Chapter 7 Suggested Problems Solutions

8. The company should analyze both options, and choose the option with the greatest NPV. So, if the company goes to market immediately, the NPV is:
$NPV = C_{Success}$ (Prob. of Success) + $C_{Failure}$ (Prob. of Failure) = $19,000,000(.55) + $6,000,000(.45)
NPV = $13,150,000

Customer segment research requires a $1.2 million cash outlay. Choosing the research option will also delay the launch of the product by one year. Thus, the expected payoff is delayed by one year and must be discounted back to Year 0. So, the NPV of the customer segment research is:
$NPV = C_0 + \{[C_{Success}\text{(Prob. of Success)}] + [C_{Failure}\text{(Prob. of Failure)}]\} / (1 + R)^t$
NPV = –$1,200,000 + {[$19,000,000 (0.70)] + [$6,000,000 (0.30)]} / 1.15 = $11,930,434.78

The company should go to market now since it has the largest NPV.

9. *a.* The accounting breakeven is the aftertax sum of the fixed costs and depreciation charge divided by the aftertax contribution margin (selling price minus variable cost). So, the accounting breakeven level of sales is:
$Q_A = [(FC + \text{Depreciation})(1 - t_C)] / [(P - VC)(1 - t_C)]$
Q_A = [($375,000 + $840,000/7) (1 – 0.35)] / [($35 – 6.10) (1 – 0.35)]
Q_A = 17,128.03 ➔ 17,129 units

b. When calculating the financial breakeven point, we express the initial investment as an equivalent annual cost (EAC). Dividing the initial investment by the seven-year annuity factor, discounted at 15 percent, the EAC of the initial investment is:
EAC = Initial Investment / $PVIFA_{15\%,7}$ = $840,000 / 4.1604 = $201,902.71

Note that this calculation solves for the annuity payment with the initial investment as the present value of the annuity. In other words:
$PVA = C(\{1 - [1/(1 + R)]^t\} / R)$
$\$840,000 = C\{[1 - (1/1.15)^7] / .15\}$ ➔ $C = \$201,902.71$

Now we can calculate the financial breakeven point. The financial breakeven point for this project is:
$Q_F = [EAC + FC(1 - t_C) - D(t_C)] / [(P - VC)(1 - t_C)]$
Q_F = [$201,902.71 + $375,000(.65) – ($840,000/7)(.35)] / [($35 – 6.10) (.65)]
Q_F = 21,488.03 ➔ 21,489 units

10. When calculating the financial breakeven point, we express the initial investment as an equivalent annual cost (EAC). Dividing the initial investment by the five-year annuity factor, discounted at 8 percent, the EAC of the initial investment is:
EAC = Initial Investment / $PVIFA_{8\%,5}$ = $575,000 / 3.99271 = $144,012.46

Note that this calculation solves for the annuity payment with the initial investment as the present value of the annuity. In other words:

$PVA = C(\{1 - [1/(1 + R)]^t\} / R)$

$\$575{,}000 = C\{[1 – (1/1.08)^5\ ] / .08\}$ ➔ $C = \$144{,}012.46$

The annual depreciation is the cost of the equipment divided by the economic life, or:
Annual depreciation = \$575,000 / 5 = \$115,000

Now we can calculate the financial breakeven point. The financial breakeven point for this project is:
$Q_F = [EAC + FC(1 – t_C) – D(t_C)] / [(P – VC)(1 – t_C)]$
$Q_F = [\$144{,}012.46 + \$165{,}000(1 – 0.34) – \$115{,}000(0.34)] / [(\$60 – 14)\ (1 – 0.34)]$
$Q_F = 7{,}042.57$ ➔ 7,043 units

17. *a*. The base-case NPV is:
$NPV = –\$1{,}350{,}000 + \$315{,}000(PVIFA_{16\%,10}) = \$172{,}466.66$

b. We would abandon the project if the cash flow from selling the equipment is greater than the present value of the future cash flows. We need to find the sale quantity where the two are equal, so:
$\$950{,}000 = (\$35)Q(PVIFA_{16\%,9})$
$Q = \$950{,}000/[\$35(4.6065)]$ ➔ $Q = 5{,}893$

Abandon the project if Q < 5,892 units, because the NPV of abandoning the project is greater than the NPV of the future cash flows.

c. The \$950,000 is the market value of the project. If you continue with the project in one year, you forego the \$950,000 that could have been used for something else.

18. *a*. If the project is a success, present value of the future cash flows will be:
PV future CFs = $\$35(11{,}000)(PVIFA_{16\%,9}) = \$1{,}773{,}519.39$

From the previous question, if the quantity sold is 4,000, we would abandon the project, and the cash flow would be \$950,000. Since the project has an equal likelihood of success or failure in one year, the expected value of the project in one year is the average of the success and failure cash flows, plus the cash flow in one year, so:
Expected value of project at Year 1 = [(\$1,773,519.39 + \$950,000)/2] + \$315,000
Expected value of project at Year 1 = \$1,676,759.70

The NPV is the present value of the expected value in one year plus the cost of the equipment, so: $NPV = –\$1{,}350{,}000 + (\$1{,}676{,}759.70)/1.16 = \$95{,}482.50$

b. If we couldn't abandon the project, the present value of the future cash flows when the quantity is 4,000 will be:
PV future CFs = $\$35(4{,}000)(PVIFA_{16\%,9}) = \$644{,}916.14$

The gain from the option to abandon is the abandonment value minus the present value of the cash flows if we cannot abandon the project, so:
Gain from option to abandon = \$950,000 – 644,916.14 = \$305,083.86

We need to find the value of the option to abandon times the likelihood of abandonment. So, the value of the option to abandon today is:
Option value = (.50)(\$305,083.86)/1.16 = \$131,501.66

19. If the project is a success, present value of the future cash flows will be:
PV future CFs = $35(22,000)(PVIFA$_{16\%,9}$) = $3,547,038.78

If the sales are only 4,000 units, from Problem #17, we know we will abandon the project, with a value of $950,000. Since the project has an equal likelihood of success or failure in one year, the expected value of the project in one year is the average of the success and failure cash flows, plus the cash flow in one year, so:
Expected value of project at Year 1 = [($3,547,038.78 + $950,000)/2] + $315,000
Expected value of project at Year 1 = $2,563,519.39

The NPV is the present value of the expected value in one year plus the cost of the equipment, so:
NPV = –$1,350,000 + $2,563,519.39/1.16 = $859,930.51

The gain from the option to expand is the present value of the cash flows from the additional units sold, so:
Gain from option to expand = $35(11,000)(PVIFA$_{16\%,9}$) = $1,773,519.39

We need to find the value of the option to expand times the likelihood of expansion. We also need to find the value of the option to expand today, so:
Option value = (.50)($1,773,519.39)/1.16 = $764,448.01

22. We can calculate the value of the option to wait as the difference between the NPV of opening the mine today and the NPV of waiting one year to open the mine. The remaining life of the mine is:
48,000 ounces / 6,000 ounces per year = 8 years

This will be true no matter when you open the mine. The aftertax cash flow per year if opened today is: CF = 6,000($1,400) = $8,400,000

So, the NPV of opening the mine today is:
NPV = –$34,000,000 + $8,400,000(PVIFA$_{12\%,8}$) = $7,728,174.04

If you open the mine in one year, the cash flow will be either:
CF$_{Up}$ = 6,000($1,600) = $9,600,000 per year
CF$_{Down}$ = 6,000($1,300) = $7,800,000 per year

The PV of these cash flows is:
Price increase CF = $9,600,000(PVIFA$_{12\%,8}$) = $47,689,341.76
Price decrease CF = $7,800,000(PVIFA$_{12\%,8}$) = $38,747,590.18

So, the NPV is one year will be:
NPV = –$34,000,000 + [.60($47,689,341.76) + .40($38,747,590.18)] = $10,112,641.13

And the NPV today is:
NPV today = $10,112,641.13 / 1.12 = $9,029,143.87

So, the value of the option to wait is:
Option value = $9,029,143.87 – 7,728,174.04 = $1,300,969.82

23. *a.* The NPV of the project is the sum of the present value of the cash flows generated by the project. The cash flows from this project are an annuity, so the NPV is:
$NPV = –\$51,000,000 + \$10,500,000(PVIFA_{13\%,10}) = \$5,975,556.50$

b. The company should abandon the project if the PV of the revised cash flows for the next nine years is less than the project's aftertax salvage value. Since the option to abandon the project occurs in Year 1, discount the revised cash flows to Year 1 as well. To determine the level of expected cash flows below which the company should abandon the project, calculate the equivalent annual cash flows the project must earn to equal the aftertax salvage value. We will solve for C_2, the revised cash flow beginning in Year 2. So, the revised annual cash flow below which it makes sense to abandon the project is:
Aftertax salvage value = $C_2(PVIFA_{13\%,9})$ ➔ $\$31,000,000 = C_2(PVIFA_{13\%,9})$
⇨ $C_2 = \$31,000,000 / PVIFA_{13\%,9} = \$6,040,935.96$

24. *a.* The NPV of the project is sum of the present value of the cash flows generated by the project. The annual cash flow for the project is the number of units sold times the cash flow per unit, which is:
Annual cash flow = 15($305,000) = $4,575,000

The cash flows from this project are an annuity, so the NPV is:
$NPV = –\$15,000,000 + \$4,575,000(PVIFA_{16\%,5}) = –\$20,106.53$

b. The company will abandon the project if unit sales are not revised upward. If the unit sales are revised upward, the aftertax cash flows for the project over the last four years will be:
New annual cash flow = 20($305,000) = $6,100,000

The NPV of the project will be the initial cost, plus the expected cash flow in year one based on the 15 unit sales projection, plus the expected value of abandonment, plus the expected value of expansion. We need to remember that the abandonment value occurs in Year 1, and the present value of the expansion cash flows are in year one, so each of these must be discounted back to today. So, the project NPV under the abandonment or expansion scenario is:
$NPV = –\$15,000,000 + \$4,575,000 / 1.16 + .50(\$11,000,000) / 1.16$
$+ [.50(\$6,100,000)(PVIFA_{16\%,4})] / 1.16 = \$1,042,630.13$