Chapter 9
Homework Solution

9-5 \(r_d(1 - T) = 0.12(0.65) = 7.80\%.

9-6 \(r_p = \frac{\$100(0.11)}{\$97.00(1 - 0.05)} = \frac{\$11}{\$97.00(0.95)} = \frac{\$11}{\$92.15} = 11.94\%.

9-8 a. \(r_s = \frac{D_i}{P_i} + g = \frac{\$2.14}{\$23} + 7\% = 9.3\% + 7\% = 16.3\%.

b. \(r_s = r_{RF} + (r_{M} - r_{RF})b\)
   \[= 9\% + (13\% - 9\%)1.6 = 9\% + 4\%1.6 = 9\% + 6.4\% = 15.4\%.

c. \(r_s = \text{Bond rate + Risk premium} = 12\% + 4\% = 16\%.

d. The bond-yield-plus-risk-premium approach and the CAPM method both resulted in lower cost of equity values than the DCF method. The firm's cost of equity should be estimated to be about 15.9 percent, which is the average of the three methods.

9-11 a. Common equity needed:
   \[0.5(\$30,000,000) = \$15,000,000.\]

b. Cost using \(r_s:\)

<table>
<thead>
<tr>
<th></th>
<th>Percent</th>
<th>Cost</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt</td>
<td>0.50</td>
<td>4.8%*</td>
<td>2.4%</td>
</tr>
<tr>
<td>Common equity</td>
<td>0.50</td>
<td>12.0</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>WACC = 8.4%</td>
</tr>
</tbody>
</table>

*8\%(1 - T) = 8\%(0.6) = 4.8\%.

c. \(r_s\) and the WACC will increase due to the flotation costs of new equity.

9-12 The book and market value of the current liabilities are both $10,000,000.

The bonds have a value of

\[V = 60(PVIFA_{10\%,20}) + 1,000(PVIF_{10\%,20})\]
\[= 60([1/0.10] - [1/(0.1* (1+0.1)^{20})]) + 1,000((1+0.10)^{-20})\]
\[= 60(8.5136) + 1,000(0.1486)\]
\[= 510.82 + 148.60 = 659.42.\]

Alternatively, using a financial calculator, input N = 20, I = 10, PMT = 60, and FV = 1000 to arrive at a PV = $659.46.

The total market value of the long-term debt is $30,000($659.46) = $19,783,800.

There are 1 million shares of stock outstanding, and the stock sells for $60 per share. Therefore, the market value of the equity is $60,000,000.
The market value capital structure is thus:

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-term debt</td>
<td>$10,000,000</td>
<td>11.14%</td>
</tr>
<tr>
<td>Long-term debt</td>
<td>19,783,800</td>
<td>22.03%</td>
</tr>
<tr>
<td>Common equity</td>
<td>60,000,000</td>
<td>66.83%</td>
</tr>
<tr>
<td></td>
<td>$89,783,800</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

9-13 Several steps are involved in the solution of this problem. Our solution follows:

**Step 1.**

Establish a set of market value capital structure weights. In this case, A/P and accruals, and also short-term debt, may be disregarded because the firm does not use these as a source of permanent financing.

**Debt:**

The long-term debt has a market value found as follows:

\[ V_0 = \frac{S2}{0.11/4} = 699, \]

or $0.699(30,000,000) = $20,970,000 in total.

**Preferred Stock:**

The preferred has a value of $72.73.

There are $5,000,000/$100 = 50,000 shares of preferred outstanding, so the total market value of the preferred is $50,000(72.73) = $3,636,500.

**Common Stock:**

The market value of the common stock is $4,000,000(20) = $80,000,000.

Therefore, here is the firm's market value capital structure, which we assume to be optimal:

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term debt</td>
<td>20,970,000</td>
<td>20.05%</td>
</tr>
<tr>
<td>Preferred stock</td>
<td>3,636,500</td>
<td>3.48%</td>
</tr>
<tr>
<td>Common equity</td>
<td>80,000,000</td>
<td>76.47%</td>
</tr>
<tr>
<td></td>
<td>$104,606,500</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

We would round these weights to 20 percent debt, 4 percent preferred, and 76 percent common equity.

**Step 2.**

Establish cost rates for the various capital structure components.

**Debt cost:**
Preferred cost:

Annual dividend on new preferred = 11%($100) = $11. Therefore,

\[ r_{ps} = \frac{11}{100}(1 - 0.05) = \frac{11}{95} = 11.6\%. \]

Common equity cost:

There are three basic ways of estimating \( r_s \): CAPM, DCF, and risk premium over own bonds. None of the methods is very exact.

CAPM:

We would use \( r_{RF} = T\)-bond rate = 10%. For \( RPM \), we would use 4.5% to 5.5%. For beta, we would use a beta in the 1.3 to 1.7 range. Combining these values, we obtain this range of values for \( r_s \):

- Highest: \( r_s = 10\% + (5.5)(1.7) = 19.35\% \)
- Lowest: \( r_s = 10\% + (4.5)(1.3) = 15.85\% \)
- Midpoint: \( r_s = 10\% + (5.0)(1.5) = 17.50\% \)

DCF:

The company seems to be in a rapid, nonconstant growth situation, but we do not have the inputs necessary to develop a nonconstant \( r_s \). Therefore, we will use the constant growth model but temper our growth rate; that is, think of it as a long-term average \( g \) that may well be higher in the immediate than in the more distant future.

Data exist that would permit us to calculate historic growth rates, but problems would clearly arise, because the growth rate has been variable and also because \( g_{EPS} \neq g_{DPS} \). For the problem at hand, we would simply disregard historic growth rates, except for a discussion about calculating them as an exercise.

We could use as a growth estimator this method:

\[ g = b(r) = 0.5(24\%) = 12\% \]

It would not be appropriate to base \( g \) on the 30\% ROE, because investors do not expect that rate.

Finally, we could use the analysts' forecasted \( g \) range, 10 to 15 percent. The dividend yield is \( D_1/P_0 \). Assuming \( g = 12\% \),

\[ \frac{D_1}{P_0} = \frac{$1(1.12)}{$20} = 5.6\%. \]

One could look at a range of yields, based on \( P \) in the range of $17 to $23, but because we believe in efficient markets, we would use \( P_0 = $20 \). Thus, the DCF model suggests a \( r_s \) in the range of 15.6 to 20.6 percent:

- Highest: \( r_s = 5.6\% + 15\% = 20.6\% \)
- Lowest: \( r_s = 5.6\% + 10\% = 15.6\% \)
- Midpoint: \( r_s = 5.6\% + 12.5\% = 18.1\% \)

Generalized risk premium.

Highest: \( r_s = 12\% + 6\% = 18\% \).
Lowest: \[ r_s = 12\% + 4\% = 16\%. \]
Midpoint: \[ r_s = 12\% + 5\% = 17\%. \]

Based on the three midpoint estimates, we have \( r_s \) in this range:

<table>
<thead>
<tr>
<th>Method</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPM</td>
<td>17.5%</td>
</tr>
<tr>
<td>DCF</td>
<td>18.1%</td>
</tr>
<tr>
<td>Risk Premium</td>
<td>17.0%</td>
</tr>
</tbody>
</table>

**Step 3.**

Calculate the WACC:

\[
WACC = \frac{D}{V}(r_{dAT}) + \frac{P}{V}(r_{ps}) + \frac{S}{V}(r_s \text{ or } r_e)
\]
\[
= 0.20(r_{dAT}) + 0.04(r_{ps}) + 0.76(r_s \text{ or } r_e).
\]

It would be appropriate to calculate a range of WACCs based on the ranges of component costs, but to save time, we shall assume \( r_{dAT} = 7.2\% \), \( r_{ps} = 11.6\% \), and \( r_s = 17.5\% \). With these cost rates, here is the WACC calculation:

\[
WACC = 0.2(7.2\%) + 0.04(11.6\%) + 0.76(17.5\%) = 15.2\%.
\]
Chapter 11
Homework Solutions

11-3 Truck:

\[
\text{NPV} = -17,100 + 5,100(\text{PVIFA}_{14\%,5})
= -17,100 + 5,100(3.4331) = -17,100 + 17,509
= \$409. \quad \text{(Accept)}
\]

Financial calculator: Input the appropriate cash flows into the cash flow register, input I = 14, and then solve for NPV = $409.

Financial calculator: Input the appropriate cash flows into the cash flow register and then solve for IRR = 14.99% = 15%.

MIRR: PV Costs = $17,100.

FV Inflows:

\[
\begin{array}{cccccc}
0 & 1 & 2 & 3 & 4 & 5 \\
\hline
5,100 & 5,100 & 5,100 & 5,100 & 5,100 & 5,100 \\
& 5,814 & 6,628 & 7,556 & 8,614 & 17,100 \\
\end{array}
\]

MIRR = 14.54% (Accept) 33,712

Financial calculator: Obtain the FVA by inputting N = 5, I = 14, PV = 0, PMT = 5100, and then solve for FV = $33,712. The MIRR can be obtained by inputting N = 5, PV = -17100, PMT = 0, FV = 33712, and then solving for I = 14.54%.

Pulley:

\[
\text{NPV} = -22,430 + 7,500(3.4331) = -22,430 + 25,748
= \$3,318. \quad \text{(Accept)}
\]

Financial calculator: Input the appropriate cash flows into the cash flow register, input I = 14, and then solve for NPV = $3,318.

Financial calculator: Input the appropriate cash flows into the cash flow register and then solve for IRR = 20%.

MIRR: PV Costs = $22,430.

FV Inflows:

\[
\begin{array}{cccccc}
0 & 1 & 2 & 3 & 4 & 5 \\
\hline
7,500 & 7,500 & 7,500 & 7,500 & 7,500 & 7,500 \\
& 8,550 & 9,747 & 11,112 & 12,667 & 22,430 \\
\end{array}
\]

MIRR = 17.19% (Accept) 49,576
Financial calculator: Obtain the FVA by inputting \( N = 5, I = 14, PV = 0, PMT = 7500 \), and then solve for \( FV = \$49,576 \). The MIRR can be obtained by inputting \( N = 5, PV = -22430, PMT = 0, FV = 49576 \), and then solving for \( I = 17.19\% \).

11-4 Electric-powered:

\[
NPV_e = -\$22,000 + \$6,290 \left[ \frac{1}{i} - \frac{1}{i(1+i)^n} \right] \\
= -\$22,000 + \$6,290 \left[ \frac{1}{0.12} - \frac{1}{0.12(1+0.12)^6} \right] \\
= -\$22,000 + \$6,290(4.1114) = -\$22,000 + \$25,861 = \$3,861.
\]

Financial calculator: Input the appropriate cash flows into the cash flow register, input \( I = 12 \), and then solve for \( NPV = \$3,861 \).

Financial calculator: Input the appropriate cash flows into the cash flow register and then solve for \( IRR = 18\% \).

Gas-powered:

\[
NPV_g = -\$17,500 + \$5,000 \left[ \frac{1}{i} - \frac{1}{i(1+i)^n} \right] \\
= -\$17,500 + \$5,000 \left[ \frac{1}{0.12} - \frac{1}{0.12(1+0.12)^6} \right] \\
= -\$17,500 + \$5,000(4.1114) = -\$17,500 + \$20,557 = \$3,057.
\]

Financial calculator: Input the appropriate cash flows into the cash flow register, input \( I = 12 \), and then solve for \( NPV = \$3,057 \).

Financial calculator: Input the appropriate cash flows into the cash flow register and then solve for \( IRR = 17.97\% \).

The firm should purchase the electric-powered forklift because it has a higher \( NPV \) than the gas-powered forklift. The company gets a high rate of return \((18\% > r = 12\%)\) on a larger investment.

11-7 a. Purchase price $ 900,000
Installation 165,000
Initial outlay $1,065,000

\[
CF_0 = -1065000; CF_{1-5} = 350000; I = 14; NPV = ? \]
\[
NPV = \$136,578; IRR = 19.22\%.
\]

b. Ignoring environmental concerns, the project should be undertaken because its \( NPV \) is positive and its \( IRR \) is greater than the firm's cost of capital.

c. Environmental effects could be added by estimating penalties or any other cash outflows that might be imposed on the firm to help return the land to its previous state (if possible). These outflows could be so large as to cause the project to have a negative \( NPV \)--in which case the project should not be undertaken.
a.

\[
\begin{array}{cccc}
\text{r} & \text{NPV}_A & \text{NPV}_B \\
0.0\% & $890 & $399 \\
10.0 & 283 & 179 \\
12.0 & 200 & 146 \\
18.1 & 0 & 62 \\
20.0 & (49) & 41 \\
24.0 & (138) & 0 \\
30.0 & (238) & (51)
\end{array}
\]

b. \( \text{IRR}_A = 18.1\% \); \( \text{IRR}_B = 24.0\% \). 

c. At \( r = 10\% \), Project A has the greater NPV, specifically $200.41 as compared to Project B's NPV of $145.93. Thus, Project A would be selected. At \( r = 17\% \), Project B has an NPV of $63.68 which is higher than Project A's NPV of $2.66. Thus, choose Project B if \( r = 17\% \). 

d. Here is the MIRR for Project A when \( r = 10\% \):

\[
\text{PV costs} = 300 + \frac{387}{1.10} + \frac{193}{(1.10)^2} + \frac{100}{(1.10)^3} + \frac{180}{(1.10)^7} = 978.82. \\
\text{TV inflows} = 600(1.10)^3 + 600(1.10)^2 + 850(1.10)^1 = 2,459.60.
\]

Now, MIRR is that discount rate which forces the TV of $2,459.60 in 7 years to equal $978.82:
$952.00 = $2,547.60(1+\text{MIRR})^7.
\text{MIRR}_A = 14.07%.
Similarly, \text{MIRR}_B = 15.89%.

At \( r = 17\% \),
\text{MIRR}_A = 17.57%.
\text{MIRR}_B = 19.91%.

e. To find the crossover rate, construct a Project \( \Delta \) which is the difference in the two projects' cash flows:

<table>
<thead>
<tr>
<th>Year</th>
<th>( \text{CF}_A - \text{CF}_B )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$105</td>
</tr>
<tr>
<td>1</td>
<td>(521)</td>
</tr>
<tr>
<td>2</td>
<td>(327)</td>
</tr>
<tr>
<td>3</td>
<td>(234)</td>
</tr>
<tr>
<td>4</td>
<td>466</td>
</tr>
<tr>
<td>5</td>
<td>466</td>
</tr>
<tr>
<td>6</td>
<td>716</td>
</tr>
<tr>
<td>7</td>
<td>(180)</td>
</tr>
</tbody>
</table>

\text{IRR}_\Delta = \text{Crossover rate} = 14.53%.

Projects A and B are mutually exclusive, thus, only one of the projects can be chosen. As long as the cost of capital is greater than the crossover rate, both the NPV and IRR methods will lead to the same project selection. However, if the cost of capital is less than the crossover rate the two methods lead to different project selections—a conflict exists. When a conflict exists the NPV method must be used.

Because of the sign changes and the size of the cash flows, Project \( \Delta \) has multiple IRRs. Thus, a calculator's IRR function will not work. One could use the trial and error method of entering different discount rates until NPV = 0. However, an HP can be "tricked" into giving the roots. After you have keyed Project Delta's cash flows into the g register of an HP-10B, you will see an "Error-Soln" message. Now enter 10 \( \uparrow \) STO \( \uparrow \) IRR/YR and the 14.53% IRR is found. Then enter 100 \( \uparrow \) STO \( \uparrow \) IRR/YR to obtain IRR = 456.22%. Similarly, Excel or Lotus 1-2-3 can also be used.

11-9 a. Incremental Cash

<table>
<thead>
<tr>
<th>Year</th>
<th>Plan B</th>
<th>Plan A</th>
<th>Flow (B - A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>($10,000,000)</td>
<td>($10,000,000)</td>
<td>$0</td>
</tr>
<tr>
<td>1</td>
<td>1,750,000</td>
<td>12,000,000</td>
<td>(10,250,000)</td>
</tr>
<tr>
<td>2-20</td>
<td>1,750,000</td>
<td>0</td>
<td>1,750,000</td>
</tr>
</tbody>
</table>

If the firm goes with Plan B, it will forgo $10,250,000 in Year 1, but will receive $1,750,000 per year in Years 2-20.

b. If the firm could invest the incremental $10,250,000 at a return of \( 16.07\% \), it would receive cash flows of $1,750,000. If we set up an amortization schedule, we would find that payments of $1,750,000 per year for 19 years would amortize a loan of $10,250,000 at \( 16.0665\% \).

Financial calculator solution:

Inputs 19 \(-10250000\) 1750000 0
Output = 16.0665

c. Yes, assuming (1) equal risk among projects, and (2) that the cost of capital is a constant and does not vary with the amount of capital raised.

d. See graph. If the cost of capital is less than 16.07%, then Plan B should be accepted; if r > 16.07%, then Plan A is preferred.

11-10 a. Financial calculator solution:

Plan A
Inputs 20 10 8000000 0

Output = -68,108,510

\[ NPV_A = \$68,108,510 - \$50,000,000 = \$18,108,510. \]

Plan B
Inputs 20 10 3400000 0

Output = 68,108,510

\[ NPV_B = \$68,108,510 - \$50,000,000 = \$18,108,510. \]
Output = -28,946,117

\[ NPV_A = 28,946,117 - 15,000,000 = 13,946,117. \]

**Plan A**

Inputs 20

\[ \text{Output} = 15.03 \]

\[ IRR_A = 15.03\%. \]

**Plan B**

Inputs 20

\[ \text{Output} = 15.03 \]

\[ IRR_B = 15.03\%. \]
Output = 22.26

IRR_a = 22.26%.

b. If the company takes Plan A rather than B, its cash flows will be (in millions of dollars):

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash Flows from A</th>
<th>Cash Flows from B</th>
<th>Project Δ Cash Flows</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>($50)</td>
<td>($15.0)</td>
<td>($35.0)</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>3.4</td>
<td>4.6</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>3.4</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>8</td>
<td>3.4</td>
<td>4.6</td>
</tr>
</tbody>
</table>

So, Project Δ has a "cost" of $35,000,000 and "inflows" of $4,600,000 per year for 20 years.

Inputs 20 10 4600000 0

Output = 39,162,393

NPV_a = $39,162,393 - $35,000,000 = $4,162,393.

Inputs 2 -35000000 4600000 0
Output= 11.71

\[ \text{IRR}_A = 11.71\% . \]

Since \( \text{IRR}_A > r \), and since we should accept \( \Delta \). This means accept the larger project (Project A). In addition, when dealing with mutually exclusive projects, we use the NPV method for choosing the best project.

c.

d. The NPV method implicitly assumes that the opportunity exists to reinvest the cash flows generated by a project at the cost of capital, while use of the IRR method implies the opportunity to reinvest at the IRR. If the firm's cost of capital is constant at 10 percent, all projects with an NPV > 0 will be accepted by the firm. As cash flows come in from these projects, the firm will either pay them out to investors, or use them as a substitute for outside capital which costs 10 percent. Thus, since these cash flows are expected to save the firm 10 percent, this is their opportunity cost reinvestment rate.

The IRR method assumes reinvestment at the internal rate of return itself, which is an incorrect assumption, given a constant expected future cost of capital, and ready access to capital markets.
11-16 a. Using a financial calculator, input the following: CF₀ = -190000, CF₁ = 87000, Nₐ = 3, and I = 14 to solve for NPV₁₉₀₋₃ = $11,981.99 = $11,982 (for 3 years).

Adjusted NPV₁₉₀₋₃ = $11,982 + $11,982/(1.14)³ = $20,070.

Using a financial calculator, input the following: CF₀ = -360000, CF₁ = 98300, Nₐ = 6, and I = 14 to solve for NPV₃₆₀₋₆ = $22,256.02 = $22,256 (for 6 years).

Both new machines have positive NPVs, hence the old machine should be replaced. Further, since its adjusted NPV is greater, choose Model 360-6.

---

Chapter 12
Homework Solutions

12-4 a. The net cost is $126,000:

<table>
<thead>
<tr>
<th>Cost Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>($108,000)</td>
</tr>
<tr>
<td>Modification</td>
<td>(12,500)</td>
</tr>
<tr>
<td>Increase in NWC</td>
<td>(5,500)</td>
</tr>
<tr>
<td>Cash outlay for new machine</td>
<td>($126,000)</td>
</tr>
</tbody>
</table>

b. The operating cash flows follow:
1. After-tax savings          $28,600  $28,600  $28,600
2. Depreciation tax savings    13,918  18,979  6,326
Net cash flow              $42,518  $47,579  $34,926

Notes:
1. The after-tax cost savings is $44,000(1 - T) = $44,000(0.65) = $28,600.
2. The depreciation expense in each year is the depreciable basis, $120,500, times the MACRS allowance percentages of 0.33, 0.45, and 0.15 for Years 1, 2, and 3, respectively. Depreciation expense in Years 1, 2, and 3 is $39,765, $54,225, and $18,075. The depreciation tax savings is calculated as the tax rate (35%) times the depreciation expense in each year.

   c. The terminal year cash flow is $50,702:

   | Salvage value | $65,000 |
   | Tax on SV*    | (19,798) |
   | Return of NWC | 5,500   |
   | **Total**     | $50,702 |

   BV in Year 4 = $120,500(0.07) = $8,435.
   *Tax on SV = ($65,000 - $8,435)(0.35) = $19,798.

   d. The project has an NPV of $10,841; thus, it should be accepted.

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Cash Flow</th>
<th>PV @ 12%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>($126,000)</td>
<td>($126,000)</td>
</tr>
<tr>
<td>1</td>
<td>42,518</td>
<td>37,963</td>
</tr>
<tr>
<td>2</td>
<td>47,579</td>
<td>37,930</td>
</tr>
<tr>
<td>3</td>
<td>85,628</td>
<td>60,948</td>
</tr>
<tr>
<td><strong>NPV</strong></td>
<td>$10,841</td>
<td></td>
</tr>
</tbody>
</table>

   Alternatively, place the cash flows on a time line:
<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>12%</td>
<td>42,518</td>
<td>47,579</td>
<td>34,926</td>
</tr>
<tr>
<td>85,628</td>
<td>50,702</td>
<td>50,702</td>
<td></td>
</tr>
</tbody>
</table>

   With a financial calculator, input the appropriate cash flows into the cash flow register, input I = 12, and then solve for NPV = $10,841.

   12-5 a. The net cost is $89,000:

   | Price | ($70,000) |
   | Modification | (15,000) |
   | Change in NWC | (4,000) |
   | **Total** | ($89,000) |

   b. The operating cash flows follow:

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>After-tax savings</td>
<td>$15,000</td>
<td>$15,000</td>
</tr>
<tr>
<td>Depreciation shield</td>
<td>11,220</td>
<td>15,300</td>
</tr>
<tr>
<td>Net cash flow</td>
<td>$26,220</td>
<td>$30,300</td>
</tr>
</tbody>
</table>
Notes:

1. The after-tax cost savings is $25,000(1 – T) = $25,000(0.6) = $15,000.

2. The depreciation expense in each year is the depreciable basis, $85,000, times the MACRS allowance percentage of 0.33, 0.45, and 0.15 for Years 1, 2, and 3, respectively. Depreciation expense in Years 1, 2, and 3 is $28,050, $38,250, and $12,750. The depreciation shield is calculated as the tax rate (40%) times the depreciation expense in each year.

c. The additional end-of-project cash flow is $24,380:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Salvage value</td>
<td>$30,000</td>
</tr>
<tr>
<td>Tax on SV*</td>
<td>(9,620)</td>
</tr>
<tr>
<td>Return of NWC</td>
<td>4,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$24,380</strong></td>
</tr>
</tbody>
</table>

*Tax on SV = ($30,000 - $5,950)(0.4) = $9,620.

Note that the remaining BV in Year 4 = $85,000(0.07) = $5,950.

d. The project has an NPV of -$6,705. Thus, it should not be accepted.

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Cash Flow</th>
<th>PV @ 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>($89,000)</td>
<td>($89,000)</td>
</tr>
<tr>
<td>1</td>
<td>26,220</td>
<td>23,836</td>
</tr>
<tr>
<td>2</td>
<td>30,300</td>
<td>25,041</td>
</tr>
<tr>
<td>3</td>
<td>44,480</td>
<td>33,418</td>
</tr>
<tr>
<td><strong>NPV</strong></td>
<td><strong>($6,705)</strong></td>
<td></td>
</tr>
</tbody>
</table>

Alternatively, with a financial calculator, input the following: CF₀ = -89000, CF₁ = 26220, CF₂ = 30300, CF₃ = 44480, and I = 10 to solve for NPV = -$6,703.83.

12-6 a. Sales = 1,000($138) $138,000
Cost = 1,000($105) 105,000
Net before tax $33,000
Taxes (34%) 11,220
Net after tax $21,780

Not considering inflation, NPV is -$4,800. This value is calculated as

\[-150,000 + \frac{21,780}{0.15} = -4,800.\]

Considering inflation, the real cost of capital is calculated as follows:

\[(1 + r_i)(1 + i) = 1.15\]
\[(1 + r_i)(1.06) = 1.15\]
\[r_i = 0.0849.\]

Thus, the NPV considering inflation is calculated as
After adjusting for expected inflation, we see that the project has a positive NPV and should be accepted. This demonstrates the bias that inflation can induce into the capital budgeting process: inflation is already reflected in the denominator (the cost of capital), so it must also be reflected in the numerator.

b. If part of the costs were fixed, and hence did not rise with inflation, then sales revenues would rise faster than total costs. However, when the plant wears out and must be replaced, inflation will cause the replacement cost to jump, necessitating a sharp output price increase to cover the now higher depreciation charges.

12-7 \[ E(\text{NPV}) = 0.05(-$70) + 0.20(-$25) + 0.50(12) + 0.20(20) + 0.05(30) \]
\[ = -$3.5 + -$5.0 + $6.0 + $4.0 + $1.5 \]
\[ = $3.0 \text{ million}. \]

\[ \sigma_{\text{NPV}} = \left[ 0.05(-$70 - 3)^2 + 0.20(-$25 - 3)^2 + 0.50(12 - 3)^2 \right]^{0.5} + 0.20(20 - 3)^2 + 0.05(30 - 3)^2 \]
\[ = $23.622 \text{ million}. \]

\[ CV = \frac{23.622}{3.0} = 7.874. \]

12-8 a. Expected annual cash flows:

<table>
<thead>
<tr>
<th>Project A:</th>
<th>Probability</th>
<th>Cash Flow</th>
<th>Probable Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>$6,000</td>
<td>$1,200</td>
<td></td>
</tr>
<tr>
<td>0.6</td>
<td>6,750</td>
<td>4,050</td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>7,500</td>
<td>1,500</td>
<td></td>
</tr>
</tbody>
</table>

Expected annual cash flow = $6,750

<table>
<thead>
<tr>
<th>Project B:</th>
<th>Probability</th>
<th>Cash Flow</th>
<th>Probable Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>$0</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td>0.6</td>
<td>6,750</td>
<td>4,050</td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>18,000</td>
<td>3,600</td>
<td></td>
</tr>
</tbody>
</table>

Expected annual cash flow = $7,650

Coefficient of variation:

\[ CV = \frac{\text{Standard deviation}}{\text{Expected value}} = \frac{\sigma_{\text{NPV}}}{\text{Expected NPV}} \]

Project A:

\[ \sigma_A = \sqrt{(-$750)^2(0.2) + ($0)^2(0.6) + ($750)^2(0.2)} = $474.34. \]

Project B:

\[ \sigma_B = \sqrt{(-$7,650)^2(0.2) + (-$900)^2(0.6) + ($10,350)^2(0.2)} = $5,797.84. \]
\[ CV_A = \frac{474.34}{6,750} = 0.0703. \]
\[ CV_B = \frac{5,797.84}{7,650} = 0.7579. \]

b. Project B is the riskier project because it has the greater variability in its probable cash flows, whether measured by the standard deviation or the coefficient of variation. Hence, Project B is evaluated at the 12 percent cost of capital, while Project A requires only a 10 percent cost of capital.

Project A: With a financial calculator, input the appropriate cash flows into the cash flow register, input \( I = 10 \), and then solve for \( NPV = 10,036.25 \).

Project B: With a financial calculator, input the appropriate cash flows into the cash flow register, input \( I = 12 \), and then solve for \( NPV = 11,624.01 \).

Project B has the higher NPV; therefore, the firm should accept Project B.

c. The portfolio effects from Project B would tend to make it less risky than otherwise. This would tend to reinforce the decision to accept Project B. Again, if Project B were negatively correlated with the GDP (Project B is profitable when the economy is down), then it is less risky and Project B’s acceptance is reinforced.