200.000 per year. Should the company lease?

The important part to realize on this is that the lease payments are basically certain, so they should be discounted at the risk free rate. The cash flows from operations have the uncertainty of a typical project, so they should be discounted at the company's cost of capital.

Hence, determine the present value of cash flows from the project as:
PV = -500,000+(450,000/0.14)*(1-1.14^{-10})-1,000,000/1.14^{10} = $1,577,508.23

Determine the present value of the lease payments as:
PV_{Lease} = (200,000/0.05)*(1-1.05^{-10}) = $1,544,346.99
Hence, the NPV is: $33,161.25
The NPV from leasing is lower, hence the decision to lease rather than to buy has a negative NPV; the company should buy.

Question 16

Suppose two companies X and Z have exactly the same operating characteristics and their business risks are perfectly correlated. They differ only in the way they finance their operations. Both companies will be liquidated exactly one year from now and shareholders will receive a liquidating dividend at the end of the year. Company X is expected to pay a liquidating dividend of $55 million, but this is uncertain, so shareholders discount this dividend at a rate of 10%. Z has issued bond to finance its operations. Currently Z's securities are trading as follows;

Bonds	$10 million
Shares	$42 million

The bonds are AAA rated and expected return is the same as on the risk free asset which is 5%.

a. Suppose company X has 250.000 shares outstanding. What is the current share price of X?

The share price is simply the present value of the end of period dividend:
divided by the number of shares
$V_0 = D_1/(1+r_E)$ = $55m/(1+10%) = $50 million
$P_0 = V_0/2,500,000$ = $50m/2,500,000 = $20 per share

b. What is the total valuation of company's Z's assets today?
The total valuation of Z is equal to its debt plus its equity:
debt+equity = $42m+$10m = $52m

c. Show how you can set up an arbitrage portfolio in order to benefit from any mispricing of companies X and Z relative to each other.

Company Z is overvalued relative to X. Hence set up an arbitrage portfolio as follows:
Sell stock of Z
Buy stock of X
Borrow

Note that the bonds have a face value so that F/1.05 = $10m, hence F = $10.5m. Then repaying the bonds at the end of the year requires $10.5m. The expected payoff to equity is then the difference of $55million (55-10.5 = $44.50m).

The cash flows are (V_1 is the end of period value of firm X):

	Today	Next year (actual)
Sell stock of Z	$42	$-V_1$+$10.50
Buy stock of X	($50)	V_1
Borrow	$10	($10.50)
Total	**$2**	**$0.00**

The last step relies on the assumption that the values of Z and X are perfectly correlated, so they are the same in all states of the world.
We can also see that if the true value for Z's shares would be $40m, not $42m, then we couldn't make an arbitrage profit.

Question 17
ABC Industries is currently financed with a 12.5% debt. The CEO decides that the proportion of debt in the current capital structure is too low because investor's in ABC stock demand a higher rate of return. ABC issues debt and pays out all proceeds as a special dividend to shareholders. The current rate of return on ABC equity is 16%, only slight higher than the 14% currently expected on the stock market index. Suppose the risk free rate is 6% and ABC has 10 million shares outstanding for a price of $18 per share.
For answering the following questions, assume all assets are priced on the SML.

a. What are the equity beta and the debt beta of ABC if the debt has an expected return of 6%?

Before Recap

D/V	12.5%
r_E	16.00%
r_M	14.00%
rf	6.00%
Share price	$18
no of shares (million)	10

The risk premium on the market is $r_M - r_F = 8\%$
Hence, the equity beta is:
$Beta_E = (16\% - 8\%) / 8\% = 1.25$

The debt beta is:
$Beta_D = 0$

b. What is the cost of capital of ABC? Answer this question by using both methods, namely unlevering betas and the weighted average cost of capital.

The cost of capital of ABC Industries can be computed using the WACC method.
$WACC = (D/V)*r_D+(E/V)*r_E = 14.75\%$

Unlevering betas gives
$beta_A = (D/V)*beta_D+(E/V)*beta_E = 1.09$
Then the cost of capital is:
$r_A = rf+beta_A*(r_M-rf) = 14.75\%$
Evidently, we obtain the same number

c. Suppose the CEO wishes to realize a target expected return of 20% through leveraging and paying the proceeds as a special dividend. How much debt should the company issue, assuming that all debt can be issued at an expected return equal to the risk-free-rate? What is the cost of capital now?

In order to achieve a return of 20%, the company's equity beta has to satisfy:
$rf+beta_E*(r_M-rf) = 0.2$, or $beta_E = (0.2-rf)/(r_M-rf) = 1.75$
$beta_E = beta_A+(D/E)*(beta_A-beta_D)$, or, solving for D/E:
$D/E = (beta_E-beta_A)/(beta_A-beta_D)$
Hence: D/E = 60.00%
Since $D/V = (D/E)/(1+D/E)$, we have D/V = 37.50%

The market capitalization of the company is currently $180million, hence the value of the company as a whole is:
V = Equity MCAP/(1 - 0.125) = $205.71 million

Giving a total value of $205.71 million, then the total value of debt outstanding should be:
Debt = V*(D/V) = $77.14 million

Hence the firm should issue an *additional* amount of debt of
Debt issue = $51.43 million
The ex dividend share price drops to $12.86 per share

Question 18
MVP Inc., a manufacturing firm with no debt outstanding and a market value of $100 million is considering borrowing $ 40 million and buying back stock. Assuming that the interest rate on the debt is 9% and that the firm faces a tax rate of 35%, answer the following questions:

a. Estimate the annual interest tax savings each year from the debt.
Annual tax savings from debt = $40 million × 0.09 × 0.35 = $1.26 million

b. Estimate the present value of interest tax savings, assuming that the debt change is permanent.
PV of savings assuming savings are permanent = $40 million × 0.035 = $14.00 million

c. Estimate the present value of interest tax savings, assuming that the debt will be taken on for 10 years only.

PV of savings assuming savings occur for 10 years = $1.26 (PVA, 9%, 10) = $8.09 million

d. What will happen to the present value of interest tax savings, if interest rates drop tomorrow to 7% but the debt itself is fixed rate debt?

PV of savings will increase
If savings are permanent = 1.26 / 0.07 = $18.00 million
If savings are for 10 years = $1.26 (PVA, 7%, 10) = $8.85 million

Question 19
A business in the 45% tax bracket is considering borrowing money at 10%.
a. What is the after-tax interest rate on the debt?
After tax Interest rate = 10% × (1 – 0.45) = 5.50%

b. What is the after-tax interest rate if only half of the interest expense is allowed as a tax deduction?

If only half the interest is allowed = 10% × (1 – 0.225) = 7.75%

c. Would your answer change if the firm is losing money now and does not expect to have taxable income for three years?

Yes. The tax savings will be much lower since the tax savings will not occur until three years from now. The after-tax interest rate will therefore be the same as the pre-tax rate (10%) for the first three years.

Question 20

ABC Inc. is a manufacturing company, which has accumulated a net operating loss of $ 2 billion over time. It is considering borrowing $ 5 billion to acquire another company.

a. Based upon the corporate tax rate of 36%, estimate the present value of the tax savings that could accrue to the company.

Ignoring the net operating loss,

PV of Tax Savings = $5 billion (0.36) = $1.8 billion

b. Does the existence of a net operating loss carry forward affect your analysis? (Will the tax benefits be diminished as a consequence?)

Yes. The net operating loss will mean that this tax savings will not occur for a while. For instance, if it will be 5 years before ABC Inc. will have enough taxable income to claim the interest deduction, this $1.8 billion should be discounted back 5 years to arrive at the present value.