Assignment 1
Solution

1.

(a) Strong-form market inefficiency. Using private information generates abnormal returns.
(b) Consistent with market efficiency. The market correctly expects the high profit of the company next quarter.
(c) Weak, semi-strong, and strong-form market inefficiency. If market is weak-form efficient, we should not be able to observe any pattern in price movement.
(d) Semi-strong, and strong-form market inefficiency. If market is semi-strong form efficient, market should incorporate *full*y and *immediately* all publicly available information (information contained in earnings announcement). The statement implies market's underreaction.
(e) This statement is not related to market efficiency at all.

2.

We don't know the debt-equity ratio of the firm but we do know the level of debt over the next five years. Therefore, APV will be appropriate method for this question. The initial investment = $60 million and the incremental operating earnings = $12 million per year $\Rightarrow$ after-tax project cash flows = ($12 million)(1-$T_C$) = ($12 million)(0.65) = $7.8 million per year for 8 years. The project will also generate depreciation tax shields because the $60 million will be depreciated on a straight-line basis over 6 years $\Rightarrow$ depreciation per year = $10 million $\Rightarrow$ depreciation tax shield = ($10 million)(0.35) = $3.5 million per year for 6 years. r_U = 10% and r_f = 5%.

Step 1: Compute the NPV_U (Compute the NPV under all-equity)

$$NPV_U = -\$60 + \sum_{t=1}^{8} \frac{\$7.8}{(1.1)^t} = -18.39 \text{ million}$$

Note that the depreciation tax shields are discounted at the risk free rate, whereas the incremental cash flows from the project are discounted at the cost of equity for all-equity financed case.

Step 2: Compute NPVF

The financing side effects that the project will generate are the interest tax shields and subsidy on the loan. Both of them can be measured by calculating the present value of the loan. Remember that the loan involves an initial cash inflow of $25 million (the loan amount) and five annual cash outflows of $5 million in principal payments (since the loan is amortized in equal installments over 5 years). Furthermore, each year the firm will have to pay an after-tax interest of r_b(1-T_C) = (5%)(0.65) = 3.25% on its outstanding loan balance. This balance is $25 million in the first year, $20 million in the second year and so on. Therefore, the net present value of the loan (in millions of dollars) is given by:

$$NPV(loan) = +\$25 - \frac{(\$25)(0.0325)}{(1.07)} - \frac{(\$20)(0.0325)}{(1.07)^2} - \frac{(\$15)(0.0325)}{(1.07)^3}$$

$$- \frac{(\$10)(0.0325)}{(1.07)^4} - \frac{(\$5)(0.0325)}{(1.07)^5} - \sum_{t=1}^{5} \frac{\$5}{(1.07)^t} = \$2.41$$

where we discount the debt cash flows at the firm's 7% cost of debt.

Step 3: Compute APV

Now we can easily calculate the project's APV as the sum of NPV_U and NPVF $\Rightarrow$ APV = –\$0.62 million + \$2.41 million = \$1.79 million. Since the APV is positive, World Cellfone Co. should accept the project and purchase the telecommunications system.

3.

a. Let's assume that the SSR Co. is all equity financed firm. In order to calculate the project's NPV of unlevered case (NPV_U), we need to know the project's all-equity or opportunity cost of capital. We know that the beta of the firm's current assets is 1.5 and the project is 15% less risky $\Rightarrow$ the beta of the project is 1.5 × 0.85 = 1.275. Since the risk-free rate r_f = 3% and the market risk premium $r_M - r_f$ = 8%, we can apply CAPM to get the project's opportunity cost of capital $r_o = r_f + \beta_o(r_M - r_f)$ = 3% + 1.275(8%) = 13.2%, assuming the firm is currently all-equity financing.

The project's initial investment is \$30 million. Its after-tax cash flows are \$10 million per year and its tax rate is 34% for 5 years. On discounting the after-tax cash flows at the 13.2% opportunity cost of capita, we get the NPV_U as follows:

$$NPV_U = -\$30 + (\$10)(PVIFA_{13.2\%,5yrs}) = \$5 \text{ million}$$

b. If the firm takes out a 5-year loan, it will generate some interest tax shields that will add value to the project. In order to compute this extra value, we must calculate the present value of the loan. The debt-equity ratio is 3/7, thus the debt amount should be \$9 million. The loan involves an initial cash inflow of \$9 million, annual 11% interest payments of \$0.99 million for five years ($\Rightarrow$ after-tax payments of 0.66 × \$0.99 million = \$0.6534 million) and a final repayment of \$9 million in six years.

$$PV(loan) = +\$9 - (\$0.6534)(PVIFA_{11\%,5yrs}) - \frac{\$9}{(1.11)^5} = \$1.244 \text{ million}$$

Or, simply, tax shield = $PV(T_C r_B B)$ = 0.3366 million ($PVIFA_{11\%,\ 5years}$) = \$1.244 million
Now we can calculate the project's APV by adding NPV_U and its loan value $\Rightarrow$ APV = \$5 million + \$1.244 million = \$6.244 million.

c. If the city council offers a subsidized 8%, \$9 million loan to the firm, its annual after-tax interest will be (0.14)(\$9 million)(0.66) = \$0.4752 million. Therefore, the present value of this loan will be:

$$PV(loan) = +\$9 - (\$0.4752)(PVIFA_{11\%,5yrs}) - \frac{\$9}{(1.11)^5} = \$1.9027 \text{ million}$$

The project's APV = \$5 million + \$1.9027 million = \$6.9027 million. Since the subsidized loan has increased the firm's APV, it should accept the city council offer.

4.

We are given the following data about Northern Sludge: B = \$30 million; S_L = \$50 million; r_B = 8%; r_S = 16%. Since we are told that there are no taxes, we know that we are in the MM world (with no taxes) and MM's Proposition II (with no taxes) applies:

$$r_S = r_0 + \frac{B}{S_L}(r_0 - r_B)$$

where r_0 = all-equity firm cost of capital. Substituting for the various quantities, we have

$$16\% = r_0 + \frac{30}{50}(r_0 - 8\%) \Rightarrow r_0 = 13\%$$

We know that $V_L = B+S_L$ = \$80 million. When Northern Sludge issues an additional \$10 million of equity to retire debt, the total firm value does not change because of MM's capital structure irrelevance ⇒ the new firm value V_L^* = \$80 million. Since the firm issues \$10 million in equity, its new equity value S_L^* = \$60 million ⇒ new debt value B^* = \$20 million. Since risk of debt does not change due to the refinancing, $r_B^* = r_B$ = 8%. The new equity cost r_S^* will also satisfy MM's Proposition II above:

$$r_S^* = r_0 + \frac{B^*}{S_L^*}(r_0 - r_B^*) = 13\% + \frac{20}{60}(13\% - 8\%) = 14.67\%$$

Therefore, we see that the cost of equity has decreased from 16% to 14.67%. This makes sense because the decrease in debt due to the refinancing lowers the risk of equity and so shareholders will require a lower rate of return (Remember the graph?).

If there exists 35% of corporate tax, then

$$r_S = r_0 + \frac{B}{S_L}(r_0 - r_B)(1 - T_c)$$

$$16\% = r_0 + \frac{30}{50}(r_0 - 8\%)(65\%) \Rightarrow r_0 = 13.76\%$$

V_L, the value of levered firm before the capital structure change, = S_L+B = \$80 million = $V_u + T_CB$, \$80 million = V_u + 0.35*30 million ⇒ V_u = \$69.5 million. V_L^*, the value of the firm after the capital structure change, = $S_L^*+B^*$ ⇒ $S_L^* = V_L^* - B^*$. $V_L^* = V_u + T_CB^*$ = 69.5 million – 0.35*20 million = \$76.5 million ⇒ S_L^* = \$76.5 million - \$20 million = \$56.5 million. (Note that the value of equity has gone down due to the loss of tax shield.), Now

$$r_S^* = r_0 + \frac{B^*}{S_L^*}\left(r_0 - r_B^*\right)(1 - T_c) = 13.76\% + \frac{20}{56.5}(13.76\% - 8\%)(65\%) = 15.09\%$$

(Note that the cost of equity, $r_S{}^*$, with corporate tax is higher than without corporate tax. This shows that the impact of capital structure change on the cost of equity is offset by the tax effect.)

5.

We are given the following data about Massey-Moss Corporation: EBIT = X = \$3 million; T_C = 40%; r_D = 14%; r_o = 18%.

a. When the firm has no debt, its value V_U is just the present value of its after-tax cash flows $X(1\text{-}T_C)$ available to shareholders discounted at the firm's cost of equity r_o:

$$V_U = \frac{X(1 - T_C)}{r_o} = \frac{(\$3{,}000{,}000)(0.60)}{0.18} = \$10 \text{ million}$$

If the firm has \$4 million in debt $\Rightarrow D_L$ = \$4 million and the firm's value will now increase due to the corporate tax shield of debt. In fact, the value of the firm is given by $V_L = V_U + T_C D_L$ = \$10 million + (0.40)(\$4 million) = \$11.6 million.

b. Now personal taxes enter into the picture. We are given the personal tax rate on debt income T_{PD} = 30% and the personal tax rate on stock income T_{PS} = 25%.

When the firm has no debt, its value V_U is just the present value of the cash flow available to shareholders after corporate and personal taxes $X(1\text{-}T_C)(1\text{-}T_S)$ discounted at the firm's after tax cost of equity $r_o(1\text{-}T_S)$:

$$V_U = \frac{X(1 - T_C)(1 - T_S)}{r_o(1 - T_S)} = \frac{(\$3{,}000{,}000)(0.60)(0.75)}{0.18(0.75)} = \$10 \text{ million}$$

When the firm has \$4 million in debt (D_L = \$4 million), the firm becomes levered and its value V_L in the presence of corporate and personal taxes is given by:

$$V_L = V_U + D_L\left[1 - \frac{(1 - T_C)(1 - T_S)}{(1 - T_B)}\right] = \$10 + \$4\left[1 - \frac{(0.6)(0.75)}{(0.7)}\right] = \$\,11.43 \text{ million}$$

6. APV:

$V_U = UCF / r_0$ = \$151.52(1– 34%)/ 0.2 = \$500.016

$APV = V_U + T_C B$ = \$500 + (34%) (\$500) = \$670

WACC:

$r_S = r_0 + B/S\,(1 - T_C)(r_0 - r_B)$, where $S = V_L - B$ = \$670 – \$500 = \$170

= 0.2 + 500/170 (0.66)(0.2-0.1)

=0.3941 = 39.41%

$$r_{wacc} = \frac{S}{S+B} r_S + \frac{B}{S+B} r_B (1 - T_C)$$

=170/670 (39.41%) + 500/670 (10%)(1 – 34%)

$=14.92\%$

$$V_L = \frac{UCF}{r_{WACC}} = \frac{151.52\,(1-34\%)}{14.92\%} = \$670$$

FTE:

$LCF = (EBIT - r_B B)(1 - T_C)$

$= (\$151.52 - \$50)(1 - 34\%) = \$67.0032$

$V_L = PV = (\$67.0032 / 39.41\%) - (-\$500)$

$= \$170 + \$500 = \$670$

7.

We are given the following data about the firm and its project: initial investment = \$7 million; project's perpetual after-tax cash flows = \$600,000; T_C = 35%; firm's r_B = 7%; firm's r_S = 14%; firm's debt-equity ratio B/S_L = 0.5.

a. If the firm and project were all-equity, the project's cash flows would have to be discounted at the all-equity or opportunity cost of capital r_0. Though we are not given this rate, we can easily infer it because we know that:

$$r_S = r_0 + \frac{B}{S_L}(1-T_C)(r_0 - r_B) \Rightarrow 14\% = r_0 + (0.5)(0.65)(r_0 - 7\%) \Rightarrow r_0 = 12.28\%$$

Now we can calculate the project's NPV if the firm were all-equity as follows:

$$NPV = -\$7 + \frac{\$0.6}{0.1228} = -\$2.11 \text{ million}$$

b. If the project were financed in a manner identical to the firm, the appropriate discount rate for project cash flows would be the firm's weighted-average cost of capital r_{WACC}. Since the debt-equity ratio B/S_L = 0.5, we can infer that B/V_L = 1/3 and S_L/V_L = 2/3. We can now calculate the r_{WACC} as:

$$r_{WACC} = \frac{B}{V_L} r_B (1-T_C) + \frac{S_L}{V_L} r_S = (1/3)(7\%)(0.65) + (2/3)(14\%) = 10.88\%$$

Now we can calculate the project's NPV when it is financed like the firm as follows:

$$NPV = -\$7 + \frac{\$0.6}{0.1088} = -\$1.49 \text{ million}$$