Chapter 5 Homework Problem Solutions
ISyE 4311

Problem 5.7
The nominal interest rate is 9.2% since \((1.04)(1.05) = 1.092\).

Net cost of the equipment is

\[100K\left[1 - \frac{0.4}{8} \left(\frac{1 - (1.092)^{-8}}{0.92}\right)\right] = 72,530.\]

After-tax values of the revenue, material and labor cost streams are:

Revenue: \[0.6(550K) \left(\frac{0.20(1.05)}{0.92 - 0.1} \left[1 - (1.092/1.1)^{-8}\right]\right) = 545,707.\]

Material: \[0.6(550K) \left(\frac{0.08(1.02)}{0.92 - 0.02} \left[1 - (1.092/1.02)^{-8}\right]\right) = 157,284.\]

Labor: \[0.6(60K) \left(\frac{1}{1.05} + \frac{1 - (1.092/1.07)^{-7}}{1.04 - 1.07/1.05}\right) = 231,942.\]

Project value = \([545,707 - (157,284 + 231,942)] - 72,530 = 83,952.\]

The factor \((r - g)\) appears in the denominator of the growing annuity formulas used below.

Here, we will use \((1 + r) - (1 + g)\). When using real values, the \((1 + g)\) factors below are, respectively, \(1/1.05, 1.1/1.05, 1.02/1.05, 1.07/1.05\).

Net cost of the equipment is

\[100K\left[1 - \frac{0.4}{8} \left(\frac{1}{1.05} - \frac{1 - (1.04/1.05)^{-8}}{1.04 - 1/1.05}\right)\right] = 72,530.\]

After-tax values of the revenue, material and labor cost streams are:

Revenue: \[0.6(550K) \left(\frac{0.20(1.05)}{1.05} \left[1 - (1.04/1.1)^{-8}\right]\right) = 545,707.\]

Material: \[0.6(550K) \left(\frac{0.08(1.02)}{1.05} \left[1 - (1.04/1.02)^{-8}\right]\right) = 157,284.\]

Labor: \[0.6(60K) \left(\frac{1}{1.05} + \frac{1 - (1.04/1.07)^{-7}}{1.04 - 1.07/1.05}\right) \left(\frac{1}{1.04}\right) = 231,942.\]

All values remain the same. Easier to use nominal values!
Problem 5.9
For machine A, the EAC of the purchase cost is 5,821, the after-tax annual cost is 2,100 and the depreciation tax shield is 1,500.
The total EAC is therefore 5,821 + 2,100 - 1,500 = 6,421.
For machine B, the EAC of the purchase cost is 9,604, the after-tax annual cost is 700 and the depreciation tax shield is 2,143.
The total EAC is therefore 9,604 + 700 - 2,143 = 8,161.
Select machine A.

Problem 5.10
Here, the tax rate is zero. In particular, this implies there is no depreciation tax shield.
For machine A, the EAC of the purchase cost is 91.84 and the annual cash flow is 200. The total EAC is therefore -91.84 + 200 = 108.16.
For machine B, the EAC of the purchase cost is 115.24 and the annual cash flow is 300. The total EAC is therefore -115.24 + 300 = 184.76.
Select machine B.

Problem 5.11
First alternative yields an after-tax value of 0.75(15K) = 11,250.
Value of the second alternative is 3K \left[ 1 + \frac{1-(1.05)^{-4}}{0.05} \right] + \frac{225}{(1.05)^4} = 13,823.
Second alternative is best.

Problem 5.12
For the first supplier, the net cost of the machine is 300K \left[ 1 - \frac{0.35}{4} \frac{1-(1.15)^{-4}}{0.15} \right] = 225,057.
The value of the revenue cash flow stream is 65K \left[ 1 - \frac{1-(1.15)^{-4}}{0.15} \right] = 185,574.
Overall project value is -39,483.
Value of the leasing option is 0.65(100K - 80K) \left[ 1 - \frac{1-(1.15)^{-4}}{0.15} \right] = 37,115.
Loan value is 210K - 70K \left[ 1 - \frac{1-(1.15)^{-3}}{0.15} \right] = 50,174. Project value is now 10,691.

Problem 5.14
Let \( P \) denote the annual production rate.
For machine A, the after-tax variable cost per year is 0.072\( P \), the fixed cost per year is 60K, the EAC of the purchase cost is 88,492, and the depreciation tax shield is 20K.
Total EAC is
\[
0.072P + 60,000 + 88,492 - 20,000 = 0.072P + 128,492 = 200,492
\]
when \( P = 1M \).
For machine B, the after-tax variable cost per year is 0.15\( P \), the fixed cost per year is 45K, the EAC of the purchase cost is 65,847, and the depreciation tax shield is 20K.
Total EAC is
\[
0.15P + 45,000 + 65,847 - 20,000 = 0.15P + 90,847 = 240,847
\]
when $P = 1M$. 
Break-even value of $P$ is 482,628.

**Problem 5.16**
Net cost of the new machine is $400K \left[1 - \frac{0.4}{10} \frac{1-(1.15)^{-10}}{0.15}\right] = 319,700$.
If the new machine is acquired, the current one will be sold. The after-tax cash flow of the asset sale is $50K - 0.4(50K - 100K) = 70K$.
By selling the current machine, the future depreciation tax shield of $8K$ per year for 5 years is forfeited. Its value is $26,817$.
The value of the annual savings is $0.6(60K)/0.15 = 240K$.
Total project value of acquiring new machine is $240,000 - 319,700 + 70,000 - 26,817 = -36,517$.
Break-even subsidy amount $S = 36,517(1.15) = 41,650$.

**Problem 5.17**
For the laser printer, the EAC of the purchase cost is 243.23, annual cost is 300 for a total EAC of 543.23.
For the ink-jet printer, the EAC of the purchase cost is 147.92, annual cost is 1K for a total EAC of 1,147.92.
NB: This is an example of a “no-brainer” — just look at the cash flows!

**Problem 5.18**
Here, we will use nominal values.
Net cost of the new machine is

$$95K \left[1 - \frac{0.4}{10} \frac{1-(1.14)^{-10}}{0.14}\right] - \frac{7.8K(1.05)^{10}}{(1.14)^{10}} = 71,752.$$ 

If the new machine is acquired, the current one will be sold. The after-tax cash flow of the asset sale is

$$20K - 0.4 \left(20K - \left[87.5K - 4(6.25K)\right]\right) = 37K.$$ 

By selling the current machine, the future depreciation tax shield of 2.5K per year for 10 years is forfeited. Its value is 13,040.
Yearly increase in profit is $15K - 3K = 12K$ in 1999 dollars = $12K(1.05) = 12.6K$ in 2000 dollars or 7,560 in after-tax 2000 dollars. The value of this after-tax profit cash flow stream is 39,433.
Total project value of acquiring new machine is $39,433 - 71,752 + 37,000 - 13,040 = -8,359$. 
