Chapter 13 Suggested Problems Solutions

8. *a.* The book value of equity is the book value per share times the number of shares, and the book value of debt is the face value of the company's debt, so:

Equity = 8,300,000($4) = $33,200,000
Debt = $70,000,000 + 60,000,000 = $130,000,000
So, the total book value of the company is:
Book value = $33,200,000 + 130,000,000 = $163,200,000
And the book value weights of equity and debt are:
Equity/Value = $33,200,000/$163,200,000 = .2034
Debt/Value = 1 – Equity/Value = .7966

b. The market value of equity is the share price times the number of shares, so:

S = 8,300,000($53) = $439,900,000
Using the relationship that the total market value of debt is the price quote times the par value of the bond, we find the market value of debt is:
B = 1.083($70,000,000) + 1.089($60,000,000) = $141,150,000
This makes the total market value of the company:
V = $439,900,000 + 141,150,000 = $581,050,000
And the market value weights of equity and debt are:
S/V = $439,900,000/$581,050,000 = .7571
$B/V = 1 – S/V$ = .2429

c. The market value weights are more relevant.

9. First, we will find the cost of equity for the company. The information provided allows us to solve for the cost of equity using the CAPM, so:

R_S = .031 + 1.2(.07) = .1150, or 11.50%

Next, we need to find the YTM on both bond issues. Doing so, we find:

P_1 = $1,083 = $35($\text{PVIFA}_{R\%,16}$) + $1,000($\text{PVIF}_{R\%,16}$) ➔ R = 2.847%
⇨ YTM = 2.847% × 2 = 5.69%

P_2 = $1,089 = $37.50($\text{PVIFA}_{R\%,54}$) + $1,000($\text{PVIF}_{R\%,54}$) ➔ R = 3.389%
⇨ YTM = 3.389% × 2 = 6.78%

To find the weighted average aftertax cost of debt, we need the weight of each bond as a percentage of the total debt. We find:

X_{B1} = 1.083($70,000,000)/$141,150,000 = .537
X_{B2} = 1.089($60,000,000)/$141,150,000 = .463

Now we can multiply the weighted average cost of debt times one minus the tax rate to find the weighted average aftertax cost of debt. This gives us:

R_B = (1 – .35)[(.537)(.0569) + (.463)(.0678)] = .0403, or 4.03%

Using these costs and the weight of debt we calculated earlier, the WACC is:

R_{WACC} = .7571(.1150) + .2429(.0403) = .0968, or 9.68%

10. *a.* Using the equation to calculate WACC, we find:
$R_{\text{WACC}} = .112 = (1/1.45)(.15) + (.45/1.45)(1 - .35)R_B$ ➔ $R_B = .0424$, or 4.24%

b. Using the equation to calculate WACC, we find:
$R_{\text{WACC}} = .112 = (1/1.45)R_S + (.45/1.45)(.064)$ ➔ $R_S = .1336$, or 13.36%

11. We will begin by finding the market value of each type of financing. We find:
$B = 5{,}000(\$1{,}000)(1.05) = \$5{,}250{,}000$
$S = 175{,}000(\$58) = \$10{,}150{,}000$
And the total market value of the firm is:
$V = \$5{,}250{,}000 + 10{,}150{,}000 = \$15{,}400{,}000$

Now, we can find the cost of equity using the CAPM. The cost of equity is:
$R_S = .05 + 1.10(.07) = .1270$, or 12.70%

The cost of debt is the YTM of the bonds, so:
$P_0 = \$1{,}050 = \$30(\text{PVIFA}_{R\%,50}) + \$1{,}000(\text{PVIF}_{R\%,50})$ ➔ $R = 2.813\%$
⇨ YTM = 2.813% × 2 = 5.63%
And the aftertax cost of debt is:
$R_B = (1 - .35)(.0563) = .0366$, or 3.66%

Now we have all of the components to calculate the WACC. The WACC is:
$R_{\text{WACC}} = .0366(\$5{,}250{,}000/\$15{,}400{,}000) + .1270(\$10{,}150{,}000/\$15{,}400{,}000) = .0962$, or 9.62%

Notice that we didn't include the $(1 - t_C)$ term in the WACC equation. We simply used the aftertax cost of debt in the equation, so the term is not needed here.

12. *a.* We will begin by finding the market value of each type of financing. We find:
$B = 260{,}000(\$1{,}000)(1.04) = \$270{,}400{,}000$
$S = 9{,}300{,}000(\$34) = \$316{,}200{,}000$
And the total market value of the firm is:
$V = \$270{,}400{,}000 + 316{,}200{,}000 = \$586{,}600{,}000$
So, the market value weights of the company's financing is:
$B/V = \$270{,}400{,}000/\$586{,}600{,}000 = .4610$
$S/V = \$316{,}200{,}000/\$586{,}600{,}000 = .5390$

b. For projects equally as risky as the firm itself, the WACC should be used as the discount rate.
First we can find the cost of equity using the CAPM. The cost of equity is:
$R_S = .035 + 1.20(.07) = .1190$, or 11.90%

The cost of debt is the YTM of the bonds, so:
$P_0 = \$1{,}040 = \$34(\text{PVIFA}_{R\%,40}) + \$1{,}000(\text{PVIF}_{R\%,40})$ ➔ $R = 3.221\%$
⇨ YTM = 3.221% × 2 = 6.44%
And the aftertax cost of debt is:
$R_B = (1 - .35)(.0644) = .0419$, or 4.19%

Now we can calculate the WACC as:
$R_{\text{WACC}} = .5390(.1190) + .4610(.0419) = .0834$, or 8.34%

13. *a.* Projects Y and Z.

b. Using the CAPM to consider the projects, we need to calculate the expected return of each project given its level of risk. This expected return should then be compared to the expected return of the project. If the return calculated using the CAPM is lower than the project expected return, we should accept the project; if not, we reject the project. After considering risk via the CAPM:

E[W] = .035 + .80(.11 – .035) = .0950 > .094, so reject W
E[X] = .035 + .95(.11 – .035) = .1063 < .109, so accept X
E[Y] = .035 + 1.15(.11 – .035) = .1213 < .13, so accept Y
E[Z] = .035 + 1.45 (.11 – .035) = .1438 > .142, so reject Z

c. Project X would be incorrectly rejected; Project Z would be incorrectly accepted.

15. We first need to find the weighted average flotation cost. Doing so, we find:
f_T = .65(.08) + .05(.05) + .30(.03) = .064, or 6.4%

And the total cost of the equipment including flotation costs is:
Amount raised(1 – .064) = $55,000,000
⇨ Amount raised = $55,000,000/(1 – .064) = $58,729,311

16. Using the debt-equity ratio to calculate the WACC, we find:
R_{WACC} = (.55/1.55)(.055) + (1/1.55)(.13) = .1034, or 10.34%

Since the project is riskier than the company, we need to adjust the project discount rate for the additional risk. Using the subjective risk factor given, we find:
Project discount rate = 10.34% + 2% = 12.34%

We would accept the project if the NPV is positive. The NPV is the PV of the cash outflows plus the PV of the cash inflows. Since are seeking the breakeven initial cost, we just need to find the PV of future inflows. The cash inflows are a growing perpetuity. If you remember, the equation for the PV of a growing perpetuity is the same as the dividend growth equation, so:
PV of future CF = $3,500,000/(.1234 – .04) = $41,972,921

The project should only be undertaken if its cost is less than $41,972,921 since costs less than this amount will result in a positive NPV.

17. We will begin by finding the market value of each type of financing. We will use B1 to represent the coupon bond, and B2 to represent the zero coupon bond. So, the market value of the firm's financing is:
B_{B1} = 60,000($1,000)(1.095) = $65,700,000
B_{B2} = 230,000($1,000)(.175) = $40,250,000
P = 150,000($79) = $11,850,000
S = 2,600,000($65) = $169,000,000

And the total market value of the firm is:
V = $65,700,000 + 40,250,000 + 11,850,000 + 169,000,000 = $286,800,000

Now, we can find the cost of equity using the CAPM. The cost of equity is:
$R_S = .04 + 1.15(.07) = .1205$, or 12.05%

The cost of debt is the YTM of the bonds, so:
$P_0 = \$1,095 = \$30(\text{PVIFA}_{R\%,40}) + \$1,000(\text{PVIF}_{R\%,40})$ ➔ $R = 2.614\%$
⇨ YTM = 2.614% × 2 = 5.23%
And the aftertax cost of debt is: $R_{B1} = (1 - .40)(.0523) = .0314$, or 3.14%

And the aftertax cost of the zero coupon bonds is:
$P_0 = \$175 = \$1,000(\text{PVIF}_{R\%,60})$ ➔ $R = 2.948\%$
⇨ YTM = 2.948% × 2 = 5.90%

$R_{B2} = (1 - .40)(.0590) = .0354$, or 3.54%

Even though the zero coupon bonds make no payments, the calculation for the YTM (or price) still assumes semiannual compounding, consistent with a coupon bond. Also remember that, even though the company does not make interest payments, the accrued interest is still tax deductible for the company.

To find the required return on preferred stock, we can use the preferred stock pricing equation, which is the level perpetuity equation, so the required return on the company's preferred stock is:
$R_P = D_1 / P_0 = \$4 / \$79 = .0506$, or 5.06%

Notice that the required return on the preferred stock is lower than the required return on the bonds. This result is not consistent with the risk levels of the two instruments, but is a common occurrence. There is a practical reason for this: Assume Company A owns stock in Company B. The tax code allows Company A to exclude at least 70 percent of the dividends received from Company B, meaning Company A does not pay taxes on this amount. In practice, much of the outstanding preferred stock is owned by other companies, who are willing to take the lower return since much of the return is effectively tax exempt for the investing company.

Now we have all of the components to calculate the WACC. The WACC is:
$R_{\text{WACC}} = .0314(\$65,700,000/\$286,800,000) + .0354(\$40,250,000/\$286,800,000)$
$\quad + .1205(\$169,000,000/\$286,800,000) + .0506(\$11,850,000/\$286,800,000)$
$R_{\text{WACC}} = .0852$, or 8.52%

18. The total cost of the equipment including flotation costs was:
Total costs = $19,000,000 + 1,150,000 = $20,150,000

Using the equation to calculate the total cost including flotation costs, we get:
Amount raised$(1 - f_T)$ = Amount needed after flotation costs
$\$20,150,000(1 - f_T) = \$19,000,000$ ➔ $f_T = .0571$, or 5.71%

Now, we know the weighted average flotation cost. The equation to calculate the percentage flotation costs is: $f_T = .0571 = .07(S/V) + .03(B/V)$
We can solve this equation to find the debt-equity ratio as follows:
$.0571(V/S) = .07 + .03(B/S)$
We must recognize that the V/S term is the equity multiplier, which is $(1 + B/S)$, so:
$.0571(B/S + 1) = .07 + .03(B/S)$ ➔ $B/S = .4775$

19. *a.* Using the dividend discount model, the cost of equity is:
$R_S = [(0.95)(1.045)/\$64] + .045 = .0605$, or 6.05%

b. Using the CAPM, the cost of equity is:
$R_S = .043 + 1.30(.11 – .043) = .1301$, or 13.01%

c. When using the dividend growth model or the CAPM, you must remember that both are estimates for the cost of equity. Additionally, and perhaps more importantly, each method of estimating the cost of equity depends upon different assumptions.

23. We can use the debt-equity ratio to calculate the weights of equity and debt. The weight of debt in the capital structure is:
$X_B = .85 / 1.85 = .4595$, or 45.95%
And the weight of equity is: $X_S = 1 – .4595 = .5405$, or 54.05%

Now we can calculate the weighted average flotation costs for the various percentages of internally raised equity. To find the portion of equity flotation costs, we can multiply the equity costs by the percentage of equity raised externally, which is one minus the percentage raised internally. So, if the company raises all equity externally, the flotation costs are:
$f_T = (0.5405)(.08)(1 – 0) + (0.4595)(.035) = .0593$, or 5.93%

The initial cash outflow for the project needs to be adjusted for the flotation costs. To account for the flotation costs:
Amount raised(1 – .0593) = \$145,000,000
⇨ Amount raised = \$145,000,000/(1 – .0593) = \$154,144,519

If the company uses 60 percent internally generated equity, the flotation cost is:
$f_T = (0.5405)(.08)(1 – 0.60) + (0.4595)(.035) = .0334$, or 3.34%

And the initial cash flow will be:
Amount raised(1 – .0334) = \$145,000,000
⇨ Amount raised = \$145,000,000/(1 – .0334) = \$150,006,990

If the company uses 100 percent internally generated equity, the flotation cost is:
$f_T = (0.5405)(.08)(1 – 1) + (0.4595)(.035) = .0161$, or 1.61%

And the initial cash flow will be:
Amount raised(1 – .0161) = \$145,000,000
⇨ Amount raised = \$145,000,000/(1 – .0161) = \$147,369,867

24. The \$7.5 million cost of the land 3 years ago is a sunk cost and irrelevant; the \$7.1 million appraised value of the land is an opportunity cost and is relevant. The \$7.4 million land value in 5 years is a relevant cash flow as well. The fact that the company is keeping the land rather than selling it is unimportant. The land is an opportunity cost in 5 years and is a relevant cash flow for this project. The market value capitalization weights are:
B = 260,000(\$1,000)(1.03) = \$267,800,000
S = 9,500,000(\$67) = \$636,500,000
P = 450,000(\$84) = \$37,800,000

The total market value of the company is:

$V = \$267,800,000 + 636,500,000 + 37,800,000 = \$942,100,000$

The weight of each form of financing in the company's capital structure is:

$X_B = \$267,800,000 / \$942,100,000 = .2843$

$X_S = \$636,500,000 / \$942,100,000 = .6756$

$X_B = \$37,800,000 / \$942,100,000 = .0401$

Next we need to find the cost of funds. We have the information available to calculate the cost of equity using the CAPM, so:

$R_S = .036 + 1.25(.07) = .1235$, or 12.35%

The cost of debt is the YTM of the company's outstanding bonds, so:

$P_0 = \$1,030 = \$34(\text{PVIFA}_{R\%,50}) + \$1,000(\text{PVIF}_{R\%,50})$ ➔ $R = 3.277\%$

⇨ YTM = 3.277% × 2 = 6.55%

And the aftertax cost of debt is:

$R_B = (1 – .35)(.0655) = .0426$, or 4.26%

The cost of preferred stock is: $R_P = \$5.25/\$84 = .0625$, or 6.25%

a. The weighted average flotation cost is the sum of the weight of each source of funds in the capital structure of the company times the flotation costs, so:

$f_T = .6756(.065) + .2843(.03) + .0401(.045) = .0542$, or 5.42%

The initial cash outflow for the project needs to be adjusted for the flotation costs. To account for the flotation costs:

Amount raised(1 – .0542) = $40,000,000 ➔

Amount raised = $40,000,000 / (1 – .0542) = $42,294,408

So the cash flow at time zero will be:

$CF_0 = –\$7,100,000 – 42,294,408 – 1,400,000 = –\$50,794,408$

There is an important caveat to this solution. This solution assumes that the increase in net working capital does not require the company to raise outside funds; therefore the flotation costs are not included. However, this is an assumption and the company could need to raise outside funds for the NWC. If this is true, the initial cash outlay includes these flotation costs, so:

Total cost of NWC including flotation costs:

$1,400,000 / (1 – .0542) = $1,480,304

This would make the total initial cash flow:

$CF_0 = –\$7,100,000 – 42,294,408 – 1,480,304 = –\$50,874,712$

b. To find the required return on this project, we first need to calculate the WACC for the company. The company's WACC is:

$R_{\text{WACC}} = .6756(.1235) + .2843(.0426) + .0401(.0625)] = .0981$, or 9.81%

The company wants to use the subjective approach to this project because it is located overseas. The adjustment factor is 2 percent, so the required return on this project is:

Project required return = 9.81% + 2% = 11.81%

c. The annual depreciation for the equipment will be:
$40,000,000 / 8 = $5,000,000

So, the book value of the equipment at the end of five years will be:
BV_5 = $40,000,000 – 5($5,000,000) = $15,000,000

So, the aftertax salvage value will be:
Aftertax salvage value = $8,500,000 + .35($15,000,000 – 8,500,000) = $10,775,000

d. Using the tax shield approach, the OCF for this project is:
OCF = [(P – v)Q – FC](1 – t_C) + t_CD
OCF = [($10,900 – 9,450)(18,000) – 7,900,000](1 – .35) + .35($40,000,000 / 8) = $13,580,000

e. The accounting breakeven sales figure for this project is:
Q_A = (FC + D)/(P – v) = ($7,900,000 + 5,000,000) / ($10,900 – 9,450) = 8,897 units

f. We have calculated all cash flows of the project. We just need to make sure that in Year 5 we add back the aftertax salvage value and the recovery of the initial NWC. The cash flows for the project are:

Year	*Flow Cash*
0	–$50,794,408
1	13,580,000
2	13,580,000
3	13,580,000
4	13,580,000
5	33,155,000

Using the required return of 11.81 percent, the NPV of the project is:
NPV = –$50,794,408 + $13,580,000($PVIFA_{11.81\%,4}$) + $33,155,000 / 1.1181^5 = $9,599,239.56

And the IRR is:
NPV = 0 = –$50,794,408 + $13,580,000($PVIFA_{IRR\%,4}$) + $33,155,000 / $(1 + IRR)^5$
⇨ IRR = 18.17%

If the initial NWC is assumed to be financed from outside sources, the cash flows are:

Year	*Flow Cash*
0	–$50,874,712
1	13,580,000
2	13,580,000
3	13,580,000
4	13,580,000
5	33,155,000

With this assumption, and the required return of 11.81 percent, the NPV of the project is:
NPV = –$50,874,712 + $13,580,000($PVIFA_{11.81\%,4}$) + $33,155,000 / 1.1181^5 = $9,518,935.29

And the IRR is:
IRR = 0 = –$50,874,712 + $13,580,000($PVIFA_{IRR\%,4}$) + $33,155,000 / $(1 + IRR)^5$
⇨ IRR = 18.11